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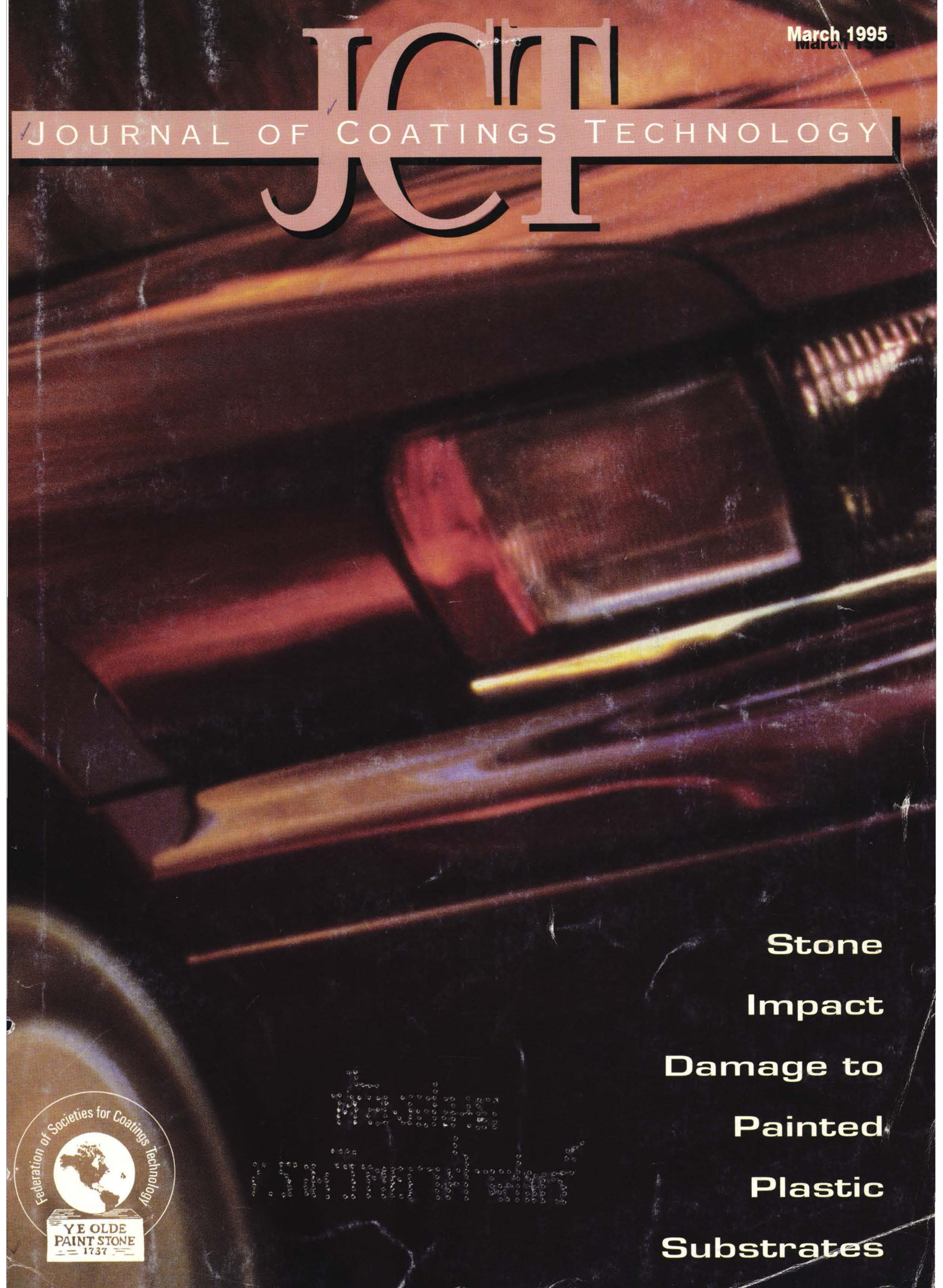
March 1995



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Technical Articles

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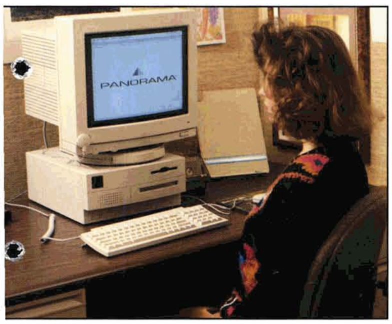

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FSCT Board of Directors 1994-95

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COMMENT

The FSCT Looks to the Future

Once upon a time this industry was fairly simple in its structure: formulations were straightforward recipes; applications were predictable; and production methods were routine. Of course, while the foregoing statement is itself simplistic, it does give some perspective when comparing the past with the state of the industry today.

New technologies fueled by government regulations, new applications, and the ever-present economics of manufacturing, have given rise to significant changes in the industry. Segmentation has become more acute with no-solvent/low-solvent coatings, high solids and water-based coatings, powder coatings, UV and EB cured coatings becoming more prevalent. Today's industry has as much in common with that of three generations ago as that of the space shuttle with a DC-3.

The Federation in recognizing the above advancements also recognizes that these changes have brought about shifts in the composition of industry personnel and in their professional interests and concerns. To address these topics, the FSCT leadership, committee chairs, and staff have been involved in a series of discussions on the future direction of the FSCT. Basic questions were asked: What is the present state of the industry and in what direction will it go? What products and services will be needed by the FSCT membership? What mechanisms need to be developed for delivering these services? What is the FSCT's mission?

This last question perhaps sets the theme for any discussion on the future course of the Federation and is offered here as a starting point:

> *"The Mission of the FSCT is to provide technical education and professional development to its members and the industry through its Constituent Societies and collectively as a Federation."*

In developing this blueprint for the future, the FSCT seeks the involvement of its Constituent Societies and their membership. Presently, a task force composed of current Officers, Past-Presidents, and Planning Committee members is meeting with Society Boards to present a proposed strategic plan and to solicit suggestions and comments. A full discussion with the FSCT Board of Directors will be made at the Spring 1995 Board Meeting. *(See related story on page 13 in this issue.)*

While the initial steps to formulate a strategic plan have been taken, a consensus needs to be reached and, afterward, implemented. The development of this strategic plan is an ongoing process to which the Federation leadership is committed.

Robert F. Ziegler
Executive Vice President

Translations provided by: French—Montreal Society Member Mario Côte of Eastman Chemical Canada Inc.-Montreal; Spanish—Beatriz Alonso Torres, of Instituto Mexicano de Tecnicos en Pinturas y Tintas.

Stone Impact Damage to Painted Plastic Substrates—R.A. Ryntz, A.C. Ramamurthy, and J.W. Holubka

JCT, Vol. 67, No. 842, 23 (Mar. 1995)

With the advent of the increased use of plastics in the automotive industry, the performance of painted plastic composites is a major concern. In particular, the resistance of painted plastics to stone-chipping has become a coating formulator's challenge. This study attempts to describe a controlled testing protocol for measuring "impact-resistance" of painted plastics and to relate their performance to the physical and mechanical properties of varying painted plastic composites.

Through utilization of a "precision paint collider" impact damage on varying thermoplastic olefin (TPO), reaction injection molded urethane (RIM), sheet molded compound (SMC), and Xenoy (a thermoplastic alloy composed of polycarbonate and polybutylene terephthalate) was assessed via digital imaging analysis of the impacted area. Failures in the impact area resulted largely from paint delamination. In the case of TPO, often times cohesive substrate delamination was observed. Boundary layers in the TPO, which can be rearranged as a result of thermal history of the substrate, affected impact resistance with greater boundary layer thickesses resulting in better impact performance. In general, of the substrates tested, the greater the temperature at which impact was performed, the greater the amount of damage inflicted upon the substrate. On RIM, however, the opposite occurred.

For two-component (2K) topcoats (those crosslinked with isocyanates), SMC performed better than Xenoy, RIM, and TPO, respectively. For one-component (1K) topcoats (those crosslinked with melamine), RIM performed better than SMC, which performed better than TPO. In general, 1K paints afforded better impact resistance than 2K paints.

Dommages dus à L'impact de Pierres sur les Substrats de Plastiques Peinturés—R.A. Ryntz, A.C. Ramamurthy, et J.W. Holubka

Avec la venue de l'accroissement de l'usage des plastiques dans l'industrie automobile, la performance de plastiques composites peinturés est d'un intérêt majeur. En particulier, la résistance de plastiques peinturés à l'écaillement aux pierres est devenue un défit pour le formulateur de revêtements. Nous essayons de décrire ici un protocole d'essaies contrôlés pour mesurer la résistance à l'impact de plastiques peinturés et rapporter leur performance aux propriétés physiques et mécaniques de divers plastiques composites peinturés.

Avec l'utilisation d'un "precision paint collider" les dommages d'impacts de divers OTP (oléfine thermoplastique), RIM (réaction injection, moulage uréthane), SMC ("sheet molded compound"), et Xenoy (un alliage thermoplastique composé de polycarbonate et de polybutylène terephthalate) fûrent évalué à l'aide d'analyses d'images digitales de la surface choqué. Les manques dans la surface d'impact fûrent le résultat de la délamination de peinture. Dans le cas OTP, la delamination cohésive de substrat fut observée à plusieurs reprises. Les couches de bornes ("boundary layers") de l'OTP, qui peuvent être réarrangé à cause de l'histoire thermique du substrat, ont affecté la résistance à l'impact, avec des couches de bornes de plus grande épaisseur résultant en une meilleure performance à l'impact. En général, des substrats mis aux épreuves, plus élevée était la température à laquelle l'impact se produisit, plus grand était le dommage infligé au substrat. L'opposé est survenu chez le RIM. Pour les revêtements deux composantes (2K) (ceux réticulés avec les isocyanates), le SMC obtenu une meilleure performance que le Xenoy, RIM et OTP, respectivement dans cet ordre. Pour les revêtements une composante (ceux réticulés avec la mélamine), le RIM obtenu une meilleure performance que le SMC qui performa mieux que le OTP. En général, les peintures 1K ont obtenu une meilleure résistance à l'impact que les peintures 2K.

Daño por Impacto de Rocas a Sustratos de Plástico Pintados—R.A. Ryntz, A.C. Ramamurthy, y J.W. Holubka

Con el reciente incremento del uso de plásticos en la industria automotiva, el comportamiento de componentes de plástico pintados se vuelve una preocupación. En particular, la resistencia de plásticos pintados al desprendimiento se ha vuelto un reto para los formuladores de recubrimientos. Se intenta describir un método controlado de prueba para la medición de "impacto-resistencia" de plásticos pintados y para relacionar su desarrollo con las propiedades fisicas y mecánicas de algunos otros componentes plásticos.

Aunque se utilizó un "comparador de precisión de pintura," el daño por impacto en las variaciones de TPO (oleofina termoplástica), RIM (reacción por inyección de uretano moldeado), SMC (compuestos laminares moldeados) y Xenoy (una aleción termoplástica compuesta de policarbonato y tereftalto de polibutileno), se evaluó vía análisis digital de imagen del área impactada. Mucho después resultaron fallas del área de impacto debido a la deslaminación de la pintura. En el caso de la TPO, se obsevaron deslaminaciones del sustrato cohesivo en varias ocasiones. Las capas superficiales en la TPO, que pueden ser rearregladas como resultado de la historia térmica del sustrato, afectaron la resitencia al impacto, con espesores más grandes de capas superficiales, que conllevaron a un mejor comportamiento al impacto. En general, de los sustratos probados, entre mayor sea la temperatura a la que se llevó a cabo el impacto, mayor fué el daño infringido al sustrato. Sin embargo, en la RIM ocurrió lo opuesto.

Para cubiertas finales de dos componentes (las entrecruzadas con isocianatos), los SMC mostraron mejor comportamiento que Xenoy, RIM y TPO, respectivamente en ese orden. Para cubiertas finales de un componente (las entrecruzadas con melamina), la RIM se comportó de mejor manera que los SMC que fueron mejores que la TPO. En general, las pinturas de un componente presentaron una mejor resistencia al impacto que las de dos componentes.

Aliphatic Isocyanates Blocked with Volatile Alcohols for Decorative Coatings—Y. Huang et al.

JCT, Vol. 67, No. 842, 33 (Mar. 1995)

Aliphatic polyisocyanates blocked with simple aliphatic alcohols, such as methanol and ethanol, are widely thought to require baking temperatures and times that are too high and/or too long for application of decorative coatings under production conditions. Here we show that polyisocyanates blocked with these alcohols can, when catalyzed with organotin catalysts, crosslink an acrylic polyol at temperatures comparable to those of commercial e-caprolactam blocked crosslinkers. With 0.5% of dibutyl tin diacetate catalyst, methanol blocked 1,3-bis (1-isocyanato-1-methylethyl) benzene (TMXDI) and methanol blocked hexamethylene diisocyanate isocyanurate are effective crosslinkers for an acrylic polyol at 145 to 155°C. It is theorized that physical factors (blocking agent diffusion rate and volatility)

Isocyanates Aliphatiques Bloqués avec des Alcools Volatils pour des Revêtements Décoratifs—Y. Huang et al.

Les polyisocyanates aliphatiques bloqués avec de simples alcools aliphatiques, tels le méthanol et l'éthanol, requiert généralement des températures et temps de cuisson qui sont trop élevés ou trop longs pour des applications de revêtements décoratifs sous des conditions de production. Nous démontrons que des polyisocyanates bloqués avec ces alcools peuvent, lorsque catalysé avec des catalyseurs organotin, réticuler un polyol acrylique à des températures comparables à celles des agents réticulants commerciaux bloqués E-caprolactames. Avec 0.5% d'un catalyseur diacétate d'étain dibutyl, le TMXDI (1,3-bis(1-isocyanato-1-methylethyl)benzene) bloqué avec du méthanol et l'hexamethylene diisocyanate isocyanurate bloqué avec du méthanol sont des agents réticulants efficaces pour un polyol acrylique à 145 jusqu'à 155°C. On théorise que les facteurs physiques (taux de diffusion de l'agent bloqueur et la volatilité) influencent fortement de durcissement.

Isocianatos Alifáticos Bloqueados con Alcoholes Volátiles Para Recubrimientos Decorativos—Y. Huang et al.

Es bien sabido que los Poli isocianatos alifáticos bloqueados con simples alcoholes alifáticos, como metanol y etanol, requieren temperaturas y veces de horneado que son muy altas y/o muy largas para aplicación de recubrimientos decorativos bajo condiciones de producción. Aqui mostramos que los poli isocianatos bloqueados con estos alcoholes pueden, cuando se catalizan orgánicamente, entrecruzar un poliol acrílico a temperaturas comparables a los entrecruzadores bloqueados con e-caprolactam comercial con 0.5% de catalizador de dibutil tin diaceteto, el 1,3-bis (1-isocianato-1-metiletil) benceno (TMXDI) bloqueado con metanol y el hexametileno diisocianato isocianurato bloqueado con metanol son entrecruzadores efectivos para un poliol acrílico de 145 a 155°C. Se ha supesto que factores fisicos (velocidad de difusión del agente bloqueador y volatilidad) influencían fuertemente la respuesta al curado.

Influence of Novel Amine Adduct on Curing of Epoxy Resins in Presence of Vinyl Acetate—A.V. Rao and P.V. Sapre

JCT, Vol. 67, No. 842, 41 (Mar. 1995)

To formulate flexible and high-solids coatings, novel amine adduct is synthesized by controlled reaction of ethylene glycol diglycidyl ether (DGEEG) and m-xylene diamine (MXDA) for curing of epoxy resins in the presence of vinyl acetate (VA). Spontaneous polymerization of vinyl acetate is observed in presence of amine adduct giving rise to an exotherm. A resinous deep brownish red color is formed in the mixture of vinyl acetate and amine adduct, indicating an interaction which is confirmed by UV spectrophotometry. The interaction is responsible for the spontaneous polymerization of vinyl acetate and a possible mechanism is proposed. The performance of conventional epoxy, viz, ethylene glycol diglycidyl ether (DGEBA) cured with novel amine adduct with and without vinyl acetate is investigated.

Influence d'un Produit d'Addition d'une Amine Unique sur le Durcissement de Résines Époxies en Présence d'acétate de Vinyle— A.V. Rao et P.V. Sapre

Un produit d'addition unique provenant d'une amine est synthétisé par une réaction contrôlé du ethylene glycol diglycidyl ether (DGEEG) et m-xylène diamine pour le durcissement de résines époxies en présence d'acétate de vinyle pour formuler des revêtements flexibles et à haute teneur en solides. La polymérisation spontanée de l'acétate de vinyle est observée en présence d'un produit d'addition d'une amine donnant lieu à une réáction exothermique. Une couleur rouge brunâtre résineux est formée dans le mélange d'acétate de vinyle et le produit d'addition d'amine indiquant une interaction qui est confirmée par spectrophotométrie UV. L'interaction est responsable pour la polymérisation spontanée de l'acétate de vinyle et un mécanisme possible est proposé. La performance d'un époxie conventionnel DGEBA (ethylene glycol diglycidyl ether) durcie avec un produit d'addition d'amine unique avec et sans acétate de vinyle est discuté.

Influencia de Nuevo Grupo de Aminas en el Curado de Resinas Epoxicas en Presencia del Acetato de Vinilo—A.V. Rao y P.V. Sapre

El nuevo grupo de amina se sintetiza por reacción controlada del etilen glicol digicidil eter (DGEEG) y la m-xileno diamina (MXDA) para el curado de resinas epóxicas en presencia de acetato de vinil (VA), usado a su vez para formulación de recubrimientos flexibles y de altos sólidos. Se observa polimerización espontánea del acetato de vinil en presencia del grupo de amina dando paso a una exotermia. Se forma un residuo resinoso de color rojo en la mezcla del acetato de vinilo y el grupo amino indicando la interacción, que se confirma por espectrofotometría UV. La interacción es responsable de la polimerizacón espontánea y se propone un posible mecanismo. Se discute el comportamiento del epóxico convencional vs. el etilen glicol diglicidil eter (DGEBA) curado con la nueva amina, con y sin acetato de vinilo.

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.

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Ten complete copies of the manuscript are required, and should be submitted to Mike Bell at the address previously listed.(For complete details, see "Roon Awards" section of the JOURNAL in the January 1995 issue.)

MANUSCRIPT PREPARATION

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

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

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

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

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

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

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

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

Title

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

Authors' Biographies and Photographs

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

Abstracts

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

Text

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

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

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

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

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

Metric System

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

Tables, Graphs, and Drawings

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

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

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

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

Photographs

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

Color prints and slides are unacceptable.

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

Nomenclature

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

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

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

Equations

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

Summary

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

Acknowledgment

If used, it should follow the summary.

References

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

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

OTHER INFORMATION

Galley proofs will be sent to the author for checking about six weeks prior to publication.

Offprints may be purchased in quantities of 100 or more. Authors will receive price quotations. Each author will receive a complimentary copy of the JOURNAL issue in which his or her paper was published.

* * * *

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FSCT Strategic Planning Discussions Focus on Membership Needs and Organizational Goals

Where lies the future direction of the FSCT? What programs and services will best address the needs of its membership and the coatings industry? What priorities need to be set and how should resources be used to meet established objectives?

Recognizing that the coatings industry is evolving, the Federation leadership is exploring the above questions. In November 1992, the Federation initiated discussions on the development of a strategic plan which would take the FSCT into the 21st Century. Taking part in the meeting were the current Officers, Executive Committee, and key FSCT Committee Chairs, as well as Staff. The group reviewed the historical background and activities of the FSCT and set objectives in the areas of technical education and information exchange, industry awareness, membership recruitment and, recognizing the importance of the Annual Meeting and Paint Industries' Show to the financial health of the organization, maintaining the strength of this event. This dialogue provided a framework for future meetings.

Following up on this initial meeting, in late 1994, the FSCT Executive and Planning Committees and Staff met as a whole to consider specific areas and to develop a draft plan. Currently, a task force composed of present Officers (Joseph P. Walton, Darlene Brezinski, Jay Austin), FSCT Past Presidents (William Holmes, John Lanning, John Oates, Colin Penny), and Planning Committee members (Richard Himics and Saul Spindel) are visiting with Society Boards of Directors to discuss this draft and to solicit the Societies' suggestions and comments. The Societies' leadership and membership are an integral part in the development of a strategic plan. Building on these discussions, the topic will be considered by the FSCT Board of Directors at its meeting in May 1995.

While it is expected that a plan in its final form will be developed following the May 1995 Board Meeting, reported here are the various areas addressed in the draft plan, as well as commentary and objectives reached in discussions.

The Mission Statement:

"The Mission of the FSCT is to provide technical education and professional development to its members and the industry through its Constituent Societies and collectively as a Federation."

In reviewing the many activities and services offered by the FSCT, it was believed that the above statement accurately reflects the broad goals of the organization. The statement provides a focus for all future efforts.

1992 Objectives

ENHANCEMENT OF TECHNICAL EDUCATION AND INFORMATION EXCHANGE

Accomplishments:

- Development of Panorama CD-ROM MSDS Retrieval System
- Editorial and graphic redesign of JOURNAL OF COATINGS TECHNOLOGY
- Revision and enhancement of Annual Meeting Technical Program

INDUSTRY AWARENESS

Accomplishments:

- Production of FSCT membership video
- Initiated membership newsletter *The Paint Stone*
- Development of international liaisons with allied organizations
- Cooperative efforts with National Paint & Coatings Association

MEMBERSHIP RECRUITMENT

Accomplishment:

- While undergoing industry consolidation and shrinkage, FSCT has maintained membership levels through active development of membership retention and recruitment programs for Societies.

While the above recruitment programs have been successful, overall membership has not changed significantly in the past 10 years. The lack of technical programming and educational opportunities for segments of the industry (powder, inks, UV/EB coatings, for example), both nationally and locally, can be seen as one cause. The constraints of the mechanics in membership processing may be seen as another reason: the current method requires a series of endorsements, readings, and election by the Societies, all of which take the active and dedicated efforts of Society volunteers who then forward the names of elected members to the FSCT office for processing. A new, computerized records system is being installed at headquarters which will provide a centralized membership system and an opportunity to simplify membership enrollment.

ANNUAL MEETING AND PAINT INDUSTRIES' SHOW

- The results of a survey of attendees and exhibitors at the 1993 convention showed that the event is very highly regarded by both groups. Attendance and exhibits have continued to increase, especially from overseas.

The FSCT should not be complacent, however. The role of the Paint Show is changing and it is no longer the unveiling point for new materials and equipment. Larger exhibitors are depending on their own larger sales forces to communicate with customers. Another factor to consider is that there is increasing competition in overseas markets and for-profit trade shows.

1995 Strategic Issues

PAST FOCUS ON MATURE MARKET

As an organization the FSCT and its Societies have historically maintained its roots in the "liquid" coatings industry. Most programs and services have not addressed the newer technologies, such as power coatings, inks, and UV and EB coatings. It was felt strongly that services should be developed for these areas of the industry.

REVENUE DEPENDENCY

A significant issue is that the FSCT is extremely dependent on the success of the Paint Industries' Show to fund its operations. With 67% of its revenue coming from the Show, this income largely subsidizes many of the FSCT activities, including the publication of the JCT. (Membership dues account for only 5% of total revenue and do not cover the cost of producing the JCT, The Paint Stone *newsletter, or the* Membership Directory, *all of which are included in the dues fee.)*

INTERNATIONAL OPPORTUNITIES

The trend towards consolidation and internationalization of the industry was also recognized and that a strategic plan should incorporate the utilization of resources and talents toward the development of overseas opportunities.

The FSCT has developed strong liaisons with allied organizations overseas. Opportunities exist to cooperate in several areas including publishing and trade show sponsorships.

CONSTRAINTS

One of the major issues in the planning process is identifying what factors limit the ability to accomplish goals and objectives. If the FSCT is to provide services, it is imperative that it have on hand an in-depth knowledge of who its members are, what their concerns and needs are, and how to best furnish these services. A basic constraint is the lack of a central data base from which to make these decisions. Until recently the FSCT had no such resource and, with the exception of the JCT, provided most services and information through the Constituent Societies. The segmentation of the industry and its further consolidation of companies, as noted above, has limited the FSCT's ability to fulfill its mission.

As a Federation, we have two fundamental resources to allocate. One is dollars. The other *is time, both that of staff and the very real resource of volunteers' time. The FSCT needs to not only make every dollar count, but also every minute of volunteer effort so that it is used as effectively as possible.*

While the FSCT has had a number of services and programs available to its membership and the industry, it has not always done a good job of making these well-known. Marketing has been weak, historically. This area also needs to be addressed as a strategic constraint.

CORE COMPETENCIES

The FSCT has, however, through its experience and operation, developed a number of competencies which will place it in a good position to succeed:

- *Ability to manage trade shows is a strength on which it can build.*
- *As an organization, the FSCT is very good at collecting and disseminating technical information.*
- *Its relationships with the Constituent Societies are very strong.*
- *Its growing relationships with other organizations, particularly international groups, is a solid foundation on which to build for the future.*

Plan Highlights

OVERALL GOALS

Fundamentally, there are two overall goals of the plan at this time:

(1) To include under the technical um brella of the FSCT all coatings technologies. This will involve some major outreach programs and cooperation with allied organizations.

(2) To become truly international. The belief is that if it fails to act now, the FSCT will miss a great opportunity to interact with an increasingly global market.

To accomplish these goals, the FSCT should consider actions in the following areas:

- Expand the technological offerings of both the programming and exhibits at the Paint Industries' Show. Work will begin on this in 1995 and further efforts will continue in succeeding years.
- Offer opportunities to interact internationally, both to individuals and allied organizations. The 1995 Spring Week Seminar and association meetings will be held in Mexico. An FSCT-sponsored trade show in Mexico City, in cooperation with the Mexico Association, is under consideration for 1996.
- Working with the Constituent Societies to develop programs locally in cutting edge technology areas which will assist in recruiting additional membership to the Societies.
- Formation of non-geographical interest-based groups which will allow people with diverse interest to remain within the organization.
- Expansion of headquarters support, including increased marketing effort and support, and a centralized membership records system to increase efficiency both at the local and national level.

Benefits

- A greatly expanded network with access to larger technical relationships. Opportunities for cross-learning; to meet and share with people in related technologies.
- International opportunities will sharply increase. Develop effective entry strategies to other countries; establish new relationships with vendors and customers.
- Greatly simplified membership records handling for Constituent Societies.
- Financial stability for both FSCT and Constituent Societies.

◆ ◆ ◆

This, then, is the initial draft proposed by the Federation volunteer leadership. The plan calls for several new changes, some refinements to ongoing efforts, and a reallocation of resources.

What can the Constituent Society look forward to: increased FSCT assistance in programming, membership development, and simplified operations, while retaining their status as independent organizations.

Meanwhile, the individual member will have increased opportunities to interact with colleagues in a variety of technical areas (the reason why many may have joined the Society), as well as more information to develop professionally in their daily work.

The leadership of the Societies have been informed of these proposals and it is hoped that their membership and they will discuss the perceived strengths and weaknesses of the plan. The final decision on this strategic plan lies with the membership and their representatives to the FSCT Board of Directors. — RFZ

Proposed Amendments to FSCT By-Laws

The following By-Laws revisions will be presented for first reading at the Spring 1995 Board Meeting.

I. DUES INCREASE

WHEREAS the Federation of Societies for Coatings Technology Board of Directors approved the following action on May 15, 1994 be it

RESOLVED that the first paragraph of the By-Laws Article XII, Section A be amended to read as follows

BY-LAWS ARTICLE XII—DUES

A. Active and Associate Members

Each Constituent Society shall pay to the Federation Office annual dues of twenty five dollars ($25.00) in U.S. funds per capita for each Active and Associate Member of the Constituent Society.

Following the defeat of the amendment to allow any class (except Educator/Student) to sit on the Board as a Society Representative, the Detroit Society proposed:

That a Society that cannot find an Active Member to serve as Society Representative be allowed to petition the Board for a waiver of hardship to allow the use of an Associate Member. This hardship waiver would be judged by a formal set of criteria that the Executive Committee would utilize before granting or rejecting the request, with the Board establishing said criteria.

II. SOCIETY REPRESENTATIVE—ELIGIBILITY

WHEREAS the Detroit Society has proposed and upon proper action by the Board of Directors be it

RESOLVED that a new and an additional paragraph be added to the By-Laws under Article IV (Organization) and as an addition to Section B. The new Paragraph to be added just prior to the list of "Duties of the Board."

Any Society that is unable after diligent effort to secure an Active Member to serve as Society Representative may petition the Board of Directors for a waiver of hardship to allow an Associate Member to serve as Society Representative. The petition must satisfy the following criteria to be acceptable by the Board of Directors.

(1) A specific candidate must be presented.

(2) The candidate must be an Associate Member of the localConstituent Society.

(3) The candidate must have a history of participation in the local Constituent Society and the FSCT. This history must cover a period of not less than 10 years.

(4) The candidate must be able to serve as an FSCT Board Member without any bias toward the product or services of his/her present employer. Further, the candidate's employer must give unconditional permission for the candidate to fulfill the duties of a member of the FSCT Board.

(5) The candidate must be a representative of a small Society that has polled all Active Members and has found it impossible to find a suitable and willing Active Member to serve as Society Representative. (For the purpose of this action a small Society is defined as one with no more than 200 total members and no more than 100 Active Members.)

(6) The candidate must be able and willing to carry out all duties as a Board Member as presented throughout Article IV.

(7) The candidate must first be presented to the Executive Committee and the Executive must recommend or not recommend to the Board.

1995 Paint Industries' Show List of Exhibitors
(As of 3/1/95)

Aceto Corp.
ACT Laboratories, Inc.
Advanced Software Designs
AI Process Systems Ltd.
Air Products & Chemicals, Inc.
Air Quality Sciences, Inc.
AKZO Nobel Chemicals & AKZO Nobel Resins
Alar Engineering Corp.
Alcan-Toyo America, Inc.
Alcoa Industrial Chemicals
AlliedSignal Corp.
Allied Colloids
American Chemical Society Industry Relations
Amoco Chemical Co.
ANGUS Chemical Co.
Anker Labelers USA Inc.
Aqualon
Arco Chemical Co.
Ashland Chemical, Inc.
Atlas Electric Devices
Aztec Peroxides Inc.

B.A.G. Corp.
BASF Corp.
BatchMaster Software, Inc.
Bohlin Instruments, Inc.
Bowers Process Equipment Inc.
Brookfield Engineering Laboratories
Brookhaven Instruments Co.
Buckman Laboratories
Burgess Pigment Co.
BYK-Chemie USA
BYK-Gardner, Inc.

Cabot Corp.—CAB-O-Sil & Special Blacks Div.
Caframo Ltd.
Calgon Corp.
Cardolite Corp.
CB Mills, Div. of Chicago Boiler
CCP Polymers
Celite Corp.
Chemical & Eng. News, American Chemical Society
CIBA-GEIGY Corp., Additives, Polymers, & Resins Divs.
The Coatings Laboratory Inc.
Coatings Magazine
Color Corp.
ColorTec Associates
Consolidated Research Inc.
Cortec Corp.
Coulter Corp. Scientific Instruments
CR Minerals Corp.
Crosfield Co.
CYTEC Industries Inc.

D/L Laboratories
Daniel Products Co., Inc.
Datacolor International
Day-Glo Color Corp.
Degussa Corp.
University of Detroit-Mercy
Disti-Kleen, Inc.
Dominion Colour Corp.
Dow Chemical Co.
Dow Corning Corp.
Draiswerke, Inc.
Drew Industrial Division—Ashland
Dry Branch Kaolin Co.

Eastern Michigan University
Eastman Chemical Co.
Ebonex Corp.
Eiger Machinery, Inc.
Elcometer, Inc.
Elf Atochem North America Inc.
EM Industries
Engelhard Corp.
Engineered Polymer Solutions
Epworth Mfg. Co., Inc.
Etna Products Inc. Specialty Chemical Div.
European Coatings Journal
Exxon Chemical Co.

Fanuc Robotics North America
Fawcett Co., Inc.
F S C T
Filter Specialists, Inc.
Fischer Technology, Inc.
Fluid Management
FMJ International Publications Ltd.
Fryma, Inc.
H.B. Fuller Co.

Paul N. Gardner Co., Inc.
Georgia Pacific Resins, Inc.
The BFGoodrich Co. Specialty Chemicals
Goodyear Tire & Rubber Co., Chemical Div.
Guertin Polymers

Haake, Inc.
The C.P. Hall Co.
Halox
Harcros Pigments Inc.
Heraeus DSET Laboratories
Hilton Davis Co.
Hoechst Celanese Corp.
Horiba Instruments Inc.
J.M. Huber Corp.
Huls America, Inc.
HunterLab

Ideal Mfg. & Sales Corp.
International Compliance Center
International Specialty Products (ISP)
ITT Marlow Pumps/ITT A-C Pumps

S.C. Johnson Polymers

Kady International
Kemira Pigments, Inc.
Kenrich Petrochemicals, Inc.
King Industries, Inc.
KTA-Tator, Inc.

Labsphere, Inc.
LaQue Center—Kure Beach Atmospheric Testing
Lawter International
The Leneta Co.
Liquid Controls Corp.
Littleford Day Inc.
The Lubrizol Corp.
Lucas Meyer, Inc.
Luzenac America

3M/Zeelan Industries, Inc.
3M, Specialty Chemicals
MacBeth—Div. of Kollmorgen
Magnesium Elektron Inc.
Malvern Instruments
Malvern Minerals Co.
McWhorter Technologies
The Mearl Corp.
Micro Powders, Inc.
Micromeritics
Mid-States Eng. & Mfg. Co.
Millipore Corp.
Milwhite, Inc.
Mineral Pigments Corp.
MiniFIBERS, Inc.
Minolta Corp.
Mississippi Lime Co.
University of Missouri-Rolla
Morehouse-COWLES, Inc.
Morton International—UCD
Myers Engineering

Nacan Products Limited
Nametre Co.
Netzsch Incorporated
Neupak Inc.
New Way Packaging Machinery
North Dakota State University

Obron Atlantic Corp.
Ohio Polychemical Co.
Olin Chemicals
Omnimark Instrument Corp.
OSi Specialities, Inc.

Paar Physica USA, Inc.
Paint & Ctgs. Ind. Magazine
Peninsula Polymers
Phenoxy Associates
Polar Minerals
Poly-Resyn, Inc.
PPG Industries, Inc. Silica Products
PPG Industries, Inc.—Specialty Chemicals Group
P Q Corp./Potters Ind.
Premier Mill Corp.
Progressive Recovery, Inc.
Pyosa S.A. De C.V.

Q-Panel Lab Products

Raabe Corp.
Radtech International North America
Ranbar Technology, Inc.
Reichhold Chemicals Inc.
RHEOX, Inc.
Rhone-Poulenc
Rohm and Haas Co.
Ronningen-Petter
Charles Ross and Son Co.
Russell Finex, Inc.

Sandoz Chemicals Corp.
Schenectady Chemicals
Schold Machine Co.
Schutz Container Systems, Inc.
Semi-Bulk Systems Inc.
SEPR (Ceramic Beads & Powders)
Shamrock Technologies Inc.
Shell Chemical Co.
Sherwin-Williams Chemicals
Silberline Mfg. Co., Inc.
Snyder Industries
Software 2000 Inc.
Sonoco Products
South Florida Test Service
Southern Clay Products Inc.
Univ. of Southern Mississippi
Specialty Minerals Inc.
Spencer Machine & Tool Co.,
Spraymation, Inc.
Startex Chemical Co.
Steel Shipping Container Institute
Sub-Tropical Testing Service
Sud-Chemie Rheologicals
Summit Precision Polymers Corp.

21st Century Containers Ltd.
Taotek North America, Inc. Corob North America Div.
Tego Chemie Service USA
Thiele Engineering Co.
Transac Inc.
Troy Corp.

U.S. Borax, Inc.
U.S. Polymers, Inc.
U.S. Silica Co.
Union Carbide Corp.
Union Miniere
Union Process, Inc.
United Mineral & Chemical Corp.

R.T. Vanderbilt Co., Inc.
Versa-Matic Pump Co.
Vorti-Siv Division/MM Industries

Wacker Silicones Corp.
Witco Corp.
World Minerals Inc.

X-Rite, Inc.

Yamada America, Inc.

