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JOURNAL OF COATINGS TECHNOLOGY

GUIDE FOR AUTHORS

GENERAL

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

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 All manuscripts will be assumed to be previously unpublished writing of the authors, not under consideration for publication elsewhere.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

The JOURNAL OF COATINGS TECHNOLOGY has first right to the publication of papers presented at the Annual Meeting of the Federation and at local regional meetings or symposia of the Constituent Societies.

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

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...for the Journal

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

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

...by Constituent Societies For Annual Meeting Presentation

Ten complete copies of the manuscript are required for committee review. The set of copies should be addressed to the Editor at the address listed previously.

...for Roon Foundation Award Competition

Ten complete copies of the manuscript are required, and should be submitted to the Chairman of the 1993 Roon Awards Committee, Louis J. Sharp, Dexter Corp., 1 E. Water St., Waukegan, IL 60085. (For complete details, see "Roon Awards" section of the JOURNAL in January 1993 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 prolbems 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 $8\frac{1}{2}$ 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 $8\frac{1}{2}$ 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$_{a}$ 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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The Federation of Societies for Coatings Technology assumes no responsibility for the opinions by authors in this publication.

Comment

What's in a Name?

The image of an organization starts with something very basic—its name. Our organization, the Federation of Societies for Coatings Technology—doesn't exactly boast the catchiest of titles. Indeed, at best, it is a rather cumbersome appellation for this group of approximately 7300 members from 33 countries.

Yet, this name does describe what we are. We are an organized association (Federation) of 26 autonomous groups (Societies) brought together by a common interest (Coatings Technology).

As I proudly wear the badge of President, I am frequently asked to explain what FSCT stands for. In a recent (and on-going) analysis of the FSCT, it was acknowledged that even some of our own members are not fully aware of the multitude of programs the Federation provides for the betterment of the industry.

If there is one key word missing from our name, that word would be EDUCATION. The Federation is dedicated to furthering the educational needs of the members and this commitment is approached on three distinct levels:

The Educational Committee focuses on promoting educational projects to benefit our members and the industry. They do this by assisting our Constituent Societies in establishing and maintaining educational programs as well as by promoting career opportunities in coatings to attract technical talent into the industry. Each year representatives of each Society meet to share information on local projects which are underway and to offer support and suggestions where needed. Reporting on the educational achievements of the local Societies would more than fill this page! This Committee will be chaired by Melinda Rutledge (Golden Gate Society) and I am confident of her abilities to lead this vital group.

The second point of our "educational triangle" is represented by the Professional Development Committee, under the very able chairmanship of Roger Woodhull (New England Society). This active group plans and promotes continuing education programs on a wide range of topics in order to provide for the professional development of our members It is through their efforts that the industry is provided with the tools to remain on the cutting edge of new technology.

The third component is the Coatings Industry Education Fund. This organization, under the aegis of the Federation, operates as a separate entity and elects its own officers from among the appointees made by the Federation. The current President—George R. Pilcher (CDIC Society)—is both dynamic and enthusiastic. The role of CIEF is to address the FSCT support of academia in the area of student education. It goes without saying that well-schooled individuals coming into the industry represent a resource for the future. As part of its responsibilities, CIEF administers the Vasta Fund, the Trigg Fund (from NPCA), and the newly organized Coatings Industry Honor and Remembrance Fund (*see page 13—Ed.*).

Finally, the educational programs are monitored through the restructured Educational Coordinating Committee under the chairmanship of another veteran, Don Boyd (Pittsburgh Society). This Committee addresses the overall approach to education, often coordinating efforts between CIEF and the local Societies and, just as importantly, avoiding duplication of effort.

The demands on today's technical personnel are greater than they have ever been. Today's coatings technologists should take pride in the fact that they represent the brains of our industry and its resource for the future.

As to our name, I thought that the Federation of Societies for the Education and Training for Technologists of the Coatings Industry (FSETTCI) might be more encompassing. On reflection, I like FSCT better!

Colin D. Penny,
President, FSCT

Abstracts of Papers in This Issue

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

A Methodology for Evaluating the Total Performance of Coatings and Coating Systems—M. Simakaski and C.R. Hegedus

JCT, 65, No. 817, 51 (Feb. 1993)

Coatings technologists are frequently asked to develop or select an optimum coating or coating system for a specific application. In most cases the intended application places several demands on the coating(s) which in turn must display numerous properties. Even when several coatings meet all of the fundamental requirements, it is usually desirable to identify the material which will outperform the others. This decision-making process becomes difficult when property trade-offs exist.

A methodology to quantitatively and consistently evaluate the cumulative effects of a number of coating (or coating system) properties on overall performance has been developed. This analysis is based on the Zero-Max Technique which converts property values to an equivalent scale for comparative purposes. A weighting value which is representative of property importance on overall performance is also determined and utilized to obtain an overall Total Performance Evaluation (TPE) rating. This approach has been demonstrated in the selection of an optimum binder system for a self-priming topcoat for military ground equipment. The demonstration illustrates that the TPE can be used to determine statistical differences between overall coating performance. The methodology is applicable to all areas of coating characterization and selection.

Model Crosslinkers for Polyols. Kinetics of Transetherification of 2-Methoxy Cyclic Ethers—M. Arai and S.P. Pappas

JCT, 65, No. 817, 59 (Feb. 1993)

A new and general method for analyzing the kinetics of reversible reactions which proceed via a common reactive intermediate is presented. The method is applied herein to acid-catalyzed transetherification of 2-methoxy cyclic ethers, which are model compounds for potentially useful crosslinkers for polyols.

Three cyclic ether acetals, 2-methoxy-2H-tetrahydropyran (2a), 2-methoxy-tetrahydrofuran (2b) and 2-methoxy-2-methyltetrahydrofuran (2c), were synthesized and their acid-catayzed transetherification reaction with equal concentrations of neopentyl alcohol was investigated by NMR analysis under reversible conditions. Extent conversions were determined

Une Méthodologie pour l'Evaluation de la Performance Totale des Revêtements et des Systèmes de Revêtements—M. Simakaski et C.R. Hegedus

JCT, 65, No. 817, 51 (Feb. 1993)

Les technologues dans le domaine des revêtements sont fréquemment impliqués dans le développement et la sélection d'un revêtement optimum ou d'un système de revêtement pour une application spécifique. Dans la plupart des cas, cette application implique plusieurs demandes pour le revêtement qui doit démontrer plusieurs propiétés. Même si plusieurs revêtement rencontrent toutes les demandes fondamentales, il est habituellement souhaitable d'identifier les matières qui performent plus que les autres. Ce procédé de décision devient difficile lorsque des compromis sur les propiétés existent.

Une méthodologie a été développée pour quantifier et évaluer les effets cumulatifs d'un certain nombre de propriétés des revêtements sur la performance globale. Cette analyse est basée sur la technique "Zero-Max" qui convertit les valeurs des propriétés en une échelle équivalente pour des buts de comparaisons. Une valeur représentative de la propriété sur la performance globale est ainsi déterminée et utilisée pour obtenir une évaluation de la performance globale (TPE). Cette approache a été utilisée pour la sélection d'un système de liant pour une couche de finition autoapprêtante dans le domaine de l'équipement militaire. Cette démonstration illustre que la TPE peut être utilisée pour déterminer les différences statistiques entre les performances globales de revêtements. Cette méthodologie est applicable à tout les domaines de la caractérisation et de la sélection des revêtements.

Modèles d'Agents de Réticulation pour les Polyols. Cinétique de la Transéthérification d'Ethers Cycliques 2-Méthoxy—M. Arai et S. Peter Pappas

JCT, 65, No. 817, 59 (Feb. 1993)

Une nouvelle méthode générale est présentée pour l'analyse de la cinétique des réactions réversibles qui procèdent via un réactif intermédiaire commun. La méthode est appliquée á la transéthérification d'éthers cycliques 2-méthoxy, qui sont des composés modèles pour la réticulation des polyols.

Trois éthers cycliques, 2-méthoxy-2Htétrahydropyran (2a), 2-méthoxy-tétrahydrofuran (2b) et 2-méthoxy-2-

Una Metodologia Para la Evaluacion de la Calidad Total de los Recubrimientos y Sistemas de Recubrimiento—M. Simakaski and C.R. Hegedus

JCT, 65, No. 817, 51 (Feb. 1993)

Los técnicos en recubrimientos se estan preguntando frecuentemente el desarrollo o la óptima selección de un recubrimiento o un sistema de recubrimiento para alguna aplicación especifica. En la mayoría de los casos, la aplicación seleccionada demanda en diversas ocasiones del recubrimiento(s) una serie de propiedades, por lo cuál este tiene que mostrar un sin número de las mismas. Es más, cuando varios recubrimientos cumplen con los requisitos fundamentales, usualmente es deseable poder identificar el material que mejora en calidad a los demás. Este proceso de decisión se vuelve dificil cuando la propiedad existe más de una vez.

Se ha desarrollado una metodología para cuantificar y evaluar consistentemente los efectos acumulativos de un número de propiedades del recubrimiento (o un sistema de recubrimiento) por sobre la calidad. Este análisis se basa en una Técnica de Zero-Max la cuál convierte los valores de la propiedad a una escala equivalente para propósitos comparativos. Se determina un valor de peso como una propiedad representativa en la calidad final y que se utiliza para obtener el rango de evaluación de la Calidad Total final (TPE). Este concepto se ha demostrado en la selección del óptimo sistema ligante para un recubrimiento final autoaspirante para equipo militar de campo. La demostración ilustra que el TPE se puede utilizar para determinar diferencias estadísticas entre la calidad final del recubrimiento. La metodología se puede aplicar a todas las áreas de caracterización y selección de recubrimientos.

Modelos de Agentes Reticulantes Para Polioles. Cinetica de Transesterificacion del 2-Metoxy Eteres Ciclicos—M. Arai and S. P. Pappas

JCT, 65, No. 817, 59 (Feb. 1993)

Se presenta un nuevo método general para analizar la cinética de las reacciones reversibles que se llevan a cabo por via normal en un intermediario reactivo general. El método aplicado aquí es en la transesterificación ácida-catalizada del 2-metoxy eteres cíclicos, los cuáles son compuestos modelo con un gran potencial de uso como agentes reticulantes para los polioles.

as functions of acid concentration and temperature. A computer program was developed, based on regression analysis, which allowed kinetic analysis of the data.

The kinetic analysis afforded composite forward and reverse rate constants as well as relative rates of reaction of the competing alcohols for the reactive intermediate and the kinetic order in p-toluene sulfonic acid. Energies of activation and relative entropies of activation, which are useful parameters for estimating the temperature dependence of shelf life and cure, were determined for 2a and 2b. The reactivity of 2c was too high for determination of these kinetic parameters by the NMR procedure.

The potential applicability of 2-methoxy cyclic ethers as crosslinkers for polyols prompted the synthesis of 2-methyl-2-methoxy-5-chloromethyltetrahydrofuran (4a) and its conversion into the previously unknown 5-phenoxymethyl derivative 4b. This conversion serves as a model reaction for the synthesis of multi-functional analogs of 2c by reaction of 4a with phenolic resins. Accordingly, the readily available 4a is a potentially useful synthon for preparation of polyol crosslinkers which possess the highly reactive 2-methoxy-2-methyltetrahydrofuran group.

méthyltétrahydrofuran (2c), ont été synthétisés et leur réaction de transéthérification avec des concentrations égales d'alcool néopentyl a été étudiée par résonnance magnétique nucléaire (RMN) sous des conditions réversibles. Des conversions ont été déterminées en fonction de la concentration d'acide et de la température. Un logiciel informatique a été développé, basé sur l'analyse de régression, permettant l'analyse cinétique des données.

L'analyse cinétique démontre des rendements relatifs de la réactioon d'alcools compétitionnants pour les intermédiaires réactifs et la cinétique de l'acide sulfonique p-toluène. Les énergies d'activation et les entropies relatives d'activation, qui sont des paramètres utiles pour l'estimation de la dépendance de la température sur la réticulation, ont été déterminées pour 2a et 2b. La réactivité de 2c est trop élevée pour la détermination des paramètres cinétiques par la procédure RMN.

Le potentiel d'application des éthers cycliques 2-méthoxy comme agents de réticulation des polyols a permis la synthèse de 2-méthyl-2-méthoxy-5-chlorométhyltétrahydrofuran (4a) et sa conversion en un dérivé inconnu de 5-phénoxyméthyl (4b). Cette conversion sert comme une réaction modèle pour la synthèse d'analogues multifonctionnels de 2c par réaction de 4a avec des résines phénoliques. Conséquemment, le 4a disponible est un synthon potentiellement utile pour la préparation d'agents de réticulation pour les polyols, qui possèdent le groupe réactif 2-méthoxy-2-méthyltétrahydrofuran.

Se sintetizaron y se investigaron las reacciones de transsesterificación ácida-catalizada de tres éteres acetálicos ciclicos, 2-metoxy-2H-tetrahidropirano (2a), 2-metoxytetrahidrofurano (2b) y 2-metoxy-2-metiltetrahidrofurano (2c) con iguales concentraciones de alcohol neopentílico con un análisis NMR bajo condiciones reversibles. Las conversiones de extensión se determinaron como funciones de la concentración del ácido y la temperatura. Se desarrollo un programa de computadora, basado en un análisis de regresión, el cuál permite analizar los datos de la cinética.

El análisis de la cinética proporcionó la composición seguida de las constantes de velocidad reversibles tan bien como las velocidades relativas de reacción de la competitividad en los alcoholes por el intermediario reactivo y el orden cinético en el ácido p-toluen sulfónico. También se determinaron las energías de activación y las entropías relativas de activación, los cuáles son parámetros muy utiles para estimar la dependencia de la temperatura de la vida media y del curado, en 2a y 2b. La reactividad de 2c fué muy alta para determinar estos parámetros cinéticos mediante el procedimiento NMR.

El potencial de aplicación de los 2-metoxy eteres cíclicos como agentes reticulantes para los polioles proviene de la síntesis del 2-metil-2-metoxy-5-clorometil-tetrahidrofurano (4a) y su conversión en un derivado previamente desconocido 5-fenoximetil 4b. Esta conversión sirve como modelo de reacción para la síntesis de analogias multifuncionales de 2c mediante la reacción de 4a con resinas fenólicas. De acuerdo a esto, la disponibilidad de 4a es un arma potencialmente útil para la preparación de agentes reticulantes de polioles que podean alta reactividad dentro del grupo 2-metoxy-2-metiltetrahidrofurano.

1993 FSCT Spring Week Seminar to Focus on "Influence of Substrates and Application Methods/ Techniques on Coatings Performance," May 18-19

"The Influence of Substrates and Application Methods/Techniques on Coatings Performance," is the theme of the 1993 FSCT Spring Week Seminar, to be held at the South Shore Harbour Resort and Conference Center in League City (Houston), TX on May 18-19, 1993. The program was developed by FSCT's Professional Development Committee.

A panel of experts has been assembled for the conference to present information on the variety of considerations which must be examined in order to develop coatings for architectural substrates, and the effects various application methods have on the process. Attendees will have the opportunity to discuss the problems and learn time honored solutions to these problems throughout the event.

Program

Topics and speakers for the program include the following:

"Masonry"—Dave Martin, Master Builders, Cleveland, OH.

"Sheet Rock"—Dave Evans, Evans Paint Store, Traverse City, MI.

"The History of Paint Applicators"—Dave Rowekamp, The Wooster Brush Co., Wooster, OH.

"Application Methods"—John Price, EZ Paintr, Milwaukee, WI.

"The Role and Importance of Basic Wood Properties and Surface Preparation in the Durability of Wood Coatings"—Bill Feist, USDA Forest Products Lab, Madison, WI.

"Finishing Alternatives for Exterior Wood Products"—Charles Jourdain, California Redwood Association, Novato, CA.

"The Successful Coating of Pressure-Treated Wood"—Alan Ross, Kop Coat, Inc., Pittsburgh, PA.

"Finishing Characteristics of Plywood, OSB, and Com-Ply Panels"—Dick Carlson, American Plywood Association, Tacoma, WA.

"Hardboard Siding as a Substrate for Coatings"—Louis Wagner, American Hardboard Association, Palatine, IL.

Registration

The registration fee for the event is $175 for FSCT members and $225 for non-members. In addition, a special arrangement has been made with the Painting and Decorating Contractors of America for registration at the member rate. (The registration is to be paid in U.S. funds, payable on U.S. banks.)

The registration fee includes continental breakfasts, luncheons, refreshment breaks, and a portfolio containing copies of the papers presented at the event.

Note: If cancellations are received less than five days prior to the seminar, a $50 charge per registration will apply.

Housing

Requests for seminar room accommodations at the South Shore Harbour Resort and Conference Center must be made on the Seminar Registration Form and returned to FSCT Headquarters.

The seminar room rate is $110 for either single or double occupancy. The reservation cut-off date is April 16, 1993.

A twenty-minute trip from Houston's Hobby Airport, the South Shore Harbour Resort and Conference Center features 250 elegantly appointed rooms with water views, and is located near the NASA/Johnson Space Center.

The hotel operates a complimentary shuttle to and from Houston's Hobby Airport. To use this service, be sure to indicate your arrival and departure plans on the registration form.

Air Transportation

Discounted airline travel arrangements to the Spring Week seminar can be made by contacting the Federation Travel Desk at 1-800-448-FSCT. An agent will make your reservations, write your ticket using your credit card number, and mail the tickets directly to you. Be sure to mention the FSCT Code: FSCT-SW.

* * *

Complete program information is available by contacting the Federation of Societies for Coatings Technology, 492 Norristown Rd., Blue Bell, PA 19422-0292.

Nominations Sought for Armin J. Bruning Award

The Armin J. Bruning Award was established to recognize an individual for outstanding contributions to the science of color in the field of coatings technology. The award commemorates Mr. Bruning, the inventor of the Davis-Bruning colorimeter, who was devoted to the pursuit of the scientific study of color.

A nominee for the award must have contributed significantly to the field of color study. These contributions could include very basic work which increases our understanding of the interaction of colorants, light and observers (human and instruments). However, the contributions of the nominee could also include various aspects of techniques or theories developed by others, or the teaching of color science or the dissemination of information in a manner which has direct benefit to the coatings industry. The nominee does not have to be a member of a Society or the FSCT.

To nominate an individual for the Bruning Award, please contact Dr. Robert T. Marcus, Chairman of the Bruning Award Committee, at Pantone, Inc., 55 Knickerbocker Rd., Moonachie, NJ 07074, (201) 935-5500.

The nomination must include documentation concerning the nominee's qualifications and contributions in the area of color science for the coatings industry. Nominations must be received prior to April 1, 1993.

"THE INFLUENCE OF SUBSTRATES AND APPLICATION METHODS/TECHNIQUES ON COATINGS PERFORMANCE"

REGISTRATION FORM

May 18-19, 1993 • South Shore Harbour Resort and Conference Center
League City (Houston), TX

NAME _____

NICKNAME (for badge) _____

JOB TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

PHONE _____

I am a member of the following Federation Society: _____

Registration Fees:

FSCT members	$175
PDCA members	$175
Non-members	$225

Your check for the seminar fee must accompany the registration form. Please make check payable to: Federation of Societies for Coatings Technology. Payment must be made in U.S. Funds, payable in U.S. Banks.

PLEASE CHECK ONE BOX IN EACH OF THE TWO COLUMNS BELOW:

YOUR COMPANY IS

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

YOUR POSITION IS

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

HOTEL INFORMATION

Arrival Date _____ Departure Date _____

Sharing Room With _____

Room Rate: $110 (single or double occupancy)

Special Room Requests: ❒ Single Occupancy ❒ Double Occupancy

Courtesy Van (from Hobby Airport): Airline _____ Arrival Time _____

(to Hobby Airport): Airline _____ Departure Time _____

Note: Hotel does not assume responsibility for alternate transportation due to missed shuttle.

One night's deposit enclosed (Separate check payable to South Shore Harbour Resort and Conference Center) or enter VISA, Mastercard or American Express credit card number and expiration date below:

Credit Card: ❒ AMEX ❒ VISA ❒ MASTERCARD

Card # _____ Expiration Date _____

Room Reservations Guaranteed only with deposit or major credit card.

CHECK IN TIME IS 3:00 PM, CHECK OUT TIME IS 12:00 NOON.
Reservations must be made no later than **April 16** to guarantee availability and rates.

Return completed form and check(s) to: **Federation of Societies for Coatings Technology**
492 Norristown Rd., Blue Bell, PA 19422-2350

Program Theme Announced for 1993 Annual Meeting; Call for Papers Issued for Event Slated for Oct. 27-29

The theme for the 1993 Annual Meeting of the FSCT will be "Today's Competitive Coatings: Lean, Mean and Green." The announcement was made by Program Committee Chairman Clifford Schoff, of PPG Industries, Inc.

The Annual Meeting will be held in conjunction with the FSCT Paint Industries' Show at the Georgia World Congress Center in Atlanta, GA, on October 27-29, 1993.

Success in the coatings industry, now, and in the future, belongs to those who take the lead by blending long-term profitability, coatings performance, and environmental protection.

The 1993 theme recognizes these goals in the terms:

LEAN: Cost effective . . . process efficient . . . waste free

MEAN: Consistent . . . tough . . . durable . . . resistant

GREEN: Environmentally friendly . . . renewable . . . recyclable . . . safe.

Sessions tentatively scheduled for the 1993 event will cover topics including: Corrosion, Manufacturing, Advanced Technologies in Coatings Research, Radiation Curing, Latex Technology, Polymer Science, Environmental Impact/Constraints and Physical Property Characterization.

Prospective speakers are invited to present original papers on the theme and its various aspects and are requested to submit abstracts (150 to 200 words) for review to Chairman Clifford Schoff, PPG Industries, Inc., P.O. Box 9, Allison Park, PA 15101.

Deadline for receipt of abstracts is March 1, 1993.

Assisting Chairman Schoff in the program development is a steering committee composed of: Ronda Miles (*Vice-Chair*), Union Carbide Corp., Garland, TX; Darlene Brezinski, Consolidated Research, Inc., Mt. Prospect, IL; Loren W. Hill, Monsanto Co., Springfield, MA; Richard J. Himics, Daniel Products Co., Inc., Jersey City, NJ; Louis F. Holzknecht, Devoe Coatings Co., Louisville, KY; Louis J. Sharp, Dexter Packaging Products, Waukegan, IL; Roger Woodhull, California Products Corp., Cambridge, MA.

Committee Activities

Report of the By-Laws Committee To the Federation Board of Directors

Proposed Revisions to FSCT By-Laws and Standing Rules

In March 1992, the FSCT Membership Services Committee conducted a survey of Constituent Society Membership Chairpersons regarding the election process for members. Based on the responses, the Membership Services Committee recommends several revisions to the FSCT By-Laws and Standing Rules. These are discussed below:

A. Length of Election Process

The survey showed that an overwhelming majority wanted to have the election process shortened.

The Membership Services Committee also recommended that only one Voting Member signature be required instead of two on the membership application form.

These recommendations have been incorporated into the following proposed revision.

STANDING RULE ARTICLE SRII, C,
titled Method of Election to Membership

Be it RESOLVED that Standing Rule Article SRII, C, Sections 1(Active Member application), 2 (Associate Member application), and 3 (Educator and Student Member applications) be amended and combined into new Standing Rule SRII, C, Section 1 as follows:

An applicant for Active, Associate, or Educator and Student class of membership must be proposed by a Voting Member who has verified the eligibility of said applicant for the class of membership proposed. If the application is approved by the Constituent Society Membership Committee, it shall be submitted to the membership of the Constituent Society at a regular meeting of the Society. Election to membership shall be by a two-thirds favorable vote of the Voting Members present and voting. If the applicant is elected to Society membership, both copies of the application, bearing the Constituent Society Secretary's certification of election, shall be forwarded to the Executive Vice President of the Federation who will sign the original and return it to the Society.