Zeneca Biocides/Zeneca, Inc.
Zeneca Resins

FSCT 1995 SPRING WEEK REGISTRATION FORM

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Federation of Societies for Coatings Technology — YE OLDE PAINT STONE 1737

Seminar Program

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Company ______________________

Mailing Address ______________________

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Phone __________ Fax __________

COMPANY (Check one)

- ❒ Manufacturers of Paints, Varnish, Lacquer, Printing Inks, Sealants, etc.
- ❒ Manufacturers of Raw Materials
- ❒ Manufacturers of Equipment and Containers
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- ❒ Government Agency
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- ❒ Environmental Services
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- ❒ Paint Consumer
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POSITION (Check one)

- ❒ Management/Administration
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- ❒ Research & Development
- ❒ Sales and Marketing
- ❒ Consultant
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❒ **FSCT Member Fee** Name of FSCT Society __________ **$225 US per person** $ __________

❒ **Non-Member Fee** **$295 US per person** $ __________

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Departure Date __________

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❒ Special needs: Please specify __________

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Note: (1) Deposit includes one night's room rate ($135) plus 10% tax.
(2) Hotel cancellations received **within seven (7) days** of arrival will incur a penalty of one night's room fee, plus tax
(3) **No-shows** will incur a penalty of two night's room fee, plus tax

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❒	May 19 — Tulum and Xcaret	No. of Persons ______	**@ $79 US per person**	$ __________
❒	May 20 — Markets to Malls	No. of Persons ______	**@ $15 US per person**	$ __________
❒	Airport Shuttle Transportation	No. of Persons ______	**@ $10 US One-Way**	$ __________

Airline__________ **Flight No.**__________

Note: Excursion and Airport Shuttle cancellations received after **May 9** are non-refundable

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❒ Please charge to the following card: ❒ MC ❒ VISA ❒ AMEX **Total Payment Due FSCT:** $ __________

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Regulatory Update March 1995

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

More Liberal U.S. EPA "Potential to Emit" Policy May Allow Many Facilities to Avoid Being Considered "Major Stationary Sources"—On January 25, 1995, the U.S. Environmental Protection Agency issued an interim policy concerning a facility's "potential to emit" regulated air pollutants, which is the basis for determining whether it is a "major stationary source" of the pollutants. The policy would allow many facilities to avoid being deemed major stationary sources and thus avoid being subject to the full range of pollution controls under the federal Clean Air Act. The key feature of the EPA policy is that facilities which have operations that keep their emissions levels at or below 50% of the emissions that would be predicted on the basis of a facility's "potential to emit" would be allowed to discharge the lower level of emissions. The "potential to emit" concept assumes that a facility is operated at maximum capacity, 24 hours a day, 365 days a year, and often results in unrealistically high emission levels. Though states are free to choose whether to adopt the policy, its implementation could well save hundreds of facilities from being considered major stationary sources.

EPA to Propose Consolidated Environmental Data Reporting—The U.S. EPA is considering a proposed rule that would allow the regulated community to report on one form TRI data, hazardous waste, water permitting, and air monitoring data. The proposal, expected to be released this summer, would reduce the reporting burden to industry through the establishment of a consolidated environmental programs database.

Reportedly, the agency initiative would determine information data standards throughout EPA, create a master facility index to link major databases through a central facility identification number, and provide the public with a significant amount of centrally located environmental data. Under the program, predominant EPA information collections which obtain information concerning environmental releases, transfers, emissions, and permits (TRI, AIRS, RCRIS, PCS, [RCRA] Biennial Report) would be incorporated into a single, annual report to EPA.

A final rule could be issued as early as mid-1996, but the program will likely take five years to implement.

EPA Staff Proposes Reforms Based on 1994 Superfund Bill—U.S. EPA staff have proposed to agency officials a list of administrative Superfund reforms aimed at implementing some of the cost allocation and public participation initiatives included in the Superfund reauthorization bill which died at the end of the 103rd Congress.

The proposed initiatives, which would be introduced as pilot programs covering six areas, are currently being evaluated by EPA Administrator Carol Browner. She is expected to decide which programs will be implemented by late February.

The initiatives include:

(1) Increasing "enforcement fairness" by accelerating settlements and examining a new cost allocation strategy;

(2) Activating a series of initiatives to alleviate cleanup and the redevelopment of abandoned urban waste sites;

(3) Allowing a greater community role in cleanup decisions;

(4) Forming a pilot program to offer health services to communities near Superfund sites;

(5) Developing guidance on cleanup standards for specific common contamination problems and procedures for setting cleanup standards in line with the anticipated future use of the site;

(6) Increasing states' control over Superfund sites within their jurisdiction, including funding to assist states in establishing voluntary cleanup programs.

Reportedly, the extent of the final reform plan will be determined by regional capability to implement the pilot projects.

Notice—The U.S. Department of Transportation's Research and Special Programs Administration (RSPA), in cooperation with the Transportation Safety Institute (TSI) and the Cooperative Hazardous Materials Enforcement Development (COHMED) Program will sponsor a series of seminars on multimodal transportation of hazardous materials in 1995. One seminar was scheduled for February 14-16 in New Orleans, LA. The remaining two Multimodal Hazardous Materials Transportation Seminars will be on May 16-18 in Minneapolis, MN, and September 26-28 in Philadelphia, PA. Shippers, carriers, and officials from federal, state, and local agencies involved in hazardous materials transportation, response, and program management are invited to attend.

Representatives from all modes (air, highway, rail, and water) will provide updates on hazardous materials transportation issues. Industry representatives will conduct a shipper/carrier panel to discuss relevant hazardous materials issues. The seminar will also feature a four-hour Basic Hazardous Materials Awareness course.

The seminar registration fee is $150. To obtain the registration form or for further information, contact TSI at (405) 949-0036.

States Proposed Legislation and Regulations

Arizona

Air Quality (Regulation)— The Pinal County Air Quality Control District (PCAQCD) has proposed amendments to current air quality regulations which would modify the state implementation plan emissions limitation provisions, including the applicable fee schedule and permit program provisions. Contact Donald Gabrielson, PCAQCD, (602) 868-6760.

Lead—AZ S. 1208 (Buster) provides for the training and certification of lead-based paint abatement programs. The bill was introduced on January 25 and sent to the Senate Committee on Health.

Arkansas

Labeling—AR H. 1350 (J. Smith) authorizes the adoption of regulations that require the labeling of rigid plastic bottles and containers with a code. Although it passed the House on January 25, the bill has subsequently been withdrawn from consideration.

California

Air Quality (Regulation)— A proposed amendment issued by the California Air Resources Board (CARB) would establish volatile organic compound (VOC) content standards for aerosol coatings products. The regulation would establish a two-tiered set of standards limiting the VOC content of 35 different categories of aerosol paints. A hearing on the proposal will be held on March 23 in Sacramento; written comments are due the same day. Contact Paul Milkey, CARB, 916-327-1517.

Hazardous Waste—CA S. 352 (Wright) exempts a solid waste facility or a recycling facility that accepts and processes empty aerosol cans and *de minimis* quantities of nonempty aerosol cans from the requirement to obtain a hazardous waste facilities permit. The legislation was introduced on February 10.

Colorado

Air Quality (Regulation)—The Colorado Air Quality Control Commission (AQCC) has issued a final rule amending its air pollution emission notice (APEN) reporting requirements for stationary sources. The rule permits modifications of the list of air pollutants to be reported on APENs and also revises the "insignificant activities list." The rule became effective on January 30, 1995. Contact AQCC, (303) 692-2000.

The Colorado APCD has scheduled a hearing on March 16, 1995 in Denver to hear public comments on a proposed rule which would impose new requirements for constructed, reconstructed, and modified major sources of hazardous air pollutants (HAPs), including procedures for establishing maximum available control technology (MACT) standards for those affected sources. Contact Kathryn Coggon, APCD, (303) 692-3247.

Graffiti—CO H. 1063 (R. Hernandez) authorizes counties and municipalities to enact regulations to control graffiti, including regulations prohibiting the sale of aerosol containers of paint, markers, and other items used to deface property to minors. On February 2, the House indefinitely postponed consideration of the bill.

Lead—CO S. 85 (Alexander) relates to the exposure of persons living in rental property to lead-based paint and lead-contaminated soil. The legislation is currently under consideration by the House Appropriations Committee.

Connecticut

Graffiti—CT S. 45 (Gunther and Smith) provides additional penalties for writing or painting graffiti on public buildings and highways. On January 4, the legislation was introduced and sent to the Joint Committee on Judiciary.

Hazardous Waste—CT H. 5915 (Sauer) allows municipalities to provide for a temporary storage site for waste paint, thereby discouraging the illegal disposal of paint. Introduced on January 19, the bill was sent to the Joint Committee on the Environment.

CT S. 226 (Fleming) ensures that the necessary costs of environmental remediation at municipally owned Superfund sites are fairly allocated. The bill, introduced on January 13, was sent to the Joint Committee on the Environment.

Lead—CT H. 5739 (Ritter) concerns financial assistance for lead paint abatement in residential housing. Introduced on January 18, the bill was sent to the Joint Select Committee on Housing.

CT H. 5974 (Knopp) reduces the cost of lead abatement for landlords and homeowners by authorizing the use of encapsulation products in this state which have been approved by Massachusetts or by the U.S. EPA. The legislation was introduced on January 19 and referred to the Joint Committee on Public Health.

CT S. 292 (Ciotto) concerns grants for lead abatement. The bill, which was introduced on January 17, was sent to the Joint Select Committee on Housing.

Florida

Air Quality (Regulation)—The Florida Department of Environmental Protection (DEP) has proposed rules, which among other things, will require the submission of permit renewal applications for affected sources no later than 180 days prior to the expiration of the permit. The regulations also establish criteria which the DEP will use to determine whether to exempt insignificant emissions units or activities of sources using general air pollution permits. Contact Beth Hardin, DEP, (904) 488-0114

Georgia

Air Quality (Regulation)—A final regulation of the Georgia Department of Natural Resources (DNR) establishes standards for a pollution prevention action grant program that gives matching grants to specified organizations for promoting and implementing pollution prevention concepts, measures, and technologies. Contact DNR, (404) 362-2687.

Lead—GA H. 585 (Thomas) provides that the owner of any rental dwelling shall be liable for all necessary expenses incurred in treating the effects of lead poisoning in any child residing in such dwelling if it is determined that such lead poisoning is the result of exposure to lead-based paint or other lead hazard. The bill was introduced on February 3 and referred to the House Judiciary Committee.

Hawaii

Graffiti—HI H. 385 (Takumi) requires that the parents of a minor be held liable for property damage, including graffiti, caused by that child. In addition, the legislation allows parents and child to jointly elect to have the child perform community service to offset the costs of the property damage. Introduced on

January 23, the bill is currently under consideration by the House Judiciary Committee.

HI H. 596 (Tom) allows counties to impose civil fines upon any person who places graffiti on county owned, managed, or maintained personal or real property. The legislation was introduced on January 23 and referred to the House Judiciary Committee.

HI H. 597 (Tom) provides a civil penalty for criminal property damage to public property by a minor and holds the minor's parents liable for any civil fine. Introduced on January 23, the House Judiciary Committee is currently considering the legislation.

HI H. 975 (Arakaki) establishes a graffiti eradication clearinghouse for the identification, cataloging, and removal of graffiti from public and private property. On January 25, the legislation was introduced and sent to the House Committee on Finance.

Hazardous Waste—HI H. 36 (Hiraki) provides an appropriation to the state Department of Health to conduct a statewide household hazardous waste collection project. The legislation was sent to the House Committee on Finance on January 18.

Lead—HI H. 381 (Shon) requires any seller of residential real estate property who knows or has reason to believe that the property contains lead-based paint to furnish this information to the purchaser. Failure to disclose this information is punishable by a fine of up to $10,000. The bill was introduced on January 23 and referred to the House Judiciary Committee.

HI H. 918 (Yamane and Yoshinaga) requires contractors involved in the removal of lead paint or underground storage tanks for state projects to obtain environmental hazard insurance. The legislation was introduced on January 25 and referred to the House Committee on Consumer Protection and Commerce.

HI H. 982 (Arkaki) establishes a childhood lead poisoning prevention program and requires a lead contamination study in pre-1978 housing. Introduced on January 25, the bill was sent to the House Committee on Finance.

HI S. 1193 (Tam) requires any seller of residential property constructed before 1980 to furnish to the purchaser a statement advising the purchaser that the property is likely to contain lead-based paint. The bill was introduced on January 23 and referred to the Senate Judiciary Committee

Solid Waste—HI H. 394 (Shon) increases the initial solid waste management surcharge per ton of solid waste. The bill, which was introduced on January 23, was sent to the House Committee on Finance.

HI S. 1445 (Tam) increases the initial solid waste management surcharge from 25 to 75 cents per ton of solid waste. The legislation was introduced on January 27 and sent to the Senate Ways and Means Committee.

Illinois

Lead—IL H. 921 (M. Davis) provides that physicians and health care providers may screen children for lead poisoning in conjunction with the school health exam when, in the physician's judgment, the child is potentially at high risk of lead poisoning. The bill was introduced on February 7.

Lead (Regulation)— A final rule issued by the Illinois Department of Public Health (DPH) amends regulations prescribing licensing standards for lead abatement contractors, supervisors, and workers. The regulation establishes licensing fees, procedures, and training standards, as well as lead mitigation and abatement guidelines. The rule became effective December 31, 1994. Contact Gail DeVito, DPH, (217) 782-6187.

Indiana

Air Quality—IN H. 1441 (Scholer) provides a pollution prevention tax credit against state tax liability for the costs of pollution prevention audits, pollution prevention training, materials substitution, and machinery and equipment purchases and modifications related to reducing the use of toxic materials. The bill is currently being considered by the House Committee on Environmental Affairs.

IN H. 1598 (Bosma) allows a county having a consolidated city to establish an air permit program that complies with the Federal Clean Air Act to obtain approval as an independent program from the U.S. EPA. On February 2, the bill was amended and released from the House Committee on Environmental Affairs

Hazardous Waste—IN H. 1471 (J. Becker) increases the tax imposed on the disposal of hazardous waste in a disposal facility from $11.50 per ton to: (1) $23 per ton in 1995; (2) $45 per ton in 1996; (3) $70 per ton in 1997; and (4) $105 per ton in 1998 and later. The bill was introduced on January 9.

IN S. 418 (Simpson) allows a hazardous waste treatment, storage, or disposal facility to reject all or part of a hazardous waste shipment that: (1) does not conform to the terms of the agreement under which the facility agrees to manage the hazardous waste; (2) does not conform to the requirements of the facility's permit; (3) would require a deviation from the facility's standard operating procedures; or (4) cannot, with reasonable efforts, be removed from the vehicle of the container in which the waste was transported. Introduced on January 11, the bill is being considered by the Senate Committee on Health and Environmental Affairs.

Lead—IN H. 1092 (Warner) allows a local health officer to inspect private property and order abatement of lead-bearing substances that impose a health hazard to humans. On January 23, the legislation passed the House and was sent to the Senate Committee on Health and Environmental Affairs.

Water Quality—IN S. 213 (Server) allows the state Department of Natural Resources to obtain compensation from a person who discharges, sprays, or releases a waste material, chemical, or other substance onto or in any waters of this state, boundary waters, or public or private lands and thereby kills wild animals. On January 5, the bill was introduced and sent to the Senate Committee on Natural Resources.

Iowa

Air Quality (Regulation)—A proposed rule of the Iowa Department of Natural Resources (DNR) would, among other things, permit the limitation of a source's hazardous air pollutant potential so that the source does not have to obtain an air operating permit; add a permit for certain spray booths; and set forth criteria for spray booths so that they will be in compliance with requirements to obtain air construction and operating permits. Contact Christine Spackman, DNR, (515) 281-8941.

Kentucky

Solid Waste (Regulation)—The Kentucky Department for Environmental Protection (DEP) has announced that it plans to amend its performance standards for new and existing underground storage tanks (UST). Contact Aaron Kealy, DEP, (502) 564-2225.

Louisiana

Air Quality (Regulation)— The Louisiana Department of Environmental Quality (DEQ) proposed a rule which would limit VOC emissions from distillation operations, batch processes, and cleanup solvent operations, using reasonably available control technology (RACT). The rule applies to sources located in ozone nonattainment areas classified as marginal or above and that emit at least 50 tons per year of VOCs. Contact Patsy Deaville, DEQ, (504) 765-0399.

Maryland

Lead—MD H. 289 (Hubbard) requires the establishment of a Lead Poisoning Screening Program and a Lead Poisoning Outreach and Education Program. On February 1, the bill was sent to the House Committee on Environmental Affairs.

MD H. 719 (Kach) requires new home builders to disclose or make a certain disclaimer as to the presence of any hazardous or regulated materials, including lead-based paint and other environmental hazards present on the site of a new home to the owner. The bill, which was introduced on February 3, was sent to the House Committee on Economic Matters.

MD S. 474 (Colburn) repeals the Lead Poisoning Prevention Program.

Massachusetts

Lead—MA H. 1831 (Paulsen) establishes a funding mechanism for the Occupational Lead Poisoning Registry. The bill was sent to the Joint Committee on Health Care on February 1.

Lead (Regulation)—The Massachusetts Department of Public Health (DPH) has announced its regulatory agenda, which includes proposed changes in lead poisoning prevention and control standards, as well as the list of substances available that is published under the state right-to-know requirements. Contact DPH, (617) 727-2665

Water Quality—MA H. 124 (Office of Natural Resources and Agriculture) reforms the Clean Water Act of the Commonwealth. On January 11, the bill was introduced and sent to the Joint Committee on Natural Resources and Agriculture.

Michigan

Lead—MI S. 110 (Shugars) establishes the Lead Abatement Contractors Licensing Act. On January 17, the bill was introduced and referred to the Senate Committee on Health Policy and Senior Citizens.

MI S. 111 (Shugars) regulates training involving lead abatement contractors. The legislation was introduced on January 17; it is currently being considered by the Senate Committee on Health Policy and Senior Citizens.

Mississippi

Water Quality—MS H. 154 (Ford) establishes requirements for individual on-site wastewater disposal systems. The House Committee on Public Buildings, Grounds, and Lands is currently considering this legislation.

Missouri

Solid Waste—MO H. 251 (Rizzo) relates to the regulation of underground storage tanks. The bill was introduced on January 11.

Water Quality—MO S. 30 (Treppler) prohibits the diversion of storm or surface water into sinkholes. The Senate Committee on Commerce, Consumer Protection, and the Environment is currently considering this bill.

Montana

Hazardous Materials—MT H. 128 (Committee on Natural Resources) expands the definition of "hazardous material incident" to include a potential release of a hazardous or deleterious substance. Introduced on January 10, the bill was referred to the House Committee on Natural Resources.

New Hampshire

Lead—NH S. 25 (Lovejoy) relates to case management by the state in lead paint poisoning cases. The legislation, which was introduced on January 5, was referred to the Senate Committee on Public Institutions, Health, and Human Services.

NH S. 156 (Roberge and Lovejoy) relates to lead paint poisoning prevention and control. On January 5, the bill was introduced and sent to the Senate Committee on Public Institutions, Health, and Human Services.

Transportation—NH H. 548 (Chandler and Russman) relates to license fees for the transport of hazardous materials and waste. On January 5, the bill was sent to the House Committee on Transportation.

New Jersey

Lead—NJ A. 2442 (Wright) requires the screening of children for lead exposure and appropriates funds for that purpose. Introduced on January 10, the bill has been referred to the Assembly Committee on Health and Human Services.

NJ A. 2130 (Gregory-Scocchi and Felice) mandates health insurance benefits for the screening and treatment of lead poisoning. On January 19, the bill was amended and released from the Assembly Committee on Insurance.

NJ S. 1014 (Sinagra) mandates health insurance benefits for the screening and treatment of lead poisoning. On January 19, the bill was amended and released from the Assembly Committee on Insurance.

New Mexico

Graffiti—NM S. 83 (Maloof) increases the penalties for persons who commit graffiti. The Senate approved the bill on February 9; it is now under consideration by the House Judiciary Committee.

NM S. 123 (Benavides) makes unlawful the sale or offer for sale of spray paint cans. The bill was introduced on January 19.

NM S. 153 (E. Jennings) prescribes penalties for graffiti that causes damage to real or personal property. The legislation was introduced on January 23.

New York

Graffiti—NY A. 1453 (Nolan) authorizes municipal regulation of the sale of aerosol paint cans and broad-tipped indelible markers. On January 23, the bill was introduced and sent to the Assembly Committee on Consumer Affairs and Protection.

NY S. 403 (Skelos) provides for driver's license suspension upon a second conviction of writing graffiti or possessing a graffiti instrument and makes possessing graffiti instruments a class A rather than a class B misdemeanor. Introduced on January 9, the bill was referred to the Senate Committee on Codes.

NY S. 505 (Maltese and Velella) authorizes family courts to order the disposition of paddling for any juvenile delinquent found to have committed acts of graffiti. The legislation was introduced on January 11 and referred to the Senate Committee on Children and Families.

Hazardous Waste—NY A. 636 (Grannis) provides a cause of action for persons injured or suffering economic loss due to exposure to hazardous waste by holding the person responsible for the exposure strictly liable for specific damages. Introduced on January 10, the bill is currently being considered by the Assembly Committee on Environmental Conservation.

NY S. 341 (Daly) establishes a voluntary program to encourage the cleanup of sites containing hazardous wastes or substances. The Senate Committee on Environmental Conservation is considering this legislation.

NY S. 342 (Daly) establishes a program for assigning proportionate shares of liability to responsible parties at inactive hazardous waste disposal sites. The bill was introduced on January 4 and sent to the Senate Committee on Environmental Conservation.

Lead—NY A. 70 (Clark) relates to the abatement of lead poisoning conditions. The bill was introduced on January 4 and currently is being considered by the Assembly Committee on Health.

NY A. 408 (Grannis) prohibits the exclusion of coverage for exposure to lead-based paint with regard to policy insuring against liability for injury. On January 4, the bill was introduced and sent to the Assembly Committee on Insurance.

NY S. 1262 (Volker) establishes a lead abatement licensing and certification program. The bill was introduced on January 26 and sent to the Senate Committee on Health.

NY S. 1684 (Galiber) imposes a $100 surcharge on any building code violation relating to lead paint and creates a lead paint education program to be funded by the surcharge. On February 1, the bill was introduced and referred to the Senate Committee on Health.

Packaging—NY A. 303 (Brodsky) requires packaging to be reuseable or recyclable. On January 5, the bill was referred to the Assembly Committee on Environmental Conservation for consideration.

NY S. 1235 (Dollinger) prohibits the sale of products in a package unless the package is composed entirely of environmentally acceptable packaging. The bill, which was introduced on January 25, is under consideration by the Senate Committee on Consumer Protection.

Recycling—NY A 359 (Brodsky) provides various tax inducements to encourage recycling, including a credit for 50% of the cost of recycling equipment and a deduction for the cost of recycling facilities. The bill was introduced on January 4 and referred to the Assembly Committee on Ways and Means.

Ohio

Air Quality (Regulation)—The Ohio Division of Air Pollution Control (DAPC) has adopted a final rule which amends regulations affecting VOC emissions in response to the U.S. EPA's review of the state implementation plan (SIP). These emissions standards will affect a number of surface coating operations, including can coatings and miscellaneous metal parts, and glass adhesion body primer systems at assembly plants, as well as other VOC emissions from such things as degreasers. Contact Tammy Saunders, DAPC, (614) 644-2270

Oregon

Air Quality (Regulation)— The Oregon Department of Environmental Quality (DEQ) has proposed a regulation that will limit the VOC content of aerosol coatings products for the metropolitan Portland area. The regulation will go into effect on July 1, 1995. Comments are due by March 21, and a public hearing will be conducted on March 22, 1995 in Portland. Contact David Nordberg, DEQ, (503) 229-5519.

Graffiti—OR H. 2531 (Brown) prohibits the sale of aerosol paint to persons under 18 years of age without the consent of a parent or guardian and imposes a $250 fine for violations. The bill, which was introduced on February 2, is being considered by the House Committee on Commerce.

OR S. 343 (Lim) creates the offense of unlawfully applying graffiti, punishable by a maximum fine of $500 and community service consisting of graffiti removal. Introduced on January 26, the bill has been referred to the Senate Judiciary Committee.

Packaging—OR S. 361 (Committee on Agriculture) allows a product or package manufacturer to satisfy requirements for recycled content, reuse, or recycling of rigid plastic containers by using reduced packages. The legislation was introduced on January 30.

Pennsylvania

Automotive Refinishing—PA H. 172 (Lloyd) regulates motor vehicle rustproofing. The legislation, introduced on January 20, was sent to the House Committee on Consumer Affairs.

Lead—PA H. 764 (Belfanti) requires certification of individuals engaged in lead-based paint activities and establishes minimum training requirements. The bill was introduced on February 13.

Rhode Island

Graffiti—RI S. 403 (Palazzo) prohibits minors from purchasing spray paint and requires sellers to place spray paint in a glass case under lock and key. Introduced on February 7, the legislation was referred to the Senate Judiciary Committee.

South Carolina

Environmental Compliance—SC S. 15 (Leventis) establishes environmental compliance history requirements for state Department of Health and Environmental Control permits and requires the filing of a disclosure statement. The bill, which was introduced on January 10, was sent to the Senate Committee on Medical Affairs.

Hazardous Waste—SC S. 162 (Leventis and Courson) provides that hazardous waste includes all waste disposed of in a land disposal site permitted to receive hazardous waste. On January 10, the legislation was introduced and referred to the Senate Committee on Agriculture and Natural Resources.

Transportation (Regulation)—A proposed regulation of the South Carolina Public Service Commission (PSC) would require motor carriers of hazardous waste to file evidence with the PSC of an acceptable safety rating in order to obtain a Certificate of Compliance. Contact Charles W. Ballentine, Executive Director, Public Service Commission, P.O. Drawer 11649, Columbia, SC 29201.

South Dakota

Lead—SD S. 35 (Committee on Agriculture and Natural Resources) protects public health and the environment from lead-based paint hazards. The legislation, which was introduced on January 10, was referred to the Senate Committee on Agriculture and Natural Resources.

Transportation—SD H. 1031 (Committee on Transportation) revises certain provisions pertaining to the regulation of motor carriers transporting hazardous materials. The bill was introduced on January 10 and sent to the House Committee on Transportation.

Tennessee

Air Quality—TN S. 263 (Rochelle) makes permanent certain sales tax credits on pollution control equipment for auto paint shops and similar businesses not otherwise covered. The legislation was introduced on February 1.

Texas

Graffiti—TX H. 1037 (Dukes) relates to the disposition of a juvenile who damages property with graffiti, to law enforcement records relating to a child who uses a graffiti tag, and to the criminal responsibility of a parent for a child's mischief involving graffiti. The bill was introduced on February 3 and has been referred to the House Committee on Juvenile Justice and Family Issues.

TX H. 1076 (West) relates to authorizing certain local governments to regulate the accessibility of certain glues and paints to business patrons. The legislation, which was introduced on February 6, is being considered by the House Committee on County Affairs.

Lead—TX H. 7 (Van de Putte) relates to the identification of children suffering from lead poisoning and to control measures for lead contamination. The legislation was introduced on January 27 and referred to the House Committee on Public Health.

Vermont

Hazardous Materials (Regulation)—The Vermont Department of Labor and Industry (DLI) has amended its regulations to require employers who receive a package, freight container, or transport vehicle containing a hazardous material to retain the U.S. Department of Transportation required markings, placards, and labels on the package, freight container, or vehicle. Contact John Roorda, DLI, (802) 828-2765.

Virginia

Air Quality—VA S. 783 (Barry) authorizes the adoption of local air pollution control ordinances provided for in Virginia's state implementation plan under the federal Clean Air Act Amendments of 1990. The bill, which was introduced on January 17, was sent to the Senate Committee on Agriculture, Conservation, and Natural Resources.

A final rule issued by the Virginia Air Pollution Control Board (APCB) requires operating permits for stationary sources as identified under Title V of the Clean Air Act, specifies permit application requirements, and exempts certain sources. Contact Nancy Saylor or Kathleen Sands, APCB, (804) 762-4421 or (804) 762-4413.

Graffiti—VA H. 2078 (Diamonstein) authorizes any county, city, or town to remove graffiti that is visible from a public right-of-way at the locality's expense. The legislation passed the House on February 6 and was sent to the Senate.

Lead—VA H. 2454 (Reid) revises current provisions relating to certification of lead workers to comply with proposed U.S regulations. On February 1, the bill was amended and released from the House Committee on General Laws.

Water Quality—VA S. 763 (Howell) eliminates the requirement that applicants for permits to discharge sewage, industrial wastes or other wastes to, or adjacent to, state waters provide a certificate of compliance from the local government where the discharge will take place. On January 16, the bill was sent to the Senate Committee on Agriculture, Conservation, and Natural Resources.

West Virginia

Inhalant Abuse—WV H. 2104 (Kiss) provides that sniffing paint is a misdemeanor with a criminal penalty. On February 1, the legislation was amended and released from the House Judiciary Committee.

Wisconsin

Air Quality (Regulation)—A proposal of the Wisconsin Department of Natural Resources (DNR) would establish a reasonably available control technology (RACT) VOC emission limit of 0.06 kilogram per liter (0.5 pounds per gallon) of adhesive or adhesive primer. Contact Raj Vakharia, Bureau of Air Management, P.O. Box 7921, Madison, WI 53707.

Wyoming

Transportation—WY S. 10 (Committee on Joint Transportation) amends provisions relative to the transportation of hazardous materials on highways. The Senate amended the bill on January 17.

Detroit Society's 1995 FOCUS Conference "Compliant Coatings for 2000" Slated for April

The Detroit Society for Coatings Technology's 20th Annual FOCUS Conference is scheduled to be held on April 4, 1995, at the Michigan State University Management Center in Troy, MI. The conference is themed "Compliant Coatings for 2000 and Beyond."

Fourteen experts on coatings technology are currently scheduled to present talks at this "all-day educational and scientific conference," according to Rosemary Brady of Akzo Coatings, Inc. and the Detroit Society. Topics to be discussed include:

Keynote Address—"Automotive Coating Requirements in 2000"—Talaat Karmo, of General Motors Corp.;

"Statistically Designed Experimentation in Coatings Research and Development"—Richard Roesler, of Miles Inc.;

"Regulatory Expectations for the Automotive Plastics Industry"—Naomi Suss, of PPG Industries;

"Options for Reducing HAPs Emissions using MPK and MAK Solvents"—Ron Stout, of Eastman Chemical Co.;

"Waste as a Profit Center"—Michael J. Lichatowich, of Niles Chemical Paint Co., Inc.;

"Polymerizable UV Stabilizers"—Mike Kindergan, of Noramco;

"Infrared Curing and Coatings Technology"—Mark Fannon, of Thermal Designs and Manufacturing;

"Characterization of Particle Coalescence in Waterborne Coatings Using Atomic Force Microscopy"—Charles Hegedus, of Air Products and Chemicals, Inc.;

"Low Emissions Paint Consortium Activities: Focus on the Powder Prove-Out Facility"—Ross Good, of Chrysler Corp. and Duane Showiak, of Ford Motor Co.;

"UMR Coatings Institute Coatings Bulletin Board"—Michael Van De Mark, of University of Missouri-Rolla;

"Adhesion Problem Solving"—Kash Mittal, Consultant;

"Computerized Information Systems: The Fast Track to Coatings Answers and Solutions"—Robert Spinhamey, of Teltech Resource Network, Inc.;

"Optimizing Your Dispersion Process with Premilling"—Dave Ulrich, of Kady Mills;

"UV Chemistry and Technology"—Ed Jurczak, of Sartomer Co., Inc.; and

"Look for the Unexpected"—Norman Roobol, of NR Painting Consultants, Inc.

For more information on the FOCUS Conference, please contact Joe Lesnek, DSCT, P.O. Box 2454, Riverview, MI 48192.

Brookfield Sets Schedule for 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.

An overview of rheology including Newtonian and non-Newtonian flow, time-independent and time-dependent viscosity behavior, measuring techniques, and data analysis will be provided.

The schedule is as follows: March 21, Charlotte, NC; April 4, Philadelphia, PA; April 6, Chicago, IL; May 2, Boston, MA; May 4, Detroit, MI; June 20, Atlanta, GA; and June 22, St. Louis, MO.

For additional information, contact Brookfield Engineering Laboratories, Inc., Dept. NR-107, 240 Cushing St. Stoughton, MA 02072.

DuPont to Conduct DOE Methodology Seminars

DuPont's Quality Management and Technology Center, Wilmington, DE, has announced the schedule for a series of public seminars on design of experiments (DOE) methodology throughout 1995.

Design of experiments allows scientists and engineers to test variable factors concurrently to make reliable business decisions. The seminars require no previous knowledge of statistics or higher mathematics.

"Strategy of Experimentation" seminars are slated for: March 14-16, Wilmington, DE; April 11-13, Houston, TX; May 24-26, Cincinnati, OH; and June 13-15, Charlotte, NC.

The schedule for "Strategy of Formulations Development" seminars is March 21-23, Wilmington; and May 9-11, Cincinnati.

A "Statistical Process Control Basics" seminar will be offered on April 26-27, in Chicago, IL.

For information on registration, contact DuPont Quality Management and Technology Center, 1007 Market St., Nemours Building 6498, Wilmington, DE 19898.

First Pacific Coating Forum Set for May 22-25

The First Pacific Coating Forum is scheduled for May 22-25, 1995, at the Shonan Village Center, Kanagawa, Japan. The symposium is sponsored by the Japan Coating Technology Association.

The forum will focus on "The Mission of Coating Technology for the 21st Century." Topics to be discussed include: automotive painting, rheology, mechanical properties, coatings on constructions and buildings, coil coatings, coating equipment and systems, and wood coating.

Contact Secretariat, Japan Coating Technology Association, Daiichi Naka-Bldg. 4F, 3-4 Nihombashi-Kobunacho, Chuouku, Tokyo 103, Japan, for details.

The Polytechnic University to Conduct Short Courses

The Polytechnic University, Brooklyn, NY, will host two intensive short courses focusing on polymeric materials. The courses will be held at the Park Ridge Marriott Hotel, Park Ridge, NJ.

The objective of the courses is to give practical guidance for applying thermal analytical methods to polymer research and production.

"Thermal Analysis in Polymer Research and Production," which is scheduled for April 24-26, will cover the following topics: instrumentation, techniques, simultaneous and combined techniques, properties, quantitative analysis by specific heat and enthalpy measurements, structure-property relationships, organic compounds, polymers, polymer stability and processing conditions, water in polymers, thermal analysis in polymer flammability, compounding and the role of additives, physical aging of polymers, thermal hazards, problem solving, and future trends.

"Viscoelastic Properties of Polymers," slated for April 27, will cover instrumentational and experimental conditions, basic principles and definitions, polymer structure-property relationships, dynamic mechanical analysis, and dielectric thermal analysis. An optional pre-course program, where instrument companies exhibit and demonstrate their new instruments, will take place on April 26.

The registration fee for "Thermal Analysis in Polymer Research and Production" is $1100. The cost for "Viscoelastic Properties of Polymers" is $450. For additional information, contact Dr. Eli M. Pearce, Director, Polymer Research Institute, Polytechnic University, Six MetroTech Center, Brooklyn, NY 11201.

Happy 75th Anniversary!
to the
Philadelphia Society
for Coatings Technology

April 28, 1995

Datacolor Announces Color Seminar Schedule

The schedule for the "Getting Color Right. Seminars on the Art, Science, and Application of Industrial Color Control Technology" has been released by Datacolor International, Lawrenceville, NJ.

This seminar focuses on practical color problem solving in industrial applications and will be offered in the following areas: March 21-22, Chicago, IL; May 2-3, Los Angeles, CA; May 25-26, Montreal, Que., Canada; June 8-9, Atlanta, GA; June 29-30, Charlotte, NC; July 18-19, Detroit, MI; Aug. 15-16, Lawrenceville, NJ; Sept. 19-20, Dallas, TX; Oct. 12-13, Hartford, CT; and Nov. 2-3, Charlotte, NC.

The registration fee for the course is $395. For more information, contact Datacolor International, 5 Princess Rd. Lawrenceville, NJ 08648.

Intensive Coatings Science Course Offered by NDSU

The Department of Polymers and Coatings at North Dakota State University, Fargo, ND, will conduct an Intensive Coatings Science Course June 5-16, 1995.

This course is designed to provide an understanding of the principles that underlie coatings technology. Although there is a one-week option available, the course is designed as a two-week event.

The following is a tentative list of topics to be covered: chain-growth and step-growth polymerization resins; film formation; acrylic, polyester, and alkyds; amine-formaldehyde resins and crosslinking; epoxy resins; urethane coatings; pigments and pigment dispersions; solvents; coatings formulation; rheology; appearance of coatings; powder coatings; high-solids; radiation curing; corrosion; and structure-property relationships

Registration for both courses is limited to 40 participants.

The cost for the two-week course is $1,700. One-week registration is available for $1,000. More information may be obtained form Marek W. Urban, Chair and Program Director, 54 Dunbar Hall, NDSU, Fargo, ND 58105.