Current Article SRII, C, Section 4 (Retired Member application) will be renumbered as new Section 2 and Section 5 (Active or Associate Member transfer) will be renumbered as new Section 3 of this Article.

B. Associate Membership Eligibility

The survey showed a strong preference among the Societies for a redefinition of the eligibility requirements for Associate Membership.

THEREFORE, be it RESOLVED that By-Laws Article III, D (Classes of Membership in Constituent Societies), Section 2 (Associate Membership) be amended to read as follows:

(2) Associate Membership: Any individual not eligible for Active Membership, but who is employed by a manufacturer of the products of the protective and decorative coatings, printing ink, or allied industries, or by those firms that manufacture or sell raw materials, supplies, or equipment required by those industries, is eligible for Associate Membership, provided that the Constituent Society has established such class of Associate Membership, and that all such Associate Members shall be subject to all specific rules and restrictions regulating the activities and responsibilities of the Associate Members which the Constituent Society may adopt.

Fred G. Schwab,
By-Laws Committee Chairman

Coatings Industry Honor and Remembrance Fund

In mid-1992, the Coatings Industry Education Fund was proud to announce the establishment of the new Coatings Industry Honor and Remembrance Fund, which is administered by the Trustees of the CIEF. The concept of an "Honor and Remembrance" fund is new to our industry, and was first suggested by FSCT President Colin Penny, who felt that many of us would like to honor friends, spouses, respected colleagues and outstanding employees in a public and substantive way. Colin felt that—by establishing a fund dedicated specifically to the honor and/or remembrance of those special people—the CIEF would be creating a meaningful and lasting tribute to their work. Since the intent of the Trustees is to use the earnings from the principal of this fund for educational assistance in the form of scholarships, fellowships, and grants to colleges and universities with coatings programs, anyone making a donation will also have the additional satisfaction of knowing that their gift will be used to help educate those who will carry on the tradition of scientific and technological excellence in the coatings industry—and who may very well be honorees of this same fund, someday.

By recognizing gifts to the Honor and Remembrance Fund in the JOURNAL OF COATINGS TECHNOLOGY, it is the Trustee's intent to give international recognition to both the donors and the honorees, as well as to focus on the educational benefits being derived from such gifts. This is a bold new venture which will enable every individual corporation and society associated with the coatings industry to really "make a difference," by recognizing specific individuals' contributions to our industry, while furthering the educational efforts of the CIEF at the same time. Gifts in any amount (made payable to "CIEF—Honor and Remembrance Fund," and sent to the Federation Office) will be recognized annually in the JOURNAL OF COATINGS TECHNOLOGY, and will be divided into the following five categories:

- Gifts up to $249
- Gifts from $250-$499
- Gifts from $500-$999
- Gifts from $1000-$9999
- Gifts of $10,000 and over

All gifts to the Honor and Remembrance Fund will be tax deductible to the extent that the law allows, and may be made as a direct gift to the Fund, as a gift in honor of a living person, or as a gift in remembrance of one who is deceased. Examples:

- The Acme Corporation
- The Ohio Coatings Society, in honor of Maynard Q. Browning
- Mr. and Mrs. Pierre M. Lundquist, in remembrance of John Z. Edwardson

It is currently the intention of the Trustees to reprint the list annually, with some indication (perhaps an asterisk) of gifts which have been added since the last printing. It is also the Trustees' intention to present a suitable plaque, in late 1993 or early 1994, to the Federation Office in Blue Bell, listing all donors of record, with sufficient room to add additional donors in the future. As of December 1992, the Honor and Remembrance Fund has received generous, and deeply appreciated, gifts from the following individuals:

The Coatings Industry Honor and Remembrance Fund (Donations through December 31, 1992)

Gifts of $10,000 and over

Len and Neta Schaeffer, in remembrance of Fred and Ruth Daniel

Gifts of $1000-$9999

Mrs. Herbert L. Fenburr, in remembrance of Dr. Herbert L. Fenburr
The Houston Society for Coatings Technology, in remembrance of Loren B. Odell

Gifts of $500-$999

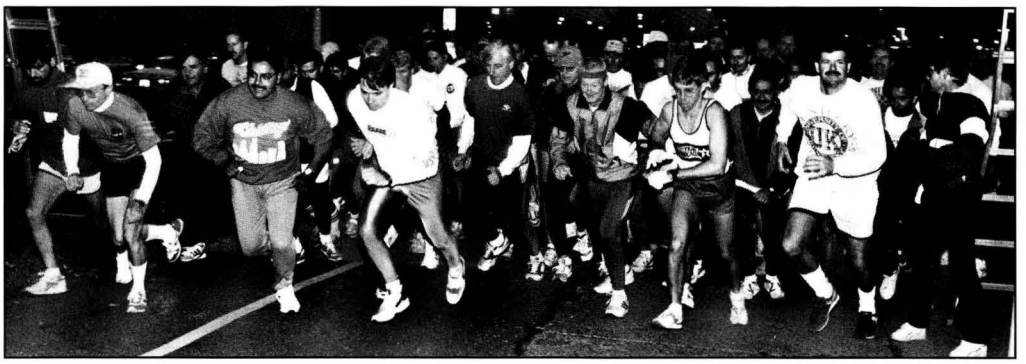
Akzo Coatings Inc. (Columbus), in remembrance of our employees who died in 1992

Gifts of $250-$499

No gifts received in this category during 1992

Gifts up to $249

Colin D. Penny



Sixth Annual Paint Show 5000

CHICAGO, IL, OCT. 22—The setting is scenic Grant Park, Lakeshore Drive at East Jackson Boulevard, the time is 6:30 a.m., Thursday, October 22, the temperature is in the mid-40s and the wind off Lake Michigan is steady. The event is the Sixth Annual Paint Show 5000 Fun and Fitness Run/Walk. Once again sponsoring the five kilometer (3.1 miles) run is Troy Corporation, East Hanover, NJ, in cooperation with the Federation of Societies for Coatings Technology.

Although the race does not begin until 7:00 a.m., contestants begin to gather as early as 6:30 a.m. Amid the still dark skies of Chicago, men and women, runner and walker, amateur and "ringer" descend on the site one by one and in small groups. The number of contestants begins to grow until, as least by this reporter's estimate, the number of runners/walkers reaches approximately 200. Having been witness to the previous five Paint Show 5000 events (Dallas in '87, Chicago in '88, New Orleans in '89, Washington, D.C. in '90, and Toronto in '91), I do believe that a record number of anxious participants have registered for this year's Fun and Fitness challenge.

The race is being organized by Lake Shore Athletic Services, a truly professional group that is experienced in setting up and managing road races. The course has been set up to begin on Lakeshore Drive opposite Buckingham Fountain. The path runs south on the Drive to Soldier Field, home of the Chicago Bears, and then back north around the Adler Planetarium and Shedd Aquarium. The home stretch is along the Drive and back to Buckingham Fountain.

As the 7:00 hour approaches, the participants begin to gather at the starting line. The lines of runners/walkers are at least 20 deep. The contestants huddle closer and closer together until the group is at a standstill, ready to embark on an early morning fitness run beside Lake Michigan. At the site of the starter's pistol, nervous energy is expended in the form of bouncing up and down. The veteran runners take these last few seconds to set their stopwatches. Finally, the pistol is fired, the race is underway.

CIEF DONATION—FSCT Executive Vice President Robert F. Ziegler (left) accepts $2000 check from Troy Corporation's Timothy M. Savage, National Sales Manager, on behalf of the Coatings Industry Education Fund. The money represents proceeds collected from the Sixth Annual Paint Show 5000 entry fees

The problem with covering a road race is you can only be in one place at a time. The runners won't be back in view for at least 12 minutes. That's not a long period of time. However, if you've ever been in Grant Park on Lakeshore Drive at 7:00 a.m., you will understand why I also took to bouncing up and down. It's cold standing still!

Well, my estimation was correct. Approximately 12 minutes elapsed before I saw the runners. To my amazement, a competitive race is shaping up, as three runners, approximately 50 feet between them, are heading past the original starting point, and around to the home stretch. By my calculation, the pace of the run is very good, with six-minute miles being churned out. It's not a blistering or world class pace, but nonetheless, much too fast for my legs.

As the race winds down the homestretch, the leader has managed to keep pace, and maintain his lead. At exactly 18:12 after the starter's pistol had sounded, Henry Guirand, of Rohm and Haas Company, crosses the finish line in victory. However, the most fascinating accomplishment about Henry's victory, in my opinion, is the fact that he's not breathing as if he has just run three miles in 18 minutes. Truly amazing!

Crossing the finish line behind Henry are George Podolsky, of Harcros Pigments, Inc., and David Wacker, of Raabe Corporation.

The fourth place finisher, and first woman to cross the finish line, is defending women's champion Kay Sandborn, of Rohm and Haas Company. Kay was the first female finisher at last year's race in Toronto. Her time this year is 18:48, an improvement of 1:17 over last year's race. This is another great effort by Kay.

A steady flow of runners crosses the finish line, until all save a few have completed the course. Those contestants who are finished line up at a station adjacent to the timeclock to receive their Paint Show 5000 sweatshirts from the Troy people.

Finally, as the clock slowly ticks towards the 40-minute mark, today's walkers are heading down the home stretch. Individually and in couples, the striders complete the 5K effort. With smiles beaming across their faces, they too shuffle off for their souvenir sweatshirts.

It's 8:15 a.m., Lake Shore Athletic Services begins to disassemble the time clock, and collect the pylons which lined the course. The staff from Troy Corporation is finishing up the last minute gathering of materials. The Sixth Annual Paint Show 5000 officially is over. By all accounts, this year's race was the most successful to date.

Portions of each registrant's $5 entrance fee is donated to the FSCT's Coatings Industry Education Fund. Once again, thanks to the staff from Troy Corporation, sponsors of the "fun run," who make the event the success that it is.

However, now it's time to set our sights on the Seventh Annual Paint Show 5000 which will take place on October 28, in Atlanta, GA, site of the 71st Annual Meeting and 58th Paint Industries' Show. As is the case, all runners, joggers, and walkers are invited to participate in this health and fitness event which also benefits the Coatings Industry Education Fund.

See you in Atlanta!

THE PROVEN STANDARD.

PROVEN EFFICACY- In intensive field tests by independent laboratories including the U.S. Navy, U.S. Forest Products Laboratory and Mississippi State University, TROYSAN POLYPHASE proved to be more effective against a broader spectrum of fungi and mildew, in a wider range of applications, than all other fungicides/mildewcides tested!

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PROVEN SUPPORT- TROYSAN POLYPHASE, like all TROY products, is backed by one of the industry's most comprehensive Technical Service departments with microbiology, formulation and application laboratory facilities. TROY'S staff of experts are ready to assist you in all phases of planning, manufacturing and marketing your formulations.

Speak to one of our application specialists about putting the proven standard to work for you. We think you will agree with the industry leaders that TROYSAN POLYPHASE is without a doubt the best way to control fungi and mildew, and at the same time improve the quality and profitability of your formulations!

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Forecast Calls for $162 Billion for R&D Expenditures In the United States in Calendar Year 1993

Expenditures for research and development (R&D) in the United States in calendar year 1993 are expected to reach $162 billion. The expenditures study is part of the annual forecast by Battelle, Columbus, OH.

The projected $162 billion in expenditures for this year represents an increase of $4.6 billion (2.9%) over the $157.4 billion the National Science Foundation estimates actually was to be spent for R&D in 1992. According to Battelle, since part of the R&D increase will be absorbed by inflation (estimated to be slightly more than 2.0% this year), a real increase in the R&D expenditures is forecasted to be less than 1%. Officials at Battelle have stated that this increase is slightly less than the 10-year average of 3.1% in real R&D.

Sources of Funds

Industrial funding for R&D will account for 51.2% of the total. Industrial support is forecast to be $83 billion, up 2.4% from 1992.

According to the study, an increase of 2.8% in federal support for R&D is anticipated, with funding expected to be $70.1 billion. This is 43.3% of the total expenditures, but is a smaller increase than originally proposed.

Funding by academic institutions is calculated to be $5.7 billion (3.5% of the total), and other nonprofit organizations will provide nearly $3.2 billion (2%).

According to sources at Battelle, prior to 1980, government was the principal funder of R&D. However, industry has been the dominant source of R&D support since 1980, and that trend is expected to continue this year and for the next several years.

Performers of Research

The report has predicted that industry will continue to perform the majority of R&D. Performance by industry is anticipated to rise to $112.7 billion, slightly less than 70% of all research. This amount compares with $18.2 billion (11.2%) by federal government laboratories, $25.5 billion (15.7%) by academic institutions, and $5.6 billion (3.5%) by nonprofit organizations.

According to Battelle, the federal government funds R&D in all four areas. Approximately 45% of the federal R&D dollars are used by industry. The government and colleges and universities each receive 25%, respectively, with the remaining 5% going to other nonprofit organizations.

The study states further that industry uses almost all of its own funds, either performing the R&D itself, or contracting with industrial researchers. Contracts and grants to nonprofit organizations make up approximately one-half of the funds received by colleges and universities. (The figure used for colleges and universities does not include the support of long-range "endowed research" programs.) Nonprofit organizations finance both themselves and academic institutions about equally; colleges and universities use all of their own funds.

Government Support

Defense, energy, space, and health and human services dominate the federal R&D scene and account for 89.2% of the total proposed federal R&D funding for this year, which essentially is the same as in 1992. The makeup of this funding will not change significantly.

According to the Battelle study, several factors will influence federal R&D support: the continuing budget deficit, a switch toward reduction or curtailment of the so-called "big science" projects, and the emphases on technology transfer and short-term projects that have industrial applicability. Also, the overriding concern over the deficit is expected to prompt a reduction in growth of both defense and total government R&D, as was forecast in earlier Battelle studies. However, the report states that national security considerations will continue to be felt through advanced research on pro-

(Continued on page 19.)

Paint Industry Group Makes Proposal at Reg-Neg Meeting; Wood Furniture Industry Holds Exploratory Meetings

The Paint Industry Caucus Group presented its initial proposal to the full Architectural and Industrial Maintenance (AIM) Coatings Regulatory-Negotiation (Reg-Neg) Committee on January 6-7, during their meeting in Raleigh-Durham, NC.

The initial proposal was in the form of a national command-and-control rule that would control the volatile organic compound (VOC) content of AIM coatings. Also included in the proposal were suggested VOC limits for AIM coatings, which were based on the results of a recently tabulated industry-wide emissions survey. As proposed, the rule could achieve a 7.53% nationwide reduction in VOC emissions from AIM coatings compared to 1990 emissions, based on projected data from the survey.

Data from the emissions survey also was presented and explained by the industry group at the meeting.

In response to the paint industry group's proposal, the other members of the Reg-Neg Committee developed a list of some 25 issues and questions concerning the proposal that they would like the industry group to address.

Responses to these questions are to be presented during the next Reg-Neg meeting, scheduled for February 11-12, in Newport Beach, CA.

Currently, negotiations are expected to continue until May 1, unless the Reg-Neg Committee and U.S. EPA decide to extend the deadline. According to the National Paint and Coatings Association (NPCA), Washington, D.C., the U.S. EPA intends to issue a proposed rule in late summer 1993 and a final rule by late January 1994.

In other Reg-Neg news, it was announced that the wood furniture manufacturing industry has held two exploratory meetings to examine the feasibility of conducting a regualtory-negotiation.

If successfully chartered, the Reg-Neg would address the development and eventual issuance of either a Control Technique Guideline (CTG), a National Emission Standard for Hazardous Air Pollutants (NESHAP), or both. These standards would establish either Reasonably Available Control Technology, Maximum Achievable Control Technology, or both, for the wood furniture manufacturing industries and their coatings operations.

Currently, the U.S.EPA is required to publish a CTG for the wood furniture industry by November 1993, and is required to publish a NESHAP by November 1994.

For more Reg-Neg information, contact Bob Nelson, NPCA, 1500 Rhode Island Ave., NW, Washington, D.C. 20005-5597.

Journal of Coatings Technology

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February 1994 Issue

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007	027	047	067	087	107	127	147	167	187	207	227	247	267	287
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013	033	053	073	093	113	133	153	173	193	213	233	253	273	293
014	034	054	074	094	114	134	154	174	194	214	234	254	274	294
015	035	055	075	095	115	135	155	175	195	215	235	255	275	295
016	036	056	076	096	116	136	156	176	196	216	236	256	276	296
017	037	057	077	097	117	137	157	177	197	217	237	257	277	297
018	038	058	078	098	118	138	158	178	198	218	238	258	278	298
019	039	059	079	099	119	139	159	179	199	219	239	259	279	299
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Regulatory UPDATE

FEBRUARY 1993

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. and edited by members of the FSCT Environmental Affairs Committee.

Priorities for the 103rd Congress will center around economic issues, followed by health care, and perhaps, NAFTA. Several issues that died during the last session will also resurface early on. Reportedly, the following issues will be among the first to face Congress this year:

Deficit/Debt Limit—The federal government is expected to run out of borrowing authority in March or early April. Congressional support will be forthcoming if President Clinton includes deficit-reduction requirements in a proposal or a short-term extension with a promise to develop a deficit-reduction package by the end of the year. President Clinton has already indicated he will submit a four-year deficit-cutting plan. Some members of Congress have warned they will attempt to attach a line-item veto provision to this measure.

Family and Medical Leave—A guaranteed parental leave law looks like a sure thing—probably as early as April. Congress passed legislation last year, but the bill was vetoed by President Bush. Reportedly, House Education and Labor Committee Chairman William Ford considered sending President Clinton a more stringent measure than the one Congress passed, but pressure from other members prompted Chairman Ford to back down.

NAFTA—The North American Free Trade Agreement (NAFTA), signed in principal by the United States, Mexico and Canada, is perhaps the largest single trade issue facing the Clinton Administration.

Congressional reaction to the signing of the pact has been mixed. Some members oppose the agreement because they feel the U.S. will lose thousands of jobs to Mexico. Other members are concerned that the environmental and worker protection provisions of the pact are less than desirable.

Several industry groups, including the National Association of Manufacturers, are urging the new administration to draft implementing legislation early in the year in an effort to boost the U.S. economy.

Reportedly, before he submits implementing legislation to the Congress, President Clinton may want to renegotiate some key provisions including those on the environment and worker protection.

Environmental Protection Agency
December 18, 1992—57 FR 60444
National Pollutant Discharge Elimination System; Storm Water Discharges: Permit Issuance and Permit Compliance Deadlines for Phase 1 Storm Water Discharges
Action: Final rule

The U.S. Environmental Protection Agency (EPA) has issued a final rule specifying deadlines for the issuance of National Pollutant Discharge Elimination System (NPDES) permits for storm water discharges associated with industrial activity and discharges from municipal storm sewer systems serving a population of 100,000 or more.

EPA also reserves the right to set application requirements and deadlines for certain discharges which it had previously exempted from the scope of the NPDES storm water regulations. Those include discharges from construction sites disturbing less than five acres of land and discharges exempt under 40 CFR 122.26 because of a lack of exposure of industrial activity to storm water.

The rule specifies that permits are to be issued or denied by one year after the regulatory deadline for submitting complete permit applications. The deadlines are as follows: October 1, 1993 for most discharges associated with industrial activity; May 17, 1994 for discharges associated with industrial activity from municipalities with a population less than 250,000 who participated in a group application; November 18, 1993 for discharges from large municipal systems; and May 17, 1994 for discharges from medium municipal systems. For applications for new discharges or existing discharges at facilities which fail to submit a complete permit application by the deadline, EPA or the state will issue or deny the permit within one year after the actual receipt of the permit application.

For further information, contact the EPA Storm Water Hotline at (703) 821-4823.

Environmental Protection Agency
December 23, 1992—57 FR 61240
1992 Master Testing List; Notice of Availability
Action: Notice

The EPA has released the 1992 Master Testing List (MTL), which is an intricate component of the Existing Chemicals Program in the agency's Office of Pollution Prevention. The MTL includes chemicals that have been identified as needing testing and those chemicals for which EPA is evaluating test data.

According to EPA, the list contains over 320 specific chemicals and nine categories. It also sets forth EPA's chemical testing program's 1992-1994 priorities. Several categories of chemicals have been added for which EPA plans to identify and assess the testing needs for the chemical components. Among the categories are chemical emissions from interior paints, varnishes, and coatings.

For copies of the MTL or for further information, contact Susan Hazen, Office of Pollution Prevention and Toxics, U.S. EPA at (202) 554-1404.

Environmental Protection Agency
December 24, 1992—57 FR 61542
Suspension of the Toxicity Characteristics Rule for Non-UST Petroleum Product-Contaminated Media and Debris
Action: Proposed rule

The EPA has proposed to suspend for three years hazardous waste regulation of petroleum contaminated debris and media released from sources other than RCRA subtitle I-regulated underground storage tanks (non-UST).

The agency plans to collect additional data, perform additional analyses, and explore other administrative and legal mechanisms to better tailor RCRA regulatory requirements to the particular issues associated with treatment of petroleum releases.

Reportedly, the suspension of the rule is a result of several state complaints that the toxicity characteristics rule may delay the cleanup of sites polluted from aboveground sources as well as imposing a prohibitive cost. EPA concurred that under current conditions fewer sites can be remediated which could potentially expose humans and the environment to further contamination.

Environmental Protection Agency
December 29, 1992—57 FR 61896
Information Collection Request Withdrawn: Toxic Chemical Release Inventory Form R and Petition
Action: Notice

The EPA has withdrawn from the Office of Management and Budget an Information Collection Request (ICR) regarding the Toxic Chemical Release Inventory Form R.

The action clears the way for manufacturers required to report annual toxic chemical emissions to use the Form R that was approved last May. Manufacturers must file the report for calendar year 1992 by July 1, 1993. The complete 1992 Form R and instruction package is expected to be distributed in early 1993.

Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA) requires manufacturers with more than 10 employees to report each year all data on toxic emissions to all environmental media during the previous year. The information is accessible through the Toxic Release Inventory database, which is available to the public.

For further information, contact Anning Smith, U.S. EPA at (202) 260-1576.

States Proposed Legislation and Regulations

Arizona

Hazardous Waste (Regulation)—Under proposed special waste rules that were submitted to the Governor's Regulatory Review Council early in January, generators would be assigned a generator identification number from the Arizona Department of Environmental Quality (ADEQ). The rules would also establish manifest requirements for those who handle such wastes. For further information, contact the ADEQ at (602) 207-2300.

California

Recycling—CA A. 11 (Eastin) authorizes the Department of General Services to establish price preferences, recycled content disclosure, recycled-product-only bids and cooperative purchasing arrangements for certain products including "solvents and paint, including water-based."

Tax Credits—CA A. 29 (Klehs) provides for credit against net corporate tax liability for 10% of cost of compliance with environmental protection or pollution control requirements imposed by any state, local, or regional public agency.

Occupational Safety and Health—CA A. 95 (Horcher) eliminates the requirement that every employer establish, implement, and maintain an effective injury prevention program, and would also make conforming changes in provisions relating to employee discharges, investigations of work conditions, and citations for violations of safety and health standards, orders, and special orders. The bill was introduced on January 6, 1993.