At a recent meeting of the Cleveland Society for Coatings Technology, President Constance Williams, of The Lubrizol Corp., acknowledged Jennifer Rumberg (left photo), of Mahoning Paint Co., Youngstown, OH, as the recipient of the Women in Coatings—Purchasing Award at the FSCT Annual Meeting and Paint Industries' Show in New Orleans, LA. Ms. Williams also announced that the Cleveland Society won second place in the A.F. Voss/APJ Awards for the paper "Correlation of Accelerated Exposure Testing and Exterior Exposure." Ben Carlozzo, of Mameco International, Solon, OH presented the check for $300 to the Society (right photo).

1995 Weather-Ometer® Workshop Dates Announced

Atlas Electric Devices Co., Chicago, IL, has released the dates for the 1995 Weather-Ometer® workshop. The two-day workshop is scheduled to be held May 17-19, August 16-18, and November 15-17, in Chicago at the Holiday Inn O'Hare.

Designed for operators of the Atlas Weather-Ometer instrument line, this course provides a hands-on training on set-up, calibration, and operation of current Xenon Weather-Ometers and Fade-Ometers.

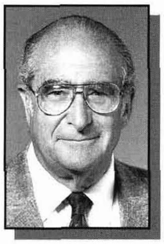
In addition, attendees may tour the Atlas Electric Devices Co.

The fee for the course is $775 and includes course materials, lunch and refreshments, and a welcoming cocktail reception.

For more information or to register for the course, contact Workshop Coordinator, Technical Services Dept., Atlas Electric Devices Co., 4114 N. Ravenswood Ave., Chicago, IL 60613.

Dr. John L. Gardon, of Akzo Nobel Coatings Inc., to Receive 1995 Roy W. Tess Award in Coatings

The 1995 Roy W. Tess Award in Coatings will be presented to Dr. John L. Gardon of Akzo Nobel Coatings Inc., Troy, MI. The presentation of the award bestowed by the Polymeric Materials: Science and Engineering Division of the American Chemical Society (ACS) will be made during the 210th meeting of the ACS on August 20-25, 1995, in Chicago, IL.



The Tess Award recognizes outstanding contributions in the fields of coatings science, technology, and engineering. Dr. Gardon will be honored for his significant achievements in a variety of areas, including his contributions to the theory and practical applications of solubility theory, for which he obtained the 1966 Roon Award. Other areas of achievements are: his extension and experimental verification of the Smith-Ewart Theory of emulsion polymerization; his additions to the adhesion literature, which correlated the ultimate peel strength with solubility parameters and critical surface tensions; and, most recently, his extensive contribution to the area of polymer synthesis, which has led to the commercialization of an entirely new class of high-durability polymers: polyurethane polyols (PUPOs).

Dr. Gardon's career-long work in polymer synthesis has been so extensive and influential that he was included in Professor Raymond B. Seymour's 1984 "Polymer Science Pioneer" series in *Polymer News*.

The body of his work, such as 48 journal and book publications and 75 patents, created over the length of Dr. Gardon's career, has established him as a key innovator in the coatings industry. In addition, Dr. Gardon's numerous invited presentations, including the FSCT's 1992 Joseph J. Mattiello Award Lecture "Polyurethane Polyols: Ester-Bond-Free Resins for High-Solids Coatings," have established his reputation as one of the seminal thinkers in the coatings science and technology fields.

Dr. Gardon received his Chemical Engineering Degree at the Swiss Federal Institute of Technology, Zurich, in 1951, and his Ph.D. from the McGill University, Montreal, Canada, in 1955. After receiving his doctorate, Dr. Gardon joined the staff of the Canadian International Paper Co.; thereafter, he accepted a position with Rohm and Haas. Subsequently, Dr. Gardon became the Director of Research at M&T Chemicals. He next served as Vice President of Coatings Research and Development with The Sherwin-Williams Co. Joining Akzo Nobel Coatings Inc. in 1985, Dr. Gardon is currently Vice-President of Coatings Research and Development.

A member of the Detroit Society, Dr. Gardon has served on various Federation committees. In addition, he was Chairman of the ACS Polymeric Materials Science and Engineering Division and of a Gordon Research Conference of the Science of Adhesion. Dr. Gardon organized and chaired four international symposia at ACS meetings, and was a Trustee of the Paint Research Institute from 1974-79. During 1994, he served as a session chairman for the International Conference of Organic Coatings, in Athens and delivered the Keynote Address to FATIPEC, in Budapest.

Reichhold Acquires Ashland's Canadian Coatings Business

Reichhold Limited, a wholly owned subsidiary of Reichhold Chemicals, Research Triangle Park, NC, has purchased the Canadian coatings business unit of Ashland Oil Co. A technical service lab and office will be operated at Reichhold's Weston, Ontario plant for Canadian customers. A number of employees in field sales, technical, and customer service, who previously worked at Ashland, will become Reichhold employees.

While specific terms of the agreement were not disclosed, the business is expected to add more than 15 million pounds annually to Reichhold's Canadian business. As part of the agreement, Ashland will toll manufacture selected coating products at its Mississauga, Ontario, manufacturing site.

Battelle-R&D Magazine Forecast Predicts Increase in R&D Expenditures for 1995

A recovery in science and technology investments has been forecasted by Battelle, Columbus, OH, for 1995. The Battelle report also predicted a $182 billion rise in expenditures for Research and Development (R&D) in the United States. This represents a three percent increase over the 1994 estimated preliminary figure of $177 billion.

According to Battelle President and CEO, Douglas E. Olesen, "A strong commitment to R&D and technology is critical to maintaining the competitiveness and profitability of industry, providing commercial products, and ensuring the health of the economy." Mr. Olesen cited four trends that can have a significant impact on industrial R&D and technology for the rest of the 90s:

▼ New, high impact commercial products will be developed as a result of technology systems applications, such as integrated product teams that will combine competencies in engineering, materials, environmental quality, electronics, business, and marketing expertise with an emphasis on rapid time-to-market.

▼ Industry is doing more intercompany cooperative research. This is occurring in such areas as the licensing of intellectual property; collaborative, multi-company research; and joint ventures by companies in the same value chain;

▼ Industry views technology as being critical to competitiveness. Superior technologies can translate into superior product quality and productivity; and

▼ The federal government is funding an increasing amount of cooperative research with industry. However, it is still a relatively small fraction of total government R&D spending and the subject of continuing political debate.

The sources at Battelle estimate that the federal government will spend $65.5 billion on R&D in 1995, an increase of 2.4% over last year. Industry will spend $107.4 billion, which represents an increase of 3.6% over 1994. The remainder of the research will be supported by universities and other non-profit organizations.

Support for R&D

The principal sources for R&D support continues to be the federal government and private industry. On the government side, the growth rate has been flattened due to cancellations of significant Department of Defense projects, such as the Strategic Defense Initiative.

In addition, concerns over the budget deficit have led to the cancellation of big-ticket items, such as the Superconducting Super Collider.

However, recently there has been strong federal support for investment in the two extremes of the technology spectrum—ba-

(continued on next page.)

Battelle Forecasts Increase in R&D Expenditures for 1995

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sic research and the commercialization of research developed through the federal laboratory system.

Basic research within the National Science Foundation and the National Institutes of Health recently has been slated for expansion. Technology transfer programs, initiatives in both the Bush and Clinton administrations, have been slated to receive greater funding in 1995.

The changing distribution of R&D funds reflects the general trends in the federal government's R&D priorities. The past decade has seen steady decreases in the percentage of federal R&D dollars spent on national defense, due to the reshaping of perceived global threats.

According to Jules J. Duga, Battelle Senior Researcher and the forecast's principal author, "Federal support for research has generally benefited from a degree of inertia. Historically, the time span between authorization of programs and their funding has been significant. The cessation of research programs has also been gradual."

Mr. Duga stated that significant changes within the federal government R&D structure will occur. For example, increases in some areas of defense spending, such as environmental clean-ups, will be offset by decreases in other areas of federally funded R&D.

The forecast notes that the mid-term election campaigns provided some clues as to how Congress will view substantive issues that relate to research. Preliminary indications suggest that programs directed toward commercialization of federal research may suffer from decreased support, similar to the approach employed during the early 1980s.

Battelle predicts that federal R&D funding for health-biotechnology and transportation will continue to be strong.

Industrial Support

On the industrial side, major changes in the industrial commitment to R&D have resulted in decreased rates of growth during the past several years, and significant changes in the character of R&D that has been undertaken. During the past decade, corporate management has placed more importance on short-term performance and growth, and less emphasis on basic R&D.

In a recent survey of companies by *R&D Magazine*, two special features stand out:

(1) An expectation, among small and large companies, that government funding of industrially performed R&D will stay the same or increase in 1995; and

(2) The exceptions to these generally optimistic observations come from companies located in the northeast and the west, which might be expected given the change in federal defense-related activities.

The generally positive outlook in this year's forecast is substantiated by the results of a membership survey by the Industrial Research Institute. Of the companies that indicated they will increase R&D expenditures, the survey shows a willingness to slightly increase funding.

More importantly, better than half of these companies appear to be increasing expenditures in new product development and systems technologies at a rate that is higher than the anticipated inflation rate, leading to real increases in commitment.

Mr. Duga said the amount of research that industry will outsource to universities and nonprofit institutions in 1995 will reach $2.5 billion, an increase of nine percent.

Performance of Industrial Research

Overall, there are differences within industry relative to the support and performance of R&D. Industry's continuing restructuring has spread into the research laboratories, albeit with the realization that efforts must continue on both short-and long-term technological advance. Although Mr. Duga expects modest increases in 1995 R&D expenditures—expanding beyond that needed to account for normal inflation—the distribution of industrial support will continue a trend that has been developing in the past few years.

Industrial performance—the work companies will do in their own labs—will increase by almost three percent to $130.6 billion in 1995.

Greater internal efforts are being directed toward relatively short-term R&D for immediate problem solving or near-term development, rather than for basic research. In fact, even "directed" basic research will have an application toward satisfying specific corporate product and process needs.

Industry will utilize external resources to a greater degree. Surveys indicate that the direct contracting of R&D with academia will not likely increase, except for those activities which represent pre-competitive, multiple supported programs.

In addition, a greater degree of contracting with independent laboratories—the so-called "fourth estate of R&D"—is being reexamined by industry. With a reduction in the internal capacity to conduct R&D programs, but with the continuing need to expand its technological assets, industry will look toward these institutions that have both the technological capabilities and the experience in dealing with practical technology development.

Finally, industrial support of R&D will increasingly involve multinational facilities, including both those which are wholly-owned subsidiaries and those which are independent of the sponsor.

In conclusion, Mr. Duga attributed the expansion of trade and the reduction of global tensions for creating an impact on R&D expenditures.

For more information on the Battelle Report, contact Battelle, 505 King Ave., Columbus, OH 43201-2693.

OSi Specialties Announces Silanes Expansion in Italy

OSi Specialties, Inc., Danbury, CT, will expand its Termoli, Italy site. The expansion, estimated at $35 million, is expected to increase the capacity for organofunctional silane finished products by 50%. The new facility should be on line before the end of 1996.

According to David I. Barton, President and CEO, OSi has invested more than $65 million in capacity expansions for silanes, including the 5,000 ton capacity at the company's Sistersville, WV, complex. Organofunctional silanes find application in a wide variety of industries including fiberglass, adhesives and sealants, thermoplastics, coatings, and rubber.

Harcros Pigments Expands Iron Oxide Pigments Plant

Harcros Pigments Inc., Fairview Heights, IL, has announced the expansion of their synthetic iron oxide facility in East St. Louis, IL. The expansion, targeted for start-up during the second quarter of 1995, is designed to produce 15 million pounds per year of yellow and black iron oxides.

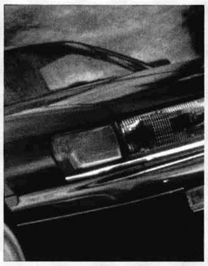
Grow Group Establishes Government Affairs Office

Washington, D.C. has been selected as the site of a government affairs office to be established by Grow Group, Inc., New York, NY. Spearheading initiatives on the environmental, international trade and business fronts will be Joseph M. Quinn. Mr. Quinn is currently the Vice President of the National Paint and Coatings Association.

Russell Banks, President and CEO of Grow, referred to the "changing political climate" in the nation's capital as an opportunity to work more closely with the government.

Stone Impact Damage to Painted Plastic Substrates

R.A. Ryntz,* A.C. Ramamurthy,* and J.W. Holubka†—Ford Motor Co.



Through utilization of a "precision paint collider" impact damage on varying thermoplastic olefin (TPO), reaction injection molded urethane (RIM), sheet molded compound (SMC), and Xenoy (a thermoplastic alloy composed of polycarbonate and polybutylene terephthalate) was assessed via digital imaging analysis of the impacted area. Failures in the impact area resulted largely from paint delamination. In the case of TPO, often times cohesive substrate delamination was observed. In general, of the substrates tested, the greater the temperature at which impact was performed, the greater the amount of damage inflicted upon the substrate. On RIM, however, the opposite occurred.

For two-component topcoats (those crosslinked with isocyanates), SMC performed better than Xenoy, RIM, and TPO, respectively. For one-component topcoats (those crosslinked with melamine), RIM performed better than SMC, which performed better than TPO. In general, one-component paints afforded better impact resistance than two-component paints.

INTRODUCTION

The use of plastics in the automotive arena continues to grow, and it is estimated that the consumption of finished plastics in the United States reached an estimated 1.04 billion kg in 1992.[1] The use of plastics in the automotive sector of the transportation industry reached levels exceeding 0.5 billion kg of engineering plastics and compositions in light passenger vehicles in 1991. Monkman International Consulting estimates U.S. usage to rise to 1.4 billion kg and worldwide usage to 5.4 billion kg by the year 2005.

One the largest end uses of polyurethanes and thermoplastic olefins (TPO) in the U.S. auto market lies in bumpers. In 1991, 89 million kg of plastics were utilized in automotive bumper applications, 51 million kg of which were urethanes (RIM thermosets) and 16 million kg of which were TPOs. By 1995, the estimated usage of plastics in bumpers will increase to 105 million kg, 57 million kg of which are expected to be urethanes, and 29 million kg of which are expected to be TPOs.

Some quote that the fascia market represents the greatest growth area for TPO in the automotive industry.[2] Consumption of TPO in automotive applications, including bumper fascias, instrument panels, and interior trim, is predicted to experience a growth of as much as 30% through the decade. By the year 2000, the consumption of TPO fascias could account for 57 million to 59 million kg.

Thermoplastic olefins are blends of polypropylene and rubber with additional fillers and additives. The polypropylene utilized is a semi-crystalline polymer that has a very low surface free energy and is difficult to paint. Rubber is blended with the polypropylene to aid in paintability, as well as some physical properties, such as low temperature impact. Additives include thermal and process stabilizers, ultraviolet stabilizers, pigments, and fillers.

When TPO is injection molded, a layering of the copolymers within the substrate occurs near the surface, due to shearing forces and thermal gradients induced during the molding process.[3] The polypropylene begins to nucleate and crystallize nonideally due to the rapid cooling effects seen at the "cool" mold surface from the injection melt. A transcrystalline boundary is formed where the axes of the polypropylene crystallites are arranged perpendicular to the TPO surface. The polypropylene directly beneath the transcrystalline boundary can crystallize in a more ideal fashion, e.g., in larger crystal spherulites, due to the delocalization of rapid "cooling" as exhibited on the molded surface (*Figure* 1).

Rubber-rich areas form directly beneath the polypropylene regions. The rubber is often elongated due to the shear forces

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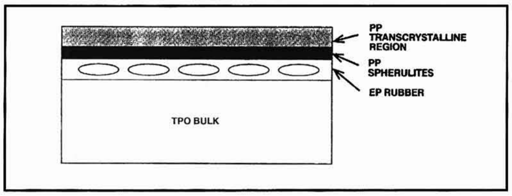

Figure 1—TPO surface morphology.

present in the injection molding process. It is important that the rubber-rich boundaries lie somewhat near the surface since it is believed that this region accounts for the "paintability" of the TPO. In fact, the same TPO blend when compression molded (no shear forces or thermal gradients are imposed on the substrate in this molding operation), afforded no evidence of layering. In the compression molded TPO, it was very difficult to attain even initial adhesion of the paint to the substrate, since the "rubber-rich" layer had never formed near the surface.

In general, plastics (e.g., TPO) are more resilient than steel, and upon minor impact (rocks striking car, minor impact, etc.) typically leave no dent or damage where steel parts would. But upon painting plastics with commercially available finishes, the impact strength of the painted part can vary appreciably from the unpainted substrate. The impact strength of TPO, like other plastics, is often interrelated with other properties of the material, such as: (1) moldability; (2) solvent resistance; (3) heat distortion temperature (HDT); (4) surface texture; and (5) paintability. Therefore, in coating TPO materials, it is important to understand the nature of the plastic as well as the effects coatings and coating solvents will have on the impact strength of the painted plastic composite.

Impact testing of painted substrates has been conducted for several decades. Typical test methods include the standard SAE J00 gravelometer test, the VDA test,[4] the Chrysler steel shot test,[5] the Zroll device,[6] the Zosel device,[7] the Splitt device,[8] the Osterbroek device,[9] and the Nissan diamondshot test.[10] Lack of precision, narrow parameter range, and lack of measurements capabilities were the problems most frequently cited for these methods of measurement.[8]

Table 1 lists several of the variables that one encounters when attempting to quantify the impact resistance of a painted substrate. Not only can the type of projectile vary in size and shape, but the way in which it impacts the substrate can have dramatic effects on the chip resistance that is quantified.

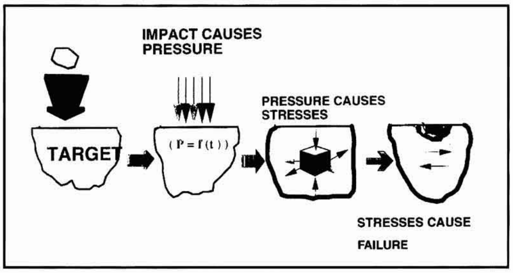

Figure 2—Phenomenology of stone impact damage—impact, stresses, and failure.

It is important to understand the type of impact and the stresses that the impact causes on the substrate (*Figure* 2). The impact from a projectile normal to the target causes pressures to be exerted on the target substrate which are time dependent. These pressures in turn cause compressional stress waves to propagate through the painted composite, which can lead to failure of the composite (either as cohesive delamination within the substrate, adhesive delamination between paint layers, fracture, void formation, or internal spallation)[11] if local stresses developed exceed the yield stresses of the material. It is, therefore, important to be able to quantify the pressures exerted on the substrate in order to understand the stresses that will be formed.

Table 1—System Attributes as Related to Impact Variables

Variables	Attributes
Projectile	Size Density Shape Modulus Poisson's ratio
Impact	Velocity Angle of incidence
Environment	Temperature Humidity Solar radiation
Coating	Viscoelastic properties (Density, Poisson's ratio, Thickness) Adhesion between layers High strain rate properties
Fixture	Stiffness
Substrate	Type (material properties) Thickness High strain rate properties UV durability Processing conditions

EXPERIMENTAL

Stone Impact Test Methods

In order to quantify pressures exerted on the substrate, it is necessary to have more control over the variables involved in impact testing. For this reason, a precision instrumented impact device for laboratory simulations[12] was utilized. The instrumented impact device (*Figures* 3 and 5) is capable of controlling the variables that govern impact phenomenon with a great degree of precision. This instrument has capabilities of launching projectiles of arbitrary size, type, and shape with a desired impact orientation to simulate outdoor conditions. This impact device has several advanced options to characterize and evaluate the dynamics of impact phenomenon. Photographic recording of the impact event, angle of rebound, measurement of contact time, measurements of stresses during the impact event, in addition to measurement of temperature rise during the impact process, are some of the capabilities of this device.

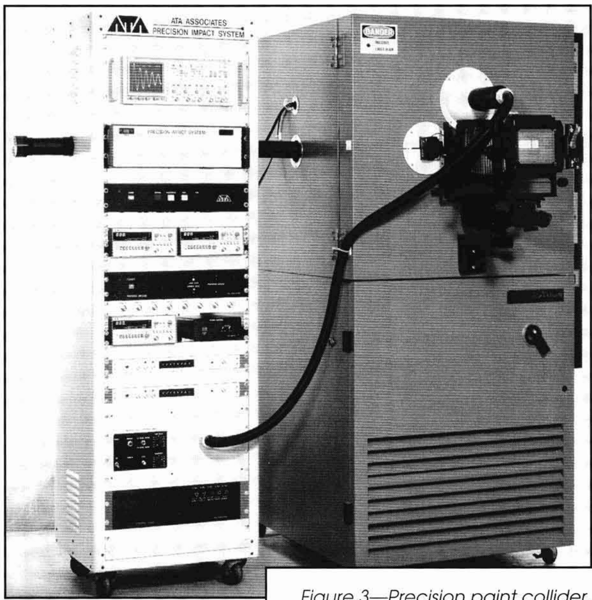

Figure 3—Precision paint collider.

the sabot by the flexible material surrounding the entrance. Upon launch, accelerative forces hold the stone in the sabot, and as the sabot is stopped, the stone flies free without touching the flexible material.[9]

Stones of special design based on cone-cylinders have often been used as standards, particularly by the U.S. Air Force, for evaluating the vulnerability of missile components to stone impact.[13] The usual design is a cone-cylinder-cone shape (*Figure* 4). The interior cone angle is 57°, since this is the angle that drills are cut, rendering easy machining of the sabots. The straight section is chosen so that the mass of the stone is the same as a sphere with the same diameter. For the Air Force study, the most common stone material was a Cedar City tonalite, a species of granite. This rock is referred to throughout this paper as the "Air Force rock" and is two grams in mass and 1.27 cm in diameter.

A holder was constructed in the precision paint collider, which held standard painted panels at angles from 5° to 90°. To simulate different initial conditions, the sample could be clamped either on one or two of its edges. To eliminate sample-to-sample variations, the entire specimen could be rotated and/or translated in precise, indexed steps so that multiple impacts (up to four) could be conducted on a 10.2 cm by 15.2 cm panel at different locations on the same sample.

The instrumented impact device for laboratory simulations (herein referred to as "precision paint collider") is based on a gas gun system as shown in *Figure* 3. The gun and its firing mechanisms are contained in a single chassis mounted in a standard vertical instrumentation rack. The barrel protrudes from either side of the rack. The rate of introduction of compressed gas into the area behind the projectile controls for the most part the velocity of the projectile. Loading of the projectile is performed from the left while the target is to the right, inside the temperature/humidity chamber.

A sabot was developed to hold a stone or projectile at a consistent orientation for the launch cycle. Stones or projectiles are placed in the cone of the sabot and are retained inside

Figure 5 shows the sample holder with a standard painted panel. The direction of impact is from the left of the photograph. The environmental chamber in which the sample holder is placed is capable of covering a temperature span from -70 to +70°C and humidity from 20 to 90%. Both temperature and humidity have proven to be dominant factors which affect viscoelastic properties of coatings,[9,10,14] and also play an equally important role in the case of plastic substrates.

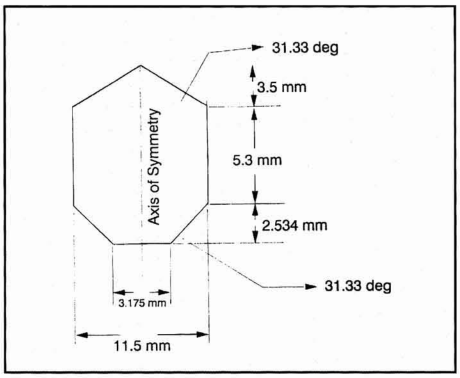

Figure 4—Dimensions of designer rock (rock: granite).

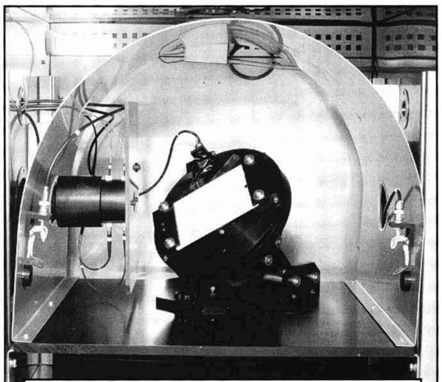

Figure 5— Sample holder in precision paint collider.

Painted Plastic Substrate Preparation

A variety of plastic substrates were painted with either Red Spot (two-component acyrlic-polyester urethane) or Morton (one-component acrylic melamine or two-component polyester urethane) topcoats as described in *Table* 2. Precleaning of the substrates involved:

(1) All TPO materials (D & S Plastics D880 or D161, Exxon AN4L, Himont 139 Reactor Grade) were cleaned simply with an air blow off prior to painting;

(2) The SMC (sheet molding compound) substrate (Budd DSM950) was IPA (isopropanol) wiped prior to painting; and

(3) The RIM (reaction injection molded urethane; Miles 110-50 20% glass reinforced) was IPA wiped prior to painting. Coatings were applied at nominal film thicknesses (see the following) unless otherwise specified.

Nominal dry film thicknesses:

Adhesion promoter: .... 7.5 microns
RIM and SMC primers: .... 20-25 microns
Basecoats: .... 30 microns
Clearcoats: .... 37.5 microns

Coatings were applied to the 10.2 cm × 15.2 cm substrates by spray applying (atomized air) the coating in a vertical position. Baking was accomplished in a horizontal position in gas fired ovens.

Analysis of Painted Substrate Impact Failures

Post impact analysis of the painted plastic substrates was performed via digital image analysis. Digital image analysis or image processing involves improvement of pictorial displays for visual interpretation followed by post processing to enhance and qualitatively analyze an acquired image.

The basic components of any digital image analysis system consists of a digitizer, image processor, a digital computer, and a display device. The image processor performs four basic functions: image acquisition, image storage, manipulation, and display. Typically, a video signal is obtained from an

Table 2—Gravelometer Matrix

Substrate	Panel #	Primer Type	Bake (°C/min)	Basecoat	Clearcoat	Bake (°C for 30 min)
D161	1	Morton AP[a]	RT/15	Morton 1K	Morton 1K	116
	2	Morton AP	RT/15	Morton 1K	Morton 1K	132
	3	Morton AP	RT/15	Morton 2K	Morton 2K	77
	4	Morton AP	RT/15	Morton 2K	Morton 2K	121
	5	Morton AP	88/15	Morton 1K	Morton 1K	116
	6	Morton AP	88/15	Morton 1K	Morton 1K	132
	7	Morton AP	88/15	Morton 2K	Morton 2K	77
	8	Morton AP	88/15	Morton 2K	Morton 2K	121
D880	13	Morton AP	RT/15	Morton 1K	Morton 1K	116
	14	Morton AP	RT/15	Morton 1K	Morton 1K	132
	15	Morton AP	RT/15	Morton 2K	Morton 2K	77
	16	Morton AP	RT/15	Morton 2K	Morton 2K	121
	17	Morton AP	88/15	Morton 1K	Morton 1K	116
	18	Morton AP	88/15	Morton 1K	Morton 1K	132
	19	Morton AP	88/15	Morton 2K	Morton 2K	77
	20	Morton AP	88/15	Morton 2K	Morton 2K	121
SMC	25	Morton SMC	82/30	Morton 1K	Morton 1K	116
	26	Morton SMC	82/30	Morton 1K	Morton 1K	132
	27	Morton SMC	82/30	Morton 2K	Morton 2K	77
	28	Morton SMC	82/30	Morton 2K	Morton 2K	121
Xenoy 1102	29	None	NA	Morton 2K	Morton 2K	77
	30	None	NA	Morton 2K	Morton 2K	121
RIM	31	Morton RIM	121/30	Morton 1K	Morton 1K	116
	32	Morton RIM	121/30	Morton 1K	Morton 1K	132
	33	Morton RIM	121/30	Morton 2K	Morton 2K	77
	34	Morton RIM	121/30	Morton 2K	Morton 2K	121
Exxon AN4L	35	Red Spot AP[b]	104/15	Red Spot 2K	Red Spot 2K	82
Himont 139 Reactor	36	Red Spot AP	93/15	Red Spot 2K	Red Spot 2K	82
D880	37	Red Spot AP	121/15	Red Spot 2K	Red Spot 2K	77
D161	38	Red Spot AP	RT/15	Red Spot 2K	Red Spot 2K	82

(a) P2054-B1/Batch #920970472.
(b) LE16610X.

RT = room temperature.
AP = adhesion promoter.
Morton 1K CC = Q65837.
Morton 1K BC = 90029HC-UR560CAFH/Electric Red.
Morton 2K CC = R789FM.
Morton 2K BC = 89000CC-R783XC/Wild Strawberry.
Morton SMC Primer = R240SMC.
Morton RIM Primer = 89069-1E-UR560CAFH/Batch #910670115.
Red Spot BC = 206LE/Wild Strawberry.
Red Spot CC = 317LE/with trimer.

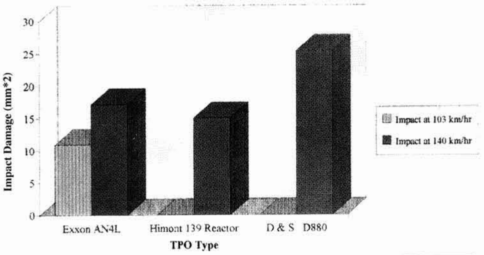

Figure 6—Effect of TPO type on impact damage.

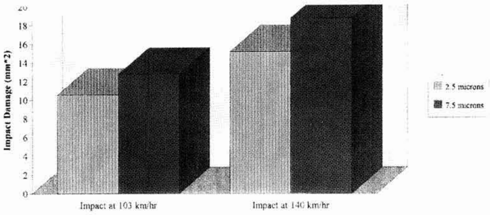

Figure 7—Effect of adhesion promoter thickness on impact damage (D161, 70°C, 15° angle).

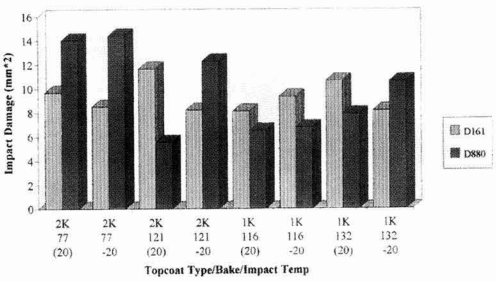

Figure 8—Impact damage (103 km/hr, 45° angle, 25°C ad pro bake).

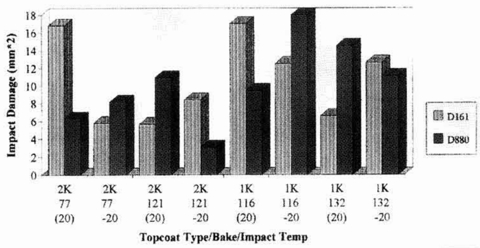

Figure 9—Impact damage (103 km/hr, 45° angle, 88°C ad pro bake).

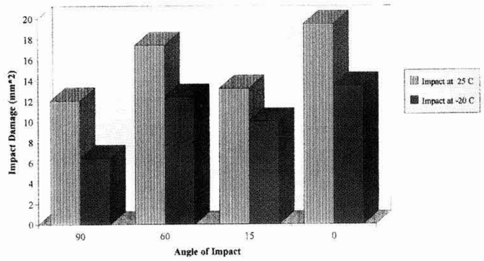

Figure 10—Effect of angle on impact damage (D880, 140 km/hr).

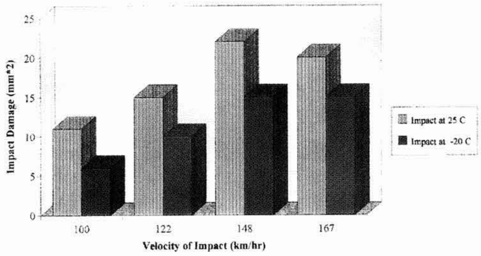

Figure 11—Effect of velocity on impact damage (D880, 15° angle).

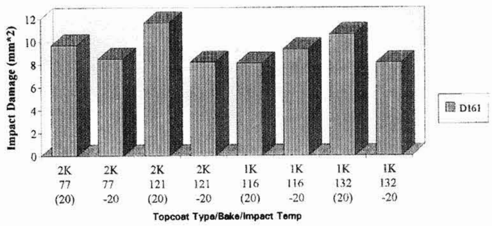

Figure 12—Impact damage (103 km/hr, 25°C ad pro bake, 45° angle).

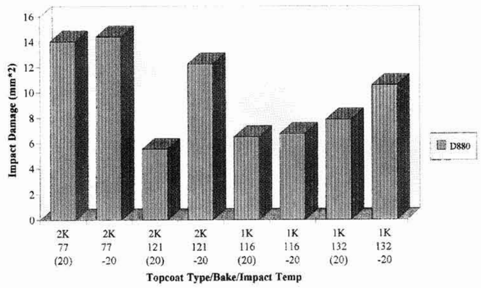

Figure 13—Impact damage (103 km/hr, 25°C ad pro bake, 45° angle).

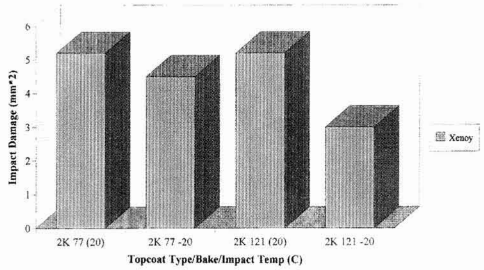

Figure 14—Impact damage (103 km/hr, 45° angle, no primer).

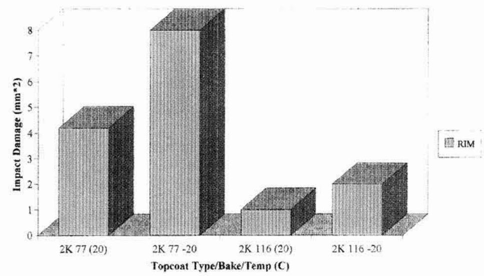

Figure 15—Impact damage (103 km/hr, 45° angle, 30 @ 121°C primer).

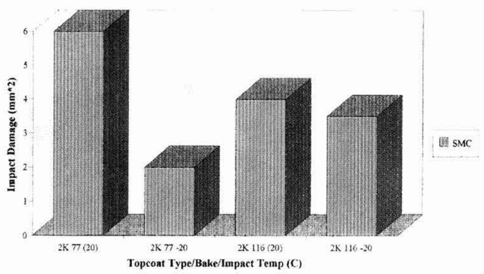

Figure 16—Impact damage (103 km/hr, 45° angle, 30 @ 82°C primer).

input device such as a video camera. The output is fed into the digitizer, which converts an image into a numerical representation suitable for processing by a digital computer. For obtaining images of objects which are a few mm or less in size, a microscope is frequently used in conjunction with the video camera.

For stone chip damage analysis, digital image analysis coupled to visual observations provided a means of rapid assessment and precise estimates of percent paint loss (area) and determination of locus of failure.

Optical Cross-Polarized Light Microscopy

In this method, the TPO is cryogenically microtomed (approximately 15 microns thick) and mounted in Canada Balsam on a microscope slide. The sample thus prepared is viewed under low magnification (ca 100×) under a cross-polarized light source.

Thermal Shock Test Method

The painted sample (nominal thickness for adhesion promoter, two-component basecoat/clearcoat baked at 88°C for 30 min part temperature) was exposed to a thermal stress as follows:

➢ The painted sample was immersed in a water bath maintained at 38°C for 4 hr, following which it was transferred to a -30°C freezer for a period of at least 3 hr.

➢ Within 60 sec after removal from the freezer, the sample was subjected to a high pressure mix of steam and water from a steam cleaner for a period of 30 sec.

The temperature of the steam/water mix was approximately 90°C, at a discharge pressure of 38 KPa measured 2.5 cm from the nozzle tip. The steam/water jet contacted the plaque at the locus of stone impact failure, from a distance of 7 cm and at a 45° angle to the plaque, on an area of approximately 100 mm^2.