CA S. 55 (Leonard) creates the Workers' Compensation Cost Evaluation Commission, to measure and monitor the net change in loss costs resulting from statutory changes in workers' compensation during the 1993-94 regular session. Adds various conflict-of-interest prohibitions; establishes maximum expenditures for rehabilitation services; limits compensation to injuries that are specific and serious; imposes additional requirements for psychiatric injuries; and makes numerous other revisions. The bill was introduced on December 30, 1992. On January 6, 1993, it was referred to the Senate Committee on Industrial Relations.

CA A. 50 (Ferguson) excludes employers with less than 45 employees from laws covering injury prevention programs and providing for specified training of employees in general safety and health work practices. The bill was introduced on December 15, 1992.

Lead (Regulatory Activity)—The California Department of Health Services reiterated its intention to submit proposed emergency regulations to implement the Childhood Lead Poisoning Prevention Act of 1991 during a rule development workshop in Los Angeles in October. The regulations were expected by the end of December 1992 but had not been released at press time.

Most of the department's efforts center around a fee structure that is to collect over $16 million each year to fund

a program to screen children under six for elevated blood lead levels and to provide case management for chronic exposures. The first two drafts of the regulation containing the fee structure propose to collect $7.5 million from the California Paint Council (CPC) and the Western States Petroleum Association (WSPA), two of the trade associations heavily involved in the development of the regulations.

Earlier in October, the two groups submitted a joint proposal that would assess 60% of the total fees to be collected to industries that continue to use lead in their product formulations or industrial processes and 40% to industries, including paint and petroleum, that have discontinued lead use. CPC and WSPA have argued that their proposal more closely fulfills the mandate of the statute that fees be assessed on the basis of a manufacturer's past and present responsibility for environmental lead contamination.

The department's proposal would allocate fees within an industry on the basis of a company's market share of sales in the previous year.

Because the use of lead in paint has been barred since 1978 and because the industry had largely discontinued lead use several decades before, CPC has argued that the allocation method would be particularly inappropriate for paint manufacturers since market shares in the 1930s and 1940s vary substantially from current market shares. The industries also maintain that their proposal would fulfill another statutory intention—the reduction of current lead usage—by penalizing companies that continue to use the element.

Legal challenges to both the regulations and to the statute are under consideration by many entities affected by the proposed rules. One issue that may be the focal point of any litigation on the matter is whether the fees to be collected by the department to fund the program are actually taxes. Under California law, any bill that imposes a tax must be approved by a two-thirds vote of both houses of the legislature. A court ruling that the funds to be collected are indeed taxes would be fatal to the funding portion of the Childhood Lead Poisoning Prevention Act of 1991, which only passed by a simple majority.

Colorado

Hazardous Waste (Regulation)—The Hazardous Waste Commission (HWC) has proposed rules that would initiate procedures for assessing fees on hazardous waste storage and disposal facilities, individual generators and those who transport hazardous waste. Under the rules, petitioners requesting interpretive rules would pay a specified filing fee. For further information, contact the Colorado HWC at (303) 692-3321.

Florida

Occupational Safety and Health—FL H. 189 (Greene) revises provisions of laws relating to occupational health and safety to: redefine the term "employer" to eliminate an exception for described agricultural labor; provide that toxic substances labeled or amended pursuant to certain federal acts are governed by such provisions of law; require described employers to post a notice in English and Spanish informing employees of their rights with respect to occupational health and safety. The bill was prefiled on January 5, 1993.

Indiana

Workers Rights—IN H. 1048 (Hayes) provides that statutory or common law remedies are available to an employee alleging an injury from sexual or racial harassment in the workplace. The bill was introduced on January 5, 1993 and referred to the House Committee on Labor.

IN H. 1188 (Fry) changes the civil penalties for violations of the Indiana Occupational Safety and Health Act (IOSHA) to the limitations in place before October 1, 1991; provides that civil penalties may be assessed up to $1,000 for a violation, except that civil penalties may be assessed up to $10,000 for repeated violations. The bill was introduced on January 6, 1993 and referred to the House Committee on Labor.

Hazardous Materials Transportation (Containers)—IN S. 295 (Weatherwax) adds the safety and maintenance requirements for containers used to transport hazardous materials to the list of federal regulations enforced in Indiana. The bill was introduced on January 8, 1993, and referred to the Senate Committee on Transportation and Interstate Cooperation.

Lead—IN H. 1245 (Avery) requires the State Department of Health to adopt rules for the certification of individuals who test for or abate lead in buildings. Requires the state department of health to adopt rules establishing educational and examination requirements for individuals who conduct lead testing or lead abatement in buildings. The bill was introduced on January 6, 1993 and referred to the House Committee on Governmental Affairs.

Massachusetts

Lead—MA H. 5867 (Joint Committee on Health Care) was the comprehensive bill amending lead paint statutes. The final version of the bill, which died in the House Ways and Means Committee on January 5, 1993, would not have adversely affected the paint industry. The primary objective of the legislation was to ensure that prospective property buyers would be notified of the existence of lead before the property was transferred.

Maryland

Automotive Paint—MD H. 63 (Maddox) authorizes auto parts stores that sell paint products for motor vehicles to sell those products only to a collision repair technician or automotive collision repair business licensed under the Business Regulation Article. The bill was prefiled on December 29, 1992.

Lead (Notice)—The Maryland Department of Environment will be proposing new lead legislation in 1993. Under current Maryland regulations, lead training requirements are limited to only two disciplines—workers and government inspectors. The state does not have the authority to decertify individuals or companies who have been cited for numerous violations. The proposed legislation will expand existing training and certification requirements, provide for decertification, expand oversight of training providers, and provide for fees to cover the costs of the program.

Meanwhile, Governor Schaefer appointed a 15-member commission to "study problems associated with childhood lead poisoning and affordable, lead-safe housing in Maryland." Commission members include child health advocates, property owners, community members, paint manufacturers, and government officials.

The commission sponsored a symposium in December where discussion topics included health effects, housing and lead hazard control, and legal liabilities and insurance. One panel discussion focused specifically on the health effects of

lead on children, but neither a consensus on the health effects of lead, nor on the proper blood lead level was reached.

Missouri

Lead—MO H. 193 (Dougherty) relates to the prevention of lead poisoning; creates a "Missouri Commission to Prevent and Control Lead Poisoning." The commission operating within the Department of Health would develop a lead inspector training and certification program for contractors, supervisors, and workers engaged in lead abatement activities. Requires the department to develop various support activities. The bill was introduced on January 6, 1993.

Packaging—MO S. 100 (Goode) allows solid waste management districts to apply annually for matching grants for district operations. Prohibits the selling of packages, packing material, or components containing specified concentrations of lead, cadmium mercury, or hexavalent chromium. The bill was introduced on January 6, 1993.

New Jersey

Graffiti—NJ A. 2122 (Romano) requires suspension of driver's license and community service for acts of graffiti. The bill was introduced on December 17 and was referred to the Assembly Committee on Judiciary, Law and Public Safety.

New York

Household Hazardous Waste—NY A. 589 (DiNapoli) relates to the management and disposal of household hazardous material; requires all products containing such material to display a symbol indicating the presence thereof; authorizes the Commissioner of Environmental Conservation to implement and conduct a household hazardous material program; imposes a special assessment of one cent on every container of any product containing a hazardous household material; establishes the Household Material Management Fund. The bill was introduced on January 6, 1993 and referred to the Assembly Committee on Environmental Conservation.

Occupational Safety and Health—NY A. 110 (Barbaro) mandates contents of signs to be posted in each workplace where toxic materials are found and directs the department of health to develop posters and information sheets for this purpose. The bill was introduced on January 6, 1993 and referred to the Assembly Committee on Labor.

Packaging—NY S. 154 (Tully) prohibits purchase of items made of or packaged in non-biodegradable materials by State departments, agencies or other state entities or by local governments for an area with a population of 200,000 or more; makes exception for purchase under a certificate of necessity approved by the Department of Environmental Conservation; limits duration of such certificate to three years. The bill was introduced on January 6, 1993 and referred to the Senate Committee on Finance.

Lead—NY S. 117 (Padavan) increases the penalty for the failure to comply with a notice and demand for the continuance of a paint condition conducive to lead poisoning from $2,500 to $5,000 and mandates such penalty. The bill was prefiled on January 4, 1993. An identical bill (A. 278—Clark) was prefiled in the Assembly on December 30, 1992.

Notice—Governor Cuomo is soon expected to sign off on nominees to the newly created New York State Advisory Council on Lead Poisoning Prevention. Mandated by legislation signed in July 1992 (NY A. 11978), the council has been established to "assist in the development of a comprehensive statewide plan to virtually eliminate lead poisoning, to recommend the adoption of lead policy and to coordinate activities of its member agencies with respect to lead poisoning prevention." Paint manufacturers will be among those represented on the council.

Pennsylvania

Air Quality (Regulation)—Final amendments to Pennsylvania's clean air "new source review" program have been promulgated. The new source review program, among other things, regulates the condition under which new stationary sources of VOCs may be built or modified. The amendments bring Pennsylvania's program into conformance with the requirements of the Federal Clean Air Act Amendments of 1990. For further information, contact the Pennsylvania Department of Environmental Resources at (717) 787-4310.

Virginia

Waste Management—Rules to establish standards and qualifications for the training and certification of waste management facility operators have been proposed by the Board for Waste Management Facility Operators (BWMFO). Under the proposal, the interim certification for such operators would be extended to December 31, 1994, or until the operator has been issued full certification, whichever comes first. For further information, contact Nellie Hotchkiss, Virginia BWMFO at (804) 367-8595.

Wisconsin

Hazardous Waste—Under a rule that went into effect on January 1, owners of sites where petroleum product discharges are being cleaned up must submit three alternative cleanup plans. One of those three alternatives must be bioremediation. For further information, contact the Wisconsin Department of Industry, Labor, and Human Relations at (608) 266-7605.

Lead (Notice)—A study commission in Wisconsin, representing a broad variety of people, spent the better part of 1992 collecting data and information so as to best determine how they may educate the general public on the causes and effects of childhood lead poisoning. Among others, the group includes representatives from the paint industry, the housing industry, and parents of lead poisoned children.

The committee, formally called the Wisconsin Council on Developmental Disabilities and the March of Dimes Birth Defects Foundation Study Committee on Prevention of Childhood Lead Poisoning, conducted a series of meetings throughout the year. Experts from all over the country including Massachusetts and Maryland, and from NPCA, testified at these meetings. With a model state law as the ultimate goal, the committee is trying to determine what legislative solutions should be pursued with regard to childhood lead poisoning. One of the issues discussed is the possibility of imposing fees on abatement contractors instead of taxing the paint industry.

British Printing Ink Manufacturers and the Paintmakers Association Merge; Sterling Crisis Impacts on the United Kingdom's Paint and Coatings Industry

The Society of British Printing Ink Manufacturers and the Paintmakers' Association of Great Britain have announced the signing of a merger agreement. The ceremony took place in London, England.

The objective of the merger is to create a broader-based organization with greater resources.

The printing ink companies and the paint producers began working together within the Paintmakers' Association on January 1 of this year.

In other news, the Paintmakers Association stated that the sterling crisis has had an immediate and severe impact on the United Kingdom's £1.6bn paint and coatings industry.

The Paintmakers Association, which represents 90% of the coatings producers in the United Kingdom, reported widespread concern among its members and evidence of the rising cost of raw materials.

According to officials at the Association, most suppliers are quoting price increases ranging between 10-18% for raw materials used in industrial coatings with an indication of rising costs to come in the future. Such coatings products are used in many industries, such as automobile and truck production and repair, construction, shipbuilding, aerospace, and offshore structures.

The materials affected include resins, color pigments, solvents, and various additives.

The Paintmakers Association has noted that three years of recession, new and growing environmental costs, and reductions in margins have made it difficult for coatings manufacturers to absorb the cost increases. The group noted that raw materials account for a large proportion of the cost of the final coatings products. In addition, it was predicted that the new high-solids/low-solvent and powder coatings products would be hit the hardest by the sterling crisis.

Witco Corporation Announces Corporate Restructuring; To Consolidation into New World Headquarters

Witco Corporation, New York, NY, has announced a full corporate restructuring that will recast the company along business lines.

In the Chemical Segment, a Polymer Additives Group and an Oleochemicals/Surfactants Group will be created, each with different elements of the previously existing Argus, Organics, and Humko Divisions, as well as recently acquired Sherex operations. Also, an International/Europe Group will be formed comprising Witco subsidiaries in France, England, and Israel, as well as its new operations in Germany, Italy, France, England, and Spain.

The petroleum operations will encompass a Petroleum Specialties Group, manufacturing white oils, petrolatums, and sulfonates domestically, in the Netherlands and Canada, and a Lubricants Group, manufacturing Kendall® and Amalie® motor oils, lubricants, and greases.

The Battery Parts, Concarb, Chemprene, and Allied-Kelite Divisions will retain their divisional distinctions.

In other news, Witco will bring together core divisional managements with its executive management into a new Witco world headquarters to be located at a site to be selected in the environs of New York City.

Functions now performed at the company's New York City office, as well as its Woodcliff Lake, NJ office, would be relocated to this new site. Also, managements and selected staff groups from Olathe, KS; Memphis, TN; Dublin, OH; Houston, TX; Oakland, NJ; Melrose Park, IL; and Bradford, PA would be relocated to the new site. The Dublin office and some facilities in the above locations will be closed.

The move to the new headquarters site is expected to occur in the second half of the this year.

According to officials at Witco, the restructuring and the headquarters' consolidation will permit streamlining in a variety of functions. Preliminary indications suggest a substantial number of jobs will be eliminated at the various locations, with the precise number being determined as the project progresses.

Battelle Forecasts R&D Expenditures for 1993

(Continued from page 16)

grams that deal with surveillance and treaty verification.

Industrial Support

The Battelle report predicts that industrial support of research will continue to grow in areas related to electronics, communications, sensors, advanced machinery, and in fields directly influenced by the need for more energy efficient products and processes. The forecast for this year cautions against placing too much significance on the distribution of performance among the major industrial sectors.

According to the study, in spite of significant changes in several major players, near-term industrial plans indicate that the slowdown in R&D growth may be stabilizing. Furthermore, industrial postures in R&D spending will be influenced by the anticipation of a stronger federal government role in encouraging public/private partnerships, promoting permanent R&D tax credits, and enhancing the roles of the federal laboratories.

In addition, it is expected that state governments will continue to expand their roles and activities in support of a broad range of activities directed toward technology-based economic development and jobs expansions.

Long-Term Outlook

The study indicates that the R&D growth rate has been slowing and is expected to continue to decline, perhaps to the point of a **decrease** in real expenditures. The Battelle forecast suggests that if there is a decrease in real expenditures, the real recovery will most likely occur more rapidly than before.

According to the Battelle report, industrial support will continue to be affected by conflicting and complex factors, including: the major changes in the traditional defense industries; the trade imbalance and efforts to correct it, as well as efforts to expand markets in response to shifts in government priorities; and the internationalization of markets.

In conclusion, the Battelle study predicts that the tenor of the federal budget for 1993 and the pro-technology attitude of the new administration give reason for a cautious optimism regarding R&D growth and accountability in the near future.

For more information on the 1993 R&D forecast, write Battelle, 505 King Ave., Columbus, OH 43201-2693.

Kerr-McGee Expands Wood-Treating Plant

Kerr-McGee Chemical Corporation, Oklahoma City, OK, has announced the expansion of its Madison, IL wood-treating plant.

Plans include the construction of a 60 x 100 foot building at the site, which currently produces 1.3 million crosstie equivalents per year.

Patented, state-of-the-art machinery is being installed in the new facility to manufacture RailFast®, a crosstie system with built-in fastening devices.

The $700,000 expansion project is expected to be operational some time this month.

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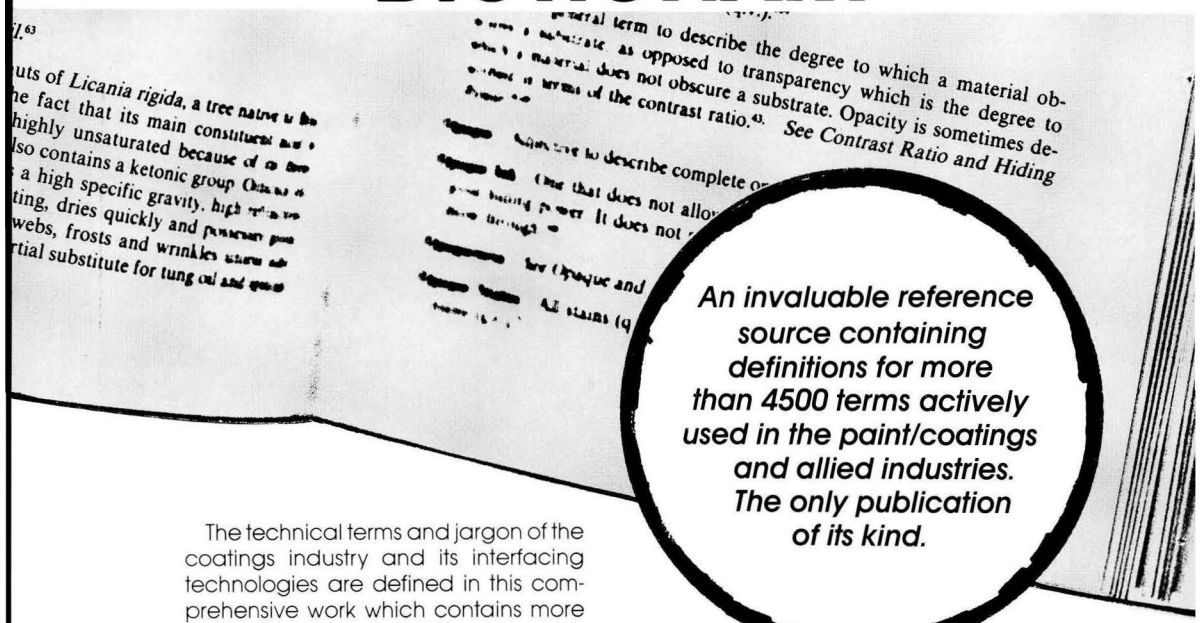

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The broad scope of terms included reflects the obvious usefulness of the dictionary to a wide audience, ranging from the layman, to artists and artisans, to technicians in all the coatings-related fields.

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An extensive bibliography of more than 600 references forms the third section.

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Federation of Societies for Coatings Technology

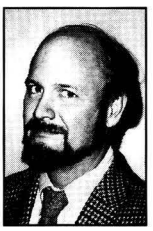
Coatings Education

1993

- ☑ Report from Federation Educational Coordinating Committee Chairman
- ☑ Report from CIEF President
- ☑ University Coatings Programs
- ☑ FSCT Educational Committee Guide for Coatings Courses, Symposia, and Seminars

Focus on Education

It is truly an exciting time for the Federation of Societies for Coatings Technology (FSCT) and, especially, FSCT Educational programs. Our dedicated, far-seeing leadership is looking at the mission of the FSCT. Needless to say, education—of our membership, of our industry, and of our communities—is an issue that comes to the fore. We are in the process of developing a method of addressing these critical areas: supporting our local Societies, supporting higher education leading to employment in our industry, and supporting technical exchange necessary for our continued professional development. The focus is on providing the means for continuous improvement, continuous education.



In an ongoing effort to better serve the FSCT, responsibility for various educational activities are becoming much more focused:

–The Educational Committee, composed of the Educational Chairpersons of the individual Societies, will continue to serve as a wellspring for ideas to improve our educational efforts at the local Society level.

–The Professional Development Committee will offer continuing technical knowledge to our membership, through short courses, symposia, and technical programs.

The Coatings Industry Education Fund (CIEF) will be taking a proactive role in shaping the FSCT's interaction with colleges and universities: funding undergraduate scholarships, graduate fellowships, and grants-in-aid for equipment to coatings programs.

–The Educational Coordinating Committee will serve as an open forum to exchange ideas: prioritizing projects and performing test-drilling work to establish the worth of each in meeting our educational challenges.

These hard working groups are broadening their nets and continuing many other activities as well.

My effort this year is with the Educational Coordinating Committee, where we are pioneering the process of test-drilling. The idea of test-drilling, allocating resources up-front, to make sure that projects are realistic and well defined is novel for organizations like ours. The FSCT Board of Directors has authorized modest funding for evaluation of educational projects. These funds are to be used to define the scope, deliverables, milestones, and customers for developing educational resources. These projects will then be funded on their own merits.

Consider an example of this system and the coordination necessary to make a meaningful project work. Two summers ago, the Educational Committee brainstormed ideas to further education in the local Societies. Many excellent ideas were put forward. One of the most often voiced concerned the quality of local meetings. We decided that the FSCT should undertake a project that would help the local Societies improve their monthly meeting programs. The ideas generated by the Educational Committee around this subject formed a starting point. John Oates has been a strong champion of the project, heading a test-drilling team that has been at work for about a year now. This team surveyed the individual Societies as to how their programs were determined. Thoughts and possible actions were solicited from the incoming Society officers in their training sessions last spring. The annual meeting of the Educational Committee this year served as another source of possibilities. With all this information on the table, we can now focus on providing the **best** way(s) for the FSCT to help the local Societies. We have compiled a list of possible projects, which was circulated to the constituent Societies for their feedback. Actually, we asked your Society officers to vote for the projects that would be most meaningful to you. Ask your local Society president for a copy of this list. Look for our action plan this spring.

This example shows how we can all work together to help one another. Local Societies must ultimately be the "educators." Your local meetings are where things get done. The Educational Chairperson is critical. We hope that position is important to you and that he/she is given a long enough tenure of office to carry out significant projects. The input from your chairperson through the Educational Committee frames the FSCT's programs. Action comes through the Educational Coordinating Committee, with the help of volunteers who believe in the FSCT as an important educational experience. Other test-drilling areas are under consideration. These will form the backbone of the FSCT educational efforts in the future.

Do you have ideas?

Can we help your Society improve its educational efforts?

What can the FSCT do?

Your input is appreciated. Please **FOCUS ON** our most important project: the continuing **EDUCATION** of ourselves, our peers, and our communities.

DONALD BOYD, *Chairman*
Educational Coordinating Committee

Coatings Industry Education Fund

The primary goals of the Coatings Industry Education Fund (CIEF), are to advance—through education and research—the knowledge and application of the Chemical, Physical, and Mathematical Sciences relating to the technology of coatings, and to aid in the dissemination of the results of such research and education to the public, through scientific publications and lectures. To accomplish this mission, the Trustees of the CIEF review requests for fellowships, scholarships, and grants from institutions of higher education which are actively engaged in offering—or creating—coatings-related programs as part of their curriculum. Such requests must be submitted in writing to the CIEF Board of Trustees in the autumn of each year, and must include detailed responses to the following twelve questions:

- What is the primary focus of the Program?
- How is the Program organized, staffed, and provided with laboratories and equipment?
- What types—and how many—students are in the Program?
- How was the Program funded during the past academic year?
- What are the selection criteria for awarding scholarships and fellowships?
- How are funds handled? Are matching funds available?
- What size of awards are currently needed to fund scholarships or fellowships?
- What other non-CIEF scholarships or fellowships are currently being administered through this Program, and what are their sources?
- What methods will be used to assess the usefulness and effectiveness of CIEF supported Programs?
- Who are the current employers of coatings program graduates from the previous three (3) academic years?

What is the targeted use or uses of the current request for funds?

After weighing all of this information—and seeking any additional information which it deems necessary to arrive at a balanced decision—the Board of Trustees announces a decision to fund, partially fund, or decline the various proposals which it has received. These decisions reflect not only the quality of the proposals, but also the amount of funds available, and the anticipated future value of the proposed program.

CIEF funding can take a variety of routes, each designed to fill a particular educational need. General scholarship funds, for instance, are made available on an annually renewable basis for use in undergraduate programs by qualifying educational institutions. The Joseph A. Vasta Memorial Scholarship in Coatings Science, on the other hand, is awarded on an annually rotating basis to a limited number of institutions with distinguished coatings programs, and is restricted to an outstanding senior in an established coatings program. The annual Vasta Scholarship of $2,500 is derived from the interest generated by a Fund which the CIEF created to honor the late Joe Vasta, who was one of our industry's most respected members. Generous donations from industry, associations, and private individuals have enabled the CIEF to offer this substantial annual scholarship in Joe's name, as a means of sustaining—and extending— his abiding interest in the education of "the next generation."

Requests for academic year 1994-95 must be received by the Trustees by no later than September 15, 1993, and should be submitted to the President of the CIEF as follows:

George R. Pilcher
Akzo Coatings Inc.
P. O. Box 147
Columbus, OH 43216-0147

All properly documented requests will be considered, and a disposition will be sent to the originator by or before February 15, 1994.

The future of the coatings industry lies in the education of our youth, both at the undergraduate and graduate levels. It is the CIEF's mission to foster this educational process through the use of scholarships, fellowships, and grants, so that the future of the coatings industry may gain ever increasing benefit from the scholars, scientists, and technologists of tomorrow.

GEORGE R. PILCHER, *President*
Coatings Industry Education Fund

Coatings Education

California Polytechnic State University

Undergraduate Polymers and Coatings Program

California Polytechnic (Cal Poly) State University, San Luis Obispo has just completed the second year of its polymers and coatings program. This program, which is offered as a concentration within the chemistry major by the Chemistry Department, is the first of its kind in the western United States. Cal Poly is one of the 21 campuses of the California State University system, enrolls over 15,000 students, and is nationally recognized for the excellence of its programs in architecture, agriculture, engineering, and the sciences. The school maintains a history of graduating students with special abilities in applied fields.

Extensive hands-on experience with modern instrumentation and equipment is a hallmark of the undergraduate education offered at Cal Poly. The polymers and coatings program was developed with the support of the West Coast Societies for Coatings Technology, particularly the Golden Gate and Los Angeles Societies. These Societies, along with the Pacific Northwest Society for Coatings Technology, provide financial support and equipment necessary for the coatings and polymers laboratory, provide internships and scholarships for students in the concentration, and help with recruitment of disadvantaged students from inner-city areas. The Societies also provide guest speakers and help arrange field trips to appropriate companies several times a year. Special recognition must be given to Johnny Gordon, James F. Calkin, and Joseph C. Reilly, of the LASCT, and John Westendorf and Steven Rearden, of the PNWSCT, for their substantial support during the past year. Support is also sought from other industries. The Western Coatings/Cal Poly Foundation was developed to provide a means for individuals or companies to support the program financially. This foundation is a major source of support for the Cal Poly program. The LASCT and the Foundation are again sponsoring a golf tournament to support the Cal Poly program. This year's tournament will be held in conjunction with the Western Coatings Societies Biennial Symposium and Show in March. The current budget crisis in California had delayed the hiring of new permanent faculty for the program but requests from qualified industry and academic personnel to spend a sabbatical year at Cal Poly are most welcome.

During the past year, the polymers and coatings laboratory has been significantly upgraded through the acquisition of new equipment, including dispersers, ovens, color computer systems, and a complete thermal and mechanical analysis system. This equipment was purchased with funds provided from industry, the Coatings Industry Education Fund (CIEF), the National Science Foundation, and the Western Coatings/Cal Poly Foundation. Several industries also donated surplus equipment which is being used in the lab.

This concentration provides educational and professional experience to chemistry majors who wish to specialize in polymers and coatings sciences, and to materials engineering majors who wish a background in polymers and coatings. The program meets the American Chemical Society requirements for certification as a chemistry/polymers degree. The West Coast Societies have offered to help by promoting the program among employees, by publicizing the program in California high schools and community colleges, and by establishing scholarships. Four Cal Poly students are receiving scholarships sponsored by the LASCT. Another eight students are receiving scholarships supported by the Federation of Societies for Coatings Technology through the CIEF.

The concentration includes five courses, including two laboratory courses, and comprises a total of 18 quarter units. An industrial internship, lasting from three to six months, is a central part of the program. Ten students took part in internships this past summer. Companies participating in the internship program include: Kelly-Moore Paint Co., Inc.; Smiland Paint Corporation; Dunn-Edwards Company; Benjamin Moore & Company; DuPont Company; Spraylat Corporation; Lilly Industrial Coatings, Inc.; Ellis Paint Company; Behr Process Corporation; and Coatings Resource Corporation. Graduates completing the concentration will have the academic knowledge, technical training, and applied experience to enter the polymer and coatings industries. Graduates have been actively recruited by industries in California, and throughout the U.S. Courses included in the concentration are listed below. The concentration is designed to be compatible with the junior and senior year of the chemistry major.

"Chem 444 Polymers and Coatings I": Overview of polymer synthesis and structure; molecular weight; thermal properties of polymers; mechanical properties, polymer crystallinity; thermodynamics of polymer solutions; kinetics, dynamics of polymer chains, interchain forces; viscoelastic properties; polymer rheology; spectroscopic analysis; current topics; and applications to coatings.

"Chem 445 Polymers and Coatings II": Polymerization methods and mechanisms; chain growth, step growth, and ring opening; catalysts and inhibitors; copolymerization; uses; film formation; structure and properties of acrylics, vinyls, polyesters, alkyds, epoxies, urethanes, phenolics, hydrocarbons, and cellulosics; raw materials in coatings; and formulation techniques.

"Chem 446 Surface Chemistry of Materials": Surface energy; capillarity; solid and liquid interface; adsorption; surface areas of solids; contact angles and wetting; friction, lubrication, and adhesion; relationship or surface to bulk properties of materials; modern methods of surface analysis; and application.

"Chem 447 Polymers and Coatings Lab I": Synthesis and characterization of polymers; step-growth, chain-growth, and ring-opening polymerization; molecular weight determination; thermal analysis; spectroscopic analysis; and mechanical analysis.

"Chem 448 Polymers and Coatings Lab II": Experimental techniques of producing and characterizing coatings; compounding and formulating modern protective coatings; modern methods of testing protective coatings; and surface preparation techniques.

"Chem 449 Internship in Polymers and Coatings": Students spend three to six months with an approved polymers and coatings firm engaged in production, development, research, or related business. Students will develop and apply research, production, and managerial skills.

The following course, from the Materials Engineering Department, is also included in the concentration.

"Met 306 Materials Engineering": Physical and mechanical properties of materials including metals, alloys, ceramics, insulating materials, semiconductors, and polymers; equilibrium diagrams; heat treatments, materials selection, and corrosion phenomena.

Industry-Related Research

Students and faculty are involved in a number of research projects in the coatings area, with cosponsorship of industry. Cal Poly has been actively involved in California's paint recycling efforts through the state Paint Recycling Task Force. Projects sponsored by paint companies and major chemical companies are also underway. All students are required to complete a senior research thesis and industries are encouraged to involve Cal Poly in their research projects.

A one-week lecture and laboratory short course in basic polymer and coatings chemistry is planned for June 15-19, 1993. For further information on the polymers and coatings program at Cal Poly, contact Dr. Dane Jones, Chemistry Department, California Polytechnic State University, San Luis Obispo, CA, 93407; (805) 756-2528.

Case Western Reserve University

The Department of Macromolecular Science is a major educational and research strength of Case Western Reserve University (CWRU), Cleveland, OH, with activities in all areas of polymer science and engineering. The activities of the department continue to reflect the exciting national and international developments in the polymer field. Faculty interests span the entire spectrum of polymer research, including synthesis, physical characterization, structure-property relationships, theoretical modeling, polymer processing, and materials development.

The department was founded in 1963 and is now entering its 30th year. It is one of nine departments in the Case School of Engineering. Currently, the department has 13 full time faculty, plus one active emeritus member (Professor Simha). In addition, eight professors from other departments (Chemistry, Physics, Biomedical Engineering, Chemical Engineering, Pathology, and Orthopaedics) hold associate appointments in Macromolecular Science. There are nine adjunct faculty from other institutions and from industry.

The graduate student body continues to grow. In September 1992, 121 students were registered for research and course credit leading towards the M.S. or Ph.D. Degree in Macromolecular Science. The M.S. Degree, from this or another institution, is required of all students before acceptance for the Ph.D. Degree program. Most graduate students are supported by research assistantships from research grants to the faculty. During 1991-92, 13 Ph.D. and eight M.S. Degrees were awarded. In addition, 28 undergraduate students were registered for the B.S. Degree in Engineering (major field: Polymer Science and Engineering), of whom four graduated in 1991-92. The latter program was the first such undergraduate engineering degree in the U.S. to obtain ABET (Accreditation Bureau for Engineering and Technology) accreditation (awarded in 1976). There also are 29 post-doctoral research associates and visiting scholars working in the research laboratories. The departmental staff comprises 12 administrators and secretaries and four technicians.

The most exciting development for the department continues to be the progress towards construction of the new building to house our research and educational activities. Detailed planning for the new Kent Hale Smith Laboratory for Science and Engineering began in 1990 with the selection of Shepley, Bullfinch, Richardson ,and Abbott as architects.

When complete it will have 80,000 gross square feet, providing 48,000 net sq. ft. of laboratories, classrooms, and offices. In addition, there will be 10,000 sq. ft. of unfinished "shell space" in the basement for further expansion. The faculty has worked closely with the architects to optimize the laboratory designs for both present needs and future flexibility. Ground breaking occurred in April 1992, at the site located on the former parking lot off Adelbert Road, facing the Medical School and the new Biomedical Research Building. The department's new building is to be connected to the A.W. Smith (Chemical Engineering) Building by a third floor bridge. The new building is adjacent to the Rockefeller (Physics) Building and to the Millis (Chemistry and Biology) Building. The new laboratory is thus centrally located to facilitate interactive research. Construction began immediately after ground breaking. A cornerstone ceremony was held on October 10, 1992 with completion of the building projected for December 1993.

Research support for the department exceeded $6 million during 1991-92, from a combination of federal, state, and industrial sources. An important facet of the departmental activities throughout its existence has been the Industrial Sponsors Program, which has provided discretionary funds that make possible the initiation of new projects. The present members of the program are: Dow; DuPont Company; Tennessee Eastman; B.F. Goodrich Company; Hoechst-Celanese; Miles, Inc.; Phillips Petroleum; Shell; 3M Company; and Xerox. The 52nd Industrial Sponsors Symposium was held on November 11-12, 1992, and included presentations by faculty members, students, and post-doctoral research associates, plus student posters.

Six major research centers have their home base within the structure of the Department of Macromolecular

Science. In July 1992 the National Science Foundation (NSF) Materials Research Grant (MRG) on Liquid Crystalline Polymers was renewed. This Center was initiated in 1986 under the direction of Professor Koenig. The present renewal grant for $550,000 per year for three years is under the joint direction of Professors Blackwell and Percec to support interactive research projects involving nine faculty from Macromolecular Science, Physics, and Chemistry. Polymer-dispersed liquid crystals are the subject of interest for ALCOM, the NSF Science and Technology Center (STC) for the study of Advanced Liquid Crystalline Optical Materials. ALCOM is a joint research activity of CWRU, the University of Akron (UA) and Kent State University. The Director of its activities at CWRU is Professor Koenig. The NASA Center for the Commercialization of Space, directed by Professor Baer, supports research on polymers, metals and ceramics, in collaboration with faculty in the Department of Materials Science.

Much of the industrial funding comes through the Edison Polymer Innovation Corporation (EPIC), a consortium of CWRU, UA, and over 70 companies, to support polymer research at the two institutions. EPIC industrial sponsorship is supplemented by funds from the State of Ohio's Thomas Edison Program. Founded in 1985, EPIC has provided over $7 million in research support to CWRU. Support is channeled to the department through two research centers: MACRO EPIC, directed by Professor Lando, and the Center for Applied Polymer Research (CAPRI), directed by Professor Hiltner. EPIC also has provided the collaborative mechanism for establishment of the Center for Molecular and Microstructure of Composites (CMMC), directed by Professor Ishida. The CMMC was initiated by a grant from the NSF with state, industry, and university matching funds, providing a total budget of $1 million per year for four years to be divided between the two institutions.

Research on coatings is focused by the EPIC Adhesives, Sealants, and Coatings Center (ECASC), which evolved from the previous Center for Adhesives, Sealants, and Coatings (CASC) at CWRU and its successor, the InterUniversity Center for Adhesives, Sealants and Coatings (ICASC) involving both CWRU and UA. The continuing development and expansion of this activity to encompass wider faculty and research topic activity is a substantial component of the overall research underway in the two universities. The ECASC Advisory Board is made up of representatives from EPIC member companies with business interests in adhesives, sealants, and coatings. The Co-Directors of ECASC are Alan Gent, of UA, and Professor Charles E. Rogers, of CWRU. Dr. David P. Tate (216-838-5015) is the Executive Manager of ECASC for EPIC.

Current research programs related to coatings, supported by EPIC and other funding sources, include: two related studies of finite element analysis modeling, with experimental substantiation, of static and dynamic deformations of multilayer coatings (the derived programs will be provided on user-friendly software); materials modification and spectroscopic studies of surface characterization for improved control of coatings adhesion; high barrier coatings and resins; low-shrinkage (zero and expanding) coatings and adhesives; electron beam curing; diamond-like coatings materials; the mechanism of corrosive attack on epoxy-coated mild steel; the surface characterization of electrogalvanized steel for coatings applications (emphasis on blistering); Langmuir-Blodgett films as coatings and membranes; liquid crystalline materials (many related studies of synthesis, characterization, and properties); mixing and flow of multicomponent systems; fatique, crazing and fracture of polymer materials, including environmental attack; surface characteristics of unsaturated polyester gel coats; polymeric emulsions and blends; effects of mechanical deformation on permeability of polymers; effects of mechanical deformation on the photodegradation of automotive coatings polymer materials.

There are many studies of closely related topics concerned with various aspects such as rheology of sterically stabilizied dispersions, surface chemistry and physics, fracture mechanics, composition and structure of multicomponent/multiphase systems, sorption, diffusion and permeation of polymer films and coatings, polymer blends and composites, polymer processing and mixing, synthesis and properties of a broad scope of polymeric materials and an extensive range of polymer characterization studies using many established and new techniques including NMR imaging and state-of-the-art surface and microscopy analysis.

The educational program in coatings is based on the graduate level course, "Fundamentals of Adhesives, Sealants, and Coatings" (EMAC 482), with C.E. Rogers and J.C. Weaver as co-instructors, with the added participation of R.M. Evans and I.M. Krieger. This three credit course is given in the spring semester, usually on the CWRU Instructional Television Network (video tape) which is available to off-campus students and people in industry. Other courses are concerned with surface science and technology and with the wide curriculum topics of the Department of Macromolecular Science leading to the B.S., M.S. and Ph.D Degrees in Polymer Science and Engineering. Special semester courses on "Adhesion and Adhesives and Sealants" and on "Coatings Science and Technology" are to be presented in coming fall semesters. Short courses on topics relevant to adhesives, sealants, and coatings are presented on a regular basis by ECASC.

For more information, contact Professor John Blackwell, Department Chairman, or Professor Rogers, CWRU, Cleveland, OH, 44106; (216) 368-4172/6376; fax: (216) 368-4202.

Eastern Michigan University

The College of Technology at Eastern Michigan University (EMU), Ypsilanti, MI, is proud of its instructional and research efforts in polymers and coatings technology within North America. The following is a description of the academic and research efforts within the University.

Academic Programs

The undergraduate program in Polymers and Coatings Technology began in 1981. In 1988, this program of study was expanded to include a graduate degree program. Currently, there are approximately 50 undergraduate and over 45 graduate majors in Polymers and Coatings Technology.

The undergraduate curriculum parallels the Chemistry major course of study for the Freshman and Sophomore years, but the upper division course work specializes in Polymer Chemistry and Coatings Technology.

Mathematics through calculus, and chemistry through physical chemistry, are required before students begin their study of coating technology. Coatings courses include two courses in basic polymer and coating theory, and two semesters of laboratory application which includes polymer synthesis, coating evaluation, and color development. There also are required courses in quality assurance, statistical process control, and formulation techniques.

The numbers of graduates during the past five years are summarized in the following table:

	1988	1989	1990	1991	1992
B.S.	13	16	12	14	77
M.S.	4	0	5	4	6
Total	17	16	17	18	13

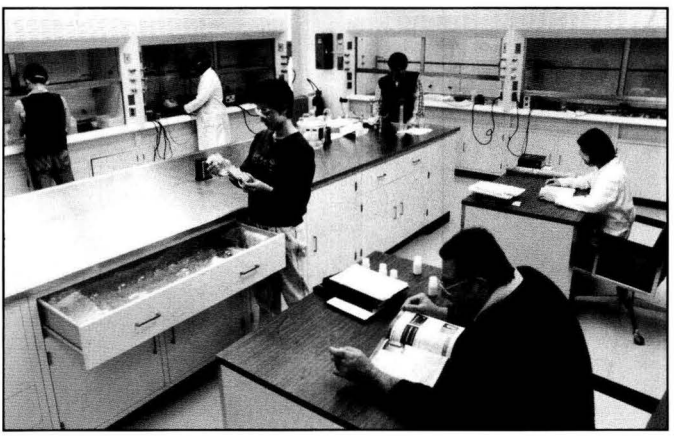
Additionally, a strong emphasis has been placed on cooperative education. All students are expected to participate between their sophomore and junior year in a minimum of one 600-hour cooperative education experience, and again between their junior and senior years. Currently, there are over 30 companies participating in the cooperative education placement. Co-ops are available throughout the year and not just limited to a spring/summer time period.

Industrial support to the undergraduate and graduate programs of study in polymers and coatings technology is extensive. Industry supports contracted research which provides jobs to a number of students enabling them to develop laboratory and formulating skills parallel to what they would experience in industry. These contracted research projects also allow the program to encumber revenue which is used to stock the laboratory with needed equipment and supples. For additional information on the instructional programs of study, contact the Program Coordinator: Dr. Taki J. Anagnostou, EMU, 201 Sill Hall, Ypsilanti, MI 48197; (313) 487-1235.

Research

The Coatings Research Institute (CRI) is the unit of the Program that is responsible for research in coatings. Currently, there are three major research centers: the Emissions Evaluation Center; the National Science Foundation Industry/University Cooperative Research Center in Coatings; and contract research with individual companies and government agencies.

CRI suffered a severe loss with the passing away of its Director, Dr. John Graham, on September 30, 1992. The search for a new Director is underway. Dr. Frank N. Jones is temporarily assuming Dr. Graham's administrative duties, and Dr. Stoil Dirlikov is taking responsibility for completion of his research projects.



EMISSIONS EVALUATION CENTER: The Emissions Evaluation Center has been developed as the result of a collaborative effort between 12 participating companies and the University.

Activities of the Center are to evaluate emissions in order to identify and reduce VOC, quantify odor potential of emitted VOCs, and analyze VOC to identify hazardous compounds.

The major research by the Center will be performed primarily for 12 member companies. Companies currently pledging support of the Center include: BASF Corporation; Chrysler Corporation; DuPont Company; Eastman Chemical Products, Inc.; Exxon Chemical America; Ford Motor Company; Morton Thiokol, Inc.; Motor Vehicle Mgr. Assoc.; PPG Industries, Inc.; Shell Oil Company; and Union Carbide.

For further information, contact Dr. Anagnostou, Director of the Emissions Evaluation Center.

NSF COATINGS RESEARCH CENTER: The National Science Foundation Industry/University Cooperative Research Center in Coatings was started in the Fall of 1990. It is one of about 50 such Centers supported by the NSF. Each Center is a consortium which performs long-range research relevant to its area (organic coatings in this case) supported by the NSF, industrial companies, and the State.

The objectives of the Center are:

(1) to expand scientific knowledge related to coatings,

(2) to discover innovative approaches to solving industry problems, such as compliance with new VOC regulations,

(3) to enlarge the cadre of coatings scientists, and

(4) to disseminate knowledge.

During 1992, the Center grew by adding three companies and by forming a partnership with Michigan Molecular Institute. The latter step greatly expands the research capabilities of the Center by involving a large and very capable research institute that focuses entirely on polymer science and its applications. The Center is also sponsoring individual projects at the University of Michigan and at California State University at Los Angeles. Current research areas are:

(1) crosslinking and the properties of crosslinked coatings,

(2) new methods for analysis of VOC emissions,

(3) rheology of high solids and waterborne coatings,

(4) scanning probe microscopy of coatings, and

(5) adhesion and corrosion protection.

These areas were selected with the guidance of the industrial members.

Further growth of the Center will depend upon its ability to attract additional member companies from the coatings industry. Three have indicated strong interest in joining in 1993, and more are being sought. Dues are $30,000/year. For further information, call or write Professor Jones, NSF Center Director.

CONTRACTED RESEARCH: In addition to the two Centers described previously, research projects are carried out under grants from government agencies and contracts with individual

companies. Examples of current research activities are:

(1) use of renewable resources in coatings,

(2) liquid crystalline polymers as coatings binders,

(3) novel air dry coatings,

(4) crosslinking mechanisms with melamine resins,

(5) epoxy resins reinforced with vegetable oils, and

(6) effects of low-odor solvents on coatings application and film properties (with the Detroit Society for Coatings Technology).

For further information on contract research, contact Dr. Jones, CRI Interim Director, EMU, 430 W. Forest Ave., Ypsilanti, MI 48197; (313) 487-2203; fax: (313) 483-0085, or any other EMU coating professors.

Kent State University

The Coatings Program at Kent State University (KSU), Kent, OH, continues to be housed in the Department of Chemistry. The program continues to service undergraduate and graduate students, employees of nearby coatings companies, and coatings personnel from around the U.S. and abroad.

On-Campus Students

"Surface Chemistry" and "The Physical Chemistry of Macromolecules" are offered in alternate spring semesters and may be taken for undergraduate or graduate credit. In addition, a one-semester hour course is offered to students entering the Coatings Program to introduce them to the discipline. Juniors and Seniors may also do a research project in the area of coatings chemistry.

Commuting Students

"Surface Coatings I," "II," and "III" are offered on Saturday mornings of the fall semester in a sequential yearly fashion. These courses are usually attended by 30-50 employees of nearby coatings companies. The companies vary in size from those which have only a few employees to the larger companies such as: PPG Industries, Inc.; The Sherwin-Williams Company, and Glidden/ICI.

These courses have a variety of speakers from industry such as Theodore Provder, of Glidden/ICI, who also is an Adjunct Professor at KSU. As a result, the students are exposed to a large range of topics applicable to the coatings area.

Since these courses are also open to and taken by KSU students, it affords the students an opportunity to gain a better insight into the coatings industry by interacting with fellow students already employed by the industry.

Short Courses

Courses just short of a week in length are held in the spring and early summer of each year. Three courses on "Rheology," "Dispersion of Pigments and Resins," and "Adhesion Principles and Practice," have been consistently offered the past several years.

Courses of somewhat shorter duration are offered in the fall. "Introduction to Coatings Technology," "Industrial Paint Applications," and "Accelerated and Natural Weathering," currently are being offered.