RESULTS AND DISCUSSION

Impact Studies

The effect of impact damage on D&S D161 TPO substrates, which is a physically compounded alloy of polypropylene and ethylene propylene rubber, with a flexural modulus of 7733 kg/sq cm, was studied in relation to its surface morphology. The effect of TPO type was studied under the following conditions: 70°C, 15° angle, rock velocities of 103 and 140 km/hr. The TPOs analyzed were Exxon AN4L (physically compounded, 7733 kg/sq cm flexural modulus), D&S D880 (physically compounded, 5624 kg/sq cm flexural modulus), and Himont 139 Reactor (a reactor grade TPO, 7030 kg/sq cm flexural modulus). Topcoating conditions are depicted in *Table* 2 (panels 35 through 37). As shown in *Figure* 6, when impacted at 103 km/hr, the Himont and D&S substrate performed better than the Exxon material. At impacts of 140 km/hr, the reactor grade material performed better than either of the two compounded grades. This phenomenon may be explained by the fact that reactor grade material is a physical graft of rubber onto the polypropylene backbone as opposed to a physical blend. This may afford greater yield strength in

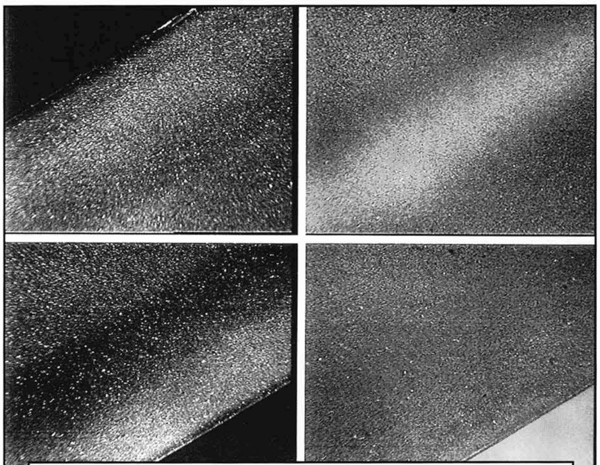

Figure 17—Effect of WBL depth on impact damage D161.

of attachment to the body. For this reason the effect of angle of impact on resultant impact failure (*Figure* 10) was studied. For this study, we utilized D880 substrate which was painted with Red Spot adhesion promoter (15 min flash at 25°C) and topcoated with Morton two-component BC/CC which was baked for 30 min at 77°C. Impact was performed at a velocity of 140 km/hr and at temperatures of 25 and -20°C. The same trend holds true for this study, that at greater impact temperatures for D880 the impact resistance of the painted substrate lessens. There seems to be little correlation to angle of impact and degree of impact resistance, however.

The effect of velocity of impact on impact damage under two different temperature extremes (25 and -20°C) was studied on D880 painted under the same conditions as described. There appears to be a direct correlation of impact velocity to impact damage, where the greater the velocity the greater the damage (*Figure* 11). The damage, however, caused by high velocity stone impact, seems to level off and remain relatively consistent in nature when the velocity exceeds 148 km/hr. The effect of impact temperature again remained consistent in this study, where for D880 the greater the impact temperature the greater the damage.

the substrate's top surface upon impact due to the lack of weak boundary layer structure. The lack of weak surface boundary layers would result in less substrate delamination upon impact. Further work is warranted in the area of reactor grade materials chip resistance.

Since adhesion to the TPO substrates described herein was attained through the use of an adhesion promoter, the effect of adhesion promoter thickness on resultant impact properties of the painted plastic substrate was also studied (*Figure* 7). The topcoating conditions are shown in *Table* 2, panel #38. Impact was conducted at 70°C and at a 15° angle. Regardless of the impact velocity, the lower the adhesion promoter thickness (2.5 vs 7.5 microns), the less the degree of cohesive delamination. Higher velocities produced greater areas of delamination.

The effect of adhesion promoter bake on impact phenomenon was studied in conjunction with impact temperature and topcoat type (both topcoat chemistries and topcoat cure temperatures were varied) on both D&S D161 and D880 substrates (*Figures* 8 and 9). Impact velocity was kept constant at 103 km/hr as was the impact angle at 45°. On D161 at low adhesion promoter bakes, with both one-component and two-component paints, generally the greater the temperature of impact the greater the degree of damage. The same trend generally occurs on D880, where higher temperature impacts appear to cause more impact damage. Topcoat bake in two-component paints does show a trend on D880. It appears that when two-component paints are cured at higher temperatures that the impact resistance of the D880 painted substrate improves.

Styling latitude of fascias necessitates the ability to differentiate slope, therefore angle,

The impact behavior of D&S D161 and D880 was compared to impact behavior of other plastic substrates, namely Xenoy, RIM, and SMC (see *Figures* 12-16, respectively). All impact studies were performed on plaques painted as described in *Table* 2 at 45° angles, velocities of impact of 103 km/hr, conducted at 20 and -20°C.

For the TPOs (D161 and D880), Xenoy, and SMC, the higher the temperature of impact the greater the degree of damage that is produced. It is interesting to note, however, that the average area of damage produced within the TPO materials (6-15 mm*2) is greater than that produced in the other substrates (1-8 mm*2). This may be due to the layering

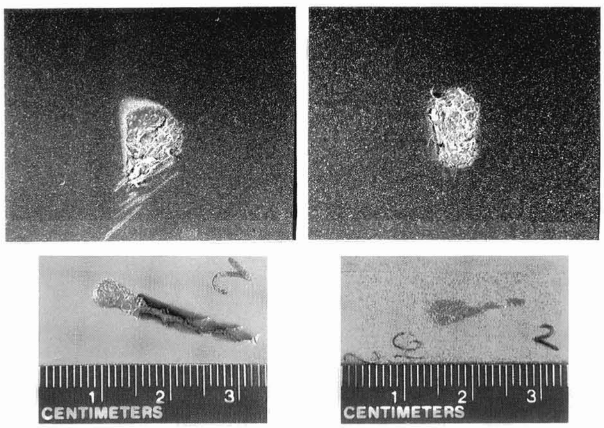

Figure 18—Effect of impact damage on D161.

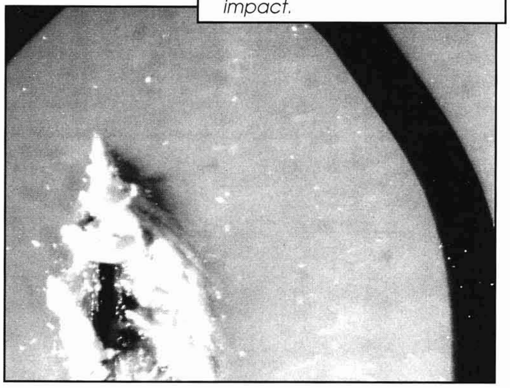

Figure 19—Cohesive delamination of D161 upon stone impact.

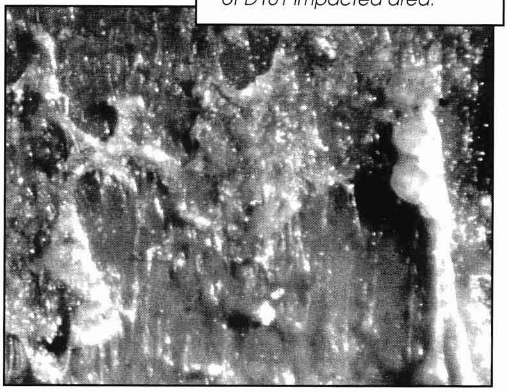

Figure 20—"Melt" behavior of D161 impacted area.

of varying modulus "boundaries" (i.e., crystalline vs amorphous regions) near the surface of the TPO materials which results in greater average damage inflicted upon impact.

For RIM, the lower temperature of impact, the greater the damage inflicted upon the painted substrate (*Figure* 15). This result is just the opposite of that obtained for the previously described substrates. Average damage estimates for the RIM substrate impacted at -20°C were 2 mm*2 (for the one-component topcoat system) and 8 mm*2 (for the two-component topcoat system). At impact temperatures of 20°C, however, the damage estimates were only 1 mm*2 and 4 mm*2 for the respective topcoated systems.

The effective damage on the substrates tested appears to be (in order of decreasing resistance to impact) for two-component topcoats: SMC>Xenoy≥RIM>D161>D880. For one-component topcoats (Xenoy was not tested under this condition), the order appears to be: RIM>SMC>D880≥D161. It is interesting to note that one-component paints perform significantly better on RIM than two-component paints, and that the same trend generally holds true on SMC and TPO. We have as yet to determine why this result occurs but we generally believe it may be due to modulus effects in the coatings.

Birefringence Studies

In order to efficiently measure the site of delamination within a TPO material exposed to stress, we utilized optical birefringence microscopy (optical cross-polarized light) to verify layers within the material. *Figure* 17 delineates the type of layering within D161 TPO substrate as viewed under this type of microscopy. A photographic representation of the data is shown in *Figure* 17. The top left quadrant and bottom left quandrant of the figure display the top and bottom of the substrate, respectively, under a red waveplate. The top and bottom right-hand quadrant display the same areas but in the absence of the red waveplate filter. In either case (in the absence or presence of the red wave plate), layering at the top and bottom of the substrate is evidenced by a shift in color. One can view the transitions of thin differently colored lines running parallel to the top surface as one descends deeper into the substrate. It is believed that these parallel lines represent layers of varying orientations and compositions within the substrate due to the shear stresses imposed in the material during the injection molding process.

When the Air Force rock was lofted at the D161 painted substrate, the damage that was incurred can best be described as cohesive delamination within the substrate (see *Figures* 18-21). If one observes the top two photographs in *Figure* 18 and the photographs of unpainted D161 damage upon stone impact in *Figures* 19 and 20, it is evident that the delamination that occurs is a destructive "ripping" of the substrate. It appears that the TPO "melts" during impact and then recystallizes upon cooling (*Figures* 19 and 20). In the photographs displayed in *Figure* 19, the impact took place at a 40° angle and as such the rock skidded across the TPO surface (shown in direc-

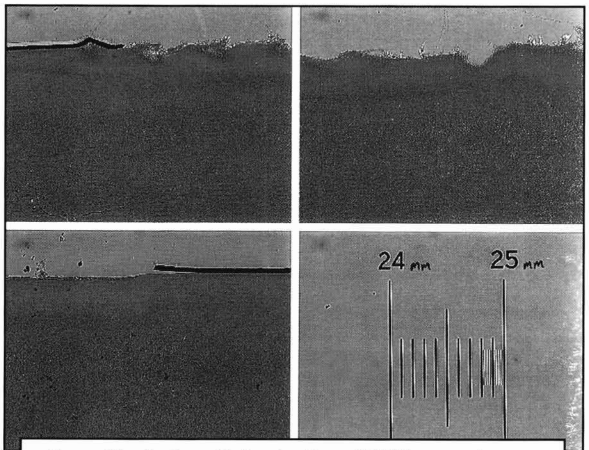

Figure 21—Surface Delamination of D161 upon stone impact.

tion from bottom to top of the pictures). A higher magnification of the delamination is pictured in *Figure* 20.

We then exposed the delamination caused by impact (shown in the top two photographs in *Figure* 18) to thermal shock conditions to determine if the locus of failure continued to propagate. The sample was inspected visually for any delamination of paint or substrate (*Figure* 18, bottom two photographs).

The delamination caused by the thermal shock test was a propagation of the cohesive failure within the substrate caused initially by stone impingement. The propagation of the cohesive delamination was similar in nature to the failure observed on painted plaques under normal thermal shock (Ford test method BI-107-05) conditions, when the TPO was painted at low topcoat cure temperatures.

The depth of cohesive failure within the TPO substrate was analyzed by cross-sectioning a stone-impacted painted TPO substrate and observing the failed area under optical cross-polarized microscopy (*Figure* 21). The failure resulted in depth of cohesive delamination of up to 200 microns.

In order to study the effect of weak boundary layer thicknesses within the D161 substrate, conditions were created within the painted plastic substrate (through thermal annealing) to effectively yield surface boundary layers with the dimensions depicted in *Figure* 22. The paint systems in all cases were identical (Red Spot adhesion promoter (flashed at room temperature for 15 min) topcoated with Red Spot two-component BC/CC and baked at 82°C for 30 min). Impact was performed with two different rock velocities (103 and 140 km/hr) at 70°C and a 15° angle. In all cases, regardless of the impact velocity, the panels that possessed thicker boundary layers exhibited less impact damage (as noted from smaller regions of cohesive delamination). The greater velocities of impact resulted in areas of greater delamination.

CONCLUSIONS

From the studies described, we have raised a lot of questions and continue along scientific paths to answer them. Some general trends do, however, appear to be present in the studies conducted thus far:

(1) Within TPO:

a) Impact damage is cohesive within the substrate and can occur at depths up to 200 microns into the surface;

b) The thickness of the boundary layers within TPO, as evidenced from optical birefringence data, affects impact resistance; the greater the depth of the initial boundary layer the greater the impact resistance;

c) Thermal shock delamination from a stone impacted area appears to occur in the same fashion (cohesively within the substrate) as delamination from a scribe as run in Ford test method BI-107-05;

d) Greater impact velocities result in greater impact damage. There appears to be a threshold value of 148 km/hr and above where impact damage remains relatively consistent and does not appreciably worsen;

e) Reactor grade TPO from Himont performs

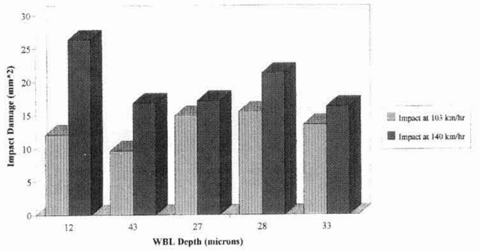

Figure 22—Effect of WBL depth on impact damage D161.

better than compounded TPOs from Exxon and D&S for impact resistance. Other reactor grades were not checked;

f) Greater adhesion promoter thicknesses on TPO result in poorer impact resistance;

g) On D880, two-component topcoats cured at 121°C afforded better impact resistance than those cured at 88°C; and

h) On D880, there is little correlation between angle of impact and impact resistance.

(2) In general, of the substrates tested (TPO, SMC, and Xenoy), the greater the temperature at which the impact occurred the greater the amount of damage inflicted within the substrate. On RIM, however, the opposite occurred;

(3) For two-component topcoats, the following order of impact damage occurred (from best performance to worst):

SMC>Xenoy≥RIM>D161>D880

(4) For one-component topcoats, the following order of impact damage occurred (from best performance to worst):

RIM>SMC>TPO

(5) In general, one-component paints afforded better impact resistance than two-component paints.

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Aliphatic Isocyanates Blocked with Volatile Alcohols for Decorative Coatings

Yun Huang, Guobei Chu, Marjorie Nieh, and Frank N. Jones—Eastern Michigan University*

Aliphatic polyisocyanates blocked with simple aliphatic alcohols, such as methanol and ethanol, are widely thought to require baking temperatures and times that are too high and/or too long for application of decorative coatings under production conditions. Here we show that polyisocyanates blocked with these alcohols can, when catalyzed with organotin catalysts, crosslink an acrylic polyol at temperatures comparable to those of commercial ε-caprolactam blocked crosslinkers. With 0.5% of dibutyl tin diacetate catalyst, methanol blocked 1,3-bis (1-isocyanato-1-methylethyl) benzene (TMXDI) and methanol blocked hexamethylene diisocyanate isocyanurate are effective crosslinkers for an acrylic polyol at 145 to 155°C. It is theorized that physical factors (blocking agent diffusion rate and volatility) strongly influence cure response.

INTRODUCTION AND LITERATURE REVIEW

This paper describes an investigation of the possibility of using volatile aliphatic alcohols, such as methanol or ethanol, as blocking agents for aliphatic polyisocyanates in liquid and powder decorative coatings. These alcohols offer several potential advantages over the blocking agents in use today:

(1) They cost less;

(2) They reduce the weight fraction of reaction byproducts because their molecular weights are lower, hence, potential emissions are reduced;

(3) The emissions, especially of ethanol, are relatively benign. Ethanol is considered safe as an additive in gasoline, and it is not on the list of Hazardous Air Pollutants, "the HAP list," to be regulated in the U.S. by 1997; and

(4) They may alter physical characteristics (e.g., solubility or melting point) of blocked polyisocyanates in useful directions.

The results of this study will show that it may be feasible to realize these advantages in decorative coatings. They will also indicate that physical factors (diffusion rates and volatility of blocking agents) may be as important as chemical factors (reaction rates) in influencing the overall cure response of blocked isocyanate coatings.

Overview of Blocked Polyisocyanates

The literature on blocked polyisocyanates is vast. After a brief overview, publications and patents most relevant to this study are reviewed.

Blocked polyisocyanates are widely used crosslinkers for polyols in powder and liquid coatings. Established applications include powder coatings for lawn mowers, appliances, and lighting fixtures, and liquid electrodeposition primers for automobiles and trucks. The blocked polyisocyanates are usually prepared by reacting an isocyanate with a nucleophilic blocking agent (H–B):

$$\mathrm{R{-}N{=}C{=}O \;+\; H{-}B \;\rightleftharpoons\; R{-}\overset{H}{\overset{|}{N}}{-}\overset{O}{\overset{\|}{C}}{-}B}$$

The blocked polyisocyanate, which is essentially unreactive at ambient temperature, is formulated with a polyol (H–O–P), usually a polyester or acrylic resin, into a coating. When the coating is applied and cured at elevated temperature, a chemical crosslinking reaction results in the formation of a urethane linking the polyisocyanate with the polyol and liberation of the blocking agent:

$$\mathrm{R{-}\overset{H}{\overset{|}{N}}{-}\overset{O}{\overset{\|}{C}}{-}B \;+\; H{-}O{-}P \;\rightleftharpoons\; R{-}\overset{H}{\overset{|}{N}}{-}\overset{O}{\overset{\|}{C}}{-}O{-}P \;+\; H{-}B}$$

The reaction is usually driven to completion by volatilization of the blocking agent, although some blocking agents, such as ε-caprolactam, may partly remain in the coating film. Two pathways for this reaction can be envisaged: elimination-addition (E–A), in which H–B cleaves to liberate free isocyanate which subsequently reacts with H–O–P; and displace-

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ment (D), in which H–O–P adds to the carbonyl group of the blocked isocyanate and H–B subsequently separates.[1-5] The alternative pathways are represented in *Scheme* 1.

While both pathways are plausible and are supported by published evidence in various cases, recent evidence (see Discussion Section) favors the E–A pathway for reactions of blocked isocyanates similar to those studied here.

Two broad classes of polyisocyanates are used: aromatic types, in which the isocyanate (–N=C=O) group is attached directly to an aromatic ring; and aliphatic types, in which it is attached to an aliphatic carbon. Both types can impart excellent mechanical properties to the coating film. Aromatic types are less expensive than aliphatics, but aliphatics impart much better UV resistance and color stability to coatings. Aromatic types are widely used in primers and in certain indoor coatings, while the more expensive aliphatic types are used for decorative coatings that will be exposed to sunlight or where excellent color stability is required.

Several classes of blocking agents such as phenols, amides (lactams), oximes, malonic diesters, and aliphatic alcohols have been widely studied.[1-5] All types of blocking agents can be used with both types of polyisocyanates. Critical considerations in the selection of a specific polyisocyanate and specific blocking agent for a given application are the film properties required and, no less important, the baking conditions to be used.

"Cure Response" of Blocked Polyisocyanate Coatings Defined

In this paper we will use the term "cure response" to describe the ability of a coating to crosslink sufficiently to impart acceptable film properties when baked in a particular oven at a specified time and temperature on a specific substrate at a specific film thickness. A coating with a fast cure response will crosslink at a lower temperature in a given time, or in a shorter time at a given temperature, than one with a slower cure response, other factors being equal. In this study, we measured cure response by testing the physical properties of coatings of a specific thickness baked at various temperatures for 30 min on a specific type of panel in a specific oven.

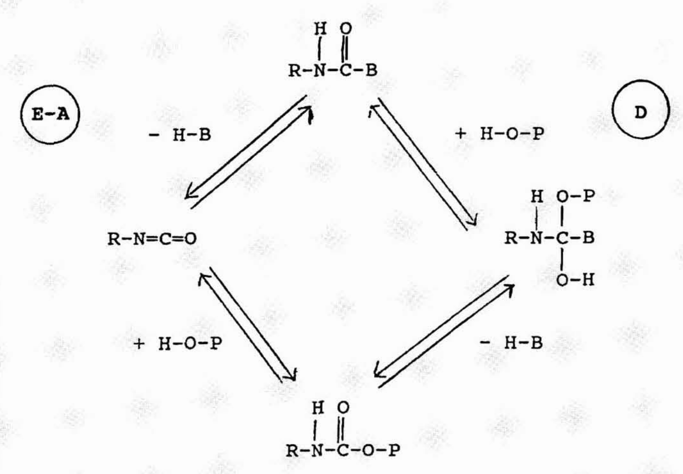
An appropriate cure response is an essential requirement of any thermoset coating. With blocked polyisocyanate coatings, which have slower cure response than most other types of decorative coatings, the formulating goal is often to attain the fastest possible cure response consistent with other requirements. Faster cure response may enable users to save energy by reducing oven temperatures, to accelerate production by passing workpieces through ovens faster, or to coat heat sensitive substrates. This important subject has been widely studied, although terminology and methodology are not uniform.

Selected Previous Studies on Cure Response

Many authors relate cure response to the rate at which a blocked isocyanate dissociates at a given temperature, implicitly assuming that the rate of the dissociation step in the E–A pathway governs the cure response of the coating. An example of such an implicit assumption is found in a 1988 patent:

> *"The chemistry of the blocked isocyanates is based on the equilibrium reaction involving urethane formation, this reaction being reversible at relatively high temperatures ... coatings of this type ... undergo crosslinking only at relatively high temperatures. The tendency of the blocked isocyanates to undergo thermal dissociation is dependent on both the isocyanate component and the chemical structure of the blocking agent. The most thermally stable compounds are urethanes obtained from aliphatic isocyanates and primary alcohols, which undergo cleavage only at 230°C. The urethanes obtained from aromatic isocyanates with primary alcohols are less stable."*[6]

Scheme 1



To the extent that such statements reflect the conventional wisdom, it is not surprising that use of aliphatic alcohols as blocking agents has been largely limited to primers, notably electrodeposition primers, where aromatic isocyanates (supposed to be more reactive than aliphatics) can be used and high bake temperatures, generally above 180°C,[2,5] for 15 to 30 min, are common.

For decorative coatings, however, the situation is quite different. Weatherability and color stability are often essential requirements, so aliphatic blocked polyisocyanates (supposed to be less reactive than aromatics) must be used, and faster cure responses are generally required. Commercial baking conditions vary widely, but many decorative coatings that are baked for 10-30 min cure at temperatures below 170°C (338°F). Because users often want to reduce times and/or temperatures,

Table 1—Deblocking Temperatures of Blocked m-Isopropenyl Benzyl Isocyanate Monomers[15]

	FTIR Deblocking Temperature, °C	
Blocking Group	-NCO Onset	Rapid -NCO Appearance
Methanol	155[a]	190[a]
N-butanol	165[b]	190[b]
N-pentanol	165[a]	190[a]
N-hexanol	155[a]	175[a]
Propylene glycol	>180[b]	—
ε-caprolactam	90[b]	125[b]
Methyl ethyl ketoxime	50[b]	65[b]
Acetone oxime	50[b]	80[b]
Cyclohexyl oxime	65[b]	100[b]
N-hydroxy succinimide	115[b]	140[b]

(a) Heating rate 1°C/min; IR measured every 5°C.
(b) Heating rate 5°C/min; IR measured every 5°C.

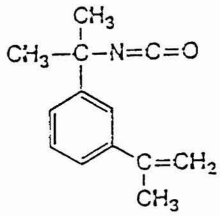
formulators often choose blocking agents with the fastest cure response consistent with other requirements. Lactams or ketoximes are widely used.[7-10] Bake schedules of 155-190°C for 10-30 min are reported for powder coatings blocked with ε-caprolactam.[7-8] Cure responses appropriate for baking temperatures in the 110-150°C/10-30 min range are attainable with ketoxime blocked aliphatic polyisocyan-ates,[8-10] but ketoximes often impart some yellowness to films. While use of aliphatic alcohols as blocking agents for aliphatic polyisocyanates in decorative coatings is described in patents,[11-14] their use in commercial practice is apparently uncommon.

Deblocking (Unblocking) Temperatures

In the literature, cure response is often discussed in terms of "deblocking temperature." It is the temperature at which some measurement, under specified conditions, of chemical or physical change reaches some arbitrarily selected level. In such discussions, there is often an implicit assumption that the crosslinking reaction follows the E–A pathway (see *Scheme* 1), and that the dissociation step is the main factor governing the rate.

Deblocking temperature measurements are convenient, and, if experimental conditions are carefully controlled, may provide useful comparisons of chemical reactivity. However, deblocking temperature is not a "constant" that characterizes a given blocked isocyanate. Deblocking temperatures measured in one type of experiment may not agree with or even correlate with deblocking temperatures measured in a different way. A further limitation of deblocking temperatures is that they cannot be expected to reliably correlate with cure response of actual coatings, where many other factors are at work.

An example of recently reported deblocking temperatures can be found in a paper by Lucas and Wu.[15] These authors are aware that factors other than deblocking temperatures may affect cure response. Their data are used here to amplify this point. Lucas and Wu reported deblocking studies of m-isopropenyl benzyl isocyanate monomer (compound 1) blocked with various blocking agents. Two deblocking temperatures are arbitrarily assigned, one as the lowest temperature at which free –N=C=O groups were detectable by FTIR as the monomer is heated and the second as the lowest temperature at which –N=C=O group formation was judged to be rapid. Results are summarized in *Table* 1.



Compound 1

The data in *Table* 1 suggest that alcohol blocked isocyanates deblock at temperatures roughly 110°C higher than oxime blocked counterparts and roughly 65°C higher than the ε-caprolactam blocked one. A formulator who thinks that the deblocking rate is the main factor governing cure response would not substitute an aliphatic alcohol for an oxime or lactam and expect to get similar cure response. That formulator would be in for a surprise.

Other Factors that Can Affect Cure Response

Deblocking temperature measurements are often effected on neat blocked polyisocyanates or on solutions of them. However, in real coatings co-reactant polyol is present, and it can have a major effect on cure response. Of course, if the D pathway is followed, the co-reactant must be directly involved in the rate controlling step of the crosslinking reaction. It can also have strong effects on the rate of crosslinking by the E–A pathway. As shown by Pappas and Urruti,[10] after the initial step, the co-reactant polyol must compete with the liberated blocking agent to react with the free –N=C=O groups, and the more reactive polyols will react faster.

Polarity of the medium can substantially affect cure response. Lucas and Wu showed that highly polar solvents can be used to suppress premature reaction during polymerization of the monomers described.[15]

Another important factor governing cure response of blocked polyisocyanate coatings is catalysis. While this subject is mentioned in patents and research papers,[15-19] few systematic studies have been reported. It is probable that catalysis is widely practiced, if for no other reason because the

Table 2—Melting Points of Blocked Isocyanates

			Melting point, °C	
Compound	Blocking Agent	Isocyanate	Measured	Lit. (20)
3a	MeOH	TMXDI	130-131	130-132
3b	EtOH	TMXDI	102-104	101-103
3c	i-PrOH	TMXDI	104-106	105-107.5
3d	t-BuOH	TMXDI	74-118	—
3e	1-MeO-2-PrOH	TMXDI	Oil	—
3f	ε-caprolactam	TMXDI	115-120	—
4	MeOH	HDII	Oil	—

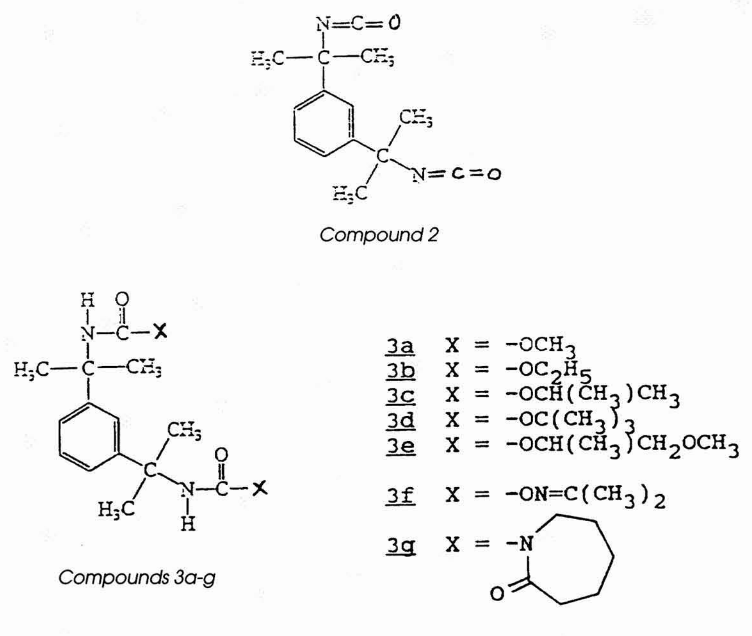


Figure 1—TMXDI and blocked TMXDIs studied

polyester resins used in many formulations contain organotin or organotitanate catalyst residues. An indication of the potential value of catalysts was provided by Blank, who described catalyzed crosslinking by 1,6-diisocyanatohexane (HDI) blocked with primary and secondary aliphatic alcohols such as 2-ethylhexanol.[16] With certain organometallic catalysts, these materials can crosslink acrylic polyols at 155-175°C in 20 min. With catalyst, cure responses are similar to those of ε-caprolactam blocked HDI. Thus, Blank's report indicates that catalysts can substantially change the relative chemical reactivities that might be predicted from deblocking data such as those in *Table* 1.

Another factor that might affect the relative reactivity of different blocking agents is the steric environment of the blocked isocyanate. Several reports[10, 20-21] suggest that alcohol-blocked aliphatic polyisocyanates having sterically hindered carbamate groups might be relatively reactive: (1) Pappas and Urruti reported that while 1,3-bis(1-isocyanato-1-methylethyl) benzene (m-tetramethylxylene diisocyanate, TMXDI, compound 2) is less reactive than other commercial aliphatic diisocyanates, oxime blocked TMXDI (compound 3f) is about as reactive as other oxime blocked diisocyanates.[10] Both observations were attributed to steric effects. Steric hindrance reduces the reactivity of TMXDI's –N=C=O groups, but steric strain relief apparently increases the reactivity of the corresponding blocked isocyanates. (2) Singh and Henderson found that TMXDI can be produced by thermolysis of carbamates such as compounds 3a-3c, in effect deblocking reactions.[20-21]

Finally, physical factors such as gelation, matrix mobility, polarity, miscibility of reactants, and diffusion and evaporation rates of blocking agents could and probably do significantly affect cure rates. Some of these factors have been discussed, for example, by Lucas and Wu,[15] but in general the attention devoted in the literature to physical factors is small in comparison to their potential importance.

To summarize this review, it may be desirable for reasons of cost, environmental regulation compliance, and formulating flexibility to use simple aliphatic alcohols as blocking agents for aliphatic isocyanates for decorative coatings, but conventional wisdom seems to hold that their cure response is too slow. However, a number of factors besides the inherent chemical reactivity of the blocked isocyanates can affect cure response, and many have not been fully explored. In this study, we will re-evaluate the conventional wisdom, demonstrating that these other factors can be used to manipulate cure response.

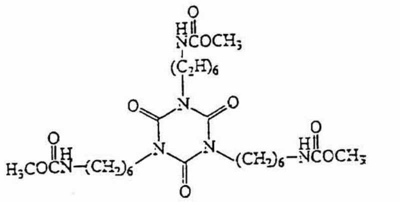
Table 3—Elemental Analyses of Blocked Isocyanates

	Elemental Analysis, calcd/found		
Compound	%C	%H	%N
3a	62.34/61.91	7.79/8.30	9.09/9.03
3b	64.29/64.40	8.33/8.89	8.33/8.42
3c	65.93/66.49	8.79/9.39	7.69/7.69

PLAN FOR THIS STUDY

Initially our investigation focused on TMXDI (compound 2), the commercial diisocyanate having the most sterically hindered –N=C=O groups. Alcohol-blocked TMXDIs (compounds 3a-3e) were synthesized and evaluated as crosslinkers for an acrylic polyol. We will show that with organotin catalysts all can function as crosslinkers below 175°C and that methanol blocked TMXDI, compound 3a, has the fastest cure response; it can crosslink a hydroxy functional acrylic resin within 30 min at 140°C. Surprisingly, the methanol blocked TMXDI affords good film properties at slightly lower temperatures than the commercial crosslinker, ε-caprolactam blocked TMXDI (compound 3g), under our conditions.

The study was briefly extended to a blocked isocyanate prepared from methanol and the isocyanurate of hexamethylene diisocyanate (compound 4). Good crosslinking was observed at 155°C in 30 min.



Compound 4

EXPERIMENTAL DETAILS

MATERIALS: Catalysts hydrated monobutyltin oxide (MBTO, Fascat 4100), butyltin tris(2-ethylhexoate) (MBTTEH, Fascat 4102), dibutyltin diacetate (DBTDA, Fascat 4200), and dibutyltin dilaurate (DBTDL, Fascat 4202) were supplied by Elf Atochem North America Inc., and proprietary catalyst XP-348 was supplied by King Industries. TMXDI and ε-caprolactam blocked TMXDI were obtained from Cytec as Powderlink RT-10. HDI-isocyanurate (HDII) was provided by Miles, Inc., as Desmodur N-3300. The acrylic resin was AU-946, obtained from Rohm and Haas as a 69 NVW solution in methyl ethyl ketone. By titration its hydroxyl equivalent weight was 0.00235 equiv/g (solids basis).

SYNTHESIS OF BLOCKED ISOCYANATES: Blocked isocyanates compounds 3a-3c and 3e were prepared by reacting TMXDI with excess methanol, ethanol, isopropanol, and 1-methoxy-2-propanol, respectively, at reflux for 6-10 hrs without catalyst under dry conditions. Blocked isocyanate compound 4 was prepared similarly from methanol and HDII. Excess alcohol was removed on a rotary evaporator at reduced (about 1 mm) pressure at 25°C, and the residues were characterized and used without further purification. Physical characteristics, elemental analyses, and ^{1}H NMR spectra of these materials are described in *Tables* 2-4. FTIR spectra showed absence of the –N=C=O peak (2260 cm^{-1}) and were otherwise consistent with the assigned structures.

TMXDI did not appreciably react with tert. butanol under reflux without catalyst. When the procedure was repeated with the addition of DBTDL catalyst, a reaction occurred; but the product was impure compound 3d as indicated by its broad melting range.

CURING STUDIES: Coatings were formulated with acrylic resin AU-946 and blocked isocyanates in stoichiometric proportions in methyl ethyl ketone solutions as described in *Table* 5. Catalysts were added and films were cast on Q-Panel R-36-P matte low carbon, cold rolled steel panels using a #24 drawdown bar. Dry film thicknesses were about 20 μm. Panels were baked in a forced air oven for 30 min; in our experience the 30 min bake gives more reproducible results, probably because it affords 15-20 min of baking at oven temperature after panel heat up.

METHODS: FTIR spectra were recorded on an IBM FTIR spectrometer, Model 44. ^{1}H NMR spectra were recorded in $CDCl_3$ solutions with Me_4Si internal standard using a Varian VXR-400 NMR spectrometer at the University of Toledo. Elemental analysis was performed by Galbraith Laboratories Inc., Knoxville, TN. Solvent resistance was measured by double rubbing with acetone saturated nonwoven paper (Kim-Wipes). Pencil hardness was measured by ASTM D 3363-74, and impact resistance was tested using a Gardner impact tester (ASTM D 2794-84). Melting points were measured on a "unimelt" capillary melting point apparatus.

RESULTS

Synthesis and Characterization of Blocked Isocyanates

Methanol, ethanol, isopropanol, and 1-methoxy-2-propanol reacted readily with TMXDI without catalyst to form blocked diisocyanate compounds 3a-3c and 3e in yields greater than 90%. For compounds 3a-3c, melting points (*Table* 2) agreed with published values, and FTIR spectra, elemental analyses (*Table* 3), and ^{1}H NMR spectra (*Table* 4) were consistent with the assigned structures of compounds 3a-3c.

Formulations and Catalyst Studies

Solutions of the blocked diisocyanates and polyols were prepared in proportions calculated to be stoichiometric on the basis of the measured hydroxyl equivalent weight of the coreactant, 0.00235 equiv/g. Proportions are given in *Table* 5. Other proportions were not investigated.

Without catalyst, formulations I-III do not crosslink appreciably when baked at 175°C for 30 min; films are dry to touch, but remain soluble in acetone. Therefore, the effect of catalysts on cure response was investigated. Five catalysts were added to the formulations, and films were baked for 30 min at 175°C with the results shown in *Table* 6.

On the basis of these results, it was concluded that dibutyl tin diacetate (DBTDA) is the most effective catalyst on a weight basis. Two other catalysts, MBT2EH and XP-348, also showed some promise; they were most effective in formulation III. It is probable that the relatively strong catalysis by DBTDA results at least partly from its relatively low molecular weight and relatively high tin content by weight. It is possible that the poor activity of MBTO results from poor solubility in the coating film.

Table 4—^{1}H NMR Spectra of Block Isocyanates

Blocked Diisocyanate Compound	δ-Value (integration and assignment)
3a	1.66 (12H, CH_3); 3.59 (6H, –CO–O–CH_3); 5.11 (2H, NH) 7.28 (3H, arom.); 7.43 (1H, arom.)
3b	1.21 (6H, –CO–OCH$_2$–CH$_3$); 1.64 (12H, CH_3); 4.03 (4H, –CO–OCH$_2$); 5.05 (2H, NH); 7.28 (3H, arom.) 7.43 (1H, arom.)
3c	1.19 (6H, –CO–OCH–(CH$_3$)$_2$; 1.65 (12H, CH_3) 4.81 (2H, –CO–OCH); 5.01 (2H, NH); 7.27 (3H, arom.) 7.42 (1H, arom.)