All of the short courses attract some attendees from a commuting distance, but the majority come from around the country and from abroad.

Scholarships

Most of the on-campus students that take coatings courses are recipients of scholarship money administered by the Coatings Industry Education Fund of the Federation of Societies for Coatings Technology. In addition, a few of the students are recipients of scholarships administered by the Chemistry Department and awarded on the basis of competitive examinations in Chemistry.

Co-Op

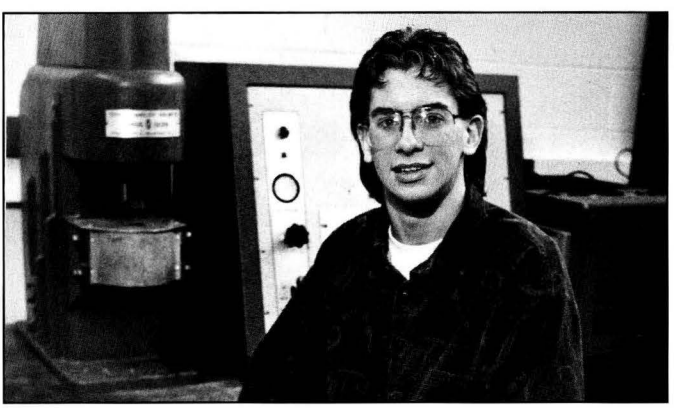
Several of the undergraduates in coatings are frequently involved in the Cooperative Education Program in Chemistry at KSU. A few students in this five-year program have worked for coatings-related companies. The students have the advantage of earning money to help pay for their college education while gaining valuable work experience in an area of their interest.

Companies get to look at prospective employees and have a good chance to hire those that fit into their company. It is anticipated that more coatings companies will take advantage of this program when they realize the value of this approach to hiring.

Analytical Instrumentation Facility

Administration of analytical analyses from sources outside of the KSU is largely centered in the Rheology and Coatings Laboratory. This has the particular advantage for coatings companies to have analytical analyses made for a reasonable fee with instrumentation to which most coatings companies do not have access.

A week-long short course on various aspects of chromatography is offered yearly in connection with this facility.



Mitech computerized Sieglaff-McKelvey Rheometer

Research and Equipment

Recent research in the laboratory has centered around topics involving surface and interfacial chemistry such as diffusion, wetting, and adhesion. A recent project with Adjunct Professor Charles Kumins was a cooperative effort with Solomat Instrumentation on Thermal Stimulated Current measurements of latex coatings to learn more about the interphase and adhesion of the coatings.

Increased research emphasis in rheological studies will be enhanced by the recent acquisition of several instruments. A Ferranti-Shirley viscometer was donated to KSU through the efforts of a former student, Dr. Richard Eley, of Glidden/ICI. Adjunct Professor Edward Collins was instrumental in the acquisition of a Mitech update of a Sieglaff-McKelvey Rheometer. These two instruments will expand the range of coating studies.

Future Plans

A graduate-level interdisciplinary Chemical-Physics Program emphasizing the capabilities of the Liquid Crystal Institute at KSU is presently going through the final stages of implementation. Inherent in this process is the development of an undergraduate material science department. The Rheology and Coatings Laboratory would anticipate the incorporation of Coatings Education in such a department.

Additional Information

Please contact Carl Knauss or Richard Ruch, Department of Chemistry, KSU, Kent, OH 44242; (216) 672-2327/2034 for further information.

University of Massachusetts at Lowell

The eastern New England coatings industry, from Rhode Island to southern New Hampshire, is a major area of coatings research, development, and manufacturing. As one measure of this, the New England Society for Coatings Technology (NESCT) has 191 members from 117 companies. Very few of the people in the industry have had any formal education about coatings, and many of them are eager to remedy the deficiency. In 1975, the NESCT asked the Plastics Engineering Department at the University of Massachusetts at Lowell, Lowell, MA, to offer an evening course in coatings technology. The Society provided guest speakers and publicity, and the University administered the course. The first time it was offered, 53 people from industry appeared and attended the entire one-year course. When the University asked whether they would be interested in a Master of Science program in coatings at night, the response was enthusiastic, and the program was launched immediately.

During its 18-year history, the coatings program has been attended by 263 students, primarily part-time students from the local coatings industry, plus a smaller number of full-time students majoring in polymers and plastics. Some of the part-time students take individual courses for self-improvement, while others go through the entire program to earn the M.S. Degree. Since this program includes a thesis, and the part-time students are mature and experienced, this has resulted in 29 excellent M.S. theses. Typical thesis topics have included the following:

"Ultraviolet Stabilization of Polyurethane Coatings";

"Two-Component Polyurethane Coatings for Wood";

"Effects of Surfactants on a Waterborne Air-Dry Acrylic Latex Coating";

"Evaluation of Inorganic Salts as Flash Rust Inhibitors in a Waterborne Air-Dry Acrylic Latex Coating";

"Development of an Aqueous Acrylic Coating for the Business Machine Market";

"Plastic Coatings in Electronics";

"Metal Cans and Their Coatings";

"Rheological Behavior of Epoxy Resin Solution Coating System for Printed Circuit Laminates";

"Powder Coatings";

"Effect of Fillers on Tensile Properties of Acrylic Latex Films";

"Effect of Coating System on Performance of Optical Fibers";

"Hydrophobic Coatings";

"Two-Part Plastisol Urethane";

"Temperature Dependence of Coating Thickness for an Electrodeposited Acrylic Emulsion";

"Development of Degradable and Nondegradable Macromolecular Aqueous Coatings";

"Environmental Protection of Copper Circuitry with Conformal Coatings"; and

"An Improved Conformal Coating Base from a Solvent-Borne Mechanically Blended Two-Polymer System."

The current M.S. Degree coatings program includes the following required courses, offered on a two to three year cycle: "Coatings Science & Technology I & II," "Adhesion and Adhesives," "Polymer Science I & II," a seminar; and a thesis.

Elective courses include: "Colloids," "Mechanical Behavior of Polymers," "Plastics Coatings in Electronics," and "Rheology of Coatings."

Part-time students generally take two to five years to complete the M.S. Degree.

The NESCT also asked for an undergraduate program for people in the coatings industry who did not have a B.S. Degree. In 1989, the University developed such a program, as an option in the part-time evening B.S. in Applied Chemistry. This included the following coatings courses: "Coatings Science & Technology I & II"; "Coatings Rheology"; "Mechanical Behavior of Polymers"; and "Adhesion and Adhesives." Since this is normally a nine-year program, it has not produced any graduates yet.

Most recently, the NESCT helped the University to apply for a grant from the Federation of Societies for Coatings Technology Coatings Industry Education Fund, with the cooperation of the D.N. Lukens Company, BYK-Gardner Company, and Premier Mill Company. This lead to the purchase of the following basic laboratory equipment: Premier Mill Dispersator with two Mixing Heads; Analog pH meter with probe and transformer; Stormer Viscometer with strobe; weight-per-gallon cup; vacuum plate; vacuum pump; two multiple clearance blade applicators; wet film gage; leveling test blade; sag tester blade; fineness-of-grind gage; dry film gage; gloss meter; Conical Mandrel; adhesion test kit—cross-hatch cutter; and heavy duty impact tester.

The University has provided laboratory space, and as soon as it is ready for use, the equipment will be installed and put to use, both for instruction and for research purposes.

For further information, contact Professor Rudolph D. Deanin, Plastics Engineering Department, University of Massachusetts at Lowell, Lowell, MA 01854; (508) 934-3420.

University of Missouri-Rolla

The Polymer and Coatings Science Program at the University of Missouri-Rolla (UMR), Rolla, MO is within the Chemistry Department. The Chemistry curriculum is accredited by the American Chemical Society and the Polymer and Coatings emphasis area is one of the first to be accredited by the American Chemical Society in the polymer area. In the four years of study, the student learns the fundamentals of chemistry and is trained in the practical aspects of polymers and coatings. During the last two years of study, the student begins to specialize in the emphasis area. Other requirements include undergraduate research in polymers and coatings and writing an undergraduate thesis. Topics for undergraduate research projects have included: "The Preparation of Anti-Fouling Coatings for Marine Applications"; "The Use of Extender Pigments for Coatings"; "The Removal of Asbestos from Window Caulking;" "Synthesis and Characterization of Biimidazol Containing Epoxies"; "Development of Coatings Evaluation Methods"; "Flask Rusting Measurement by Spectrophotometric Integration;" and "New Phthalocyanine Pigments."

Over the past three years, the department has increased the number of coatings and polymer science majors through a strengthened recruiting effort, improved communication of opportunities available to students, and scholarship offerings.

Financial support is guaranteed to students in the amount of $500 per semester if they maintain a cumulative grade point average (GPA) of 3.5 or better on the A equals 4.0 basis. Scholarships of $250 per semester are given if they maintain a cumulative GPA of 3.00 to 3.50. Both are given provided they are making satisfactory progress towards the B.S. Degree in Chemistry with their interest in Polymers and Coatings Science. Occasionally, a student with lower averages but extenuating circumstances is supported at $100 per semester to encourage academic performance and to try to increase enrollment in the program. The Federation of Societies for Coatings Technology (FSCT), the Kansas City and St. Louis Societies for Coatings Technology, the National Paint and Coatings Association, and various coatings related industries are the major contributors to the scholarship program.

Each year students have the opportunity to attend the FSCT Annual Meeting and Paint Industries' Show to gain first hand knowledge of the industry and develop perspectives on the role of new graduates entering the coatings industry. Funds to support the students attendance at the Show have been provided by U.S. Paint Corporation over the last several years.

Another important part of the students' training process is summer jobs with coatings companies. These experiences provide students with practical insights about specific work opportunities and permit industries to direct developing scientists' talents toward solving specific technical problems. Students have been placed at U.S. Paint, Halburton, Cuba Industrial Finishes, and P.D. George Company in the last several years.

As part of Missouri's economic development activities, they have funded a "Dematech" laboratory at UMR. This 10,000 sq. ft. facility is being set up as a demonstration mini-production plant to show forefront technology in paint manufacturing techniques and apparatus. This will be available to companies to test new production techniques, to manufacture small batches of paint on a limited basis, and to be a demonstration production plant for the paint industry. The facility features the latest in computer aided manufacturing equipment.

Dr. Harvest Collier at UMR, along with the University of Missouri-St. Louis, was awarded an $800,000 grant from the National Science Foundation to continue the support of programs aimed at increasing access to science and engineering education for minority students in the St. Louis region. In addition to this, Dr. Collier has brought five to 10 high school science teachers to the UMR campus for the last several summers to help them with their computer skills.

The Department's Polymer and Coatings Science Industrial Advisory Board is active in providing guidance for the future of our program. Thanks to Dr. Albert Armour, of Du Pont Company; Dr. Murrae Bowden, of Bellcore; Steve Ellebracht and Dr. Frank Knoll, of Dow Chemical Company; Al Heitkamp, of Cargill, Inc.; Dr. Art Lind, of McDonnell Douglas Corporation; Dr. Theodore Provder and June Thomason, of Glidden/ICI; and Dr. Robert Steinkamp, of Exxon.

The current Paint Short Course offerings include: "Basic Composition of Coatings"; "Paint Formulation"; "Physical Testing"; and "Basic Coatings for Sales and Marketing."

For more information, contact: Dr. Collier, Dr. James Stouffer, or Dr. Michael Van De Mark, UMR, Chemistry Dept., Rolla, MO 65401-0249; (314) 341-4420.

North Dakota State University

Although it may not be the headline news for the coatings industry, since North Dakota State University (NDSU), Fargo, ND, is a leading academic institution in the field of polymers and coatings, two years in a row NDSU has received favorable mention in the *U.S. News and World Report* survey of public colleges, and the city of Fargo has been selected by the *Money Magazine* as the fifth most desirable place to live in the U.S. All this, along with the Fargo Dome ready for hosting major events, and the academic environment in the Fargo/Moorehead area, certainly created additional incentives for these headlines. Here are some facts from 1992/93. This year the university accommodated a freshman class 20% larger than last year's fall flux. Also, last fall, NDSU's new $10.5 million computer center was ready for students. The new center houses industrial agriculture laboratories, where part of the research in the Polymers and Coatings Department will be conducted through the program on the utilization of agricultural products in coatings. Construction is continuing with a $400,000 skywalk, which will link Hultz Hall and Ladd Hall across West College Street. Construction on the 270-ft. span began in August, and will be completed early in 1993. The skywalk is a part of a 1978 plan calling for links and corridors between campus buildings. Perhaps the thing most directly affecting the Polymers and Coatings

Department teaching and research activities is the recent grant from 3M Company. This grant, received with the help of 3M employees and NDSU alumni, creates a new faculty position in the Polymers and Coatings Department. The search will soon begin. The faculty and staff of the Polymers and Coatings Department would like to take this opportunity to thank all 3M NDSU alumni who so generously supported the professorship grant.

A major renovation project in Dunbar and Ladd Halls, adding more space to the existing coatings and research labs, is underway. A $1.2 million grant for this project was received from the National Science Foundation with a 50/50 match from the State of North Dakota. Finally, after two years of planning, this year NDSU made a footnote in history: for the first time this land-grant institution offers semester courses—rather than quarters, of years past.

The Department of Polymers and Coatings continues to focus on three major areas: undergraduate and graduate education, research, and serving the coatings industry in the form of short courses. The Polymer and Coatings Industrial Advisory Board, consisting of many prominent industrial scientists and managers from the coatings industry, helps in achieving these goals and the departmental mission.

Undergraduate education has always been one of the top priorities at NDSU. Enrollment in coatings courses remains steady and some increase is expected in the next few years. One of the major attractions to undergraduates is the scholarship program which again exceeded $50,000. The faculty and students are grateful to the scholarship programs from PPG Industries, Inc. supporting Donald P. Hart and Frederick M. Loop Scholarships, Albert Bean, Glidden/ICI, Federation of Societies for Coatings Technology, Northwestern Society for Coatings Technology, Ernest T. Trigg, George A. Nichols, John Rooney, Carlton L. Rydstrom Foundations, Valspar Corporation, The Wicks Fund, The Rheineck Memorial Scholarship Fund, and The Messer Award, for providing this opportunity and helping our students become involved in coatings science. Last year, Miles, Inc. initiated an undergraduate summer research program at NDSU, supporting two undergraduate students who conducted coatings research supervised by the Polymers and Coatings faculty. The department is thankful to Miles for the support, and is looking forward to future summer research programs.

Our graduate students are trained to meet the highest standards. The students take advanced graduate courses from disciplines related to their research areas and conduct research under their professor's supervision. All advanced degree candidates receive $12,000/year tuition free teaching or research assistantships. Research support comes from such companies as DuPont Company, Hitachi Chemical Company, Hüls-Nuodex, Eastman Kodak, FMC, James River, 3M, Medtronic, BYK, Monsanto, Shell Chemical Co., Valspar, as well as the National Science Foundation, the U.S. Department of Agriculture, and the Office of Naval Research. The first year graduate fellowship program was established at the Polymers and Coatings Department by the Coatings Industry Education Fund. The faculty and students are thankful for the support. Although taking advance courses is a part of the graduate education, the primary objective of the M.S. and Ph.D Degrees is to utilize the classroom and lab experience in polymers and coatings research. Inquiries or questions regarding the graduate program can be obtained by contacting Professor Marek W. Urban, Director of the Polymers and Coatings Graduate Program at (701) 237-7633.

Intensive short courses offered to the coatings industry by the faculty of the Polymers and Coatings Department have a long standing tradition at NDSU and have served the coatings industries for over a decade. Two coures, "Coatings Science" and "Environmentally Compliant Coatings" were offered last June, and were taught mainly by the present (Bierwagen, Glass, Urban) and the former faculty members. Emeritus Professor Zeno W. Wicks, Jr. and Adjunct Professor Dr. Loren W. Hill, the recipient of the 1991 Mattiello Memorial Lecture Award, participate each year. Drs. Ronald Bauer, Philip Boudjouk, John Gillham, Frank Jones, Steven Kiefer, and Cliff Schoff participated in the courses and the Polymers and Coatings faculty are thankful to PPG Industries, (Dr. Schoff), Monsanto (Dr. Hill) and Morton International (S. Kiefer), for allowing their employees the time to teach both courses. The same short courses are scheduled to be offered in 1993. The "Environmentally Compliant Coatings" course is scheduled for June 7-12, and the "Coatings Science" course will be offered June 14-26. Questions about the course content can be obtained from Dr. Urban, the Short Course Director, and inquires regarding the 1993 Polymers and Coatings short courses can be obtained by calling the course coordinator, Debbie Shasky at (701) 237-7633.

The faculty of the department has been actively involved in various research activities. Professor Bierwagen, besides his duties as a Regional Editor North America for *Progress in Organic Coatings*, continues to focus his research interests on computer modeling of organic coatings behavior, pigment dispersion and adsorption, CPVC studies, expert systems for coatings, corrosion, and surface defects in coatings applications methods. This research, in particular the corrosion program, will have a significant impact on further understanding of physical coatings properties. Last fall, Professor Bierwagen was an invited speaker at the University of Stuttgard, he presented an invited lecture at the Second North American Research Conference on Organic Coatings, at Hilton Head, SC, and he presented a lecture at the Second Annual ASM/ESD Advanced Coatings Technology Conference in Chicago, IL.

Professor J. Edward Glass continues research on water soluble polymers, their rheology, and associative thickeners in latex systems. As a result of these activities, his research group continues to publish and present research papers at national and international scientific meetings. A particularly active research program involves the study of associative thickeners and their extensional viscosity. Professor Glass has edited four books in the area of water soluble systems published by the American Chemical Society (ACS), and continues to be active organizing various symposia and workshops. He is scheduled to organize the next ACS Symposium on waterborne polymers held during the fall 1993 ACS National Meeting in Chicago.

Professor Urban's recent research themes are adhesion to plastics monitored spectroscopically, behavior of small molecules in polymeric systems, non-equilibrium crosslinking reactions monitored by photoacoustic spectroscopy, and the understanding of molecular level interactions of monomers and polymers in coatings and films. He was an invited speaker at the Adhesion Science Gordon Research Conference in 1992. This year he finalized editing the Advances in Chemistry Series #236 book entitled *Structure-Property Relations in Polymers: Spectroscopy and Performance*, published by ACS, and has finished writing the book *Vibrational Spectroscopy of Surfaces and Interfaces*, which will be published by Wiley & Sons. Dr. Urban is scheduled to chair and organize two major ACS Sympo-

sia: "Hyphenated Methods in Polymer Analysis," in Chicago, in 1993; and "Spectroscopic Methods in Polymer Characterization," in Washington, D.C., in 1994. He also is an invited speaker to the 1993 International Coatings Conference held annually in Athens, Greece.

This year Professor Philip Boudjouk agreed to serve as Interim Chairman of the department. He is internationally recognized for his pioneering work in the areas of organic-metallic and silicone synthesis chemistry using ultrasound. Professor Boudjouk's research is highly respected by chemical communities around the world. His recent research interests are in the area of silicone polymer chemistry and utilization of agricultural products.

Further information about other departmental activities can be obtained by contacting: NDSU, Dept. of Polymers and Coatings, Fargo, ND 58105; (701) 237-7633.

University of Southern Mississippi

Historically (but not physically), the University of Southern Mississippi (USM), Hattiesburg, MS, Polymer Science Department has moved a long way in coatings research and education from its conception and birth by Dr. Shelby Thames in 1970. USM's Polymer Science Department has completed its third move in 21 years and is now housed in an 86,400 sq. ft. Polymer Science Research Center 150 yards and many light years away from the coatings research of Drs. James Scott Long and Thames supported by the Pan American Tung Research and Development League. The three story Research Center, formally opened on April 2, 1991, was designed by the firms of Canizaro, Trigiani and Associates and Eley and Associates, both of Jackson, MS. Quoting the architects . . .

> "The Research Center consists of two wings arranged in an 'L' shape, joined by the central circulation point, a three story skylit atrium. The space includes a monumental stair, public seating areas, and display cases.
>
> Teaching laboratories, classrooms, a 130-seat auditorium, and other public spaces are located on the ground level. Offices and research laboratories are located on levels two and three. An annex with high bay spaces houses processing equipment, high pressure cells, a machine shop, glass shop, and mechanical equipment rooms. Exterior materials are red brick, granite, and limestone. Each level is expressed through unique fenestration: large glass openings on the ground level, punched windows on level two, and a vision and spandrel glass band on level three. Interior finishes range from such economical materials as painted concrete block partitions and vinyl tile flooring in the majority of spaces, to finer materials such as stone walls and bases, mahogany wood paneling, and terrazzo flooring in the atrium, conference rooms, and auditorium."

In 1992, the University of Southern Mississippi received an endowment, from the Southern Society for Coatings Technology, to fund a Distinguished Professorship in the Department of Polymer Science. This is the first such endowment provided by the coatings industry.

The recipient of this Distinguished Professorship was Dr. Shelby F. Thames, the founder and driving force behind the USM Department of Polymer Science.

The Research Center was designed to create an environment providing students with both the basic science knowledge and the research skills necessary in today's technologically competitive world. The capstone of the coatings curriculum for undergraduates is a five-credit hour lecture/laboratory course and two terms of independent research under the direction of a faculty member. The five-hour course stresses both the theoretical basis of coatings and the economic feasibility of coatings. As a result of their independent research projects, and under the direction of Dr. Thames, undergraduate students Sammy Pace and Gregory Tregre won the 1989 and 1990 Alfred L. Hendry Award, respectively. Mr. Tregre also presented an invited paper at the Southern Society for Coatings Technology Annual Meeting in Memphis, TN, on April 5, 1991.

Good communication skills developed by four required presentations as part of the lecture portion of the independent research were evident in Mr. Tregre's presentation. Lectures on literature searching by computer, other computer software programs useful for scientists, experimental design, and professional ethics are also part of the course.

A recent addition to the curriculum which was stimulated by the Industrial Advisory Committee is a one-credit hour laboratory safety course. This course is mandatory prior to or concurrent with the independent research course. This introduction to safety will undoubtedly be continued when the student goes to work.

An increase in undergraduate and graduate student enrollment, 130 and 62 respectively, as of 1992, is a result of recognition of USM's polymer science program, a demanding job market, and scholarship and fellowship assistance. The Department is grateful for the many years of scholarship assistance from the Federation of Societies for Coatings Technology, and both the Dallas and Southern Societies for Coatings Technologies.

The school believes the model for determining scholarship stipends developed by Roger Hester, Department Chair, is a most efficient use of scholarship funds. The model places the emphasis on earning the award. Students are often given scholarship assistance their first term in residence based on such things as high school GPA and standardized test scores. The scholarship award, however, is determined after the student's fall term grade point average is calculated. If the student does not apply herself/himself and does not attain a minimum 2.85 GPA (4.00 scale), no scholarship award is given for the spring term. Moreover, to encourage out-

standing performance, higher GPAs bring incrementally higher awards, similar to an industrial bonus system.

Three of the 1990-91 Polymer Science B.S. Degree graduates have accepted positions with coating related companies (Sherwin-Williams Company, BASF, Resinall). Seven other B.S. Degree graduates are attending graduate school. With decreasing state funding to higher education nationally, graduate fellowships received from both the Amoco Foundation and the Shell Development Fund are essential to the USM polymer science graduate program, as has been the coatings industry support of the undergraduate program.

At USM's Polymer Science Research Center students not only have the opportunity to work with a wide range of new sophisticated instrumentation such as a 400 MHz solids state NMR, environmental scanning electron microscope, single crystal and powder X-ray diffractometers, and a FTIR/Raman spectrophotometer, but they are also taught by faculty that know the value of everyday equipment for testing hardness, viscosity, etc.

For more information, contact Gerald Mattson, USM, Polymer Science Dept., P.O. Box 10076, Hattiesburg, MS 39406-0076; (601) 266-5087.

University of Waterloo

Coatings research at the University of Waterloo, Waterloo, Ontario, Canada, is in the Institute for Polymer Research, which spans the departments of Chemistry, Chemical Engineering, and Mechanical Engineering. The University of Waterloo was established in 1957. It now has some 25,000 students and is the largest cooperative education institution in the world. Waterloo produces more chemistry, physics, engineering, mathematics and computer science majors than any other university in Canada. It is nationally recognized as a leader in research and education.

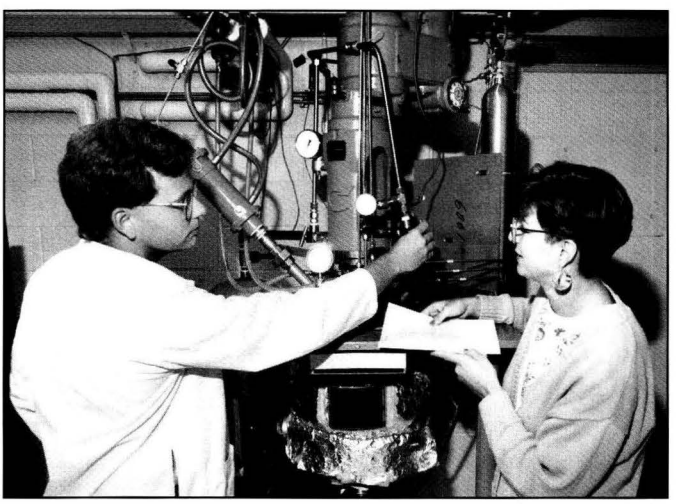
The Institute for Polymer Research (IPR) was established in 1984 to provide research services to polymer-related industries and comprehensive graduate instruction in polymer science and engineering. Originally founded as the University of Waterloo Copolymer Group in 1979, IPR combines the polymer research capabilities of 12 faculty members and about 50 graduate students. Nearly all the students move to industrial positions when they graduate. The Institute is made up of faculty members and representatives of major North American chemical companies. It has become one of the leading centers of polymer expertise devoted to creating an imaginative, results-oriented program of graduate studies and research in experimental polymer science and engineering.

Students undertaking graduate study and research under the supervision of the Institute members have a choice of several programs. Depending on whether the initial enrollment is through the Chemical Engineering Department or the Guelph-Waterloo Centre for Graduate Work in Chemistry, Masters and Doctoral Degrees in Chemical Engineering or Chemistry are obtained. The Institute awards industry-sponsored scholarships in Polymer Science and Engineering, including scholarships from the Coatings Industry Education Fund (CIEF).

An attractive option for many graduate students is the Cooperative M.Sc. or Cooperative Ph.D. program. In the Co-op M.Sc. program, an initial semester of course work is followed by two semesters of research off-campus in an industrial or government laboratory. Following this first-hand exposure to an industrial research problem, the student returns to campus to complete an original research project. In the Co-op Ph.D program, students have an opportunity to undertake a more detailed applied research project before completing their thesis requirements on campus.

Major funding support in recent years has helped provide state-of-the-art research equipment and facilities, including: polymerization pilot plant, with vessels up to 25 liter capacity; high pressure polymerization vessels; size exclusion chromatography apparatus with continuous viscometer and laser light scattering detectors; dynamic mechanical spectrometer for rheological and cure characterizations; impedence spectroscopy (10^{-4} Hz to 1 GHz); 300 MHz high resolution NMR spectrometer; disc centrifuge and Coulter counter for latex particle size characterization; on-line density/flow/viscosity sensors; instrumented impact testers; thermal characterization equipment; glossmeters; Fourier Transform Infrared spectrometers; and scanning and transmission electron microscopes.

Some of the equipment is designed and built on-site and much of the software for data acquisition and calculations is written locally.



Pilot plant reactor

Graduate students are encouraged towards coatings-related research by CIEF scholarships which are awarded on the basis of scholastic records, research ability, and relevance of thesis research to coatings industry interests. The following brief description of the activities of the four current CIEF scholarship holders serves also to provide some flavor to this aspect of the IPR research.

Mark Dubé is a Ph.D student in Chemical Engineering, working under the supervision of Professor Alex Penlidis. His research involves the copolymerization of butyl acrylate/methyl methacrylate/vinyl acetate polymers with various compositions. The work is aimed to develop a systematic approach to the analyses of multicomponent polymerizations, which are the norm in coatings polymers. Progress has also been made in defining operating regions and experimental conditions for the emulsion terpolymerization of this film-forming copolymer.

Gerald Vandezande is a Ph.D. student in Chemistry, working under the supervision of Dr. Alfred Rudin. He has been able to produce vinyl acetate/butyl acrylate latex polymers at commercial solids levels and with varied, controlled monodisperse particle sizes. His current research is a study of the effects of particle size and size distribution on properties of architectural paints. In addition, he has developed modified latexes that provide significant raw material cost savings over current products. This part of the research is being prepared for the 1993 Roon competition.

Kevin Suddaby is a Ph.D. student in Chemical Engineering, who is jointly supervised by Professors Kenneth O'Driscoll and Rudin. He has devoted considerable effort to the characterization of molecular weight distributions of non-homogeneous polymers and mixtures, such as those in most coatings systems. Mr. Suddaby is also studing the synthesis of methacrylate macromers (low molecular weight polymers possessing a terminal vinyl group). Macromers of this type are useful in high solids coatings, since the terminal vinyl group enables them to undergo further polymerization after application to substrates.

Phillip Choi is a Ph.D student in Chemical Engineering. He is supervised by T. Kavassalis and Dr. Rubin. His research involves molecular dynamics calculations of the properties of nonionic surfactants and cellulosic thickeners. He has developed an algorithm to calculate effects of molecular structure and molecular size on the behavior of alkyl phenol ethoxylate surfactants. Properties that can be deduced are three-dimensional solubility parameters and emulsifying properties. He is now turning his attention to the design of compatibilizers for polymer mixtures.

In other coatings research, Dr. Sarah Eckersley, who is a post-doctoral fellow with Professor Rudin, has studied the mechanism of coalescence of acrylic latexes. This work received Second Prize in the 1988 Roon Awards competition. A more complete model of latex film formation has been developed recently and several articles that summarize this work have been submitted to the JOURNAL OF COATINGS TECHNOLOGY.

Also, as part of the coatings-related program, instrument technician Jack Pronovost and Dr. Rudin have modified the design of the traditional Stormer viscometer so that a new, motor-driven unit provides readings on paint viscosities in a fraction of the usual time required for the measurements.

The research programs at the IPR are reviewed with the members of the Industrial Advisory Board. The industrial membership of the IPR includes 15 companies based in the U.S. and Canada. Several of these are major components of the coatings industry.

While the IPR serves as an umbrella organization of the polymer researchers at Waterloo, it does not fund research itself. Individual faculty members fund their own research through granting agencies and industrial contracts. Any proprietary research is more readily kept confidential with this agreement. The IPR group includes the following faculty members: Charles M. Burns, with research interests in adhesion, adhesives and surface properties of polymers, and compatibilization of polymers; Scott Collins, with research interests in soluble and supported organometallic polymerization catalysts; Thomas Duever, who works in applied statistics, experimental design, and optimization of polymer production processes; Mario Gauthier, with research interests in synthesis and characterization of very highly branched polymers and polymer-supported reagents; Professor O'Driscoll, whose research is in vinyl polymerization kinetics, polymerization reaction modeling, high solids systems, and use of macromers as comonomers; Alexander Penlidis, who supervises the polymerization pilot plant and has research ongoing in mathematical modeling and simulation of polymerization processes, ethylene-vinyl acetate emulsion copolymerization, polymer reactor design and computer control, and sensors for polymerization reactions; Alan Plumtree, whose work is in mechanical behavior and fracture of polymers and applications of fracture mechanics in characterizing polymeric materials; Gary Rempel, with research interests in chemical modification of polymers and kinetics and mechanisms of catalytic polymerization processes; Alfred Rudin, whose research is in polymer characterization, polymer blends, emulsion polymerization, toughening of polymers, and latex-based coatings; Jim Stevens, with research in molecular relaxations in polymer melts and glosses and in ion-conducting polymers; Morris Tchir, who carries out research in the use of NMR spectroscopy for the characterization of polymer structure and properties; and Costas Tzoganakis, with research interests in reactive processing of polymers, polymer rheology, and mathematical modelling and computer simulation of polymer processing.

The undergraduate programs in both Chemistry and Chemical Engineering at Waterloo include polymer options. All the engineering students and most chemistry students are enrolled in the co-op program and will have relevant industrial experience by the time they graduate. An offer has been made to the Canadian protective coatings industry to mount a coatings specialty as part of the undergraduate chemistry program.

For further information, contact the IPR Director, Professor Rudin, or the Associate Director, Professor Penlidis, at the Institute for Polymer Research, University of Waterloo, Waterloo, Ontario, Canada N2L 3G1; (519) 888-4617; fax (519) 888-6179.

1993 Educational Committee Guide to Coatings Courses, Symposia, and Seminars

This compilation of courses, symposia, and seminars on coatings-related topics is based on information obtained from Constituent Societies of the Federation, educators, and various industry sources.

CALIFORNIA

California Polytechnic State University, Chemistry Department, San Luis Obispo, CA

Concentration in Polymer and Coatings Chemistry

Fall, winter and spring quarters courses offered. The purpose of the program is to provide Chemistry Majors with the skills and background necessary to enter the polymers and coatings industry with a proper background, and to prepare students for graduate study in polymers, coatings, or related fields. The program meets the American Chemical Society requirements for certification as a chemistry/polymers degree. The concentration includes five courses, including two laboratory courses, and comprises a total of 18 quarter units. An industrial internship, lasting from three to six months, is a central part of the program. Students must be admitted to undergraduate degree program at Cal Poly. Current tuition is approximately $600 per quarter.

A brief outline of the courses is given below:

Polymers and Coatings I (Chem 444)

Overview of polymer synthesis and structure; molecular weight; thermal properties of polymers; mechanical properties, polymer crystallinity; thermodynamics of polymer solutions; kinetics; dynamics of polymer chains, interchain forces; viscoelastic properties; polymer rheology; spectroscopic analysis; current topics; applications to coatings.

Polymers and Coatings II (Chem 445)

Polymerization methods and mechanisms; chain growth, step growth, and ring opening; catalysts and inhibitors; copolymerization; uses; film formation, structure and properties of acrylics, vinyls, polyesters, alkyds, epoxies, urethanes, phenolics, hydrocarbons, and cellulosics; raw materials in coatings and formulation techniques.

Surface Chemistry of Materials (Chem 446)

Surface energy; capillarity; solid and liquid interface, adsorption; surface areas of solids; contact angles and wetting; friction, lubrication and adhesion; relationship or surface to bulk properties of materials; modern methods of surface analysis; applications.

Polymers and Coatings Lab I (Chem 447)

Synthesis and characterization of polymers; step-growth, chain-growth, and ring-opening polymerization; molecular weight determination; thermal analysis; spectroscopic analysis; mechanical analysis.

Polymers and Coatings Lab II (Chem 448)

Experimental techniques of producing and characterizing coatings; compounding and formulating modern protective coatings; modern methods of testing protective coatings; surface preparation techniques.

Internship in Polymers and Coatings (Chem 449)

Students spend three to six months with an approved polymers and coatings firm engaged in production, development, research, or related business. Students will develop and apply research, production, and managerial skills.

(Tuition scholarships supported by the Federation of Societies for Coatings Technology at California Polytechnic State University are available for undergraduate students interested in this curriculum.)

Materials Engineering (Met 306)

Physical and mechanical properties of materials including metals, alloys, ceramics, insulating materials, semiconductors, and polymers; equilibrium diagrams; heat treatments, materials selection, and corrosion phenomena.

Contact: Dr. Dane Jones, Chemistry Department, California Polytechnic State University, San Luis Obispo, CA 93407. Tel: (805) 756-2528. Fax: (805) 756-1670.

Introduction to Polymer and Coatings Chemistry—June 15-19, 1993.

Provide persons working in coatings-related industry and secondary and junior-college teachers with basic overview of polymer chemistry and its application to modern coatings chemistry and technology. Industry personnel completing the course should be able to apply polymer chemistry principles to coatings problems and understand formulation and testing of modern polymers and coatings. Teachers should be able to include polymers and coatings related materials in their courses and to advise their students on opportunities in polymer and coatings chemistry. Mornings will be spent in lecture and discussion sections. Afternoons will be spent in the polymers and coatings laboratory. Students will learn the basics of polymer synthesis and characterization. Students will study formulation, properties, and testing of modern coatings. Enrollment is limited to 25 students. The course will be taught by permanent faculty of the Cal Poly Chemistry Department. Fee: $500. Includes all costs for course lectures, laboratories, materials, and room and board in college dormitories.

Contact: Dr. James Westover, Chemistry Department, California Polytechnic State University, San Luis Obispo, CA 93407. Tel: (805) 756-2566. Fax: (805) 756-1670.

University of Southern California, Department of Chemical Engineering, Los Angeles, CA

Minor in Polymer Science—September—May. Nine months. Los Angeles, CA.

A series of at least four 3-unit courses on polymer science including introductory lecture and lab courses, lecture course on physical properties of polymers and materials courses. Objective is to complement current programs in the Department of Chemical Engineering by providing students with background in polymer science and engineering. Fee: $529 per unit.

Contact: Ronald Salovey, Dept. of Chemical Engineering, University of Southern California, Los Angeles, CA 90089-1211. Tel: (213) 740-2225. Fax: (213) 740-8053.

University of California, Berkeley Extension, Continuing Education in Engineering

Strategies for Cost-Effective Pollution Prevention in Paints and Coatings Facilities—March 1-3, 1993. Three days. UCLA Extension, 10995 Le Conte Ave., Los Angeles, CA.

This is not a seminar on meeting environmental compliance regulations. It is intended instead for those who have to deal with the rising cost of compliance—and still get the job done. Fee: $895 including all course materials.

Getting into Compliance with Air Quality Regulations for Paints, Coatings, and Printing Facilities—June 8-11, 1993. Three-and-one-half days. UC Extension Downtown, 150 Fourth St., San Francisco, CA.

The purpose of this course is to present information on air toxic regulations and why many companies and states are in violation of the Clean Air Act. This course also gives you tools required to bring coating companies into compliance. Fee: $895 including all course materials.

Contact: Kathy M. Snyder, Continuing Education in Engineering, University Extension, University of California, 2223 Fulton St., Berkeley, CA 94720. Tel: (510) 642-4151. FAX: (510) 643-8683.

American Society for Testing and Materials

Measuring Paint Volatile Organic Compounds (VOC)—November 3-4, 1993, Los Angeles, CA.

This two-day course should enable you to run the ASTM test methods listed in EPA Reference Method 24 correctly and accurately, with meaningful, precise results; understand the basic principles of ASTM tests to measure VOC under EPA New Source Performance Standard (NSPS); obtain and prepare good representative samples; run VOC measurements of coatings; identify the variables in each test method; calculate VOC whether reported as grams per liter, grams per liter minus water, or as kilogram of VOC as applied solids; improve the precision with which you can run these methods. Fee: $535. Includes all referenced publications, course notes, coffee breaks, and transportation to laboratory demonstration.

Contact: Kathy Dickinson, ASTM,1916 Race St., Philadelphia, PA 19103. Tel: (215) 299-5480. Fax: (215) 299-5470.

HunterLab

Color Matching Seminar—June 9-10, 1993, Hyatt at Los Angeles Airport, Los Angeles, CA.

This course combines everything from building a color database unique to your own process through proper laboratory procedures. Gain a better understanding of how to select colorants as you create formulas for an accurate match. First day is lectures and presentations, second day individual consultations hands-on with samples and instruments. Fee: $395.

Contact: Joan Dorsch, Hunter Associates Laboratory, Inc., 11491 Sunset Hills Rd., Reston, VA 22090-5280. Tel: (703) 471-6870. Fax: (703) 471-4237.

Western Coatings Societies (Golden Gate, Los Angeles, Pacific Northwest, and Rocky Mountain Societies for Coatings Technology)

21st Biennial Symposium and Show—March 23-25, 1993, Disneyland Hotel and Convention Center, Anaheim, CA.

Symposium theme is "Visions—Opportunities—Challenges."

Contact: Donald Jordan, Cargill, Inc. 2801 Lynwood Rd., Lynwood, CA 90262. Tel: (213) 537-9935; or Sandra L. Dickinson, Synergistic Performance Corp., 17821 E. 17th St., Ste. 190, Tustin, CA 92680. Tel: (714) 544-8200.

COLORADO

American Chemical Society

Polymer Coatings —March 27-28, 1993, Denver, Co.

Define mechanisms of polymer formation, which types of pigments, solvents, and additives to use, how to formulate waterborne or high-solids coatings, and which factors to consider when optimizing the rheological properties of coatings formulations. Program covers Putting Formulations Together; Resins — Addition Polymers/Condensation Polymers; Pigments and Pigment Volume Concentration; Extender Pigments; Metal and Corrosion Inhibiting Pigments; Water and Solvents; Additives; Calculations and Testing; VOC Regulations; UV Cured Coatings; Powder Coatings; Formulating Trade Sales and Industrial Coatings. Fee: $745 ACS Members; $845 Non-members.

Contact: Dr. Shelby F. Thames, University of Southern Mississippi, Box 10076, Hattiesburg, MS 39406-0076. Tel: (601) 266-4080. Fax: (601) 266-5880.

FLORIDA

Center for Professional Advancement

Lubrication, Friction and Wear—February 8-11, 1993 (three or four days), Dearfield Beach, FL.

Practical application of basic principles of lubrication and the problems associated with lubrication under field conditions. Topics covered are the underlying principles of friction and wear as applied to lubrication under hydrodynamic, elasthydrodynamic and boundary conditions bearing design, lubrication of bearings, functions, properties, specifications, performance and cleanliness of lubricants, failure diagnosis and methods to detect incipient bearing malfunction. Fee: three days—$990; four days—$1250.

Contact: Registration, Center for Professional Advancement, 144 Tices Lane, East Brunswick, NJ 08816. Tel: (908) 613-4500. Fax: (908) 238-9113.

University of Missouri-Rolla Coatings Institute

Basic Coatings for Sales and Marketing Personnel—February 8-10, 1993, Sheraton Plaza Hotel, Orlando, FL.

This course is designed especially to aid sales and marketing people in the coatings industry to have a better understanding of the composition of coatings. Fee: $695.

Contact: Dr. Michael Van De Mark, UMR Coatings Institute, 142 Schrenk Hall, Rolla, MO 65401. Tel: (314) 341-4419.

GEORGIA

Polymer Coatings Mini-Course—October 25-26, 1993, Atlanta, GA.

Sponsored by Dr. Shelby F. Thames and Dr. James O. Stoffer.

Define mechanisms of polymer formation, which types of pigments, solvents and additives to use, how to formulate waterborne or high-solids coatings, and which factors to consider when optimizing the rheological properties of coatings formulations.

Program includes Putting Formulations Together; Resins — Addition Polymers/Condensation Polymers; Pigments and Pigment Volume Concentration; Extender Pigments; Metal and Corrosion Inhibiting Pigments; Water and Solvents; Additives; Calculations and Testing; VOC Regulations; UV Cured Coatings; Powder Coatings; Formulating Trade Sales and Industrial Coatings. Fee to be determined.

Contact: Dr. Shelby F. Thames, University of Southern Mississippi, Box 10076, Hattiesburg, MS 39406-0076. Tel: (601) 266-4080. Fax: (601) 266-5880.

National Paint and Coatings Association

Production Planning and Inventory Management Seminar—February 25 and 26, 1993. Hyatt Airport Hotel, Atlanta, GA. *__Note__: Open only to NPCA members.

The seminar provides a conceptual framework for developing a consistent, systematic approach to the many planning and control decisions necessary for managing manufacturing operations. Fee: $725.

Contact: Juliette Benedicto, NPCA, 1500 Rhode Island Ave. N.W., Washington, D.C. 20005. Tel: (202) 462-6272. Fax: (202) 462-8549.

Federation of Societies for Coatings Technology

71st Annual Meeting and 58th Paint Industries' Show—October 27-29, 1993, World Congress Center, Atlanta, GA.

Program theme is: "Today's Competitive Coatings: Lean, Mean and Green."

Contact: Federation of Societies for Coatings Technology, 492 Norristown Road, Blue Bell, PA 19422. Tel: (215) 940-0777. Fax: (215) 940-0292.

ILLINOIS

DePaul University, Chicago, IL

Coatings Technology Master of Science Program—Chemistry Department, DePaul University.

To satisfy the demand for technical professionals in the coatings industry at an advanced level and to provide an opportunity for Bachelor of Science level coatings chemists in the Chicago area to enhance their knowledge and skill for improved levels of performance. The program includes five advanced courses in Organic Chemistry, Inorganic Chemistry and Physical Chemistry; three courses in Polymer Chemistry (Synthesis, Characterization, and Physical Chemistry), and four courses in Coatings Technology, two of which are Coatings Laboratory. The 12-course curriculum will require nine quarters of study. Fee: $230 graduate tuition per credit hour.

Coatings Laboratory I (CHE 461)—Held on Saturday mornings (four-hour sessions).

This course is designed to introduce individuals to the definitions, concepts, and methodologies commonly practiced by the coatings laboratories. These include paint compositions, properties, testing and analysis, rheology, film formation, hiding power, and wetting.

Coatings Laboratory II (CHE 463)—held on Saturday mornings (four-hour sessions).

This course involves the experimental techniques in synthesis and characterization of polymers used in the coatings industry. Synthesis of polymers by free radical, emulsion, redox, ionic, and condensation polymerizations are introduced. Characterization of the polymers by spectroscopy, viscosity, and thermal techniques are introduced.

Coatings Technology I (CHE 460)—Offered every two years.

This course involves an overview of coatings industry, coatings formulation (physical chemistry of coatings and coatings composition and properties), color theory and reduction to practice, coatings manufacture and application, surface chemistry of metals, and government/regulatory consideration.

Coatings Technology II (CHE 462)—Offered every two years.

This course focuses on the binders used in the coatings industry. The major classes of binders, their preparation, characterization, and use in paints are surveyed. Surface characterization of films and coatings are also surveyed.

Polymer Synthesis (CHE 430)—Offered every two years.

This course is designed to introduce the basic concepts of polymers, various definitions, and the physical and organic chemistry of the reactions by which polymer molecules are synthesized.

Physical Chemistry of Polymers (CHE 432)—Offered every two years.

This course looks at the broad subject of the physical chemistry of polymers: mechanical behavior (rheology, viscoelasticity); the several states of polymers (glassy, crystalline, molten and solution, and elastomers or rubbery polymers); transport properties; fabrication (of fibers, films and foams); kinetics of polymerization; and molecular weight determinations and polymer identifications.

Also offered are the following advanced courses:

Advanced Organic Chemistry I (CHE 450)—Offered every year.

Advanced Organic Chemistry II (CHE 452)—Offered every year.

Advanced Physical Chemistry (CHE 472)—Offered every two years.

Advanced Inorganic Chemistry I (CHE 422)—Offered every two years.

Advanced Inorganic Chemistry II (CHE 424)—Offered every two years.