Table 5—Formulations

Formulation	Blocked diisocyanate	Weight ratio[a]
I	3a (methanol/TMXDI)	80/20
II	3b (ethanol/TMXDI)	79/21
III	3c (isopropanol/TMXDI)	78/22
IV	3d (tert-butanol/TMXDI)	77/23
V	3e (1-MeO-2-prOH/TMXDI)	75/25
VI	3g (ε-caprolactam/TMXDI)	73/27
VII	4 (methanol/HDII)	79/21

(a) Acrylic resin solution/blocked-isocyanate weight ratio.

It is reported[12] that combinations of 1,4-diazabicyclo [2.2.2] octane (DABCO) and organotin catalysts sometimes have synergistic catalytic effects on isocyanate/polyol reactions. To investigate the possibility that a similar effect might occur in blocked-isocyanate reactions, combinations were compared at 150°C bakes, with the results presented in *Table* 7.

The results indicate that DABCO has at most a weak synergistic effect in two cases; apparently DBTDA is the dominant catalyst. Synergistic effects were not investigated further.

Blocking Agent Cure Rate Studies

The previously mentioned results provide a framework for study of the main questions: How do the different blocked isocyanates compare in effective cure rates, and why? For this study, standard formulations with acrylic resin and dibutyltin diacetate were baked at different temperatures. The results are shown in *Table* 8.

The data in *Table* 8 show that under these circumstances reactivities imparted by the different blocking agents for TMXDI are ranked methanol>ε-caprolactam>ethanol> isopropanol>1-methoxy-2-propanol. Little significance can be assigned to the results with formulation IV because of the impurity of blocked isocyanate compound 3d.

DISCUSSION

Technological Considerations

These results establish that some aliphatic alcohol-blocked aliphatic isocyanates are capable of cure responses that are useful at decorative coating cure schedules. With 0.5 phr of DBTDA catalyst methanol-blocked TMXDI cured the acrylic resin satisfactorily in 30 min at 140°C (284°F), a common temperature for cure of liquid decorative coatings and a goal of current powder coating development efforts. Surprisingly, methanol-blocked TMXDI (compound 3a) had a slightly faster cure response than the commercial standard, ε-caprolactam-blocked TMXDI. There appears to be room for further increases in cure response by manipulation of co-reactant, catalyst, and formulation.

It is evident that these results do not correlate with the deblocking temperatures of the chemically similar monomer measured by Lucas and Wu (see *Table* 1). The deblocking data might lead one to predict that the alcohol blocked TMXDI would require bakes of roughly 60°C higher than the ε-caprolactam counterpart, but the actual results indicate comparable cure response. Thus, it is shown tha catalysis can strongly affect relative cure responses in ways that would not be predicted from most types of deblocking temperature measurements.

As a blocking agent, methanol has several appealing features. It is less expensive than any of the blocking agents used commercially, and because of its low molar mass it yields much less VOC than other blocking agents that volatilize during cure. While methanol is moderately toxic, other crosslinkers that give off methanol (e.g., melamine-formaldehyde resins) are widely used in industrial bake coatings.

While ethanol imparted a slightly slower cure response than methanol, it may also have utility, especially since by-product ethanol is exempt from Hazardous Air Pollutant (HAP) regulations scheduled for 1997 in the U.S. In this respect, ethanol has a potential advantage over ε-caprolactam and methanol, which are subject to HAP restrictions.

In cases where the blocking agent is entirely volatilized during cure and where it is counted as VOC, theoretical VOC levels from blocked polyisocyanate coatings are proportional to the molar mass (M) of the blocking agents. Thus methanol (M = 32) could potentially reduce VOC by a factor of 3.5 relative to ε-caprolactam (M = 113) or by a factor of 2.7 relative to methyl ethyl ketoxime (M = 87). Potential reduction factors by substituting ethanol (M = 46) are 2.5 and 1.9, respectively. However, actual VOC reductions may be less because some fraction of the lactam and oxime blocking agents may remain in the coating film for its lifetime. It is sometimes said that ε-caprolactam should not be counted as VOC because of its low volatility; however, it is included under the current legal definition of VOC in the U.S.,[22] and it is on the HAP list.

While compound 3a may be useful in liquid coatings, it may be especially well-suited for powder coatings. Its melting point, 130-131°C, is convenient for powder coating production. A practical question we have not addressed is whether the evolving methanol will cause popping or pinholing in

Table 6—Acetone Rub Resistance with Various Catalysts[a]

Formulation	Acetone double rubs with each catalyst				
	MBTO	MBT2EH	DBTDA	DBTDL	XP-348
I	3	4	200+	10	3
III	7	200+	200+	50	140
IV	8	4	200+	10	5

(a) Panels baked at 175°C for 30 min. Catalyst level 0.5 parts per hundred (phr) of coating solids.

Table 7—Effect of DABCO on the Activity DBTDA Catalyst

Formulation	Acetone Rub Resistance		
	DBTDA 0.5 phr	DBTDA + DABCO 0.25 phr each	DBTDA + DABCO 0.5 phr each
I	200+	60	200+
II	80	40	200+
III	50	30	105
IV	4	3	4
V	70	3	70

Note: Panels baked at 150°C for 30 min.

Table 8—Cure Response of Formulations I-VII at Different Bake Temperatures; Catalyzed with 0.5 phr DBTDA

Formulation/ Blocking Agent	Bake Temperature, °C for 30 min 175	160	155	150	140	130
I/methanol						
Solvent resistance[a]	200+	200+	—	200+	170	15
Pencil hardness[b]	3H	4H	—	4H	4H	H
Impact resistance[c]	25/2	30/2	—	30/2	30/10	15/2
II/ethanol						
Solvent resistance[a]	200+	200+	—	80	4	—
Pencil hardness[b]	4H	4H	—	H	—	—
Impact resistance[c]	30/2	30/2	—	25/2	—	—
III/isopropanol						
Solvent resistance[a]	200+	200+	—	50	3	—
Pencil hardness[b]	4H	4H	—	2H	—	—
Impact resistance[c]	30/2	20/2	—	25/2	—	—
IV/tert-butanol						
Solvent resistance[a]	200+	20	—	4	—	—
Pencil hardness[b]	4H	B	—	—	—	—
Impact resistance[c]	10/2	5/2	—	—	—	—
V/1-MeO-2-propanol						
Solvent resistance[a]	200+	70	—	5	—	—
Pencil hardness[b]	4H	4H	—	—	—	—
Impact resistance[c]	30/2	25/2	—	—	—	—
VI/ε-caprolactam						
Solvent resistance[a]	200+	200+	—	200+	50	3
Pencil hardness[b]	4H	4H	—	3H	3H	—
Impact resistance[c]	30/2	20/2	—	5/2	10/2	—
VII/HDI isocyanurate/methanol						
Solvent resistance[a]	200+	180	160	60	—	—
Pencil hardness[b]	4H	4H	4H	4H	—	—
Impact resistance[c]	160/160	160/160	160/160	30/5	—	—

(a) Solvent resistance: acetone double rubs.
(b) Pencil hardness: ASTM D 3363-74.
(c) Impact resistance: direct/reverse, in-pounds, ASTM D 2794-84.

thick films, as sometimes occurs in powder coatings. There is good reason to think that this problem can be overcome, or at least managed: a methanol evolving crosslinker, tetramethoxymethyl glycoluril, is gaining acceptance in the powder coating market.

Compound 4 may be especially well-suited for use in solvent-borne coatings, especially in high-solids formulations. It is soluble in common coatings solvents, and it has a low viscosity relative to other blocked isocyanates.

Mechanistic Considerations

From a scientific point of view, the results of this study raise several questions. For example: (1) Why is methanol-blocked TMXDI the most reactive member of the series studied? (2) Why is it so much more reactive than might be predicted from deblocking temperature studies? (*Table* 1). (3) Why are catalysts so effective, and what reactions are actually being catalyzed?

To address such questions, it is desirable to postulate a pathway for the reaction of blocked isocyanate with hydroxy-functional co-reactant. As noted in the Introduction Section, two pathways have been proposed, elimination-addition (E-A) and displacement (D), as shown in *Scheme* 1. Each has been supported with experimental data in specific cases, but recent authors lean toward the E–A pathway as the predominant mechanism. Pappas and Urruti showed that reactions of oxime-blocked TMXDI (compound 3f) with alcohols follow an E–A pathway,[10] and Provder obtained convincing evidence for the E–A pathway in reactions of oxime-blocked isophorone diisocyanate trimer.[17] In the ensuing discussion we will assume the E–A pathway, recognizing that the D pathway has not been disproven. We will also assume that all reactions in the E-A mechanism are reversible. This assumption seems justified by the chemical similarity of the forward and reverse reactions and of the known high reactivity of alcohols with –N=C=O groups in the presence of organotin catalysts. Finally, we will assume that side reactions, such as allophanate formation or hydrolysis, do not play a significant role.

Our presumption at the outset of the study was that TMXDI blocked with sterically hindered alcohols would react faster to relieve the extra steric crowding of the blocked TMXDI. However, the opposite proved true—methanol-blocked TMXDI cured at the lowest temperature despite being the least hindered TMXDI adduct. Further, the relatively unhindered methanol-blocked HDII (compound 4) crosslinks readily (although not as readily as compound 3a) even though its structure has the least possible steric hindrance. Thus it appears that steric hindrance of the blocked isocyanate plays only a secondary role in governing relative cure response.

What role might catalysts play? It is clear from our results and from those of Blank,[16] Provder,[17] Muizebelt,[18] and Schaffer et al.,[19] that catalysts can accelerate the overall crosslinking process. In the E–A pathway they could, in principle, act by accelerating either the first (elimination) or the second (addition) step or by accelerating both. However, all possibilities raise puzzling questions. For example, why should a catalyst accelerate the forward (addition) step more than it accelerates the chemically similar reverse (reblocking) step of the elimination reaction? And, why is methanol-blocked TMXDI the most reactive? It is difficult to rationalize all the available data based on catalyst considerations alone. That leads us to consider physical factors.

Let us imagine a situation in which cure is being effected under pressure in a closed container so that blocking agent can not escape. Then when the coating is heated a dynamic equilibrium would be established among all the chemical species shown in the E–A pathway in *Scheme* 1: blocked isocyanate, free blocking agent (H–B), free isocyanate, free co-reactant (H–O–P), and final product. Addition of catalyst to this closed system could accelerate any or all of the four reactions of the E–A pathway. If some are accelerated more than others, the result would be a change in the equilibrium concentrations.

In real cases, crosslinking is effected in open systems and the blocking agent can escape. The equilibrium described is driven to completion by evaporation of blocking agent, or perhaps in some cases by chemical reactions that remove the blocking agent from the equilibrium. It seems plausible that the overall cure response might be strongly influenced by the rates at which the blocking agent can move away from the reaction site, diffuse to the surface of the film, and evaporate. In fact, the factors that do correlate with the cure responses observed in this study are molecular size of the blocking agents (inversely) and their volatility (directly). The same factors influence the relative rates at which the blocking agents can diffuse through the film to the surface and evaporate from the film. It seems unlikely that this is a coincidence.

Thus we propose that the overall cure response is strongly influenced by physical as well as by chemical factors. With reference to the questions raised at the start of this discussion: (1) Methanol-blocked TMXDI is the most reactive of the series 3a-3e because methanol is physically able to leave the film fastest; (2) Apparently physical factors affect the cure response in formulated coatings, curing process (where co-reactant polyol and catalyst are present) more than in unblocking experiments (where they are absent); and (3) Further studies are needed to elucidate the mechanism by which catalysts accelerate the kinetically complex crosslinking process.

SUMMARY AND CONCLUSIONS

Simple alcohols are potentially useful blocking agents for polyisocyanates. Methanol blocked polyisocyanates have the fastest cure response and are potentially the most useful as they maximize the advantages of low cost and low VOC. The cure response of a methanol-blocked TMXDI was slightly faster than that of the commercially used ε-caprolactam-blocked TMXDI with catalysis by dibutyltin diacetate (DBTDA). Ethanol, while offering a slightly slower cure response than methanol, may be attractive because it is exempt from regulation as a Hazardous Air Pollutant.

Evidence indicates that the cure responses of alcohol-blocked TMXDIs are strongly influenced by physical factors (diffusion and/or evaporation rates) as well as by chemical reaction rates.

ACKNOWLEDGMENT

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Influence of Novel Amine Adduct on Curing of Epoxy Resins in Presence of Vinyl Acetate

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To formulate flexible and high-solids coatings, novel amine adduct is synthesized by controlled reaction of diglycidyl ether of ethylene glycol (DGEEG) and m-xylene diamine (MXDA) for curing of epoxy resins in the presence of vinyl acetate (VA). Spontaneous polymerization of vinyl acetate is observed in the presence of amine adduct giving rise to an exotherm. A resinous deep brownish red color is formed in the mixture of vinyl acetate and amine adduct, indicating an interaction which is confirmed by UV spectrophotometry. The interaction is responsible for the spontaneous polymerization of vinyl acetate and a possible mechanism is proposed. The performance of conventional epoxy, viz., diglycidyl ether of bisphenol A (DGEBA) cured with novel amine adduct with and without vinyl acetate is investigated.

INTRODUCTION

Curing of epoxy resins involves the transformation of low molecular weight liquids or solids by means of chemical reaction between epoxide and active hydrogen of an amine or an amine adduct. The curing process is of particular importance in coatings; therefore, knowledge of the kinetics of curing and how the rate changes with diluents (reactive monoepoxides) or solvents to predict the chemical conversion and properties achieved after a cure schedule is essential.[1] The curing of epoxy in the presence of reactive diluents and nonreactive solvents changes the coating properties' low crosslinking density, resulting in less hardness with reactive diluents and low solid coatings with the use of solvents.

In this study, a different approach is proposed. Crosslinking density or lowering of the solids are not affected when the monomer is used as a co-solvent. The monomer does not cut down the crosslink density, but simultaneously gets converted into a polymer, which raises the solid content of the coating. However, the problem of *in-situ* polymerization of the monomer during epoxy curing at ambient temperature has become a limitation. Complexes are convenient initiating agents for polymerization compared to conventional initiators at ambient temperature. Imoto and Otsu[2-4] noticed the formation of a complex between monomer and metal halide, resulting in the delocalization of electrons on the double bond leading to spontaneous polymerization. When a vinyl monomer forms a complex and subsequently undergoes initiation of polymerization, two effects can be expected to occur in the propagation process. The first is the change in reactivity of monomer, and the second is the change in stereochemistry of the resulting polymer.[5]

Gylord et al.,[6-8] have also reported spontaneous polymerization of donor-acceptor complexes formed between monomer and maleic anhydride. In this study, vinyl acetate monomer is used as a co-solvent in a mix of epoxy and novel amine adduct wherein the novel amine adduct forms a complex with vinyl acetate resulting in spontaneous polymerization of vinyl acetate. This approach helps the coating technologist to formulate high-solids coatings with superior properties with an additional advantage of cutting down the mix viscosity of epoxy and hardener for easy application. Also, complex formation of vinyl acetate and novel amine adduct results in crimson coloration, which persists even after polymerization. From the intensity of this coloration in the epoxy coating, the distribution of vinyl acetate polymer can be seen visually.

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EXPERIMENTAL

Materials

RAW MATERIALS: The raw materials used in this study are listed in *Table* 1 and are used as supplied.

LIQUID EPOXY: Diglycidyl ether of bisphenol A (DGEBA) epoxy is prepared by condensation of bisphenol A and epichlorohydrin using 40% caustic lye as a catalyst. Mole frac-

Table 1—Raw Materials

Raw Materials	Suppliers[a]
Bisphenol A	Dow Chemical, USA
m-Xylene diamine (MXDA)	Nissho Iwai, Japan
Ethylene glycol	NOCIL
Epichlorohydrin	Dow Chemical, USA
Sodium hydroxide	Standard Alkalies
Vinyl acetate	Vam Organics

(a) Indian origin unless specified.

Table 2—Characterization of Resins[a]

	Type of Resin		
Property	DGEBA	DGEEG	DGEEG-MXDA
Color on Gardner scale	2-3	<1	4
Viscosity (poise)	300-400	—	27-36
Epoxide equivalent weight	240-280	165-185	—
Amine value	—	—	427

(a) 100% solid resins.

tion of bisphenol A to epichlorohydrin is maintained as 1:3, whereas bisphenol A to sodium hydroxide is 1:2. The reaction is carried out in a four-necked flask fitted with a variable speed stirrer, thermometer, addition funnel, and a Dean-Stark separator with a condenser. Bisphenol A and epichlorohydrin are charged in the flask and heated to 80°C for dissolution. At this temperature, a controlled addition of caustic is done and an exotherm is observed. The water of caustic lye and water of reaction are collected azeotropically with epichlorohydrin by recycling epichlorohydrin back into the flask through the Dean-Stark separator. It is important to maintain less than a percent of water in the reaction flask at any point of time. In four to five hours, caustic lye is added; the reaction product is digested and excess epichlorohydrin and water, if any, are distilled off under vacuum of 50 mm and at 150°C. The resin is purified by separating the salt by vacuum filtration using a Buchner funnel and celite bed. The final filtered resin is characterized in *Table* 2.

Liquid Epoxy of Ethylene Glycol: Diglycidyl ether of ethylene glycol (DGEEG) is prepared by condensing ethylene glycol and epichlorohydrin in 40% caustic lye as described previously. The ratio of ethylene glycol to epichlorohydrin is 1:4 and ethylene glycol to sodium hydroxide is 1:2. The characterization of resin is briefed in *Table* 2.

Novel Amine Adduct (DGEEG-MXDA): In a four-necked round bottom flask, fitted with variable speed stirrer, additional funnel, thermometer, and condenser, two moles of m-xylene diamine (MXDA) are charged at ambient temperature. In three to four hours, one mole of DGEEG is slowly added with the addition funnel, so that the exotherm is controlled at 60°C max. The reaction mixture is digested for two hours, strained, and characterized (see *Table* 2).

Mixing Procedure of Base and Hardener and Film Application

The amine is dissolved in the liquid epoxy as parts per hundred grams of resin (PHR) described elsewhere[9] at ambient temperature. The exotherm, after curing for 30 min with vigorous stirring, is also measured. This procedure is used to ensure homogeneous mixing of the semisolid mass. The reaction mixture of homogenous nature is applied on a sanded mild steel panel using a bar-coater. The same procedure is repeated using the mixture containing vinyl acetate. The exotherm mix and film properties of the compositions are tabulated in *Table* 3.

IR Spectra: IR spectra are recorded for the DGEEG-MXDA samples with and without vinyl acetate as a thin film by using a Perkin-Elmer IR Spectrophotometer Model No. 684.

UV Spectra: UV spectra on a Perkin-Elmer UV spectrometer are recorded for DGEEG-MXDA, VA, and for the mixture containing different fractions of monomer vinyl acetate and novel amine adduct (DGEEG-MXDA) in methanol to study the percent absorbtions at 470 nm.

NMR/ESR Spectra: NMR spectra are taken in $CDCL_3$ on various XL-100 spectrophotometers, wherein signal intensities are used to identify the environment of vinyl acetate

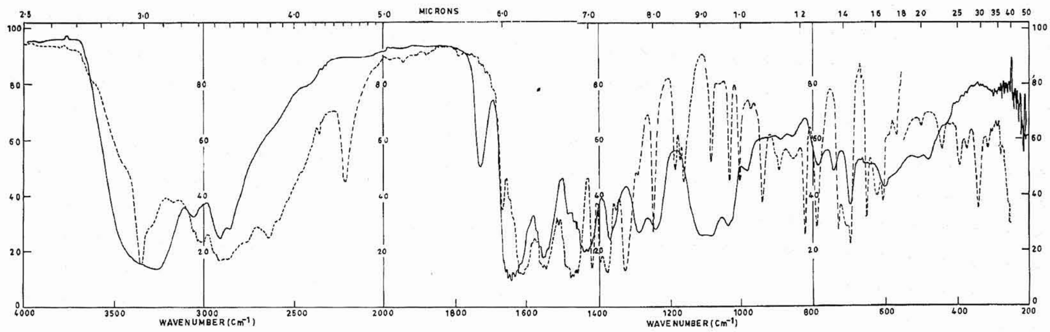

Figure 1—IR Spectrum of: DGEEG-MXDA/vinyl acetate: ———; DGEEG-MXDA: — — — —.

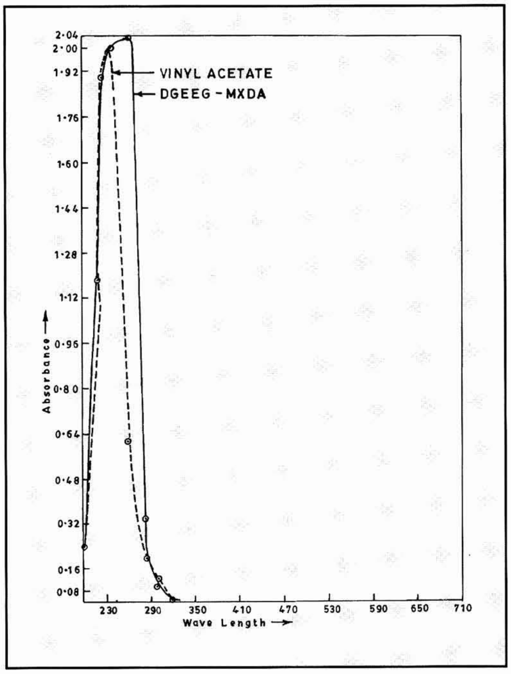

Figure 2—UV spectra of reactants.

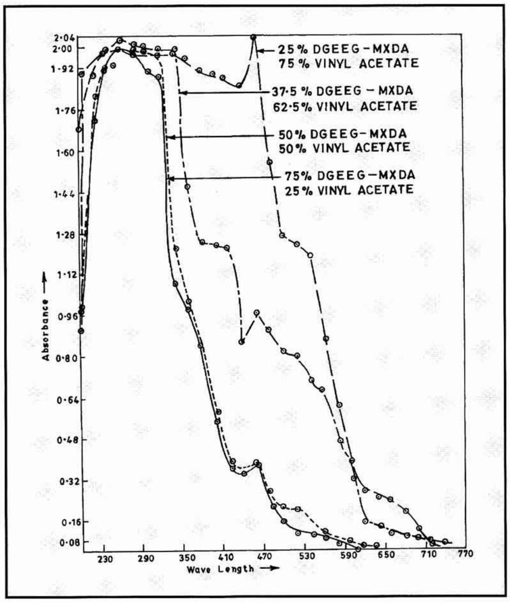

Figure 3—UV spectra of different mixtures.

proton. Spectra of VA, DGEEG-MXDA, and their mixtures after 30 min and 24 hr are recorded.

ESR spectra of pure vinyl acetate, DGEEG-MXDA, and their mixtures (7:3) are recorded on varian XE-line Century series, X-band spectrophotometer at 30°C. The mixture of vinyl acetate/DGEEG-MXDA was subjected to ESR analysis before mixing and after 0.5 hr of mixing.

RESULTS AND DISCUSSION

Curing of epoxy resins with amine adducts such as aliphatic amine reacted with aromatic epoxy based on bisphenol A is well-known. However, the curing agents like m-xylene diamine (MXDA) adduct of diglycidyl ether of ethylene glycol (DGEEG) have not been studied. DGEEG is synthesized in the laboratory as described elsewhere[11] and it was reacted with MXDA. This novel approach of using aliphatic epoxy (DGEEG) reacted with aromatic amine (MXDA) on either side of epoxy is expected to show a mesogenic phase, which is under investigation.[12]

Structurally, this novel amine adduct is compatible with monomers like vinyl acetate, whereas conventional adducts, such as bisphenol A epoxy adduct of aliphatic amines, are not compatible with vinyl acetate. Surprisingly, we observed a resinous mass of crimson color when novel amine adduct is mixed with vinyl acetate. Therefore, experiments were undertaken to study the interaction of vinyl acetate and novel amine adduct.

When vinyl acetate and ethylene diamine are mixed, vigorous reaction is noticed hydrolyzing vinyl acetate as expected, whereas IR spectra of novel amine adduct and vinyl acetate mixture showed the presence of polyvinyl acetate (*Figure* 1). A detailed study of the interaction between vinyl acetate and novel amine adduct is conducted by UV spectrophotometry. *Figures* 2 and 3 show the UV spectra of different weight fractions of DGEEG-MXDA in the mixture of novel amine adduct and vinyl acetate, as well as individual reactants. Neither the vinyl acetate nor the novel amine adduct showed absorbtions in the visible region. However, all of the mixtures of vinyl acetate and novel amine adduct showed absorbance at 470 nm, indicating an interaction between the two compounds resulting in a complex formation.

Further evidence regarding the association of vinyl acetate and novel amine adduct is noticed in the cured film of DGEBA and DGEEG-MXDA with vinyl acetate (*Figure* 4). The uni-

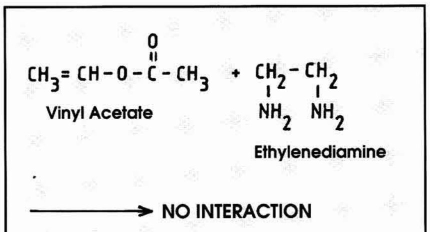

Figure 4—Interaction of ethylene diamine and vinyl acetate

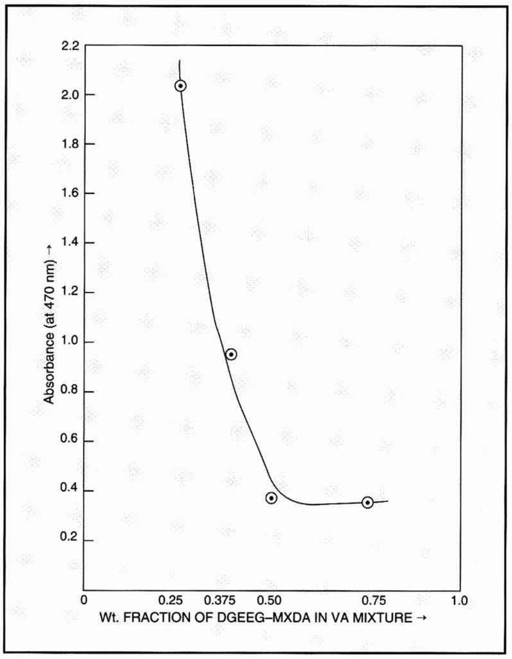

Figure 5—Concentration vs absorbance.

form color distribution is absent in the cured film of DGEBA and DGEEG-MXDA. A complex formation appears to depend on the concentration of vinyl acetate, which can be seen from a plot made between the fraction of DGEEG-MXDA and absorbance at 470 nm (*Figure* 5). The complex formation between vinyl acetate and DGEEG-MXDA is understandable in view of low electron density on $-CH_2-NH_2$ of DGEEG-MXDA interacting with electronegative vinyl acetate as a whole (*Figure* 6).

[DGEEG-MXDA] + [VA]
——> [Complex] ——> [Initiating species]
[Initiating species] + [VA]
——> Polyvinylacetate

Electron spin resonance spectra (ESR) is recorded for the mixture of DGEEG-MXDA and vinyl acetate (*Figure* 7) to establish the nature of the initiating species. A single split spectrum for the mixture after 30 min, which is absent either for DGEEG-MXDA or VA, gives evidence of the presence of a radical ion in the mixture that is responsible for initiating the polymerization of vinyl acetate. However, the intensity of the single split spectrum is very weak due to the viscous resinous mass formation. NMR spectra of novel amine hardener, monomer, and its mixture (after 0.5 hr and 24 hr mixing) are recorded and shown in *Figure* 8. No peak at 4.40, 4.45, and 4.48 is observed in the mixture after 30 min; however, after 24 hr, a peak appeared (*Figure* 8) at 4.40, 4.45, and 4.48 ppm, indicating isotactic, heterotactic, and syndiotactic polyvinyl acetate, respectively.[13] Polymerization of vinyl acetate gives rise to atactic polymer, but it appears in the presence of novel amine adduct stereoregular polymer. This formation gives indirect evidence that the novel amine adduct might have crystalline arrays, leading the vinyl acetate molecules to orient in a systematic way before the polymerization. Literature on stereoregular polymerization in liquid crystalline solvent is known,[14] and work is underway to confirm the mesogenic nature of novel amine adduct (DGEEG); this explains the stereoregular polymerization of vinyl acetate.

EVALUATION OF CURED FILMS OF BISPHENOL A EPOXY AND NOVEL AMINE ADDUCT WITH AND WITHOUT VINYL ACETATE

Films of bisphenol A epoxy novel amine adduct without vinyl acetate mix A (DGEBA/DGEEG-MXDA) and with vinyl acetate mix B (DGEBA/DGEEG-MXDA VA) were applied on cured sanded mild steel panels and cured for seven days. In the present work, 10% VA has been chosen in mix B. The dry film thickness of the cured film based on mix A and mix B is maintained at 45-50 microns. The properties of two films to identify the effect of polyvinyl acetate in the film were compared. From *Table* 3 the deterioration on the film properties of mix B confirms that polyvinyl acetate does not deteriorate the film properties. However, an improvement in the flexibility due to polyvinyl acetate is observed. Moreover, the nonpolar polyvinylacetate in mix B helped the film on absorption and release of water, passing the humidity tests; whereas mix A failed the humidity test. This is an important requirement for the coatings technologist, besides the high-solids coating with the 90% vinyl acetate retention without any cracking of the films. The superior flexibility and humidity resistance of mix B is mainly contributed by polyvinyl acetate that was formed by spontaneous polymerization of VA in presence of DGEEG-MXDA novel amine adduct.

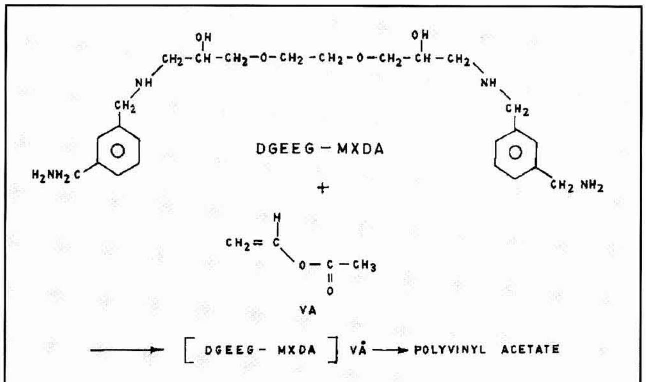

Figure 6—Interaction of DGEEG-MXDA

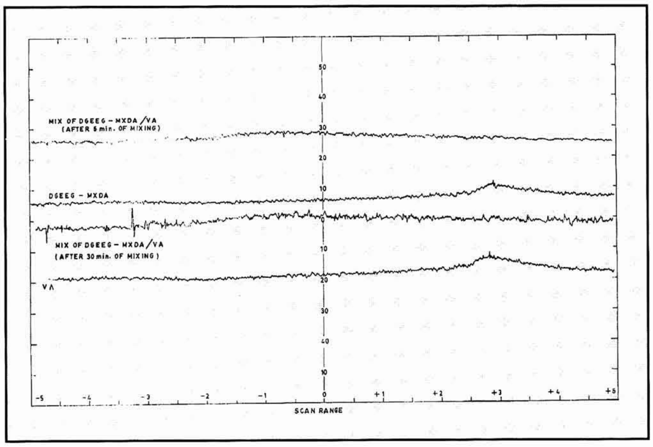

Figure 7—ESR spectra.

Table 3—Characterization of Mixtures Base and Hardener With and Without Vinyl Acetate (VA)

Property	Mix A (DGEBA/ DGEEG-MXDA)	Mix B (DGEBA/ DGEEG-MXDA/VA)
Temp. before mixing	30°C	30°C
Temp. (max) after 30 min mixing	40°C	65°C
Film properties (10)		
Dry film thickness (μ)	45-50	45-50
Scratch hardness (gm)[a]	2200	2100
Erichsen cupping value	9	10
Solvent resistance (acetone)	50 strokes	50 strokes
Impact resistance	900 gm from	900 gm from
Reverse and front (ASTM D2794-92)	80 cm height	80 cm height
Corrosion resistance		
Salt spray (ASTM B117)	120 hr (passes)	120 hr (passes)
Humidity (48°C at 50% RH)	120 hr (fails)	120 hr (passes)

(a) In accordance with BS3900, Part E2 scratch test.

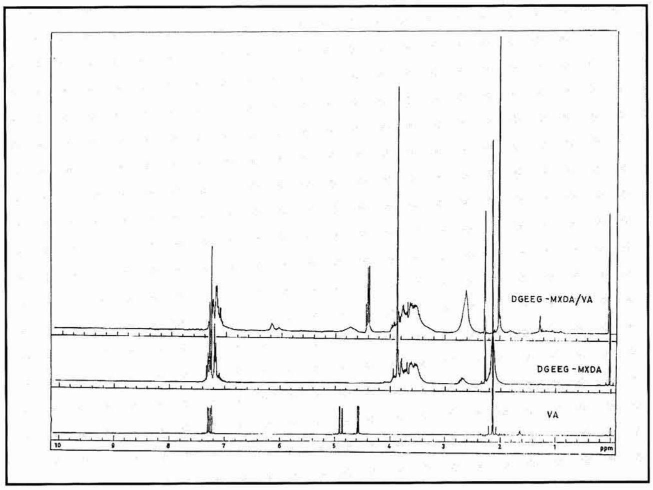

Figure 8—NMR spectra.

CONCLUSIONS

Coatings based on DGEBA/DGEEG-MXDA with VA exhibit good corrosion resistance and chemical resistance, give rise to high-solids coatings. DGEEG-MXDA and VA interact resulting in a complex formation which is responsible for spontaneous polymerization of VA.

ACKNOWLEDGMENTS

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Tribology & Tribochemistry for Innovations in Organic Coatings

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For many coatings technologists today, tribology is just a word—and one with a vague meaning at that!

It is the avowed purpose of this short paper to:

- Alert polymeric coatings technologists of the potential importance of tribology and tribochemistry to their innovative R&D work; and
- Stimulate the study, by these coatings technologists, of the tribological and tribochemical factors applicable to the design, preparation, and uses of organic coatings.

Tribology is a recently created word, having been coined only about 30 years ago. The word is derived from the Greek "tribos," which means rubbing. A formal definition often given for tribology is: "the science and technology of interacting surfaces in relative motion, and of associated subjects and practices."

A simpler definition often used is: "The science and technology of surfaces in sliding contact."

Tribology is thus an interdisciplinary concept which concerns itself with the wear, friction, and of lubrication surfaces in moving contact.

Tribochemistry concerns itself with the chemical changes that occur when surfaces are in moving contact.

Historical

Wear, friction, and lubrication have influenced mankind from time immemorial. These factors continue to affect us today because they relate to conservation, reliability, efficient utilization of resources, and economics. Tribological concepts were employed in Egypt 5,000 years ago to enable chariot wheels and axles to last longer. Egyptian bas-reliefs show lubricants being used in conjunction with rollers and sledges to transport heavy weights. Leonardo da Vinci (1452-1519) first postulated a scientific approach to friction. He recognized that friction force is proportional to load as well as independent of contact area.

Today, tribology is actively studied by universities and resource centers around the world and in corporate research laboratories whose products are influenced by tribological factors.

Friction and Wear

Friction and wear always occur when two surfaces undergo sliding or rolling contact under load. Friction dissipates energy. Wear is a major cause of material wastage. An understanding of these mechanisms will better enable tribologists to make the right selection of coatings for specific end uses.

In many cases, friction depends on surface roughness. On rubbing or sliding, initial contact is made at a few isolated asperities (high spots). The basic characteristics of the surfaces are thus changed: they became smoother or rougher, their physical properties are altered, their chemical natures may be altered, and there is a "wear process."

Such changes may be beneficial, as when surfaces "run-in" to produce optimal operation—or they may be disastrous, as when wear and/or other failures occur, requiring shut-down, repairs, or replacements.

The assumption that low friction is associated with smoothness is basically incorrect. Another misconception is that high friction always means greater wear; the friction/wear relationship is highly complex.

In tribology studies, it is necessary to know the distribution of high spots, slopes, spacing, and the radii of peaks. In practical situations, loads or stresses of any kind are supported by the contacting asperities. Profilometry has found wide application in such studies; many other sophisticated, modern analytical tools are used to measure physical, as well as other properties.