Polymer Characterization (CHE 434)—Offered every two years.

This course discusses the various chemical spectroscopic, physical, and mechanical methods of analysis of polymers to understand the structure property relationship of polymers.

Contact: Dr. Gregory B. Kharas, Chemistry Department, DePaul University, 1036 W. Belden Ave., Chicago, IL 60614. Tel: (312) 362-8185 or (312) 362-8180. Fax: (312) 362-5324.

Chicago Society for Coatings Technology and Chicago Paint and Coatings Association

A Course in Coatings Technology—January 13-May 12, 1993 (18 weeks), DePaul University, Chicago, IL.

The course is modular in design. Features guest lecturers who are experts in their field. Course is intended to be an introduction to the chemistry theory formulation and application of coatings. Program includes Introductory Concepts; Polymer Technologies; Coatings Technologies; Additives; Pigments; Application Techniques and Testing; Production and Quality Control; Governmental Regulations. Fee: $450 for complete course, text, and banquet.

Contact: Susan Simpson, Amoco Chemical Co. Tel: (708) 961-7988 or Kevin Murray, Applied Polymer Systems. Tel: (708) 364-4140.

American Chemical Society

Polymer Coatings—August 21-22, 1993, Chicago, IL.

Define mechanisms of polymer formation, which types of

pigments, solvents and additives to use, how to formulate waterborne or high-solids coatings, and which factors to consider when optimizing the rheological properties of coatings formulations. Program includes Putting Formulations Together; Resins — Addition Polymers/Condensation Polymers; Pigments and Pigment Volume Concentration; Extender Pigments; Metal and Corrosion Inhibiting Pigments; Water and Solvents; Additives; Calculations and Testing; VOC Regulations; UV Cured Coatings; Powder Coatings; Formulating Trade Sales and Industrial Coatings. Fee: to be determined.

Contact: Dr. Shelby F. Thames, University of Southern Mississippi, Box 10076, Hattiesburg, MS 39406-0076. Tel: (601) 266-4080. Fax: (601) 266-5880.

American Society for Testing and Materials

Measuring Paint Volatile Organic Compounds (VOC)—May 5-6,1993, Chicago, IL.

This two-day course should enable you to run the ASTM test methods listed in EPA Reference Method 24 correctly and accurately, with meaningful, precise results; understand the basic principles of ASTM tests to measure VOC under EPA New Source Performance Standard (NSPS); obtain and prepare good representative samples; run VOC measurements of coatings; identify the variables in each test method; calculate VOC whether reported as grams per liter, grams per liter minus water, or as kilogram of VOC as applied solids; improve the precision with which you can run these methods. Fee: $535. Includes all referenced publications, course notes, coffee breaks, and transportation to laboratory demonstration.

Contact: Kathy Dickinson, ASTM,1916 Race St., Philadelphia, PA 19103. Tel: (215) 299-5480. Fax: (215) 299-5470.

National Paint & Coatings Association

Manufacturing Management Committee Seminar—April 21-22, 1993. Hyatt Regency Woodfield, Schaumburg, IL. Co-sponsor is FSCT Manufacturing Committee.

Contact: Juliette Benedicto, National Paint & Coatings Association, 1500 Rhode Island Ave., N.W., Washington, D.C. 20005. Tel: (202 462-6272. Fax: (202) 462-8549.

KENTUCKY

Products Finishing Magazine

Plasticoat '93—May 4-6, 1993. Conference and Exhibition, Drawbridge Estate and Convention Center, Ft. Mitchell, KY.

Contact: Cindy Goodridge, Gardner Management Services, 6600 Clugh Pike, Cincinnati, OH 45244. Tel: (513) 527-8977 or (800) 950-8977. Fax: (513) 527-8950.

National Paint and Coatings Association

Production Planning and Inventory Management Seminars—March 25-26, 1993, Louisville, KY. Open only to NPCA members.

Contact: Juliette Benedicto, National Paint & Coatings Association, 1500 Rhode Island Ave., N.W., Washington, D.C. 20005. Tel: (202) 462-6272. Fax: (202) 462-8549.

LOUISIANA

University of New Orleans Metropolitan College. Sponsored by University of California, Berkeley Extension, Continuing Education in Engineering

Getting into Compliance with Air Quality Regulations for Paints, Coatings, and Printing Facilities—January 12-15, 1993. Three-and-one-half days. New Orleans, LA.

The purpose of this course is to present information on air toxic regulations and why many companies and states are in violation of the Clean Air Act. This course also gives you tools required to bring coating companies into compliance. Fee: $895, including all course materials.

Contact: Carol Abrahamson, University Extension, Continuing Education in Engineering, University of California, 2223 Fulton St., Berkeley, CA 94720. Tel: (510) 642-4151. Fax: (510) 643-8683.

Southern Society for Coatings Technology and the Department of Polymer Science at The University of Southern Mississippi

Modern Coatings Technology—February 22-23, 1993, Hyatt Regency Hotel, New Orleans, LA.

Design, formulation, and testing for people in coatings research, development and testing of waterborne, high-solids and powder coatings. Define formulation/performance relationships and convey appropriate methods for technological development of superior yet cost-effective coatings. Program includes Polymer Design/Selection; Hiding in Latex Paints; Formulating Waterborne/Trade Sales Coatings; High-Solids Coatings; Selection of Associative Thickeners; Photodegradation and Stabilization of Coatings; Advances in Powder Coatings Technology; Ultraviolet Curing and Photopolymerization of Coatings; High Performance Coatings via Organosilanes. Fee: $595 advance registration.

Contact: Dr. Shelby F. Thames, University of Southern Mississippi, Box 10076, Hattiesburg, MS 39406-0076. Tel: (601) 266-4808. Fax: (601) 266-5880.

20th Annual Waterborne, Higher-Solids, and Powder Coatings Symposium—February 24-26, 1993, Hyatt Regency Hotel, New Orleans, LA.

The symposium will present chemistry, formulation, and new developments in waterborne, higher-solids, and powder coatings. The symposium is a presentation of papers written by outstanding industrial and academic scientists that cover a wide range of topics. Fee: $395 advance registration. Registration includes a copy of the proceedings and refreshments throughout the symposium.

Contact: Dr. Shelby F. Thames or Dr. Robson F. Storey, University of Southern Mississippi, Box 10076, Hattiesburg, MS 39406-0076 . Tel: (601) 266-4808, (601) 266-4879. Fax: (601) 266-5880, (601) 266-5504.

MASSACHUSETTS

University of Massachusetts at Lowell, Lowell, MA

Fall and spring semesters, 14 weeks each, September-December, January-May. These programs are primarily for people working in the local coatings and adhesives industries. The courses are also popular as electives in the regular chemistry and plastics curricula. New England Society for Coatings Technology provides informal support and lecturers. Fee: University Tuition.

Bachelor of Science in Applied Chemistry with an Option in Coatings

Coatings Science and Technology I & II, Coatings Rheology, Chemistry of High Polymers I & II, Mechanical Behavior of Polymers, Adhesives and Adhesion.

Master of Science in Plastics with an Option in Coatings and Adhesives

Coatings Science and Technology I & II, Adhesion & Adhesives, Polymer Science I & II, Color Science and Applications,

Colloids, Mechanical Behavior of Polymers, Plastics Coatings in Electronics, Rheology of Coatings, Seminar, Thesis.

Contact: Dr. Rudolph D. Deanin, University of Massachusetts at Lowell, Lowell, MA 01854. Tel: (508) 934-3426.

MICHIGAN

University of Detroit Mercy, Detroit, MI

Polymer Surface Coatings I and II (CHM 425 and 426) (CHM 525 and 526—Graduate)—(I)—early September to mid-December; (II)—early January to mid-May.

Designed to relate the chemical, physical and mechanical properties of polymers with their functions as protective coatings. Comparisons are made between coatings made with various polymers such as acrylics, polyesters and polyurethanes, alkyds, and varnishes. The effects of solvents (and mixtures of solvents), fillers, wetting and flatting agents are related to the special requirements of coatings. The equipment required for the preparation and applications of coatings is discussed, as well as the necessary evaluation tests and the significance of these tests.

Polymer Engineering and Science I & II (CHM 420 &421) (CHM 550 & 551—Graduate)—(I)—early September to mid-December; (II)—early January to mid-May.

Provide an overview of terminology, synthesis, properties, and fabrication of polymers and the systematic coverage of major classes of macromolecules including their preparation, properties and uses.

Contact: Dr. Kurt C. Frisch or Ms. Eleanore Eldred, Polymer Institute, University of Detroit-Mercy, 4001 W. McNichols Road, Detroit, MI 48219. Tel: (313) 993-1270. Fax: (313) 993-1409.

Adhesion and Durability of Polymeric Coatings

Fundamentals of adhesion. Requirements for good adhesion. Relationship between polymer structure and adhesion. Promoting and maintaining adhesion. Effect of adhesion on durability and corrosion resistance of coatings. Selection of primers and adhesion promoters. Adhesion of coatings to plastics. Fee: $264.

Auto and Industrial Finish Processing

Cleaning and preparation. Coatings application: manual and automatic. Finish curing. Testing results. Fee: $264.

Polymer Technology for Coatings

Overview of basic polymer concepts. Polymers for auto coatings emphasized. Paint Calculations. Relationship between polymer structure and coatings properties. Fee: $264.

Surface Coatings Technology

Principles of formulation. Pigment dispersions. Paint driers and additives. Formation and structure of paint films. Solvents. Fee: $264.

Contact: G. Gabriel, Mercury Paint, 14300 Schaefer Hwy., Detroit, MI 48227. Tel: (313) 491-5650. Fax: (313) 491-8490.

Eastern Michigan University, Ypsilanti, MI

Polymer and Coatings Technology I (IDT-400)—Fall Semester (September to December).

Acquaint students on the chemistry of polymeric film formation and the use of pigments in coating technology. Review the various chemistries of film formation using Triglyceride, Alkyd, Emulsion and Phenolic Resin. Describe the utilization of hiding and nonhiding pigments with their role in Pigment-Binder, Pigment Volume Concentration, and Critical Pigment Volume Concentration. Test methods are defined within their role of characterizing film performance. Fee: $263.

Polymer and Coating Technology Laboratory I (IDT-401)—Fall Semester (September to December).

Acquaint students with laboratory techniques used in the coating industry including synthesis of varnishes, alkyds and epoxy esters. Synthesize alkyds including stoichiometry of formulations; formulate paints using various triglycerides; explore various techniques of film evaluation. The above are used to acquaint students with real film performance with the chemistry of the polymers they have synthesized. Fee: $288.

Polymer and Coatings Technology II (IDT 402)—Winter Semester (January to April).

Acquaint students with the chemistry of film formations and color technology as it applies to the coatings industry. Review the chemistry of film formation using isocyanates, emulsions, epoxy resins and amino resins. The concepts of solvent or waterborne along with high solid systems are stressed. Colored pigments are introduced along with the methodologies of paint fabrication and film evaluation. Fee: $263.

Polymer and Coating Technology Laboratory II (IDT-403)—Winter Semester (January to April).

Acquaint students with laboratory techniques in the synthesis of polymers and their use in coating technology. Synthesize Emulsion Polymers, Amino Resins, Isocyanate Prepolymers and Thermoset Acrylics. Prepare finished paint systems and evaluate their films on various substrates as applied by air spray, electrostatic, or dip techniques. Fee: $288.

Coating Formulation Concepts (IDT-460)—Winter Semester (January to April).

Illustrate formulation techniques and presentation of data. Designed to instruct students on formulation techniques using software programs and accumulate literature data via the ACS base in Washington, D.C. Members of industry give presentations, thus, illustrating how practicing coating chemists effectively use suppliers. Culminating student experience is to give a two-hour presentation on a specific assigned project. Fee: $263.

Quality Assurance Techniques for Coatings Technology (IDT 479A)—(January to April).

Acquaint students with the application of SPC techniques in coating technology to achieve maximum quality assurance. The concepts and basic philosophy of Statistical Process Control (SPC) are presented including Control Charts, Statistic Principles, and Experimental Design. These tools are included in exercises which illustrate their proper utilization in the coating industry. Fee: $263.

Introduction to Color Technology (IDT 479B)—September to December

Introductory survey course which blends color measurement and visual aspects of color technology. Enable students to develop understanding of color as it relates to industrial processes by a combination of lecture and laboratory hands-on experiments of pigmentation, dispersing, and shading techniques. Fee: $263.

(Tuition scholarships supported by the Federation of Societies for Coatings Technology at Eastern Michigan University are available for undergraduate students interested in this curriculum.)

Contact: Dr. Taki J. Anagnostou, Eastern Michigan University, 201 Sill Hall, Ypsilanti, MI 48197. Tel: (313) 487-1235. Fax: (313) 487-8755.

Chemical Coaters Association International

Surface Coating '93—April 13-15, 1993, Grand Center Convention Facility and Amway Grand Hotel, Grand Rapids, MI.

Technical presentations, workshops, and exhibits are offered.

Contact: Chemical Coaters Association, P. O. Box 54316, Cincinnati, OH 45254.

MISSISSIPPI

UNIVERSITY OF SOUTHERN MISSISSIPPI, DEPARTMENT OF POLYMER SCIENCE, HATTIESBURG, MS

Surface Coatings (PSC 470, 470L)—September to December

This four-hour lecture, one-hour lab course is designed for students with a background in organic and physical chemistry. It is taught at the senior undergraduate/graduate level and includes chemistry and physics of binders, pigments, solvents and additives for surface coatings. Pigment dispersion, coatings formulation, surface chemistry, quality control, testing of raw materials and products, application methods, corrosion, and coatings specifications are included.

Organic Polymer Chemistry I and II (PSC 301, 302)—September to May.

This course (three-hour lecture, one-hour lab each term) is a systematic study of polymers, including polymer formation techniques, kinetics, and properties, with emphasis on step and addition polymerization, and stereoregular polymerization.

Polymer Techniques (PSC 341L, 342L)—September to May.

Laboratory methods of polymer synthesis, structural determination, and characterization (two-hour lab each).

Polymer Rheology (PSC 360)—September to December.

Theory and practice of fluid flow are emphasized (three-hour lecture).

Polymer Processing I (PSC 361, 361L)—January to May.

Extrusion technology, reaction injection molding, blown films, and wire coating are emphasized (three-hour lecture, two-hour lab).

Physical Chemistry of Polymers I and II (PSC 401, 402)—September to May.

Polymer structure, chain confirmation, solution properties, thermo-dynamics, fractionation, molecular weight measurement, instrumental analysis of polymers, morphology, structure-property relations are taught (three-hour lecture).

Introduction to Macromolecules (PSC 412)—June to August.

An introduction to the chemistry and physics of natural and synthetic high polymers (three-hour lecture).

Polymer Kinetics (PSC 480)—January to May.

Introduction to polymerization kinetics and reactor design (three-hour lecture).

Undergraduate Research (PSC 490, 490L, 491, 491L)

Individual research. Prospectus is prepared and research plan is executed with final status report required (one-hour lecture, three-hour lab each term).

Graduate Organic Polymer Chemistry I, II, and III —(PSC 701, 702, 703)—September to May.

An in-depth study of polymer forming reactions, their scope and limitations. Relationships between molecular weight, polymer structure, and physical properties of polymers are established (three-hour lecture each).

Graduate Polymer Physical Science I, II, and III (PSC 710, 711, 712)—September to May.

Includes such topics as light scattering, end group analysis, osmometry, polymer fractionation, NMR, IR, UV, and visible spectroscopy, thermoanalytical evaluation, mass spectrometry, polymer chain confirmation, macromolecular solutions, molecular weight distribution, morphology, rheology, structure-property relations, and kinetics of addition-, condensation-, and copolymerization (three-hour lecture each).

Physical Properties of Macromolecular Solids (PSC 810)—September to December.

Advance study of glassy and crystalline physical state of macromolecular solids emphasizing the influence of morphological structure (two-hour lecture).

Polymer Physics (PSC 811)—September to December.

Study of polymer conformation, phenomenological and molecular theories of polymer relaxation and diffusion in polymers (three-hour lecture).

Conformational Analysis (PSC 812) —September to December.

Study of molecular interactions that control polymer conformation. Molecular modeling in material design (three-hour lecture).

(Tuition scholarships supported by the Federation of Societies for Coatings Technology at the University of Southern Mississippi are available for undergraduate students interested in this curriculum.)

Coatings Science for Coatings Technicians—May 17-20, 1993.

Define basic principles of coatings design, synthesis, performance, and testing for industrial trade sales coatings; emphasis on environmentally compliant coatings. Lab sessions affording use of instrumentation for identifying testing and evaluating coating performance. Course includes Physical Testing — Wet Coating/Formulation Constants and Rheological Properties; Physical Testing — Applied Coatings/Mechanical Properties, Color, Chemical Resistance, Weathering Tests, and Microscopy of Film Morphology; Chemical Characterization/FTIR, GC, Molecular Weight by Analysis, DSC, NMS, and X-Ray. Fee: $875.

Coatings Science for Coatings Formulators—June 7-10, 1993.

Emphasis on formulation techniques and principles with special emphasis on economic, VOC regulatory, and coating performance criterion. Features influence on physical, chemical and end use application properties. Lab sessions affording experimentation and formulation development. Course includes Formulations within VOC Guidelines/Waterborne and High-Solids; Physical Properties/Hiding Optimization and Durability; Component Selection/Rheology Modifiers, Coalescing Agents, Flatting Pastes, Bactericides and Anti-Fouling Agents, Anti-Settling Additives, Leveling and Flow Control Agents, Defoaming Agents, UV Absorbers, Adhesion Promoters. Fee: $875.

Coatings Science for Coatings Chemists—June 14-17, 1993.

Interactive lectures emphasizing coatings selection, design, formulation, testing, and durability with special emphasis on low VOC environmentally compliant coatings. Course includes Introduction to Coatings Science/Resin Selection, Formulation of Low VOC Coatings, and Principles of Film Formation — Performance Requirements; Appearance Requirements; Associative Thickeners; Effect of Additives; Coating Analysis/Physical Properties and Chemical Characterization. Fee: $875.

Coatings Science of Powder Coatings — Application and Formulation —August 9-12, 1993.

Emphasis on the chemistry of powder coatings; new technologies in powder coatings; formulation of powder coatings; production of a powder coating using contemporary powder coatings

equipment; evaluation of coating properties. Course includes Introduction to Powder Coatings/Resin Selection, Selection of Crosslinking Agents, Pigment Selection, and Additives; Processing Conditions; Physical Testing — Applied Coatings/Mechanical Properties, Chemical Resistance, and Weathering Tests. Fee: $875.

Contact: Dr. Shelby F. Thames, Dept. of Polymer Science, University of Southern Mississippi, Box 10076, Hattiesburg, MS 39406-0076. Tel: (601) 266-4080. Fax: (601) 266-5880.

MISSOURI

University of Missouri-Rolla, Rolla, MO

Chemistry Curriculum (with specialization in polymer and coatings science)—This program encompasses the standard chemistry curriculum, plus courses in coatings, surface, and polymer chemistry. It is designed to provide undergraduate training in coatings science and technology.

Students seeking coatings science specialization are encouraged to seek summer employment at a coatings-oriented firm, as well as cooperative work-study programs with such firms. Students also participate in a senior research project in polymer and coatings science. This leads to the B.S. degree in Chemistry. M.S. and Ph.D. degree programs are also available for graduate studies.

Chemistry and Inherent Properties of Polymers (Chem 381)

A basic study of the organic chemistry of natural and synthetic high polymers, their inherent properties, and their uses in plastic, fiber, rubber, resin, food, paper, and soap industries.

Polymer Science Laboratory (Chem 384)

Lectures and laboratory experiments dealing with polymerization reactions, solution properties, and bulk or solid properties will be presented. Each student will prepare polymers and carry out all characterization experiments on actual samples which were prepared.

Fundamentals of Protective Coatings I (Chem 385)

Study of the basic principles of protective coatings with particular reference to the paint and varnish industry. Classification, manufacture, properties, and uses of protective coatings.

Inorganic Polymers (Chem 401)

A study of non-traditional organic and inorganic polymers and polymerization processes. Survey and discussion of classes of inorganic polymers, their characterization, and application.

Polymer Physical Chemistry and Analysis (Chem 484)

A study of the physical properties of macromolecular systems including polymer solutions, gels, bulk polymers, and rubbers. The chemical characterization of polymers based on their thermal, spectroscopic, microstructure, and molecular weight is also discussed.

Structure and Properties of Polymer (Chem E 375)

A study of the parameters affecting structure and properties of polymers. Syntheses, mechanisms, and kinetic factors are emphasized from the standpoint of structural properties.

Corrosion and Its Prevention (Chem E 381)

A study of the theories of corrosion and their application to corrosion and its prevention.

Chemical Engineering of High Polymers (Chem E 383)

Solution properties, molecular weight determination, and bulk properties including rheological behavior of high polymers are studied and used to explain techniques of characterization, manufacture, and processing of representative commercial types.

Chemical Engineering Fluid Dynamics (Chem E 439)

Fundamentals of Newtonian flow, non-Newtonian flow, flow through packed beds, two-phase flow, flow around submerged objects, and other related topics are discussed.

Plasma Polymerization (Chem E 475)

Fundamental aspects of polymer formation in plasma (weakly ionized gas), and properties of polymers formed by such a process will be studied.

Polymer Membranes for Separation (Chem E 476)

Basic principles of transport through a polymer membrane and transport characteristics of some polymers are studied. The selection of polymers and the method of preparing functional membranes for some separate processes are also studied.

(Tuition scholarships supported by the Federation of Societies for Coatings Technology to University of Missouri-Rolla are available for undergraduate students interested in this curriculum.)

Contact: Jim Stoffer or Harvest Collier, Chemistry Dept., University of Missouri-Rolla, Rolla, MO 65401. Tel: (314) 341-4419.

Introductory Short Course—The Basic Composition of Coatings—March 8-12, 1993.

This course is designed to introduce the newcomer, as well as those involved in raw material manufacture, sales and technical service, to the technical aspects of paint manufacture, testing and use. Fee: $795.

Introductory Short Course—Paint Formulation—March 15-19, 1993 and May 17-21, 1993.

This intense five-day course will take you through the basic steps of paint formulation, from understanding the process to an actual laboratory formulation. Fee: $895.

Basic Coatings for Sales and Marketing Personnel—July 28-30, 1993, St. Louis Airport Marriott Hotel.

This course is designed especially to aid sales and marketing people in the coatings industry to have a better understanding of the composition of coatings. Fee: $695.

For all of the previously mentioned University of Missouri-Rolla Short Courses, contact: Michael R. Van De Mark, or Cynthia Campbell, Chemistry Department, 236 Schrenk Hall, University of Missouri-Rolla, Rolla, MO 65401-0249. Tel: (314) 341-4419. Fax: (314) 341-6033.

NEW JERSEY

The Center for Professional Advancement, East Brunswick, NJ

Web Coating Processes and Applications—March 29-31, 1993.

Participants will gain an understanding of the more typical coating, drying and associated auxiliary equipment used in today's commercial converting processes. Major topics covered are: unwinding, winding and web handling; coating of webs by various processes; the drying or curing of these coated substrates. Fee: $990.

Pharmaceutical Coating Technology—April 26-28, 1993.

Participants will gain an understanding of the raw materials, processes, and problems associated with current methods for producing coated products. Among topics covered are traditional sugar coating and film coating methods. The potential for optimization of the coating process, the technology associated with film coating, and comparison of the various types of processing equipment. Fee: $990.