In industry, medicine, and everyday living, today's emphases are on high speeds, higher temperatures, faster production, greater stresses during fabrication and use, greater durability, etc. These point out the need for the application of tribology, for example, in brakes, bearings, rockets, machinery, human joint replacements (bio-tribology), gears, sporting equipment, etc. A modern automobile contains more than 2,000 tribological contacts. Accordingly, automobile manufacturers now have laboratories specializing in tribological engineering. It is partially because of tribology that today's engines can last well over 100,000 miles as compared with about a third of that in the past.

Wear-induced failures occur by abrasion, adhesion loss, fatigue, erosion, corrosion, or by a combination of these factors. However, the theoretical bases of our understanding of these forms of wear are still in their infancy.

In most scenarios, tribology is involved with resistance to motion. This, in turn, includes heat release, noise release, and chemical change. In the past, coping with problems of friction and wear was an exercise in trial and error. Engineering has typi-

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Mr. Glaser graduated Magna Cum Laude from Tufts University with the B.S. Degree in Chemical Engineering, and did graduate work in Chemistry at University of Chicago, and in Polymer Chemistry at Northwestern University. Prior to his retirement, he served as Vice President, Research & Development, of the Midland Division, Dexter Corporation. Mr. Glaser has been a major contributor to the coatings industry for 55 years.

> "Tribology is thus the science/technology/engineering understanding of what happens when surfaces are in contact, such as through rubbing, sliding, or fabricating."

cally progressed by using empirical data, usually with surprisingly good results. This empirical approach is fast becoming obsolete. To make innovative improvements today, we must investigate and learn to understand the basic mechanisms of wear, friction, and lubrication, as well as new techniques of fractal geometry and chaos theory.

Tribology is thus the science/technology/engineering understanding of what happens when surfaces are in contact, such as through rubbing, sliding, or fabricating. When one or more of these surfaces contain polymeric components and/or lubricants, the tribological effects can be of significant importance to coating chemists, especially in their innovative research and development work.

Lubricants and Lubrication

Lubricants are important ingredients in studies of wear and friction. With organic coatings applications, lubricants can be either integral (self-lubricating) or applied externally. The original lubricants were readily available mineral oils, modified with a host of additives such as fatty acids to give improved performance. The role of lubricants is critical because of their intimate proximity to the asperities of the surfaces involved. Tribology concerns itself with several different types of lubrication. A study of these may well lead to the solution or improvement of thorny coatings-related problems.

Under sliding conditions, the thickness of the lubricant film between two surfaces depends on the orientation of the surface roughness relative to the sliding direction. The work done against friction is dissipated as heat, especially in the asperities. The heat created can affect the chemical stability of the lubricants and/or of the polymers in the coated surfaces involved. Analogous situations exist in the forming or fabrication of coated metals such as appliances, building products, automotive parts, cans, containers, jar closures, screw caps, etc. All of these coated components are either self-lubricated *in-situ* (via the polymeric coatings) or post-lubricated before fabrication.

Lubricated surfaces must function satisfactorily both when the surfaces slide past each other and when they are in static contact. To maintain effective lubrication and to minimize wear, it is imperative that the lubricant film resist displacement from the contact zone and persist in separating the surfaces for the required contact time.

Another important characteristic of a lubricant film subjected to a steady force is the phenomenon "stick-slip"—sometimes referred to as oscillating friction or interrupted motion. Stick-slip motion can be involved in wear, fractures, and sound generation.

In some cases with coated surfaces, as lubricant films are worn away, further *in-situ* lubricant may diffuse to the surface to replenish the lubricant there. Friction of wood-on-wood or wood-on-metal is very erratic because of the presence of varying amounts of wood fatty acids. If these are removed, the respective co-efficients of friction become much more reproducible.

Possible Applications of Tribology to Coatings Technology

(1) Exterior can coatings: mobility, abrasive wear.

(2) Coil coatings: abrasion during coil operation; fabrication.

(3) Aircraft coatings: durability (wear); effects on speed.

(4) Military problems: wear (service life without repainting); ease of coating removal.

(5) Coatings for bowling: wear (lanes and pins); ball control; consistency; pin action.

(6) Golf ball coatings: wear; control, consistency; distance.

(7) Non-stick cook/bakeware coatings: wear (service life); retention of non-stick properties.

(8) Marine anti-fouling coatings: effectiveness; wear, service life; diminution of effectiveness.

(9) Automotive coatings: durability; cleanability; polish-ability.

(10) Highway marking coatings: wear, service life.

(11) Architectural coatings: wear, service life; washability, cleanability.

(12) Corrosion-resistant coatings: effectiveness; wear, service life.

(13) Metal preparation treatments (phosphates, chromates, etc.): do asperities formed by such treatment adversely affect important properties of coated object?

(14) General: can *in-situ* or self lubrication supplant the present need for post-lubrication of coated surfaces which will be subsequently formed, rolled, impacted, et al.?

Here are some questions that technologists might pose about the influence of tribological concepts in the coatings industry studies:

◆ What is the true nature of the chemical interactions, if any, between thin layers of adsorbed lubricant and both coated and uncoated surfaces?

◆ Do enhanced chemical reactions occur at the lubricant/surface interfaces under the influence of frictional heating caused by sliding, fabrication, coiling, etc.?

◆ If such chemical reactions do occur, how do they affect the performance properties of the lubricants and coatings involved?

◆ In fabrication, sliding, coiling, rubbing of coated surfaces, etc., do we mechanically induce bond-breaking (mechanochemistry) in the lubricant and/or in the polymeric binder of the coating? How might such changes affect performance properties?

◆ Is the lubricant solvating or reacting with the coating on the surface at the friction-induced high temperature?

◆ What are the overall tribological (tribochemical, thermochemical, mechanochemical) effects on coatings involved in sliding contacts? What are the resulting components?

These are some of the problems in coatings technology where the application of tribological principles may be of importance to readers of the JOURNAL OF COATINGS TECHNOLOGY.

Universities, government laboratories, coatings, automotive and lubricant manufacturers, metal producers, and others now have tribology R&D facilities designed to better understand the many basic principles involved, improve their company's products, and make their products more economical.

In summary, and based on my many years of activity in coatings R&D, both my experience and my intuition combine to tell me that tribological and tribochemical insights may well give coatings technologists important help—help in solving the ecological, performance, and economical problems confronting us today.

Information on sources of research and technology in tribology—governmental, university, and corporate—is available from the National Science Foundation.

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*This paper is based primarily on these readings.

UV Curing of Pigmented High-Build Wood Coatings Based on Non-Air-Inhibited Unsaturated Polyesters

Michael J. Dvorchak—Miles Inc.*

Introduction

Pigmented coatings based on non-air–inhibited, unsaturated polyesters (NAI/UPEs) are usually applied (by direct/indirect roll or curtain coater) to medium-density fiberboard using UV flat-line curing equipment and conventional photoinitiators. Until now, such coatings could not be completely cured at thicknesses beyond 4 mils because the titanium dioxide (TiO_2) pigment kept the UV light from penetrating deeply enough. One attempt to solve this problem—dual-curing—allowed thicker films to be cured but required managing two separate curing steps.

This paper shows that the proper choice of resins, the UV equipment, and photoinitiator allows acceptable cure of wood coatings as thick as 11.8 mils and with pigment-to-binder ratio of up to 0.3.

Discussion

This section details the choices of NAI/UPE, UV-cure equipment, and UV photoinitiator that led to improvements in through-cure.

Traditional Unsaturated Polyesters

Traditional air drying unsaturated polyesters are polycondensation products based on saturated and unsaturated dicarboxylic acids, such as maleic or fumaric acids, and primary bivalent alcohols. Typically, these systems are dissolved in styrene, which reacts with and crosslinks the unsaturated resin when a dryer system, i.e., a cobalt salt and an organic peroxide, is used. The cobalt salt decomposes the peroxide to form free radicals, R′•, which initiate the crosslinking of the system.[2] This reaction mechanism is described in *Figure* 1.

These types of systems are two-component coatings with the cobalt in the formulated product and the peroxide added just prior to use. They have a short pot life which is typically about 5-10 min. They also have a problem with surface drying; the coatings' surface does not cure and will be sticky because the oxygen in the air inhibits the free radical mechanism. A mechanism for oxygen termination is given in *Figure* 2.

To overcome this effect, a paraffin wax is usually added to the formulation. While the system is curing, the paraffin wax migrates to the surface. Oxygen from the atmosphere is excluded; thus, chain termination is prevented. This technique works but requires removal of the wax since the wax leaves a low gloss appearance. The surface must then be sanded and polished to get a high-gloss appearance. This additional sanding and polishing is very labor intensive.

Work in the mid 1950s[2] saw the development of NAI/UPEs that cured without the aid of waxes. These unsaturated polyesters would have the same hardness and chemical resistance of traditional unsaturated polyesters and would give a high gloss without sanding and polishing. The oxygen inhibition could be prevented through the introduction of allyl ether groups to the modified fumarates. *Figure* 3 shows a reaction mechanism on the surface.

The radical R[1] attacks the allyl ether forming the allyl ether radical (Step A). This allyl ether radical can then react with a hydrogen atom (Step B), and in conjunction with another allyl ether radical and oxygen, form hydroperoxides which will aid in the further development of new radicals in the presence of a cobalt drier (Step C).

A reaction path within the film is shown in *Figure* 4. The radical R[1] attacks the allyl ether forming the allyl ether radical (Step A). This radical then attacks the double bond of a fumaric acid group (Step B) forming a radical that can in time form the three-dimensional network of the polymer.[3]

How these two separate reactions may take place within the coating is described in *Figure* 5. On the surface, the oxygen actually aids in the cure due to the allyl ether groups. Below this surface, the copolymerization of styrene and fumaric acid groups occurs without being inhibited.[4]

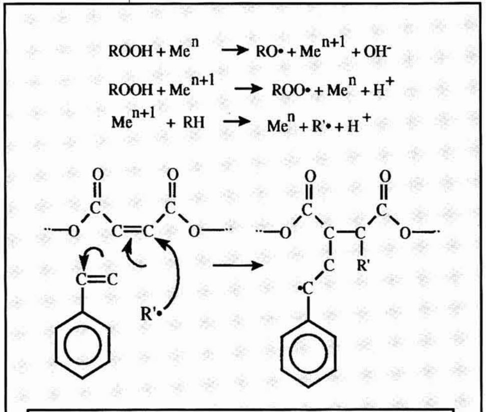

Figure 1—Free radical crosslinking of a traditional air drying unsaturated polyester.

UV-Curing of NAI/UPEs

UV-Curing Mechanism: The most significant method of cure for these NAI/UPEs is through the use of UV light and photoinitiators. This free radical-cure mechanism allows for instantaneous cure of the NAI/

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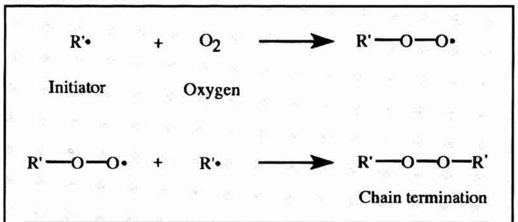

Figure 2—Chain termination of the free radical initiator by oxygen.

UPEs. It eliminates any difficulties due to ingredients in certain woods that can inhibit the peroxide/cobalt cure mechanism. It also has the added advantage of working as a one-component system and not requiring inert gas to prevent oxygen from inhibiting surface cure. Typical photoinitiators for a NAI/UPE are those based on hydroxy propiophenones.

The cleavage reaction of 2-hydroxy-2-methyl-1-phenyl-propan-1-one when it is photolyzed is given in *Figure* 6.

This cleavage goes through a very short triplet state and then decomposes by α-splitting to give a benzoyl radical and a 2-hydroxy-2-propyl radical.[5]

UV-Cure Equipment

The improvement reported here—the ability to cure thick films at high pigment loadings—was largely a result of changing from standard UV arc-lamp ovens to UV ovens that have long- and short-wave electrodeless bulbs—bulbs with energy outputs of up to 600 watts per inch.

In standard arc lamp ovens, the UV light is blocked by the TiO_2 (rutile) pigment in the coating and cannot penetrate much beyond approximately 4 mils (*Figure* 7).[6]

Some improvement came with gallium-doped, low-wattage, long-wave fluorescent bulbs (TLO3s), but not enough to allow complete cure of pigmented films thicker than 4 mils (*Figure* 8).

Even with a refinement—using arc long-wave gallium-doped lamps alongside short-wave arc lamps, a development that led to shorter wood-coating lines—thicker pigmented films still did not develop full hardness.

The electrodeless bulbs described here, however, develop full hardness at up to 11.8 mils and at pigment-to-binder ratios of 0.3.

UV Photoinitiators

A second improvement can be made in choosing the proper UV photoinitiator.

European researchers found that the photoinitiators used in unpigmented wood coatings (see *Table* 1, photoinitiators A, B, and C) cannot initiate cure of pigmented coatings because they activate in the same UV range that is blocked by the TiO_2 (rutile) pigment.

But two new photoinitiators, photoinitiators D and E, activate above the 380 nm cutoff of TiO_2 and therefore can activate cure of thick, heavily pigmented coatings (*Figure* 9). These photoinitiators with NAI/UPEs have been used commercially in Italy for the last five years[7-9] (*Figure* 10).

This study used photoinitiator D, which is a solid and dissolves in the resin systems free monomer, in the following systems: UV topcoat, UV sealer, air dry topcoat, and solvent-borne resin. Photoinitiator E, which is a liquid version of photoinitiator D, was used for the water reducible and 100% solids UV topcoat.

UV-curable NAI/UPEs are available in three forms: those that contain styrene, those that are reduced in solvent and do not contain styrene, and those that are water-reducible but contain no styrene or solvent (VOC about 0.2 lbs/gal). The latest development of NAI/UPEs is a low-viscosity product containing no styrene, solvent, or water—only resin and UV photoinitiator. Many NAI/UPEs produce fully cured, high-build coatings (up to about 11.2 mils WFT) in systems with pigment-to-binder ratios of up to 0.3.

Experimental

Sample and Film Preparation

Samples were prepared by grinding rutile TiO_2 into the resin solution, then drawing them down on glass and UV curing them. The degree of cure was measured by the Koenig pendulum hardness instrument. In addition, hardness was measured four days later to see if there had been any post cure.

Test Protocol, UV-Curing Devices

Films were cured using three different types of UV exposures: a UV-arc lamp oven (*Figure* 11) for its spectral curve; TLO3 bulbs (*Figure* 8) followed by a UV-arc lamp oven; and an electrodeless oven using a gallium-doped V bulb (*Figure* 12) followed by a D bulb (*Figure* 13). In addition, each UV-curing device was evaluated at two different UV energy dosages.

Table 2 gives the energy dosage that each film received during the curing process.

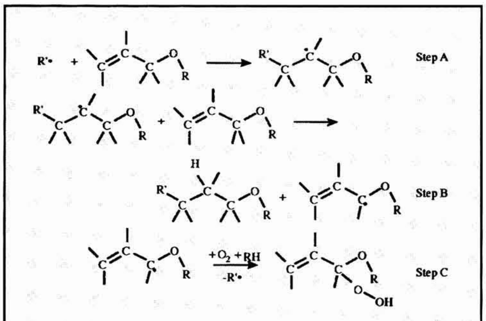

Figure 3—Reaction of a free radical with an allyl ether in the presence of oxygen to form hydroperoxides.

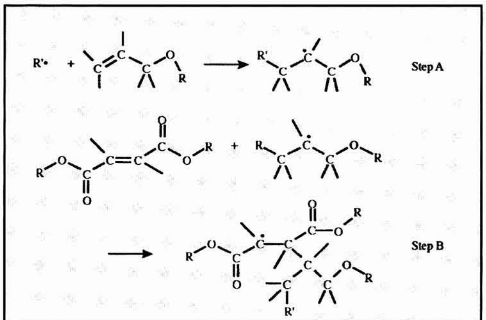

Figure 4—Reaction of the free radical with an allyl ether modified fumarate without the presence of oxygen.

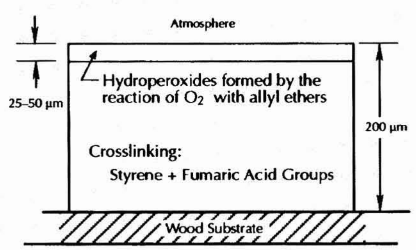

Figure 5—Curing of non-air-inhibited unsaturated polyester coatings.

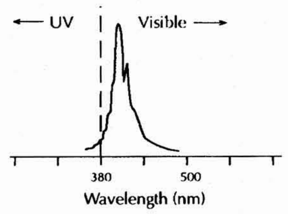

Figure 8—Emission spectrum of Gallium-doped (TLO3) low-wattage long-wave fluorescent bulb.

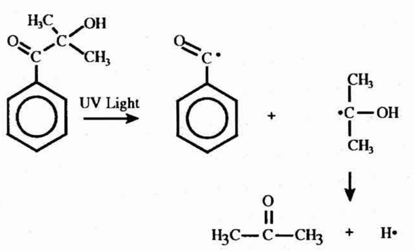

Figure 6—Cleavage of 2-hydroxy-2-methyl-1-phenyl-propan-1-one under the influence of UV light.

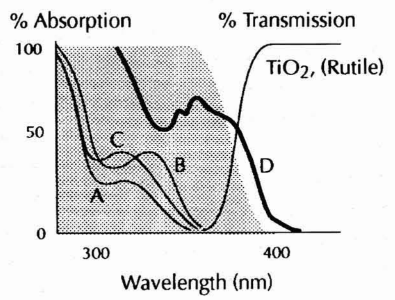

Figure 9—Absorption curves for photoinitiators used.

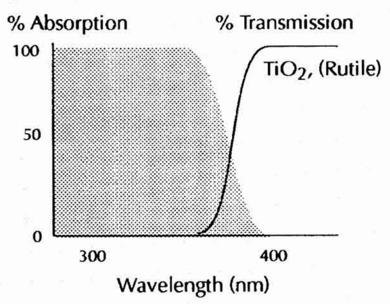

Figure 7—Absorption/transmission of TiO_2 rutile.

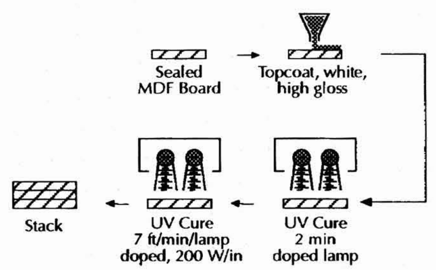

Figure 10—UV-curable pigmented NAI/UPE line.

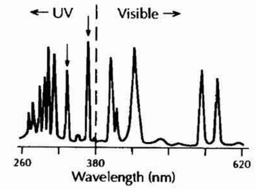

Figure 11—Emission spectrum of high-pressure mercury vapor UV lamp.

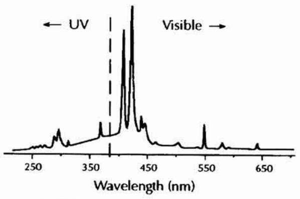

Figure 12—Emission spectrum of V bulb.

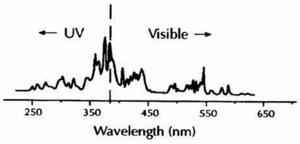

Figure 13—Emission spectrum of D bulb.

Data Analysis

UV Topcoat Based on NAI/UPE Resins

Appendix 1, *Figures* A-F show that hardness development generally decreases with increasing film thickness and pigment-to-binder ratio. This trend is especially evident in the UV-arc lamp series (*Appendix* 1, *Figures* A & B), where no cure was measured above 8 mils WFT with 0.3 pigment-to-binder ratio.

Post cure occurred in most cases. This post curing can actually be a benefit with the NAI/UPE: the initial lower hardness will make it easier to sand and polish the coating if that becomes necessary, as is the case when the coating is applied in a dusty environment.

UV Sealer Based on NAI/UPE Resins

The UV sealer based on NAI/UPE gave the best hardness development of all the pigmented NAI/UPEs tested. *Appendix* 2, *Figures* A-F show the development of hardness achieved with arc lamp, TLO3/arc-lamp and electrodeless V and D bulbs.

The UV sealer NAI/UPE also showed the greatest amount of post cure of all the systems tested, and developed the highest hardness (165 sec initial to 180 sec after four days) at the most critical point of the testing matrix (about 11.8 mils at a pigment-to-binder ratio of 0.3). Cure criteria were easily met when the coating was subjected to the electrodeless V and D bulbs at 600 W. This resin system is especially designed for UV cure.

UV Cure of Air-Dry/ NAI/UPE Topcoat

For various processing reasons, furniture manufacturers choose to UV-cure pigmented coatings that are not specifically designed for UV cure.

Some will dual-cure these systems both by air drying with cobalt salt and peroxide and by UV curing. We found that coatings cured in this way do not harden fast enough (see *Appendix* 3, *Figures* A-E) for four of the six techniques for unpigmented systems listed in *Table* 2. However, the coatings cured with the TLO3 and arc lamp at 300 W developed hardness better (*Appendix* 3, *Figure* D) than the coatings cured with electrodeless V and D bulbs at 300 W (*Appendix* 3, *Figure* E). Interestingly, at 600 W, the air dry NAI/UPE produced the best hardness under the electrodeless V and D bulbs at 600 W (*Appendix* 3, *Figure* F).

Solvent-Borne NAI/UPE Resins

We tested solvent-containing NAI/UPE resins as alternatives to reactive monomer-based resins. These NAI/UPE products can be cured either by cobalt salt and peroxide or by UV. Curing by UV, however, requires a flash off time to remove solvents before the cure (*Appendix* 4, *Figures* A-F). P/B values of "0.0" for the elctrodeless V and D oven were not tested (*Appendix* 4, *Figures* E & F).

Water-Reducible NAI/UPE Resins

Water-reducible NAI/UPEs, which contain no styrene or solvent, have the same properties as products that contain these diluents. A 3-mil coating based on such products requires a five-minute flash off at 150°F to remove the water before UV cure,[10] and this flash-off time increases as the film becomes thicker. Formulations for this product have VOCs as low as 0.2 lbs/gal (*Appendix* 5, *Figures* A-F).

Highly Pigmented, 100% Solids UV-Topcoat Based on NAI/UPE Resins

A new product that avoids solvent, water, or styrene is the 100%-solids NAI/UPE. Coatings based on this recently developed product can be UV cured as well as air cured.

This NAI/UPE can tolerate only a liquid photoinitiator because it has no styrene or solvent to dissolve a solid photoinitiator. The formulations tested contained the liquid photoinitiator E instead of the solid

Table 1—Key to Photoinitiators

Code	Photoinitiators
A	1-Hydroxycyclohexyl phenyl ketone
B	2,2-Dimethoxy-2-phenyl acetophenone
C	Benzoin isopropyl ether
D	2,4,6-Trimethylbenzoyldiphenoyl-phosphine oxide (solid)
E	Proprietary blend of aromatic ketone (liquid)

Table 2—Energy Dosage Received by Coating During Curing

UV Oven Type[a]	Bulb, Watt/in.	UV Energy Dosage, J/cm²
UV-arc oven	200	0.352
UV-arc oven	300	0.587
TLO3 UV-arc oven	200	0.352
TLO3 UV-arc oven	300	0.587
Electrodeless V and D	300	V = 0.105 D = 0.287
Electrodeless V and D	600	V = 1.533 D = 3.658

(a) Line speed on all ovens was 6 ft per min.

photoinitiator D, *Table* 1. The solid photoinitiator D, however, should give the best through-cure if a method can be found to incorporate it into this NAI/UPE. Coatings produced with the liquid photoinitiator at higher film builds and pigment-to-binder ratios developed less than adequate hardness (*Appendix* 6, *Figures* A-F). Future work will focus on finding more effective liquid photoinitiators.

Conclusions

Pigmented wood coatings based on NAI/UPE can be UV cured: at thicknesses of up to 11.8 mils and at pigment-to-binder ratios of up to 0.3; and in styrene, solvent, or water, or as 100% solids. Pigmented NAI/UPE coatings are best UV cured with electrodeless V and D bulbs and photoinitiator D or E.

We tested high-film builds and pigment-to-binder ratios under lab conditions. We will conduct plant trials on wooden substrates to verify the lab tests.

Acknowledgment

Special thanks to Patrick J. McFarlane for his dedicated and timely lab work in carrying out the experiments.

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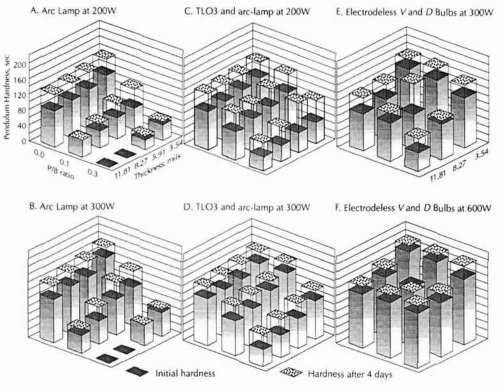
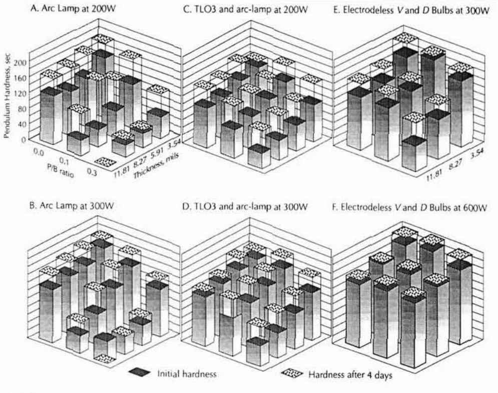
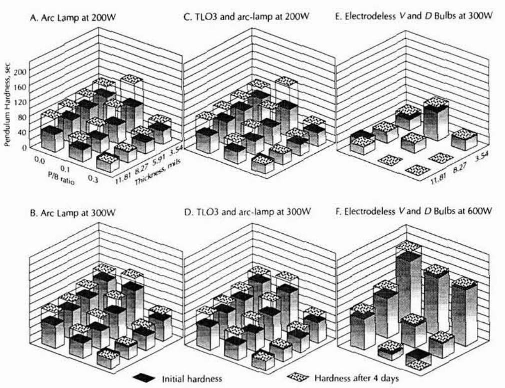
Appendix 1—UV Curing of Topcoat Based on Non-Air-Inhibited Unsaturated Polyester



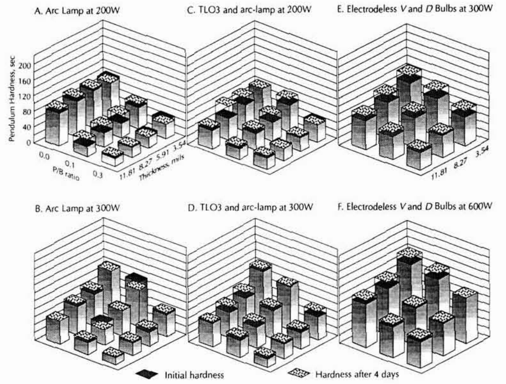
Appendix 2—UV Curing of Sealer Coating Based on Non-Air-Inhibited Unsaturated Polyester



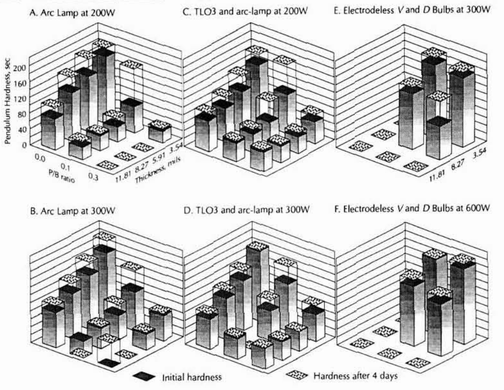
Appendix 3—UV Curing of Air-Dry Topcoat Based on Non-Air-Inhibited Unsaturated Polyester



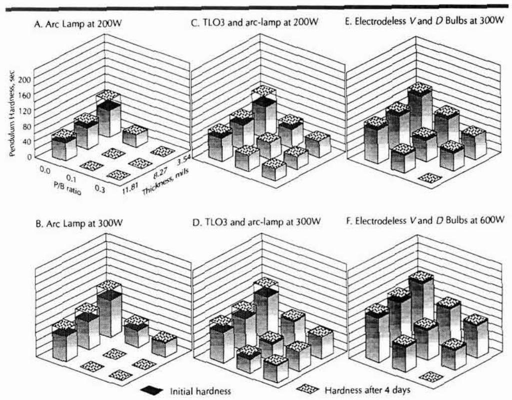
Appendix 5—UV Curing of Water-Reducible Coating Based on Non-Air-Inhibited Unsaturated Polyester



Appendix 4—UV Curing of Solvent-Borne Coating Based on Non-Air-Inhibited Unsaturated Polyester



Appendix 6—UV Curing of 100% Solids UV Topcoat Based on Non-Air-Inhibited Unsaturated Polyester



FSCT Technical Advisory Committee Met with Society Technical Committee Chairmen

August 19, 1994 — O'Hare Marriott Hotel, Chicago, IL

Sixteen Society Technical Committee representatives met with members of the Federation's Technical Advisory Committee (TAC) on August 19, 1994, at the O'Hare Marriott Hotel, in Chicago, IL.

The meeting was called to order by TAC Chairman Gail Pollano (New England) with the following in attendance: Augustine Ohamuo (Baltimore); Roland Staples (Birmingham); Kenneth Pendleton (CDIC); Phil Smith (Chicago); Ben J. Carlozzo (Cleveland); Latoska Price (Detroit); Robert D. Athey, Jr. (Golden Gate); Dennis Steele (Houston); Steve Bussjaeger (Kansas City); V.C. "Bud" Jenkins (Los Angeles); Rene Decary (Montreal); Philip Peterson (New York); Neil R. Shearer (Philadelphia); Mark A. Harley (Pittsburgh); John S. Baker (Rocky Mountain); and Todd Yonker (St. Louis).

Technical Advisory Committee Members in attendance were: Fred Anwari (Cleveland); Noel Harrison (Dallas); Rose Ryntz (Detroit); Ed Ferlauto (Northwestern); and Valerie Braund (Pacific Northwest)

FSCT President-Elect Joseph P. Walton, (Cleveland), JCT Technical Editor Robert F. Brady (Baltimore), and Hiro Fujimoto, of Advanced Technologies of Michigan, attended the meeting as guests.

Also present were FSCT Staff members Michael G. Bell, Director of Educational Services, and Patricia D. Viola, Director of Publications.

Society Reports on Activities

Baltimore

The Society Technical Committee aerosol program is underway. The Society plans to publish a paper based on VOC formulations. It is hoped that this will be completed in 1995. The Society is requesting the assistance of additional members for Technical Committee work.

Birmingham

The Birmingham Club published the results of its solids/density project. The paper was presented at the Annual Meeting in Atlanta and won an APJ/Voss Award. The Club has put its museum project on hold due to the economy, but this project may be revitalized in the near future. Birmingham is working on a VOC chart, which it hopes to publish this year. The Club also plans a seminar for November 1995 entitled, "Paint at the Crossroads." The Club is investigating the addition of an Educational Committee, and plans to have a representative attending the FSCT Educational Committee meeting.

CDIC

The CDIC Society did not have much success with its project to meet with the technical directors of local companies to learn about their research needs and to learn how the Society can help. However, the Society will continue to pursue this matter. CDIC met with representatives of the Philadelphia Society regarding its "Formulator's Data Disk" and is investigating the possibility of adding its information on extender pigments to this program.

Chicago

The Chicago Society is moving slowly with its Technical Committee projects. The Society is hoping to start new activities beginning in September and feel the information discussed during this meeting would be most useful in assisting the Committee's organizational efforts.

Cleveland

The Society plans to deliver the paper, "Correlation of Accelerated Testing and Exterior Exposure Sites," at the 1994 FSCT Annual Meeting in New Orleans, LA. The Technical Committee also made a presentation at the Society's "Symposium on Advances in Coatings Technology." The committee plans to continue to work on the corrosion test project in 1995.

Detroit

Detroit's Technical Committee will deliver the paper, "The Cure Behavior of Silicone-Epoxies and Urethane Modified Acrylates in Interpenetrating Polymer Networks," at the 1994 Annual Meeting. This paper was developed in conjunction with the University of Detroit-Mercy.

Golden Gate

The Golden Gate Society delivered a paper at the 1993 Annual Meeting reviewing a collaborative testing program on coefficient friction determination. Plans call for the committee to make a presentation in 1995 dealing with statistical work-up of the data on the tests using the James machine. Testing on the machine is complete but the data has not been interpreted.

Houston

Due to increased workload, Technical Committee Chairman Dave Siller, has resigned. The Society paper, "Variable Characteristics of Titanium Dioxide Pigments Using SEM and Particle Size Analyses," will be resubmitted to JCT. Parts II & III of the project are being worked on.

Kansas City

The Kansas City Society added table top exhibits to the annual joint program with the St. Louis Society, held at Lake of the Ozarks, MO. The exhibits provided additional revenue. The Society is also working on four projects: "Performance of Exterior Finishes on Medium Density Hardboard," "Compliant Coatings: Artificial vs. Natural Weathering," "Performance of Extender Pigments in Exterior Latex Finishes," and "Extractive Staining on Wood Substrates Induced by Finishes Containing Calcium Compound Extenders." The Society also worked on a recycled paint project during the past year.

Los Angeles

The Los Angeles Society will present two papers at the 1994 Annual Meeting in New Orleans, "Bridge Painting Overspray: Measurement Techniques and Environmental Effects," and "VOC Testing Comparison: EPA 24 vs. the Cal Poly Method." The Society also worked on setting up a coatings lab at Cal Poly-Pomona. The Society has successfully solicited equipment from several companies. Los Angeles' *Graffiti Abatement Handbook* has reached an international audience. The goal is to publish a fourth edition to be sent to 1,000 cities around the world. The Society also has prepared a program, "Paint and Coatings Technology, Short and Simple." This is presented to high school students and reviews many aspects of the coatings industry.

Montreal

The Montreal Society is currently working on three projects, one in cooperation with the Northwestern Society. The three projects are: an acid rain study, which resulted in a paper at the 1994 Annual Meeting (with Northwestern Society); an ultra fine TiO_2 study; and a study on the evaluation of latex sealers on light cement joint compound. The Society has also published a lexicon of definitions used in the paint industry which are related to the environment. The Society has also translated the Los Angeles Society *Graffiti Abatement Handbook* into French.

New York

Four projects are currently underway by the New York Society. These are: rheological modifiers; defoamers; zero volatility latex; and the annual symposium. The rheological modifiers paper should be completed by the end of the year; the defoamer project is in the research stage; a subcommittee has been developed to work on the zero volatility latex paper; and the seminar will be developed in the fall.

Northwestern

The Northwestern Society Technical Committee will present a paper entitled, "A Study of the Effect of Acid Rain on Alkyd, Polyester, and Silicone Modified High Solids Coatings" at the 1994 Annual Meeting. This was developed in conjunction with the Montreal Society. The Society has also had two papers published in the JCT in the past year (see July and August issues). The Society is conducting experimental work on the analysis of free formaldehyde in coatings materials. This data will be reported when it is assembled. A new project being undertaken is a study of adhesion.

Philadelphia

The Philadelphia Society Technical Committee completed a busy year and arranged a complete list of speakers for its programs. The Society has a separate technical meeting which includes a speaker, apart from the regularly scheduled monthly meeting. The Society sponsored a technical seminar entitled, "Extender Pigments—More Than Dead Space," which included nine presentations on the topic. The seminar attracted 145 attendees.

Pittsburgh

The Pittsburgh Society has not had a Technical Committee for the past three years. The Society's 1993 technical program "Enviro-Paint '93," drew over 30 attendees. Pittsburgh is looking to work on some joint activities with the Cleveland Society in the future. The Society worked on a latex paint collection project with Allegheny County in 1992.

Rocky Mountain

The Society is planning a paper on the effects of color and insulation on the surface temperature of coatings, and recently completed the preliminary work. Although the company handling the exposures was sold and the exposures had to be sent elsewhere, the Technical Committee feels the abbreviated exposure period will still allow it to acquire useful data.

St. Louis

The St. Louis Society is currently working on a program entitled, "The Effect of Varying the Stoichiometry in High-Solids, Two-Component Epoxy Coatings." The Society's Technical Committee made a presentation in May, and the paper is being considered for publication in the *American Paint and Coatings Journal.* Two variable studies are being planned from the study.

Technical Advisory Committee Update

Chairman Pollano reported that the TAC would be responsible for judging the APJ/Voss Awards and the Society Speaker Awards in 1995. She said the TAC wants to work with the Societies to improve the quality of the papers delivered and the actual presentations of these papers at the Annual Meeting. The committee will be developing criteria for the program and reviewing the tools now available to judge the papers.

Ed Ferlauto reported on the Lead Abatement projects underway by the TAC. He said the committee will continue to work with ASTM but will stop working with NIBS due to lack of activity on the part of the group.

FSCT Update

FSCT President-Elect Joseph P. Walton reviewed some of the activities underway within FSCT and touched on some of the changes being enacted. He said that the Federation was in good shape financially and that Headquarters was planning to purchase a new computer system with the latest association software. Mr. Walton said the Executive Committee had investigated a certification program and decided against pursuing it at this time. He mentioned that Spring Week will be held in Cancun, Mexico in 1995.

Mr. Walton reviewed FSCT cooperative efforts with the National Paint and Coatings Association. He encouraged FSCT member involvement in the State Paint Councils as a means of providing scientific input to those legislators who will determine regulations affecting the coatings industry.

The status of the Strategic Plan developed by FSCT was covered. The Federation's strategic planning emphasizes the need to provide increased services to its membership. One goal is to maintain and improve the viability and vitality of the Paint Industries' Show. Mr. Walton said the officers are asking the various committees involved with developing sessions for the Annual Meeting to expand programming to attract a wider audience. This includes programs in inks, adhesives, radiation curing, and powder coatings.

JCT Update—How to Submit a Paper

Dr. Robert F. Brady, Technical Editor of the Journal of Coatings Technology, stated that a paper in the JCT is a mechanism for teaching the latest information to industry peers. It should: (1) contain a significant body of work and reach a definite conclusion; (2) present the latest work in the field; (3) present procedures that are useful and reproducible; and (4) identify experimental techniques.

Pat Viola, FSCT Director of Publications, discussed the route a manuscript takes after being submitted to JCT. She emphasized the contributions of the Editorial Review Board, the 24-member group who critiques papers received. Each paper is sent to three separate reviewers, thereby eliminating the possibility of a prejudiced critique. Reviews are generally completed within eight to ten weeks.

She announced that, beginning in January 1995, the JCT will expand its coverage to include more "practical" papers. The January issue will also bring a new design to the JCT, and the entire publications team is excited about the new direction the magazine is taking.

How to Conduct a Successful Round-Robin

Hiro Fujimoto of Advanced Technologies of Michigan (AToM) addressed the meeting on how to conduct a successful round-robin. Dr. Fujimoto developed a scenario of how a round-robin usually develops. He said the results are based on repeatability and not reproducibility. He also said that interlaboratory testing introduces variables which must be kept in mind when running a round-robin. These are: equipment used; operators; environmental factors; reliability of proposed test methods; and representative test samples.

Journal of Coatings Technology

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010	030	050	070	090	110	130	150	170	190	210	230	250	270	290
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012	032	052	072	092	112	132	152	172	192	212	232	252	272	292
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014	034	054	074	094	114	134	154	174	194	214	234	254	274	294
015	035	055	075	095	115	135	155	175	195	215	235	255	275	295
016	036	056	076	096	116	136	156	176	196	216	236	256	276	296
017	037	057	077	097	117	137	157	177	197	217	237	257	277	297
018	038	058	078	098	118	138	158	178	198	218	238	258	278	298
019	039	059	079	099	119	139	159	179	199	219	239	259	279	299
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CHICAGO—JANUARY

"Moisture Control Additives"

Thomas Johnson, of ANGUS Chemical Co. delivered the evening's presentation, "REACTIVE OXAZOLIDINE MOISTURE CONTROL ADDITIVES FOR POLYURETHANE COATINGS."

Mr. Johnson illustrated the significance of controlling moisture in high-solids urethane systems to prevent cratering, reduced gloss, and erratic viscosities. The speaker also stated that moisture will always occur as a trace in liquids or absorbed on pigments.

VICTOR M. WILLIS, *Publicity*

DALLAS—JANUARY

Dry Color Pigment Production

It was noted that President Benny Puckett, of Kelly-Moore Paint Co., was appointed to the Federation's Manufacturing Committee.

The evening's guest speaker was Jeffrey J. Norris, of Engelhard Colors. He addressed the members on the "PRODUCTION PROBLEMS ASSOCIATED WITH DRY COLOR PIGMENT PRODUCTION," especially relative to meeting VOCs. Mr. Norris also stated that China and Indonesia are exporting colored pigments to the United States.

H. EDWARD SPRADLIN, *Publicity*

DETROIT—NOVEMBER

"Quality Control of Metallic Pearlescent and Special Effect Finishes"

The November meeting was a joint meeting with the Detroit Paint and Coatings Association.

Bob Santine, of X-Rite, Inc., was the speaker for the evening. Mr. Santine discussed the "USE OF A MULTI-ANGLE SPECTROPHOTOMETER FOR QUALITY CONTROL OF METALLIC, PEARLESCENT, AND SPECIAL EFFECT PAINT FINISHES."

Due to increasing customer expectations for color matching of automotive color-keyed parts, the speaker stated that the importance of the multi-angle spectrophotometer has increased. Spectrophotometers normally measure only one angle, so the multi-angle spectrophotometer was developed to address this problem.

JAN K. HAMMOND, *Secretary*

DETROIT—DECEMBER

"Odor Quantified Solvents"

The evening's speaker was Detroit Society member Latoska N. Price, of Akzo Nobel Coatings Inc., who spoke on "THE ROLE OF ODOR QUANTIFIED SOLVENTS ON THE VISCOSITY BEHAVIOR OF HIGH-SOLIDS RESINS AND THE PHYSICAL BEHAVIOR OF FORMULATED PAINTS."

Ms. Price noted that since the U.S. EPA's 1990 Clean Air Act legislation has been implemented into various control technique guidelines (CTGs), the coatings formulator must select a solvent to meet the environmental stewardship of formulated paints. Not only are the amount and type of solvents regulated through CTG and hazardous air pollutant (HAP) guidelines, but also the perceived odor of paint.

Research on quantifying the effect of various solvents on the perceived odor of paints

Pittsburgh Society Officers for 1994-95 (from left) — Membership—Jeff Sturm; Secretary—Jim Rediske; Society Representative—William Spangenberg; President—Mark A. Harley; Vice President—Brij Sharma; and Treasurer—James Giammarco.

formulated with those solvents has been conducted. According to Ms. Price, this research elucidates the ability of low and high odor solvents to formulate low VOC paints and the effect those solvents have on the resultant physical properties of cured films. The role of glass transition temperature acrylic binders was subsequently studied to determine the solubility characteristics of hard and soft resins in the selected solvents. Both acrylic and polyester resins were crosslinked with high-solids melamines, and the humidity resistance, chip resistance, and hardness of the cured films were determined.

JAN K. HAMMOND, *Secretary*

LOUISVILLE—JANUARY

Environmental Update

The members were informed by Dan Fortney, of American Dispersions, Inc., that plans for the Spring Symposium "Spectrum of Coatings Science," have been finalized. Mr. Fortney credited Technical Chairman Ilona Nemeth Duvall, of Red Spot Paint and Varnish Co., with organizing the event, which is scheduled for April 19, at the Executive West Hotel.

Educational Committee Chairman, Paul Baukema, of Akzo Nobel Coatings, Inc., discussed the 1995 educational grant. Mr. Baukema informed the assembly that the executive committee voted to increase this year's grant to $1,000. Last year's grant was $800, but increased costs associated with these courses necessitated the increase.

Roy Funkhouser, of Law Environmental, updated the membership on developments from the Kentucky Paint Council's recent meeting. Mr. Funkhouser mentioned that he will be tracking the interests of the new Republican Congress. He also indicated that risk assessment and environmental clean-up will be emphasized in 1995. According to Mr. Funkhouser, there are two target areas on the agenda: lead paint and groundwater protection plans.

Manufacturers will be asked to submit their plans that will decrease the levels to "low-risk" levels, not "zero" levels of contamination. Mr. Funkhouser stated that the upcoming Kentucky Chamber of Commerce meeting on March 22 will include insights from the Kentucky Department of Environmental Protection and a lengthy discussion of the legal implications associated with this year's groundwater protection plans.

The meeting concluded with a slide show of the 1994 FSCT Annual Meeting and Paint Show, which was compiled by Jim Flanagan, of Flanagan Associates, Inc.

DAN FORTNEY, *Secretary*

NEW ENGLAND—NOVEMBER

"Role of Acetylenic Glycols in Water-Based"

President Joanne Monique, of Ashland Chemical Inc., announced that the Society is seeking a Technical Committee Chairman.

The featured speaker of the evening was Sam Morrell, of the S.P. Morrell Co. and his topic was "THE ROLE OF ACETYLENIC GLYCOLS IN WATER-BASED COATINGS."

According to Mr. Morrell, acetylenic glycols are nonionic surface active agents that promote foam control, rapid wetting, reduced water sensitivity, coverage, and improved color development. He stated that a surfactant will reduce the surface tension of a solvent at very low concentrations. Increased surfactant, on the other hand, increases the surface pressure. At high concentrations, most surfactants form a film on the surface of a liquid; however, acetylenic glycols do not, said the speaker.

Acetylenic glycols (DIOLS) act as defoamer, anti-foaming, and nonfoaming agents in one. They also prevent air entrainment and foam in SBR latex.

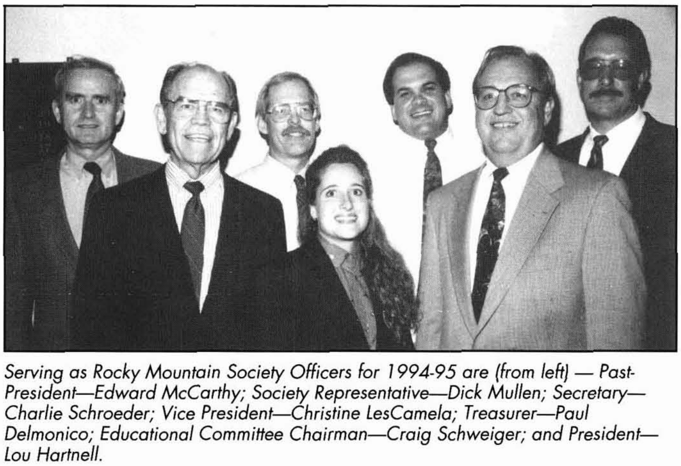
Mr. Morrell concluded that these DIOLS may be possible alternatives for conventional surfactants, wetting agents, and defoamers in water-based coatings.

GENE C. ANDERSON, *Secretary*

NEW ENGLAND—JANUARY

Clean Air Act Amendments

President Joanne Monique, of Ashland Chemical Inc., announced that the NESCT/NECA will cooperate on a paint project that oversees the painting of a home of a needy family or small civic structure.



Serving as Rocky Mountain Society Officers for 1994-95 are (from left) — Past-President—Edward McCarthy; Society Representative—Dick Mullen; Secretary—Charlie Schroeder; Vice President—Christine LesCamela; Treasurer—Paul Delmonico; Educational Committee Chairman—Craig Schweiger; and President—Lou Hartnell.

David Lloyd, of NPCA, discussed the changes proposed by the new Republican majority Congress. The first change was proposed by Rep. Tom Delay (R-TX), who requested that a moratorium be placed on any regulations issued since November 1994 until July 1995. Another change is that EPA will be required to make a "cost benefit analysis" and "risk assessment" before any new law could be passed. This would force many new rules to come to a halt.

Robert Ross, of Eastman Chemical, discussed Titles I, III, and V of the Clean Air Act Amendments (CAAA) of 1990 and compliance issues for the paint and coatings industries.

Mr. Ross stated that EPA designed CAAA to address the problem of ground level ozone and hazardous air pollutants. Ground level ozone is formed by VOCs reacting with other pollutants, such as nitrogen, in sunlight. The speaker acknowledged that ozone is essential in the upper atmosphere for blocking out harmful UV rays from the sun; however, too much ozone in the form of urban smog can cause damage to crops, trees, and other vegetation.

According to Mr. Ross, the objectives of Title I of the CAAA are to reduce ground level ozone in nonattainment areas and to prevent deterioration of ambient air quality in attainment areas. Individual states set the emission limits on facilities and charge fees for any facility that exceeds those limits. Permits will be issued for facilities over the limits of Title V of the CAAA.

Major sources are categorized depending on the degree of nonattainment; an individual state can exceed the federal regulations, said Mr. Ross.

He also informed the attendees that Title III of the CAAA is to minimize cancer and long-term health risks from hazardous air pollutants (HAPs). HAPs are any air pollutant listed pursuant to subsection (b) of Title V. Currently, the list contains 189 chemicals.

The next area addressed by Mr. Ross was the maximum achievable control technology (MACT) standard as it applies to facilities that meet the following major source definition: A major source means any stationary source or group of stationary sources located within a contiguous area and under common control that emits or has the potential to emit considering controls, in the aggregate, 10 tons per year or more of any hazardous air pollutant or 25 tons per year or more of any combination of hazardous air pollutants. The administrator may establish a lesser quantity, or in the case of radionuclides different criteria, for a major source than that specified in the previous sentence, on the basis of the potency of the air pollutant, persistence, potential for bioaccumulation, other characteristics of the air pollutant, or other relevant factors.

According to the speaker, printing, ships, wood furniture, and epoxies are some indus-

Constituent Society Meetings and Secretaries

BALTIMORE (Third Thursday—Martin's West, Baltimore, MD). CONNIE SAUER, Duron, Inc. 10460 Tucker St., Beltsville, MD .

BIRMINGHAM (First Thursday—Strathallan Hotel, Birmingham, England). DAVID C. MORRIS, PPG Industries (UK) Ltd., P.O. Box 359, Rotton Park St., Birmingham, B16 OADS, England.

CDIC (Second Monday—Location alternates between Cincinnati, Columbus, Dayton, and Indianapolis). WILLIAM JELF, III, Akzo Nobel Coatings, Inc., P.O. Box 147, Columbus, OH 43216-0147.

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—Roadhouse, Independence, OH). RICHARD A. MIKOL, Tremco Inc., 10701 Shaker Blvd., Cleveland, OH 44104.

DALLAS (Second Thursday following first Wednesday—Radisson Hotel, Dallas, TX). CHIP NEWCOMB, 1448 N. Joe Wilson Rd., Cedar Hill, TX 75104.

DETROIT (Second Tuesday—meeting sites vary). JAN SPALDING, BASF Corp., 26701 Telegraph Rd., Southfield, MI 48086-5809.

GOLDEN GATE (Monday before third Wednesday—alternates between Francesco's in Oakland, CA, and Holiday Inn in S. San Franscisco). DON MAZZONE, Dowd & Guild, Inc., 14 Crow Canyon Ct., #200, San Ramon, CA 94583.

HOUSTON (Second Wednesday—Medallion Hotel, Houston, TX). GUY SULLAWAY, Courtaulds Coatings, P.O. Box 4806, Houston, TX 77210.

KANSAS CITY (Second Thursday—Cascone's Restaurant, Kansas City, MO). RANDALL L. EHMER, Walsh & Associates, Inc., 500 Railroad Ave., N. Kansas City, MO 64116.

LOS ANGELES (Second Wednesday—Steven's Steakhouse, Commerce, CA). JOSEPH B. EVANS, Trail Chemical Corp., 9904 Gidley St., El Monte, CA 91731.

LOUISVILLE (Third Wednesday—Executive West Motor Hotel, Louisville, KY). DAN FORTNEY, American Dispersions Inc., P.O. Box 11505, Louisville, KY 40211.

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, St. Laurent, Quebec). LUC MILLETTE, Frank E. Dempsey & Sons Ltd., 2379-46nd Ave., Lachine, Que., H8T 3C9, Canada.

NEW ENGLAND (Third Thursday—Sheraton Lexington Hotel, Lexington, MA). GENE C. ANDERSON, Chemcentral Corp., 38 Spindlewick Dr., Nashua, NH 03062.

NEW YORK (Second Tuesday—Landmark II, East Rutherford, NJ). JOHN W. DU, Hüls America, Inc., P.O. Box 365, Piscataway, NJ 08854.

NORTHWESTERN (Tuesday following first Monday—Jax Cafe, Minneapolis, MN). JOSEPH J. MILLS, Milsolv® Corp./Minnesota, 2340 Rose Pl., Roseville, MN 55113.

PACIFIC NORTHWEST (PORTLAND SECTION—Tuesday before third Wednesday—Tony Roma's, Mall 205, Portland, OR; SEATTLE SECTION—Third Wednesday—Wyndham Garden Hotel, Sea-Tac, WA; VANCOUVER SECTION—Thursday after third Wednesday—Abercorn Inn, Richmond, B.C.). EDWARD LINTON, Cloverdale Paint Co., 6950 King George Hwy., Surrey, B.C., V3W 4Z1, Canada.

PHILADELPHIA (Second Thursday—Williamson's Restaurant, GSB Bldg., Bala Cynwyd, PA). THOMAS G. BROWN, Consultants Consortium, 209 Fox Ln., Wallingford, PA 19086.

PIEDMONT (Third Wednesday—Ramada Inn Airport, Greensboro, NC). ROY MODJEWSKI, Akzo Nobel Coatings, Inc., 1431 Progress St., High Point, NC 27261.

PITTSBURGH (Second Monday—Montemurro's Restaurant, Sharpsburg, PA). JAMES REDISKE, Miles Inc., Mobay Rd., Pittsburg, PA 15205.

ROCKY MOUNTAIN (Monday following first Wednesday—Zangs Brewery, Denver, CO). CHARLES SHROEDER, Fel-Pro Inc., 6120 E. 58th Ave., Commerce City, CO 80022.

ST. LOUIS (Third Tuesday—The Salad Bowl Restaurant, St. Louis, MO). MICHAEL P. HEFFERON, Walsh & Associates, Inc., 1801 S. Hanley Rd., St. Louis, MO 63144.

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). WALTER R. NAUGHTON, JR., Scott Paint Corp., 7839 Fruitland Rd., Sarasota, FL 34240.

TORONTO (Second Monday—Meeting sites vary). NATALIE JANOWSKY, Degussa Canada Ltd., 4261 Mainway Dr., Burlington, Ont., L7R 3Y8, Canada.

WESTERN NEW YORK —MARKO MARKOFF, 182 Farmingdale Rd., Cheektowaga, NY 14225.

Southern Society Officers for 1994-95 (from left) — Society Representative—R. Scott McKenzie; President—Jeff Shubert; Vice President—Robert Wayne West; Secretary—Walter R. Naughton, Jr.; and Treasurer—Eve De La Vega-Irvine.

tries that will be targeted by this promulgation in 1994-95. Other areas to be targeted in 1997 are the automotive and paper industries. In the year 2000, the wood paneling, appliances, cans, and metal furniture industries will be under scrutiny.

Mr. Ross added that EPA must make residential risk studies in 1998 and 2006 to determine excessive risks. At that time, EPA may enforce stricter standards.

Q. Does the major source definition apply to all facilities?

A. Only if the facility is in a nonattainment transport region.

MICHAEL IANNUZZI, *Treasurer*

NEW YORK—JANUARY

New Jersey Legislation

Larry Waelde, of Troy Corp. reported that the Spring Symposium "Recent Advances in Additives and Modifiers for Modern Coatings" will take place on May 3-4. Mr. Waelde said that 15 papers are scheduled to be presented.

In addition, the Rheological Committee project is near completion and is being planned for presentation at the 1995 FSCT Annual Meeting and Paint Show in St. Louis, MO. Also, the committee's inquiry into New York City's traffic sign paints is being made.

Sid Rubin, of Empire State Varnish Co., informed the membership on the procedures for access to the Mattiello Library.

The meeting's guest speaker was Paul DiGaetano, of the 36th District of New Jersey. Mr. DiGaetano serves as Chairman of the Assembly Policy and Rules Committee.

Mr. DiGaetano began by stating that when the ECRA (now ISRA) reform bill was signed into law one-and-a-half years ago, he spent three weeks educating himself on the issues. He urged the New York Society, and other lobbying groups to educate elected officials.

The speaker stated that the legislature is diverse and very few members, if any, are knowledgeable in the day-to-day problems faced by constituents. Mr. DiGaetano has made it his job to become more knowledgeable in the areas that affect New Jersey businesses and to modify legislation to be more business friendly. He cited two examples as New Jersey's Right to Know Law and the removal of 2,000 DOT items from reporting requirements. The most notable being White Out® and the increase from zero to a 500 pound reporting threshold.

Mr. DiGaetano covered the Pollution Prevention Act. This Act requires the identification of each toxic ingredient, and studies every process that is used. A plan to reduce the use of toxics must be reduced by 50% in five years. Another problem is that 1987 was the planned base year, with enactment scheduled for 1988. However, the act was passed in 1990. The passed act states that the year prior to enactment will be used as the base year, so any reduction prior to 1989 is not available for credit. The speaker's committee has named 1987 as the base year and allows reduction since 1987 to be used for reduction credit.

Mr. DiGaetano also changed the act to remove nonproduct output from reportable output. The paperwork that was mandated had no minimum threshold. This made orphan drugs impossible to produce due to excessive costs. Prioritization of the money being spent on pollution prevention has been permitted.

According to the speaker, the focal point of the battle between the legislature and the environmental coalition is recycling. The coalition is determined to prevent recycling as being counted as pollution prevention. The hierarchy of pollution prevention lists source prevention as the preferred technology followed by recycling. This fine point in definition is the battle between the legislature and the environmentalists.

Mr. DiGaetano stressed the need for the NYSCT to educate lawmakers, and to spread the views and needs of the coatings industry. He believes that the moment is right for the environmental law reformers. The economy is in a recession and the public is more concerned with jobs than with the environment. A fair balance between the needs of industry and the protection of the environment is necessary.

Q. The Clean Air Act will require New Jersey to spend $700 million in auto emission testing equipment. Omaha requires all buses and trucks to be fitted with emission devices. Can New Jersey do the same?

A. This new emission testing is a Federal law. The loss of $700 million Federal highway funds, along with the mandated 30% failure rate, and the lengthy time of the test has resulted in the Federal EPA's compromise to lower the test from an eight minute test to a 50/15 test—50 seconds or, if the lines get too long, 15 seconds.

JOHN W. DU, *Secretary*

NORTHWESTERN—JANUARY

"Optimizing Dispersions"

President Mike Grivna, of Hirshfield's Paint Mfg. Inc., informed the members that the Minnesota Technical Assistance Program will hold their Annual Paint and Coatings Expo and asked if the NWSCT would be interested in assisting with the program.

Mr. Grivna also stated that FSCT Spring Week is scheduled for Cancun, Mexico, May 17-21. The theme will be "Coatings in the Americas."

Educational Committee Chairman, Mustapha Bacchus, of The Valspar Corp., made a motion to increase this year's donation to North Dakota State University by $500. This increase would bring the total to $3,000. The motion was approved.

The Nominating Committee was unsuccessful in finding a candidate to replace Hal Christhilf as Vice-President. Joe Mills, of Milsolv® Corp./Minnesota, will act as both Secretary and Vice-President until September, when two new officers will be added.

The first speaker of the evening, Dave Ulrich, of Kady International, presented "OPTIMIZING DISPERSION WITH KADY PRE-MILLING."

Mr. Ulrich stated that the three most important steps to successful premilling are wetting of the particle, deagglomeration, and stabilization. When choosing dispersing equipment, the buyer should pay attention to the type or combination used, such as: (1) a blade or prop disperser; (2) rotor/stator mixer; (3) rotor/stator mill; and (4) blade mixer and a media mill.

According to the speaker, the following are advantages to rotor/stator premilling:

—eliminates of settling in the pre-mix;

—deaerates to efficient media milling;

—eliminates costly and time consuming media mill passes;

—allows the use of finer media in your mill;

—color increases can be achieved by extra color strength;

—easier to clean with less equipment;

—reduces clogging in micro-media mills;

—can be retrofitted to increase capacities;

—continuous units can produce higher viscosities; and

—reduction in operating costs.

The second speaker of the meeting was Mark Drukenbrod, of CB Mills. He discussed "ADVANCES IN VERTICAL AND HORIZONTAL MILLING."

Mr. Drukenbrod explained the use of a continuously operating agitator bead mill with a horizontal grinding container for dispersion and fine wet-grinding in a completely enclosed system. He said that this mill offers process control management, and a chart recorder provides a hard copy of the batch history on a minute by minute basis.

In addition, the speaker discussed the various parameters available for programming.

JOSEPH J. MILLS, *Secretary*

Toronto Society Officers for 1994-95 (from left) — Educational Chairman—Walter Fibiger; President—David P. Jack; Technical Chairman—Robert E. Synder; Secretary—Natalie Janowsky; Past-President—Mike W. Hazen; Alex King; Membership Chairman—Linda Cruz; John Porter; Peter Hiscocks; Society Representative—Art Hagopian; Environmental Chairman—Jackson W. Chan; Vice President—Bob C. Ng; Vik Rana; and Publicity Chairman—John MacLean.

comments on the topics of the monthly meetings and technical areas of industry interest.

Dick Stewart, of Firestop Systems, Inc., distributed a press release that proposed a reduction in the number of mailings to companies receiving more than two meeting notices. Members disagreed, citing that all belong individually. Dennis Songhurst, of Reichhold Ltd., suggested that only members who have paid in full should receive meeting notices. A motion was made and seconded to accept the change. Discussion revealed that some companies would accept reduced mailings, however, some members wanted notices sent to their home address. The cost of mailing the notice was determined not to be an issue. Ed Linton, of Cloverdale Paint Co., called for a vote on restricted mailing as per Mr. Stewart's memo, and the motion was defeated.

Dave Pasin, of Gibson Paint, stated that the introductory course started on January 11, and there are 16 attendees. The revised text is being used. Mr. Pasin also noted that the eight-week course "Practical Aspects of Modern Coatings" is scheduled to begin on September 13. The course will be of interest to both chemists and applicators, and will feature a different lecturer each week.

Dharma Kodali, of Cargill Technical Oils, delivered the evening's presentation titled, "UTILIZATION OF A NEW REACTIVE DILUENT TO FORMULATE LOW VOC COATINGS."

KELVIN J. HUGET, *Secretary*

PACIFIC NORTHWEST (VANCOUVER)—JANUARY

"Low VOC Coatings"

Deryk Pawsey, of Rohm and Haas Canada, Inc., was elected an Honorary Member of the Pacific Northwest Society.

Manufacturing Committee Chairman Valerie Braund, of General Paint Ltd., distributed a questionnaire to be mailed to operations/manufacturing managers. Ms. Braund asked the paint company representatives for the names of manufacturing managers to whom she should send the questionnaire. The Seattle and Portland sections will also receive copies.

Technical Committee Chairman Yoichi Seo, of Flecto Coatings, Ltd., will be sending a questionnaire to members to solicit

New FSCT Members

NEW YORK

Active

Abraham, Frederick J.—Pride Solvents, Avenel, NJ.
Chu, Qun—Ultra Additives Inc., Paterson, NJ.
Cole, Richard T.—Cook & Dunn Paint Corp., Carlstadt, NJ.
He, Mingbo—The Mearl Corp., Buchanan, NY.
Igbokwe, Edward O.—Hoboken Paints Inc., Lodi, NJ.
Lau, David C.—D/L Laboratories, Inc., New York, NY.
Slutsker, Tom N.—Por-Is, Inc., Morristown, NJ.
Tracton, Arthur A.—The Tracton Co., Hillsborough, NJ.

Associate

Burns, Joseph F.—Morton International, Yardley, PA.
Cavanna, Dino F.—The Tartaric Chemicals, New York, NY.
Genter, Rick H.—E.W. Kaufmann Co., Clark, NJ.
Marchand, Melanie A.—Air Products and Chemicals, Philadelphia, PA.
Moerck, Rudi E.—Harris Specialty Chemicals, Jacksonville, FL.
Morris, Richard B.—Coatings ASI, E. Rutherford, NJ.
Shah, Chet S.—Nisu Chem International, Matawan, NJ.

NORTHWESTERN

Associate

Meister, John S.—Union Carbide Corp., Lisle, IL.

PACIFIC NORTHWEST

Active

Cabot, Michael B.—Fuji Silysia Chemical Ltd., Portland, OR.
Cheirrett, Mark K.—Elo Coatings, Seattle, WA.
Dailey, Darrin E.—Pacific Chemtech Inc., Portland.
Dobbins, Corinne—Gaco Western Inc., Seattle.
Harris, Warren F.—Pacific Testing Labs., Seattle.
Howard, John—Multi Veritas Research Services Ltd., Vancouver, B.C.
Lozinski, Larry P.—Fargo Paint & Chemicals Inc., Calgary, Alb.
Simonson, Jeff H.—Alexander Art LP, Keizer, OR.
Twu, Yeong-Tay D.—Gaco Western Inc., Tukwila, WA.
Venus, Terry L.—McWhorter Technologies, Portland.
Vitomit, Sergio—Napier International Technologies Inc., Surrey, B.C.
Zearfoss, N. Ruth—Associated Chemists, Portland.

Associate

Baymiller, Brian R.—Fuji Silysia Chemical, Portland, OR.
Hughes, Rodney S.—Fuji Silysia Chemical, Portland.
Keane, Mary M.— Michelman Inc.—Cincinnati, OH.
Mills, Martin D.—Martin Mills Consultants, N. Vancouver, B.C.
Peterson, Matthew L.—Fuji Silysia Chemical, Portland.
Pinfield, Robert D.—Points West Dist., Ltd., Delta, B.C.
Thomas, Douglas S.—J.F. Shelton Co., Portland.
Wehr, Gerry—GW Technologies, Vancouver, B.C.

PIEDMONT

Active

Elliott, Templeton A.—Zeneca Specialty Ink, Winston-Salem, NC.
Letchford, Robert J.—FMC Corp., Bessemer City, NC.
Templeton, James B.—Aspect Minerals Inc., Spruce Pine, NC.
Tarbell, Scott C.—McWhorter Technologies, Forest Park, GA.
Walter, Anita L.—Monsanto Co., Atlanta, GA.

For more information on how to become a member of the Federation of Societies for Coatings Technology call Tori Graves or Marie Wikiera at (610) 940-0777

Future Society Meetings

CDIC

(Apr. 10)—CDIC 75th Anniversary.
(May 8)—"EVALUATION OF NEW GENERATION COALESCING AGENTS FOR INDUSTRIAL ACRYLIC LATEXES"—Thomas M. Larson, Exxon Chemical Co.

Chicago

(Apr. 4)—"NEW TECHNOLOGY IN SMALL MEDIA MILLING"—Harry Way, Netzsch, Inc.
(May 12)—Annual Awards Banquet.

Cleveland

(Mar. 21)—"USING KAOLIN PIGMENTS TO REPLACE CRYSTALLINE SILICA"—Thad T. Broome, J.M. Huber Corp.
(Apr. 11)—Manufacturing Symposium.
(Apr. 18)—Annual Meeting. "UNIQUE WETTING & DISPERSING ADDITIVES"—Edward Orr, BYK-Chemie.
(May 4-5)—Educational Symposium.
(May 16)—Awards/Past-Presidents'/Spouses' Night.

Golden Gate

(Apr. 17)—"EASILY DISPERSIBLE, LOW OIL ABSORPTION, OPACIFYING ORGANIC PIGMENTS ENCAPSULATING TITANATED LITHOPONE"—Michael Issel, Sino American Pigments.
(May 15)—"HIGH-SPEED DISPERSION TECHNIQUES"—Rocky Courtain, Morehouse Industries, Inc.
(June 19)—Manufacturing Committee Seminar.

Los Angeles

(Apr. 12)—Bosses' Night. "EASILY DISPERSIBLE, LOW OIL ABSORPTION OPACIFYING ORGANIC PIGMENTS ENCAPSULATING TITANATED LITHOPONE"—Mike Issel, Sino American Pigments.
(May 10)—Awards Night. "HIGH-SPEED DISPERSION TECHNIQUES"—Rocky Courtain, Morehouse Industries, Inc.
(June 14)—Annual Meeting.

Montreal

(Apr. 5)—"RHEOLOGY MODIFIERS"—Bob Briell, Southern Clay Products.
(May 3)—"ADHESION PROMOTERS"—Eastman Chemicals.

New England

(Apr. 20)—Joint Meeting with New England Paint and Coatings Association. "NEW COALESCING SOLVENTS FOR WATERBORNE COATINGS"—Peter Doty, Dow Chemical Co.; and "COATINGS IN FORENSICS"—James Corby, FBI.
(May 25)—"NEW CHEMISTRIES IN DEFOAMERS AND WETTING AGENTS"—Fred Lewchik, BYK-Chemie.

Pacific Northwest (Puget Sound Section)

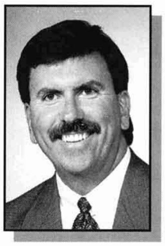
(Apr. 19)—"EASILY DISPERSIBLE, LOW OIL ABSORPTION OPACIFYING ORGANIC PIGMENTS ENCAPSULATING TITANATED LITHOPONE"—Mike Issel, Sino American Pigments.
(May 4-6)—48th Annual Spring Symposium, Portland, OR.
(May 17)—Joint Meeting with Puget Sound Paint and Coatings Association. "HIGH-SPEED DISPERSION TECHNIQUES UPDATE"—Rocky Courtain, Morehouse Industries, Inc.

Pittsburgh

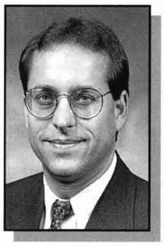
(Apr. 10)—Joint Meeting with SSPC, PDCA, NACE, and PSCT.
(May 8)—"COLOR TRENDS FOR THE COMING YEAR"—PPG Industries, Inc. Past-Presidents' and Spouses' Night.

Toronto

(Apr. 10)—Technical Symposium.
(May 8)—"Non-Toxic Anticorrosive Pigments in Aqueous Media"—Robert E. Snyder, A.R. Monteith (77) Ltd. (Toronto Society Technical Committee Presentation).



G.D. Weaver



W. Konecny

Gary D. Weaver has been appointed Eastern Area Sales Manager of the Colorants and Additives Business Group of Hüls America, Inc., Piscataway, NJ. Mr. Weaver, a member of the Dallas and Houston Societies, will be responsible for managing all activities related to the sales of colorants and additives product lines along the Eastern seaboard.

The company has also promoted **William Konecny** to Eastern Regional Accounts Manager within its Coatings Raw Materials Group. In this capacity, Mr. Konecny will oversee the sales of coatings raw material product lines in the Northeastern United States.

SC Johnson Polymer, Racine, WI, has named **Debra K. Moran** as Marketing Manager. Her new responsibilities will include defining future business opportunities for the coatings business and the strategic development of the powder coating business. Ms. Moran is a Chicago Society member.

Sartomer Co., Exton, PA, has named **James Zawicki** Product Manager, Specialty Monomers. Mr. Zawicki, a member of the Cleveland Society, will be responsible for marketing the company's line of nonradiation cured monomers and oligomers.

The company also appointed **Albert Tuccio** to the position of National Sales Manager. In this capacity, he will oversee all domestic sales activities and coordinate the company's sales force.

In addition, **Ihor Korchynsky** has accepted the position of National Accounts Manager. His focus will be on developing long-term strategic account objectives beyond the daily commercial sales and service concerns.

Craig J. Aiken has been named North American Sales Manager for ICI Surfactants Household Business, Wilmington, DE. He has been with ICI since 1977, and was previously Product Manager.

Also, **Peter J. Shea** has accepted the position of Accounting Manager for ICI Surfactants, New Castle, DE, with the additional responsibility of Business Analyst for ICI Surfactants Industrial Business.

Steven R. Barbanel has been named Business Director for the European Headquarters of BFGoodrich, Performance Resins and Emulsions Div., Brussels, Belgium. His duties will include business direction for waterborne polymers used in paints and coatings, graphic arts, adhesives, textiles, paper, and nonwovens.

The company has also announced the appointment of **Jeff Michaels** to Plant Manager of their Leominster, MA, plant. Mr. Michaels was previously in charge of manufacturing for Sanncor Industries, which was purchased by BFGoodrich in December 1993.

Douglas G. Boller has been appointed Director of Business Development and Technology of Degussa Corp., Ridgefield Park, NJ. In this capacity, Mr. Boller has overall corporate responsibility for the coordination of the company's technical and research activities within the United States.

Troy Corp., East Hanover, NJ, has promoted **Timothy M. Savage** to Vice President of Domestic Sales for its North American markets. Mr. Savage will direct a newly reorganized sales force that provides preservatives and performance additives to coatings, wood protection, metalworking fluids, and building materials markets. He is a member of the Baltimore, New York, and Southern Societies.

T.M. Savage

The corporate executive office of The Mearl Corp., Briarcliff Manor, NY, has announced the promotion of **William Sullivan** to Director, Henry J. Mattin Labs., Ossining, NY. His new appointment coincides with the retirement of **Lou Armanini**, Dr. Sullivan's former supervisor.

Jim Gistis has been promoted to Western Regional Sales Manager for Zeneca Resins, Wilmington, MA. Based in Chicago, IL, Mr. Gistis will manage sales activities in the western half of the country.

In other news, **John Kibbee** has been promoted to Demand Manager. In his new position, Mr. Kibbee will develop and communicate rolling 24-month sales forecasts and manage the implementation of the materials requirements planning process.

Alan Eschbach, formerly Vice President, Domestic and International Sales and Marketing of Rheometric Scientific, Piscataway, NJ, has been named Executive Vice President and Chief Operating Officer. He reports to **Robert E. Davis**, President and Chief Executive Officer.

The company has also made the following changes in its domestic operations: **Paul Newbatt**—Sales Manager, Americas; **Don Becker**—Manager Rheology Products, Americas; **James Ferrara**—Product Specialist, Thermal Sciences; **Frank Baker**—Business Manager, On-Line Processing and Automatic Quality Assurance Products; **Thomas Luckenbach**—Manager, Marketing Communications; **John Fisk**—District Sales Manager, South Central United States; **Brad Barchus**—District Sales Manager, Midwest United States; and **Iggy Chan**—District Sales Manager, Northeast United States.

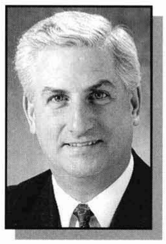
Irving Skeist, founder of Skeist Laboratories, was bestowed the 14th ASC Award by the Adhesive and Sealant Council, Washington, D.C. The award is given annually to an individual who has contributed original research or otherwise significantly advanced the adhesive and sealant industry.

Bruce G. Davis has joined Witco Corp., Greenwich, CT, as Vice President of Purchasing and Logistics. Mr. Davis was previously Vice President of Purchasing and Logistics at Standard Products, Dearborn, MI.

Union Process, Inc., Akron, OH, has named **Malcolm MacKay** Director of Sales and Marketing. Mr. MacKay has worked in engineering, applications, and sales of dispersion equipment with several manufacturing companies.

Rheox, Inc., Hightstown, NJ, has appointed **Sharon Martin** Sales Representative, Eastern Region. She will be responsible for the sale of the company's products in New England, New York, New Jersey, Delaware, and Eastern Pennsylvania.

John Morrell has accepted the position of Divisional Vice President, Resins and Specialty Chemicals, Nacan Products Ltd., Brampton, Ont. The Toronto Society member will be responsible for marketing, sales, and technical development of the Canadian Resin Div., including sales in the United States paint and coatings industry.



J. Morrell

Jay Fitzpatrick has been named Senior Account Manager of the Performance Products Group of E.T. Horn Co., La Mirada, CA. Mr. Fitzpatrick, a member of the Los Angeles Society, will handle sales in the coating, elastomer, and composite industries.

In addition, **Jeffrey S. Martin** has been named Sales Manager of the Performance Products Group. Mr. Martin will be responsible for the sales functions of the Group, serving the coatings, ink, construction, adhesive, elastomer, and composite industries. He is also a Los Angeles Society member.

The company recognized another Los Angeles Society member, **Jeanne R. Doolittle,** Senior Account Manager, for her sales and technical contributions with several accounts in the Western region.

Eleven scientists from Reichhold Chemicals, Inc., Research Triangle Park, NC, have been presented with the company's Technical Achievement Awards.

The recipients and their product achievements included: **Dick Benton** and **Roy Williams**, high-solids polyester; **Bryan Naderhoff** and **Tim Takas**, waterborne two-component epoxy; **Gerry Naples** and **Shi Yang**, waterborne oil modified urethane; **Venkatram Krishnan**, high-performance textile printing binder; **Jan Grossman** and **Becky Durney-Cronin**, core-shell water-dispersible elastomer for flexographic printing; **Sean Walsh**, SMC technology and resin system development; and **Neil Jarvis**, repulpable hot melt adhesive.

AlliedSignal's Performance Additives business unit has announced the promotion of **Marilyn J. Nicosia** to Supervisor, Customer Services. In her new position, Ms. Nicosia is charged with facilitating a range of activities within the customer service department as well as maintaining inventory at several warehouses and coordinating literature and technical bulletins.

Arne R. Salvesen has accepted the position of President of Morehouse-COWLES, Inc., Fullerton, CA. Mr. Salvesen was previously President of Heidelberg West, Inc., and has served as President of several units of Rockwell International and Mark Controls Corp.

John C. Kerr was promoted to Market Development Manager, Publication Gravure, for Hercules Inc., Resins Div., Wilmington, DE. He will retain his previous duties as Western Region Sales Account Manager while overseeing all logistical activities to facilitate demand for resinates by gravure customers.

In other news, **Richard M. Krawiec** has been named Marketing Manager, Graphic Arts. He will formulate and implement the overall market strategy for ink-related products and services.

Suzanne M. Marra, Manager of Marketing Research and Communications, has assumed the additional title of Marketing Manager, Dispersions for Hercules. In her new position, she will be responsible for the marketing strategy for the division's dispersions business.

Rhône-Poulenc Inc., Cranbury, NJ, has appointed **Paul Ling-Kong Hung** to the position of Technical Service Manager for Coatings Products. In his new role, Dr. Hung will be responsible for the technical service requirements of customers using polyisocyanate resins marketed by the company's coatings and construction materials business in North America.

Raw Materials

Pigment Dispersions

Daniel Products Co. introduces two new solvent-free colorant product lines, one powdered and one aqueous. The Tint-Ayd® AP powdered colorants are available for high-performance emulsion and water-reducible industrial coatings. Tint-Ayd® NV aqueous colorants are for use in all types of waterborne architectural, industrial, specialty, and wood finish coatings systems.

Circle No. 30 on Reader Service Card

Brown Dispersions

Synthetic Van Dyke Brown dispersions for preserving and enhancing the natural look of wood grain are introduced by Hüls America, Inc. The GPD® colorant line is intended for use in alkyd paints and nitrocellulose lacquers, while the Aquasperse® II dispersions may be incorporated into water-based coatings. These products reportedly feature lot-to-lot consistency, environmental friendliness, and shelf stability.

Circle No. 31 on Reader Service Card

Polyamide-Imides

Resins designed to provide resistance to high temperature and steam conditions while exhibiting bonding strength are introduced by Ciba Polymers Div. Rhodeftal® resins are applicable in industrial and consumer products, such as high temperature nonstick coatings and self lubricants, automotive and coatings uses, and appliances.

Circle No. 32 on Reader Service Card

Fluoroadditive

Teflon TE-3667N, a new aqueous dispersion grade of PTFE fluoroadditive, is introduced by DuPont. This grade is intended for use as an additive to provide lubricity, reduce wear, increase gloss and release, and reduce blocking in applications ranging from composites and coil coatings to paints, waxes, finishes, inks, polymers, and greases. The product is characterized by a narrow molecular weight distribution, and contains few acid end groups.

Circle No. 33 on Reader Service Card

Foam Control

Antifoam Compound S370 is designed for use in silicone-sensitive foaming systems without causing surface defects. The low surface tension foam control agent is purportedly compatible with surfactant formulations and may be used in applications which require spreading power. Reported characteristics of this Wacker Silicones Corp. product, whose applications include chemical processing and formulating, adhesives, and paints and coatings, include alkali and shear resistance.

Circle No. 34 on Reader Service Card

Defoamer

Air Products and Chemicals, Inc. has developed a new defoamer intended to provide knockdown defoaming and sustained antifoaming over time in a variety of waterborne formulations, including pigment grind applications, printing inks, industrial maintenance coatings, and wood coatings. Surfynol® DF-62 is a liquid, ether-modified, silicone defoamer for long-term efficacy applications.

Circle No. 35 on Reader Service Card

Fungicide

The Fibers, Organics and Rubber Div. of Miles Inc. has received EPA registration for a new technical fungicide which is based on the active ingredient tebuconazole. This product is used in the manufacture of solvent- and water-based wood preservatives as well as in the preservation of plastics. Preventol A8 also offers control of decay and staining organisms.

Circle No. 36 on Reader Service Card

Testing Equipment

Penetrometer

The PNR 10 penetrometer digitally displays test conditions and measurement results with 1/100 mm resolution. Penetration test kits are available to perform tests on floor polish, waxes (hard and paste), highly viscous and semi-fluid varnishes, putty, paints, and other materials. Additional features of this Petrolab Corp. instrument include electronic alignment of penetrator tip with the sample surface and alarms to indicate when test results are outside user-programmed limits.

Circle No. 37 on Reader Service Card

Weathering Testing

CTH-Glas Trac™ combines solar radiation with 24-hour temperature and nighttime humidity control to simulate the extreme sunlight, heat, and humidity conditions of automotive interiors. This Heraeus DSET mechanism features dual-axis tracking to maximize solar irradiance. The device tests automotive trim materials such as air bag covers, b-pillar materials, carpet/hat trays, consoles, door panels, fabrics, and more.

Circle No. 38 on Reader Service Card

Equipment

Milling Machine

A ring mill RG series milling machine features a bead chamber bottom lid with no hole or slit, preventing beads from passing through the lid and allowing the mill base to go through the most condensed area for milling efficiency. Other characteristics of this Sanwa Chemical Ind. Co. Ltd. machine include two axles, a wire ring, a cooling system, optional tank rotation, and a speed changing system. A variety of models are available, ranging from 2- to 3,000-liter capacity.

Circle No. 39 on Reader Service Card

Books/ Publications

Corrosion Science

A collection of 15 technical papers presented at the National Association of Corrosion Engineers (NACE) International's annual conference has been printed. *Surface and Interface Characterization in Corrosion* addresses the complex interaction between the metal-electrode interface in monitoring corrosion reactions. Also examined are a variety of surface-sensitive techniques and specific applications for various surfaces.

Circle No. 40 on Reader Service Card

Laboratory Supplies

The 1995 edition of the Whatman LabSales catalog provides a complete directory of Whatman's products, containing more than 2,000 new listings of laboratory equipment and supplies. Stir/hot plates, electrodes, and pH, conductivity, and water meters are featured. Also included are thermometers, refractometers, cuvettes, plasticware, and glassware used in molecular biology, biotech, clinical, and environmental science laboratories.

Circle No. 41 on Reader Service Card

Terephthalic Acid

Purified terephthalic acid (PTA) is the topic of a 16-page brochure. Bulletin TA-11, "Purified Terephthalic Acid: The Foundation for Clearly Exceptional Performance," describes Amoco Chemical Co.'s development of PTA as well as the company's research, manufacturing, and shipping capabilities. Also discussed is PTA's use in polyethylene terephthalate (PET) resins for fiber, bottle, and other end-use applications.

Circle No. 42 on Reader Service Card

Synthetic Rubber

A six-page chart rating the degree of resistance of fluoroelastomer synthetic rubber to more than 750 chemicals and other substances has been published by Pelmor Labs., Inc. "General Chemical Resistance of a Fluoroelastomer" lists each chemical alphabetically and assigns ratings, such as "excellent resistance," "good resistance," etc., to each. Ratings are based on extensive laboratory tests and experiments performed by outside organizations.

Circle No. 43 on Reader Service Card

Gas Chromatography

A gas chromatography/mass spectrometry (GC/MS) application note, entitled "General Utility of the Mass Spectrometric Detector for the Analysis of Materials by Gas Chromatography," is available from the Perkin-Elmer Corp. The publication focuses on GC/MS as a method of analysis for complex molecular mixtures. Descriptions are provided on 10 varied applications, ranging from the analysis of perfume to the testing of drugs.

Circle No. 44 on Reader Service Card

ISO 9001

ISO 9001, The Standard Interpretation—Second Edition provides a step-by-step guide to interpreting and implementing the requirements of ISO 9001. A calendar of conformance activities provides a detailed outline for a compliance project plan in this 128-page book from ISO Easy. Also included are hints on writing procedures documents, a comparison of ISO 9001 and Total Quality Management, and a complete glossary help in understanding the standard and creating a quality system.

Circle No. 45 on Reader Service Card

Software

Process Manufacturing

PC-based manufacturing software for the soaps, cosmetics, and chemical industries is available. BatchMaster software has modules for management of such operations as inventory, MRP, production, purchasing, order entry, laboratory, and platinum accounting. This BatchMaster Software Corp. product is industry specialized with quality control monitoring, formula revision history, and compliance reporting.

Circle No. 46 on Reader Service Card

Color Matching

EasyMatch™, a color-matching software system for the paint and coatings industry, is available. This Hunter Associates Lab., Inc. software allows the user to formulate colors, adjust batches, and work off waste. Additional features include automatic determination of suitable combinations of pigments to match a standard, automatic correction of an off-color trial or batch, and a display of predicted formulas listed in order of closest match, best overall match (closest and least metameric), or lowest cost.

Circle No. 47 on Reader Service Card

Color Quality

Software is introduced by Datacolor International which offers color inspection, statistical quality analysis, statistical process control, and system capabilities. Applications of Datamaster® 300 and 600 color quality control software, featuring SmartChek™ autotolerancing technology, include color measurement of incoming raw materials and colorants, pass/fail color inspection of work in process, color measurement of batches against standards, and color certification of product shipments.

Circle No. 48 on Reader Service Card

Laboratory Apparatus

Spectrophotometer

A new portable spectrophotometer for analyzing extremely small samples is introduced. Minolta Corp.'s CM-503i features a Ø3 mm measurement area and meets ISO and DIN standards for d/8 geometry as well as CIE recommendations for d/0 geometry and ASTM t/0 geometry. Data is calculated using a variety of color and color-difference formulas, observer functions, and any of 11 illuminants on this instrument.

Circle No. 49 on Reader Service Card

Coating Thickness

Separate probe models have been added to the PosiTector 6000 Series of coating thickness gauges by DeFelsko Corp. The separate probe gauges feature instant auto-calibration to NIST, interchangeable probes, and a combination probe that measures on both ferrous and nonferrous substrates. All probes are hermetically sealed and manufactured with a precision honed-and-ground stainless steel housing, high-flex cable, a sapphire tip, and gold-plated connectors designed for the industrial environment.

Circle No. 50 on Reader Service Card

Particle Size Analyzer

The model LA-910 laser particle size distribution analyzer features a low-end limit of 0.02 microns (20 nanometers), unattended operation for up to 24 samples with a reservoir system that can supply and store three kinds of dispersion media, and a new dry feeder capable of dispersing cohesive fine powders down to submicron sizes. This instrument, offered from Horiba Instruments, comes with a 486 hard drive, 8 MB RAM, a full color graphic monitor/printer computer system, an operator interface, and data acquisition and management software.

Circle No. 51 on Reader Service Card

Color Measurement

A new portable color measurement sensor, the MiniScan/EX, employs an LCD screen which displays numerical and graphical data with automatic storage and retrieval of tristimulus or spectral data. The instrument is designed to analyze the visible spectrum of light from 400 to 700 nanometers in 10-nanometer increments. Up to 99 product setups, 800 tristimulus sample readings, or 350 spectral data readings can be stored in the memory of this HunterLab product.

Circle No. 52 on Reader Service Card

Water Analyzer

Perstorp Analytical has introduced a handheld water analyzer which simultaneously measures pH, conductivity, and temperature of water and aqueous solutions. The battery-operated Triple-Check™ includes a splashproof membrane keypad and LCD screen. A temperature sensor built into the conductivity probe provides automatic temperature compensation, and a general purpose pH electrode is supplied.

Circle No. 53 on Reader Service Card

Air Flow Alarm

An air flow alarm unit is designed for ducting and fume hood applications to ensure adequate face velocity. This device provides both audible and visible warnings when the air flow falls below the OSHA standard. The Airfiltronix Corp. unit runs continuously from the AC supply using a wall-mounted transformer, and a test button is provided to confirm both audible and visual alarm operation.

Circle No. 54 on Reader Service Card

Paints/ Coatings

Containment Coatings

Sherwin-Williams Industrial and Marine Coatings introduces a new line of coatings developed for secondary containment areas to protect concrete surfaces and the surrounding environment from possible contamination. These coatings offer varying degrees of chemical resistance and flexibility to protect secondary containment structures and process area floors and slabs. Other areas where the Corobond™ line may be used include spill/leak prevention, tank farm containment, chemical loading and unloading, and drum storage.

Circle No. 55 on Reader Service Card

Paint System

Unicolor, a recyclable waterborne paint system developed by Unicolor Ecopaints, allows for ecologically bearable coating of metallic and wooden substrates with solvent-free waterborne paints and newly designed recovery systems. Waterwash spray booths can be converted to make use of Unicolor's complete program of air-curing or stove-drying coatings. Unicolor is designed to eliminate waste disposal problems resulting from the coating process; the overspray, taken into solution by the aftermix in the waterwash spray booth, is filtered and concentrated back to its original application constants, allowing it to be reused.

Circle No. 56 on Reader Service Card

Miscellaneous

Label System

A fully integrated on-site label production system features software that drives a variety of printers, including dot matrix impact, direct thermal/thermal transfer, and continuous form laser. The Diagraph LPT/1060 thermal/thermal transfer printer offers an internal rewind with an eight-inch OD capacity, present sensor for peel and disperse mode, and 300 dots per inch for high-resolution printing. The Diagraph® Corp. product is driven by a processor designed for immediate data processing and instant first label out.

Circle No. 57 on Reader Service Card

Ceramic Diffuser

The Filtros Plant of Ferro Corp. has introduced a star-shaped porous ceramic diffuser which diffuses air or gases into fluids held in tanks of almost any shape, including cylindrical. The Star Performer diffusion device features the fine bubble producing properties of porous ceramic along with uniform diffusion through its six evenly spaced arms. The gadget can also be modified to accommodate differently shaped tanks, and air supply can be connected from either above or below the unit.

Circle No. 58 on Reader Service Card

Microwave Extraction

CEM Corp. and the Canadian government have signed a technology transfer agreement to advance the use of microwave energy for solvent extraction for molecular analysis. The new alliance includes the integration of the Canadian government's MAP™ (microwave assisted process) into CEM's microwave extraction system applications. The new process reportedly expands the applications that may be developed in organic analysis through selective heating of the chemical components of a substance.

Circle No. 59 on Reader Service Card

Pail Inserts

New inserts made specifically for five-gallon plastic pails are available. These seamless inserts, designed for use in the ink, paint, adhesive, coating, and chemical industries, are tapered and heightened to provide a tailored fit for most major brands of plastic pails. These CDF Corp. liners are vacuum-formed in low- or high-density polyethylene and offer a contoured lip that snaps onto the pail's top chime to prevent slippage.

Circle No. 60 on Reader Service Card

**Coatings Formulation Has Never Been More Challenging.
Learn How You Can Successfully Meet the Challenge,
by Attending . . .**

"Formulating for the New Clean Air Act"

**Tuesday and Wednesday,
March 21-22, 1995**

**Cleveland Airport Marriott
Cleveland, Ohio**

**Sponsored by
The Professional Development Committee
of the Federation of Societies for Coatings Technology
492 Norristown Rd., Blue Bell, PA 19422-2350
(610) 940-0777 • Fax: (610) 940-0292**

Calendar of Events

FEDERATION MEETINGS

For information on FSCT meetings, contact Federation of Societies for Coatings Technology, 492 Norristown Rd., Blue Bell, PA 19422 (610) 940-0777, FAX: (610) 940-0292.

1995

(Mar. 21-22)—"Formulating for the New Clean Air Act." Seminar sponsored by the Professional Development Committee. Cleveland Airport Marriott, Cleveland, OH.

(May 17-21)—FSCT Spring Week. Spring Seminar on the 17th and 18th; Board of Directors Meeting on the 20th; Incoming Society Officers Meeting on the 21st. Fiesta Americana, Cancun, Mexico.

(June 20-21)—"Polymer Chemistry for the Coatings Formulator." Seminar sponsored by the Professional Development Committee, Chicago, IL.

(Oct. 9-11)—73rd Annual Meeting and 60th Paint Industries' Show. Cervantes Convention Center, St. Louis, MO.

(Nov. 6-7)—"Formulating for the New Clean Air Act." Seminar sponsored by the Professional Development Committee. Denver, CO.

1996

(Oct. 23-25)—74th Annual Meeting and 61st Paint Industries' Show. McCormick Place North, Chicago, IL.

1997

(Nov. 5-7)—75th Annual Meeting and 62nd Paint Industries' Show. Georgia World Congress Center, Atlanta, GA.

SPECIAL SOCIETY MEETINGS

1995

(Mar. 29-31)—Southwestern Paint Convention. Sponsored by Houston and Dallas Societies. Airport Hyatt Regency, Dallas, TX. (Benny Puckett, Kelly-Moore Paint Co., Inc., 301 W. Hurst Blvd., Hurst, TX 76053; (817) 268-3131).

(Mar. 29-July 5)—"Understanding the Basics of Coatings II." Sponsored by the Joint Educational Committee of the New York Society for Coatings Technology and the Metropolitan New York Paint and Coatings Association. Course held Wednesday evenings for 15 consecutive weeks at Fairleigh Dickinson University, Hackensack, NJ. (Mildred Leonard, NYSCT Office, Rm. 208, 520 Westfield Ave., Elizabeth, NJ 07208; (908) 354-3200).

(Apr. 4)—"Compliant Coatings for 2000 and Beyond." Sponsored by the Detroit Society. Michigan State University Management Center, Troy, MI. (Joe Lesnek, DSCT, P.O. Box 2454, Riverview, MI 48192; (812) 428-9200).

(Apr. 11)—"Manufacturing Principles to Survive the 90s." Seminar sponsored by the Cleveland Society and the Cleveland Paint & Coatings Association. Cleveland Hilton South, Cleveland, OH. (J.P. Walton, Jamestown Paint Co., 108 Main St., Jamestown, PA 16134; (412) 932-3010 or fax: (412) 932-5147).

(Apr. 19)—"Spectrum of Coatings Science." Sponsored by the Louisville Society. Executive West Hotel, Louisville, KY. (Ilona Nemeth, Red Spot Paint Co., P.O. Box 418, Evansville, IN 47703-0418; (812) 428-9200).

(Apr. 19-21)—Southern Society Annual Meeting. Hyatt Regency, Savannah, GA. (Wayne West, Thompson & Formby, Inc., 10136 Magnolia Dr., Olive Branch, MS 38654).

(Apr. 22)—"Springfest '95." Sponsored by the Northwestern Society. (Robin Norcutt, George C. Brandt, Inc., 2975 Long Lake Rd., Roseville, MN 55113; (612) 636-6500).

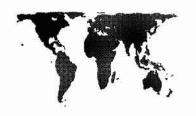
(May 3-4)—"Recent Advances in Modifiers for Modern Coatings." Symposium sponsored by the New York Society. Holiday Inn North, Newark Airport, Newark, NJ. (Larry Waelde, Troy Chemical Corp., c/o NYSCT Office, 520 Westfield Ave., Elizabeth, NJ 07208; (908) 354-3200).

(May 4-5)—"Focus on the Future." 38th Annual Technical Symposium sponsored by the Cleveland Society. Quaker Square Hilton, Akron, OH. (Sharie Moskaluk, The Sherwin-Williams Co., 601 Canal Rd., Cleveland, OH 44113-2498; (216) 566-3661).

(May 4-6)—48th Annual Spring Symposium. Sponsored by the Pacific Northwest Society. Red Lion Lloyd Center, Portland, OR. (Ken Wenzel, Chemical Distributors, Inc., P.O. Box 10763, Portland, OR 97210; (503) 243-1082).

(May 8-9)—Eastern Training Conference and Show. Sponsored by the Philadelphia Society for Coatings Technology. Valley Forge Convention Center, Valley Forge, PA. (Wayne Kraus, Hercules Inc., Research Center, 500 Hercules Rd., Wilmington, DE 19808; (302) 995-3435. Booth reservations: Larry Kelly, Eastech Chemical, Inc., 5700 Tacony St., Philadelphia, PA 19135; (215) 537-1000).

OTHER ORGANIZATIONS



1995 — North America

(Mar. 20-24)—"Basic Composition of Coatings." 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).

(Mar. 26-31)—"Corrosion '95." Annual conference sponsored by National Association of Corrosion Engineers (NACE) International. Orange County Convention Center, Orlando, FL. (NACE International, P.O. Box 218340, Houston, TX 77218-8340).

(Apr. 2-7)—38th Annual Technical Conference sponsored by Society of Vacuum Coaters (SVC). Chicago Marriott Downtown, Chicago, IL. (SVC, 440 Live Oak Loop NE, Albuquerque, NM 87122-1407).

(Apr. 5-7)—10th Annual Conference sponsored by Architectural Spray Coaters Association (ASCA). Doral Ocean Beach Resort, Miami, FL. (ASCA, 230 W. Wells St., Ste. 311, Milwaukee, WI 53203).

(Apr. 24-28)—"Applied Rheology for Industrial Chemists." Short course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Director, Professional Development Institute, P.O. Box 1792, Kent, OH 44240).

(Apr. 24-28)—"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).

(Apr. 28-May 2)—"International Ultraviolet and Electron Beam (UV/EB) Curing Conference and Exhibition." Seminar sponsored by RadTech International. Opryland Hotel, Nashville, TN. (Chris Dionne, RadTech International North America, 60 Revere Dr., Ste. 500, Northbrook, IL 60062).

(May 3-4)—1995 International Symposium on Developing Plastics Technologies. Sponsored by the Canadian Plastics Institute. Queen's Landing Inn, Niagara-on-the-Lake, Ontario. (The Canadian Plastics Institute, 1262 Don Mills Rd., Unit 48, Don Mills, Ont. M3B 2W7, Canada).

(May 8-12)—"Dispersion of Pigments and Resins in Fluid Media." Short course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Director, Professional Development Institute, P.O. Box 1792, Kent, OH 44240).

(May 15-19)—"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 15-20)—"Interpretation of IR and Raman Spectra: Lectures, Interpretation Workshops, and FTIR Laboratories." Course sponsored by the Fisk Infrared Institute. Vanderbilt University, Nashville, TN. (Clara D. Craver, Fisk Infrared Institute, 1000 17th Ave. North, Nashville, TN 37208-3061).

(May 22-24)—Eighth International Symposium on Polymer Analysis and Characterization (ISPAC-8). Sanibel Island, FL. (ISPAC Registration, 815 Don Gaspar, Sante Fe, NM 87501).

(May 22-25)—"Coatings Science for Coatings Technicians." Short course sponsored by University of Southern Mississippi (USM), Hattiesburg, MS. (Shelby F. Thames, Director, USM, Box 10037, Hattiesburg, MS 39406-0037).

(May 22-26)—"Adhesion Principles and Practice for Coatings and Polymer Scientists." Short course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Director, Professional Development Institute, P.O. Box 1792, Kent, OH 44240).

(June 5-8)—"Coatings Science for Coatings Chemists." Short course sponsored by University of Southern Mississippi (USM), Hattiesburg, MS. (Shelby F. Thames, Director, USM, Box 10037, Hattiesburg, MS 39406-0037).

(June 5-9)—"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 12-15)—"Coatings Science for Coatings Formulators." Short course sponsored by University of Southern Mississippi (USM), Hattiesburg, MS. (Shelby F. Thames, Director, USM, Box 10037, Hattiesburg, MS 39406-0037).

(June 25-29)—"Coating Work in Nuclear Facilities." Symposium sponsored by The American Nuclear Society and The National Board of Registration for Nuclear Safety Related Coating Engineers and Specialists. Marriott Hotel, Philadelphia, PA. (Dean M. Berger, Executive Secretary, NBR, P.O. Box 56, Leola, PA 17540).

(July 17-19)—"Basic Coatings for Sales, Marketing, and General 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. 7-10)—"Introduction to Powder Coatings Technology." Short course sponsored by University of Southern Mississippi (USM), Hattiesburg, MS. (Shelby F. Thames, Director, USM, Box 10037, Hattiesburg, MS 39406-0037).

(Sept. 11-15)—"Basic Composition of Coatings." 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. 14-15)—"Advanced Radiation (UV/EB) Curing Marketing/Technology." Seminar sponsored by Armbruster Associates Inc. Newport Beach Marriott Hotel and Tennis Club, Newport Beach, CA. (David Armbruster, Armbruster Associates Inc., 43 Stockton Rd., Summit, NJ 07901).

(Sept. 19-22)—"New Horizons '95." Conference jointly sponsored by the American Oil Chemists' Society (AOCS) and the Chemical Specialties Manufacturers' Association (CSMA). Omni Sagamore Resort, Bolton Landing, NY. (Rebecca Richardson, AOCS, P.O. Box 3489, Champaign, IL 61826-3489).

(Sept. 20-21)—"Advanced Radiation (UV/EB) Curing Marketing/Technology." Seminar sponsored by Armbruster Associates Inc. Newark Airport Marriott Hotel, Newark, NJ. (David Armbruster, Armbruster Associates Inc., 43 Stockton Rd., Summit, NJ 07901).

(Sept. 20-22)—"Accelerated and Natural Weathering Techniques for Coatings and Polymers." Short course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Director, Professional Development Institute, P.O. Box 1792, Kent, OH 44240).

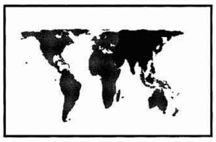
(Sept. 25-29)—"Paint Formulation." Short course sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (Cynthia N. Campbell, UMR Coatings Institute, Dept. of Chemistry, 142 Schrenk Hall, Rolla, MO 65401-0249).

(Sept. 26-29)—"Introduction to Coatings Technology." Short course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Director, Professional Development Institute, P.O. Box 1792, Kent, OH 44240).

(Sept. 29-Oct. 1)—"Fall Decor 1995." Sponsored by the National Decorating Products Association (NDPA). McCormick Place North, Chicago, IL. (Teri Flotron, NDPA, 1050 N. Lindbergh Blvd., St. Louis, MO 63132-2994).

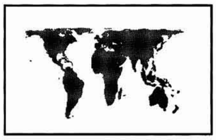
(Nov. 10-16)—1995 International Conference and Exhibition. Sponsored by the Steel Structures Painting Council (SSPC). Dallas, TX. (Dee Boyle, SSPC, 4516 Henry St., Ste. 301, Pittsburgh, PA 15213-3728).

Asia



(May 23-24)—First Pacific Coating Forum. Sponsored by the Japan Coating Technology Association. Shonan Kokusai Village, Kanagawa, Japan. (Secretariat, Japan Coating Technology Association, Daiichi Naka-Bldg. 4F, 3-4 Nihombashi-Kobunacho, Chuouku, Tokyo 103, Japan).

Australia

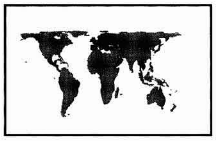


(July 20-22)—Surface Coatings Association Australia Conference and Exhibition. Southern Cross Hotel, Melbourne, Australia. (Kahren Giles, Conference Manager, SCAA Conference and Exhibition, The Meeting Planners, 108 Church St., Hawthorn, VIC 3122).

1996 — Australia

(Jan. 18-25)—International Schools and Conference on X-ray Analytical Methods—AXAA '96. Sponsored by the Australian X-ray Analytical Association (AXAA), Inc. Sydney, Australia. (The Secretariat, AXAA '96, GPO Box 128, Sydney, NSW 2001, Australia).

Europe



(May 15-18)—"Recycle '95." Forum and Exposition. Sponsored by Maack Business Services. Swissôtel, Zürich, Switzerland. (Maack Business Services, Moosacherstrasse 14, CH-8804 AU/Zürich, Switzerland).

(June 12-14)—"17th Annual International Conference on Advances in the Stabilization and Degradation of Polymers." Luzern, Switzerland. (A.V. Patsis, Institute of Materials Science, State University of New York, New Paltz, NY 12561).

(June 19-22)—"Science and Technology of Pigment Dispersion." Luzern, Switzerland. (A.V. Patsis, Institute of Materials Science, State University of New York, New Paltz, NY 12561).

(June 20-23)—"Polymer Blends and Alloys." Luzern, Switzerland. (A.V. Patsis, Institute of Materials Science, State University of New York, New Paltz, NY 12561).

(July 10-14)—"21st Annual International Conference in Organic Coatings Science and Technology." Athens, Greece. (A.V. Patsis, Institute of Materials Science, State University of New York, New Paltz, NY 12561).

(Aug. 21-25)—"Advances in Emulsion Polymerization and Latex Technology." Davos, Switzerland. (Gary W. Poehlein, Interdisciplinary Programs, Georgia Institute of Technology, Atlanta, GA 30332-0370).

(Sept. 19-21)—"Eurocoat '95." Congress-Exhibition organized by AFTPV. Eurexpo Conference Center, Lyons, France. (E. Andre, UATCM, 5 rue Etex, F-75018 Paris, France).

(Sept. 26-28)—"Surcon '95." Biennial International Conference sponsored by the Oil & Colour Chemists' Association. London, Heathrow. (Chris Pacey-Day, 967 Harrow Rd., Wembley HA0 2SF, United Kingdom).

(Oct. 16-20)—First International Congress on Adhesion Science and Technology (ICAST). Amsterdam, The Netherlands. (ICAST '95, P.O. Box 346, 3700 AH Zeist, The Netherlands).

Advertisers' Index

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Humbug from Hillman

The "Phantom" has gently struck again. This time with a copy of the "Stripped Gears" column from *The Rotarian*. Phant recommends this one:

➾ The gerontologist was explaining some facts of aging to a group of retirees. "Your body never ceases to replace itself," he told them, "Every day your body replaces millions of cells."

A loud voice interrupted from the back of the room: "How come my new cells are as wrinkled as the old ones?"

♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦

Dick Stewart apparently has managed to stay ahead of the nurses from the "funny farm." As he ran by the post office, Dick dropped off these "few items of wisdom."

➾ If you live your allotted span of three score years and ten, your heart will beat two thousand, five hundred and seventy six million times. Then it will stop . . .

➾ A young lawyer who had just passed the Bar was in court for his first case. When his turn came, he laid his hat and coat on an empty seat and stepped up before the judge.

"Young man, I assume that this is your first experience in this court," the judge said sternly.

With that awful, 'what have I done wrong' feeling, the lawyer said, "Yes sir."

"I thought so," said the judge. "Before we proceed, kindly get your hat and coat and put them where you can see them."

➾ A man died. As he breathed his last, he started to float toward a distant light. Higher and higher he floated until he was completely surrounded by a warm, very bright light. This all goes to prove a theory I (Dick) have been working on . . . When you die you turn into a moth.

There was more, folks, but enough is enough!!!

♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦

I am pleased to be able to get back to a more normal agenda, thanks to Jeff Sturm who has, again, sent me a copy of the *Yetter Letter*, which included:

A pretty stewardess on a Chicago-Los Angeles flight had her hands full fending off two persistent drunks. The one seated in the front of the plane was doing his best to persuade her to come to his apartment. At the rear, the second drunk was trying for an invitation to her apartment.

As the plane headed for the runway, the front seat pest handed her a key and a slip of paper on which he had written his address. "Here's the key and my address," he whispered, "See you tonight?"

"Okay," she said, smiling sweetly as she headed for the character at the rear. She handed him the key and slip of paper and said, "Don't be late."

My pen pal, Larry Hill, writes a very clever column, "Overspray," which appears in *Surface Coatings Australia*. I am indebted to Frank Borrelle who keeps me supplied with photocopies of the column from time to time and, thus, with Larry's kind permission, I can share some of the tidbits with JCT readers.

➾ The young bride was reporting eagerly to her husband on the behavior of the neighbors. "They are a very happy couple. Every morning when he leaves for work he kisses her. Wouldn't it be nice if you did that?" "Yeah, great, great," said the husband, "but I haven't even been introduced to her yet."

➾ And here's a few for the legal eagles:

—Possession is nine points of the law . . . lawyer's fees are the other 91 points.

—Talk is cheap . . . if lawyers don't do the talking.

—Only a lawyer can write a thousand words and call it a brief.

—If you can't get a lawyer who knows the law, get one who knows the judge.

—Then there's the barrister's wife who confided to her maid, "I think my husband is having an affair with his secretary." "No, never!" gasped the maid, "you are only saying that to make me jealous."

♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦

The recent increase in the price of postal stamps brings to mind the endless wait in line at the big city post offices when such an event comes to pass. I feel lucky each time I visit our small local post office and rapidly, without any wait, conclude my postal business of the day. I even have time to chat a while with our friendly and helpful postmaster, Bob Johnson.

A long time ago, Robert Benchley wrote about it his way: "The U.S. Post Office is one of the most popular line standing fields in the country. It has been estimated that six-tenths of the population of the United States spend their entire lives standing in line in the post office. When you realize that no provision is made for their eating or sleeping or intellectual advancement while they are thus standing in line, you will understand why six-tenths of the population look so cross and peaked. The wonder is that they have the courage to go on living at all."

The Best of Robert Benchley—Avenal Books, 1983

♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦

George Washington was elected the first President of the United States, and for eight years nobody complained about the mess in Washington—mostly because it was in Philadelphia.

We're lucky that computers are creating artificial intelligence, because we're running out of the real thing.

—The Lion

—Herb Hillman, Humbug's Nest,
P.O. Box 135, Whitingham, VT 05361.


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