Additives for Coatings—May 11-13, 1993.

Participants will gain an overview of chemicals that are used as coating system additives. Introduction to and study of additives which are basic to the development of paints, coatings, inks, and plastics. Also covered is the chemical make-up of additives, the way in which they function, their purpose and methods of incorporation. Fee: $990.

Powder Paint Systems—September 27-29, 1993.

Participants will gain an understanding of the technology and equipment for dry powder paint and related coating applications and how this system can effectively replace solvent or water-based media. Among topics covered are the powder itself, pretreatment of the material to be coated, pretreatment and powder application equipment, ovens, conveyor systems, and ancillary gear. Fee: $1045.

Contact: Registration, Center for Professional Advancement, 144 Tices Lane, East Brunswick, NJ 08816-0257. Tel: (908) 613-4500. Fax: (908) 238-9113.

New York Society for Coatings Technology and Metropolitan New York Paint and Coatings Association

Basics of Coatings I—September to December 1992.

Discussion of the effects of polarity and solubility on coatings materials. Introduction to raw materials and curing mechanisms. Fee: $250 per semester.

Basics of Coatings II—March to June 1993.

Application, curing and physical testing equipment and procedures. Fee: $250 per semester.

Courses I and II constitute a basic sequence designed to introduce technicians, sales personnel, and others with little formal education in chemistry to the materials and methods employed in coatings.

Chemistry of Coatings—September to December 1993.

A more detailed exploration of the binders and other raw materials used in coatings; mechanisms of drying and curing; principles of formulation. Prerequisite—Organic Chemistry. Fee: $250 per semester.

Rheology of Coatings—March to June 1994.

Introduction in the principles of rheology and pigment dispersion. Prerequisite—Physical Chemistry. Fee: $250 per semester.

Chemistry of Coatings and Rheology of Coatings constitute an advanced sequence designed to increase the knowledge of those with formal training in chemistry, and to inform them of the newest and best techniques.

All above courses held at Fairleigh Dickinson University, Rutherford, NJ.

Contact: Don Brody, Consultant, 115 Mornside Road, Verona, NJ 07044-1001. Tel: (210) 239-7243. Fax: (201) 460-7549.

NORTH CAROLINA

University of North Carolina, Greensboro, Department of Chemistry, Greensboro, NC

Introduction to Polymer Science (CHE 570e)—15 Weeks. January 1993—April 1993. University of North Carolina, Greensboro, Room 219 Petty Building.

Identification of types of polymerization. Molecular weight distribution. Determination of molecular weights. Viscoelastic properties of polymers. The objective of the course is to give students an introduction to polymer chemistry with emphasis on the physical chemical aspects. Fee: $15 through UNCG Office of Continuing Education (Rm. 209 Forney Bldg.).

Contact: Albert B. Rives, University of North Carolina Greensboro, Dept. of Chemistry, Greensboro, NC 27412. Tel: (919) 334-5473; Fax: (919) 334-5402).

NORTH DAKOTA

North Dakota State University, Fargo, ND

Environmentally Compliant Coatings—June 7-11, 1993.

Course will be taught at the research level with emphasis on the underlying physical, organic, and polymer chemistry. Theoretical considerations will be related to practical problems, and new approaches will be suggested. The course will cover the following areas of coatings: High Solids, Water-Reducible Coatings, Latex, Powder Coatings, Radiation Curing, and Characterization and Analysis of Coatings. Fee: Registration — $750; Lodging and Meals — $300.

Coatings Science—June 14-25, 1993.

Provides an understanding of principles that underlie coatings technology. Approaches to improving coatings performance and cost, recent developments, safety, environment, will be taught with emphasis on the underlying basic physical, organic, and polymer chemistry. The course will cover existing and new technologies in the following areas: Film Formation, Resins and Crosslinking Reactions, Solvents, Pigments, Coatings Additives, Color and Appearance, Rheology, Fundamentals of Latex, Powder, High Solids, Solvent and Waterborne Coatings and their Formulation. Fee: Registration — $1500; Lodging and Meals — $750.

Contact: Prof. Marek W. Urban, North Dakota State University, Department of Polymers & Coatings, Fargo, ND 58105. Tel: (701) 237-7633. Fax: (701) 237-VIEW.

OHIO

Case Western Reserve University, Cleveland, OH

Courses are offered by either the Department of Macromolecular Science (EMAC) or by the Department of Chemical Engineering (ECHE), as part of full academic program for B.S., M.S., or Ph.D. degrees in Macromolecular Science and Engineering. Overall coverage of polymer science and engineering includes topics relevant to coatings science and technology, and research projects directly concerned with coatings.

Courses on the 400-level (first and second year graduate students) often are given over the Instructional Television Network (ITN), via VCR cassette, available to students in industry for either audit or academic credit. Call (216) 368-2982, or write ITN, CWRU, Cleveland, OH 44106.

Polymer Materials (EMAC 176)

The materials properties associated with the use of synthetic and natural polymers in films, fibers, composites, rubbers, paper, foods, etc., are described and correlated with physical and chemical structures.

Introduction to Polymer Science (EMAC 270)

An introduction to the science and engineering of large molecules; correlation of molecular structure and properties of molecules in solution and bulk; control of significant structural variables in polymer synthesis; analysis of physical methods for characterization of molecular weight, and morphology.

Polymer Analysis Laboratory (EMAC 272)

Experimental techniques in polymer synthesis and characterization; synthesis by free radical emulsion, anionic and condensation polymerization; investigation of polymer structure by x-ray diffraction, electron microscopy, infrared, NMR and circular dichroism spectroscopy; molecular weight determination by light scattering and viscosity measurement; study of chemical and mechanical properties.

Polymer Properties and Design (EMAC 276)

Engineering properties of polymers and their evaluation in terms of selection and design procedures. The relation of properties to the chemical and physical structures of polymers and application conditions.

Polymer Engineering (EMAC 376)

Mechanical properties of polymer materials as related to polymer structure and composition. Introduction to melt rheology and electrical, optical, and surface properties of polymers.

Polymer Processing (EMAC 377/477)

Rheological, molecular, structural, engineering, and compounding factors affecting processibility and properties of polymers; principles and procedures for extrusion, melting, calendering, injection molding, coatings and other primary processing methods. Considerations of pertinent mechanisms and theories with emphasis on the application of theory to practice.

Polymer Production and Technology (EMAC 378)

Engineering operations for industrial polymerization procedures. Finishing and fabrication of polymers. Production and technology of plastics, elastomers, fibers, and coatings.

Polymer Processing and Properties Laboratory (EMAC 379)

Experimental and industrial production techniques and practice in mixing, plastics processing, elastomer extrusion, fiber and composites production. Testing of plastics, elastomers, fibers, coatings and composites. Maintenance and quality control. Processing project.

Macromolecular Synthesis (EMAC 470)

The organic chemistry of macromolecules. The mechanisms of polyreactions, the preparation of addition, condensation and biopolymers, and the chemical reactions of polymers.

Physical Chemistry of Macromolecules (EMAC 472)

The major areas of the physical chemistry of macromolecules are treated; theories and experimental methods of polymer solutions, physical methods for determination of chemical structure and configuration.

Macromolecular Physics (EMAC 474)

Introduction to the physics of amorphous and crystalline polymers. Equilibrium elastic properties of rubbery materials. Viscoelasticity. The liquid-glass and glass-glass transitions. The morphology, characterization and deformation behavior of crystalline polymers.

Applied Macromolecular Science and Engineering (EMAC 476)

Properties, processing and technology of plastics, elastomers, fibers, films, and coatings. The mechanical behavior of polymers related to polymer structure and composition.

X-Ray Crystallography (EMAC 479)

A basic description of the scattering of x-rays by crystalline and semicrystalline solids including polymers. Techniques of structure analysis.

Polymer Composite Processing (EMAC 481)

Factors affecting the selection of composite processing methods. Characteristics and applications of compression, injection and reinforced injection molding of composites. Filament winding and pultusion methods.

Fundamentals of Adhesives, Sealants, and Coatings (EMAC 482)

The principles of film formation, film application methods, and related fabrication factors and procedures. Relevant adhesion theories and practices, aspects of rheological treatments, optical and other factors which affect applications. The nature and properties of constituent polymer materials, pigments, solvents, and other additives. Selection and design of systems for mechanical, surface environmental resistance, and other properties.

Macromolecular Synthesis II (EMAC 570)

A series of advanced topics in methods and mechanisms of polymerization of synthetic and biopolymers. Coordination, emulsion, ionic and topochemical polymerizations. Novel polymerization methods.

Physical Chemistry of Macromolecules II (EMAC 572)

A series of advanced topics in the physical chemistry of polymers, including conformational statistics of flexible chains, optical properties of polymers and the physical chemistry of biological materials and systems.

Polymer Rheology (EMAC 575)

A systematic study of deformation and flow of matter, with emphasis on polymeric and colloidal systems; topics include rheology of non-Newtonian fluids, the flow properties of simple fluids and dispersions, linear viscoelasticity, polymer solutions and melts, and applications to processing of polymers.

Selected Topics in Macromolecular Synthesis (EMAC 670); Physics (EMAC 671); Physical Chemistry (EMAC 672); Special Topics (EMAC 690)

Content varies depending on the interests of the students and faculty. The topics presented represent advanced and special topics at the forefront of the science and engineering of polymers and polymeric systems. Courses are given on a demand basis.

Characterization of Macromolecules (EMAC 678)

Laboratory experience is gained with the synthesis and characterization of polymers. Methods used include light scattering, viscosity infrared, circular dichroism and NMR spectroscopy. Solid samples are characterized by x-ray diffraction, electron microscopy and differential thermal analysis.

The Scientist in the Industrial Environment (EMAC 691)

Course conducted on a seminar basis, focusing on how R&D management plans, justifies and operates within the corporate structure and the areas which R&D encounters in so doing—finance, law, purchasing, manufacturing, marketing and environmental control.

Surfaces and Adsorption (ECHE 464)

The structure of interfaces including 2-D symmetry, the thermodynamics of interfaces, nature of interactions across phase boundaries, wetting, spreading and surface energetics, adsorption on liquid and solid substrates, properties of adsorbed films; instrumental methods in surface science.

Dispersion and Emulsion (ECHE 466)

The structure and dynamics of dispersions, measurement techniques, electrokinetic phenomena, stability, DLVO, stochastic processes; investigation of colloid systems, including emulsions, micro-emulsions, sols, gels and foams; filtration processes.

Courses also are offered in: Polymers in Medicine (EMAC 471); Biopolymers (EMAC 473); and Characterization of Biopolymers (EMAC 475).

Contact: Charles E. Rogers, School of Engineering, Dept. of Macromolecular Science, Case Western Reserve University, Cleveland, OH 44106. Tel: (216) 368-6376.

American Chemical Society

Frontiers in Polymer Chemistry—May 12-14, 1993. University of Akron, Akron, OH.

This course is of value to chemists actively involved in polymer science. Its intensive coverage of the field is of special benefit to researchers and managers concerned with the synthesis, modification, and application of new polymers. Enrollment is limited to a maximum of 35 attendees. Fee: ACS Member—$1195. Nonmember—$1295.

Contact: American Chemical Society, Dept. of Continuing Education, Meeting Code FRPC9104, 1155 Sixteenth St., N.W., Washington, D.C. 20036. Tel: (800) 227-5558 or (202) 872-4508.

HunterLab

Color Matching Seminar—April 21-22, 1993, Cincinnati Marriott, Cincinnati, OH.

This course combines everything from building a color database unique to your own process through proper laboratory procedures. Gain a better understanding of how to select colorants as you create formulas for an accurate match. First day is lectures and presentations, second day individual consultations hands-on with samples and instruments. Fee: $395.

Contact: Joan Dorsch, Seminar Coordinator, Hunter Associates Laboratory, Inc., 11491 Sunset Hills Rd., Reston, VA 22090-5280. Tel: (703) 471-6870; Fax: (703) 471-4237.

Products Finishing Magazine

Qualifinish '93—March 23-25, 1993, Drawbridge Inn, Cincinnati, OH.

The Conference on Quality in Finishing includes ISO 9000, TQM/SPC, Quality in Electroplating, EN, Anodized Aluminum, etc. Fee: $400.

Plasticoat '93—May 4-6, 1993, Drawbridge Inn, Cincinnati, OH.

Focusing on the application of thermoplastic powder coating, application of thicker-film, functional powder coatings. Fluidized bed application of vinyls and nylons, electrostatic spray of functional thermoplastic coatings, flame spray, nylon coating of small parts and PVDF finishes on aluminum extrusions for architectural applications will also be addressed.

Contact: Shirley Spears, 6600 Clough Pike, Cincinnati, OH 45244. Tel: (513) 527-8977. Fax: (513) 527-8950.

Kent State University

Surface Coatings III—Chemistry 40093 (undergraduate); ***Chemistry 5-70093*** (graduate)—September 11—December 11, 1993.

Special topics of interest to coatings chemists and students. Subjects: Extenders, Graft Copolymer Binders, Film Formation and Cure, Analytical Characterization of Coatings, Color Measurements, Corrosion Protection, Adhesion, Statistical Analysis and Quality Control, Coating Characterization (physical), Powder Coatings, Coating Application and Inspection. Fee: $524 (tentative).

Applied Rheology for Industrial Chemists—April 26-30, 1993. Four-and-one-half days.

Aimed at providing practitioners in the coatings, adhesives, elastomers, and plastics industries with insights which will enable them to write and understand specifications, improve quality control and learn techniques in rheology. The course covers subjects related to rheology, kinematics and dynamics, dispersion, interfacial and polymer rheology, with discussions divided equally between principles and application. Fee: $825.

Dispersion of Pigments and Resins in Fluid Media—May 10-14, 1993. Four-and-one-half days.

The chemistry and mechanical aspects of the dispersion of pigments and resins in fluid media are discussed. Subjects covered include: theoretical underpinnings of dispersion, ranging from fundamentals of dispersion preparation and modification to stabilization. Practical consequences are shown, followed by expert presentation on the operation of a variety of dispersion equipment and plant practice. Fee: $825.

Adhesion Principles and Practice for Coatings and Polymer Scientists—May 24-28, 1993. Four-and-one-half days.

This course is designed for industrial scientists and technologists who encounter adhesion problems. Common problems are addressed through theoretical treatments. Closely allied with coatings, as well as rheology, the subject of adhesion is addressed by topics ranging from principles of bonding to surface chemistry, to a wide variety of mechanical properties. Adhesion principles are discussed first, then applied problems that have been solved in the industrial and academic settings. Fee: $825.

Introduction to Coatings Technology—October 5-8, 1993. Three-and-one-half days.

Presented in cooperation with Chemistry Department and Pacific Technical Consultants, this introductory course is designed to help technical and non-technical newcomers understand the coatings industry, its challenges and opportunities. It covers the evolution of coatings technology and the progress the coatings industry is making in its rapid change from art to science. Coverage includes: many raw materials and their functions in both architectural and industrial finishes; regulatory restrictions, economic forces; factors that influence the composition and performance of coatings; formulation and calculations including anatomy of paint and chemicals, weight and volume relationships, testing procedures, basic quality assurance, safety, pollution control regulations and waste management. Fee: $700.

Weathering Techniques for Coatings and Polymers—September 29-October 1, 1993. Two-and-one-half days.

Presented in cooperation with Chemistry Department and Portage Technical Consultants, this course is designed to help predict the service life of coatings and polymers by accelerated and natural weathering techniques. Lectures include the variation of accelerated and exterior testing as well as a correlation between natural weathering with various spectroscopic methods. Accelerated testing of coatings for corrosion control, along with an overview of laboratory accelerated weathering methods are described. Appearance performance modeling for accelerated data, weathering through FTIR spectroscopy and uses of florescent UV in weathering are presented. Fee: $625.

Fundamentals of Chromatographic Analysis—June 7-11, 1993. Four-and-one-half days.

Presented in cooperation with Chemistry Department and Varian, this course is designed to provide a coherent overview of chemical separations via chromatographic methods. Materials included are: gas, liquid and thin-layer methods of chromatographic analysis. The course stresses the three techniques as complementary rather than competing processes and is a blend of fundamental information on theory and instrumentation with applications, including coatings. Fee: $825.

Industrial Painting: Application Methods—October 12-14, 1993.

Gain a working knowledge of current methods used to apply paints. Learn why customers may have problems with your paints and how you can help them. Subjects: Cleaning Methods, Conver-

sion Coatings, Finishing Processes for Metals and Plastics, Liquid Processes, Powder Coatings, Electrodeposition, Waterborne and High Solids Coatings, Production Problems, Future Trends, Sprayed Paint Defects (Their Causes and Cures). Fee: $625.

Surface Chemistry — Chemistry 4057l—15 Weeks.

Theory and behavior of inorganic and organic colloidal dispersions and their applications to industrial chemistry. Viscosity Sedimentation, Diffusion, Osmosis, Donnan Equilibrium, Light Scattering, Surface Tension, Absorption, Wetting, Electrical Phenomena, Van Der Waals Forces, Double Layer Theory, and Electropheresis.

Physical Chemistry of Macromolecules — Chemistry 40583—15 Weeks.

An introduction to the physical chemistry of macromolecules. Subjects: Molecular Forces and Bonding, Conformation, Thermodynamics, Molecular Weights, Collegative Properties, Light Scattering, Viscosity, Spectroscopy, Mechanical Properties, Rheology and Mass Transitions.

Contact: Carl J. Knauss, Kent State University, Chemistry Department, P. O. Box 5190, Kent, OH 44242-0001. Tel: (216) 672-2327. Fax: (216) 672-3816.

PENNSYLVANIA

Lehigh University, Bethlehem, PA

Coatings-related courses are offered in the departments of Chemical Engineering (ChE), Chemistry (Chem), and Materials Science (Mat).

Physical Chemistry of Printing Inks (Chem 385)

Physical chemical mechanisms of printing processes; composition, dispersion processes for pigments rheology and printability of inks; color-matching; development of solventless inks and specialty inks.

Polymer Synthesis and Characterization Laboratory (ChE 388/Chem 388)

Techniques include: free radical and condensation polymerization; molecular weight distribution by gel chromatography; crystallinity and order by differential scanning calorimetry; pyrolysis and gas chromatography; dynamic mechanical and dielectric behavior; morphology and microscopy; surface properties.

Polymer Science (ChE 392/Chem 392)

Introduction to concepts of polymer science. Kinetics and mechanism of polymerization, synthesis and processing of polymers, characterization. Relationship of molecular conformation, structure and morphology to physical and mechanical properties.

Physical Polymer Science (ChE 393/Chem 393/Mat 343)

Structural and physical aspects of polymers (organic, inorganic, natural). Molecular and atomic basis for polymer properties and behavior. Characteristics of glassy, crystalline, and paracrystalline states (including viscoelastic and relaxation behavior) for single and multicomponent systems. Thermodynamics and kinetics of transition phenomena. Structure, morphology, and behavior.

Organic Polymer Science (ChE 394/Chem 394)

Organic chemistry of synthetic high polymers. Functionality and reactivity of monomers and polymers. Theory of stepgrowth and chaingrowth polymerization in homogeneous and heterogeneous media. Polymerization by addition, elimination, substitution and coupling reactions. Ionic free-radical and coordinate catalysis.

Colloid and Surface Chemistry (Chem 395)

Physical chemistry of everyday phenomena. Intermolecular forces and electrostatic phenomena at interfaces, boundary tensions and films at interfaces, mass and charge transport in colloidal suspensions, electrostatic and London forces in disperse systems, gas absorption and heterogeneous catalysis.

Engineering Behavior of Polymers (ChE 482/Chem 482/Mat 482)

A treatment of the mechanical behavior of polymers. Characterization of experimentally observed viscoelastic response of polymeric solids with the aid of mechanical model analogs. Topics include time-temperature superposition, experimental characterization of large deformation and fracture processes, polymer adhesion, and the effects of fillers, plasticizers, moisture and aging on mechanical behavior.

Emulsion Polymers (ChE 483/Chem 483)

Examination of fundamental concepts important in the manufacture, characterization, and application of polymer latexes. Topics covered include colloidal stability, polymerization mechanisms and kinetics, reactor design, characterization of particle surfaces, latex rheology, morphology considerations, polymerization with functional groups, film formation and various application problems.

Polymer Blends and Composites (ChE 485/Chem 485)

An intensive study of the synthesis, morphology, and mechanical behavior of polymer blends and composites. Mechanical blends, block and graft copolymers, interpenetrating polymer networks, polymer impregnated concrete, and fiber and particulate reinforced polymers are emphasized.

Polymer Processing (ChE 486)

Application of fundamental principles of mechanics, fluid dynamics and heat transfer to the analysis of a wide variety of polymer flow processes. A brief survey of the rheological behavior of polymers is also included. Topics include pressurization, pumping, die forming, calendering, coating, molding, fiber spinning and elastic phenomena. Held every second year.

Topics in Colloid and Surface Chemistry (Chem 487)

Applications of colloid chemistry, special topics in surface chemistry. Lectures and seminar. May be repeated for credit as different topics are covered. Held every second year.

Topics in Polymer Science (ChE 492/Chem 492)

Intensive study of topics selected from areas of current research interest such as morphology and mechanical behavior, thermodynamics and kinetics of crystallization, new analytical techniques, molecular weight distribution, non-Newtonian flow behavior, second-order transition phenomena, novel polymer structures. Credit above three hours is granted only when different material is covered.

24th Annual Short Course—Advances in Emulsion Polymerization and Latex Technology—June 7-11, 1993, Sinclair Laboratory Auditorium, Lehigh University.

This course is an in-depth study of the synthesis, characterization, and properties of high polymer latexes. The subject matter includes a balance of theory and applications as well as a balance between chemical and physical problems. Fee: $900 for entire week, or $300 per day.

Contact: Dr. Mohamed S. El-Aasser, Emulsion Polymers Institute, Lehigh University, Iacocca Hall, Bethlehem, PA 18015. Tel: (215) 758-3082; Fax: (215(] 758-5880.

Corrosion Control by Coatings—September.

This annual course is aimed at those concerned with protective coatings research and technology, and also provides demon-

strations of basic laboratory techniques. Opportunities are available for individualized instruction.

Introduction to Coatings Technology—February to May, Northeastern Christian Junior College, Villanova, PA.

This 12-week evening course (two hours per week) is designed for new coatings formulators, as well as sales and marketing personnel in coatings and allied industries. Focus is on six basic coatings formulations and the formulation technology, raw materials, application, and performance of each. Enrollment is limited. Fee: Philadelphia Society members, $300; non-members, $350.

Course is presented in conjunction with Lehigh University; successful course completion earns 3.6 CEU credits; course may be qualified for credit at another institution by prior arrangements.

Contact: Dr. Richard Granata, Zettlemoyer Center for Surface Studies, Sinclair Lab #7, Lehigh University, Bethlehem, PA 18015 (215) 758-3574.

Philadelphia Society for Coatings Technology

Waterborne Coatings Formulations—May 1993. Airport Hilton, Philadelphia, PA.

Contact: Peter C. Kuzma, VIP Products Corp., 3805 Frankford Ave., Philadelphia, PA 19124. Tel: (215) 535-3025.

RHODE ISLAND

Dry Color Manufacturing Association and Inter-Society Color Council

Color Pigments, Regulations, and the Environment—April 20-21, 1993, Doubletree Hotel, Newport, RI.

Contact: Romesh Kumar, Hoechst Celanese Corp., 500 Washington St., Coventry, RI 02816. Tel: (401) 823-2161.

TENNESSEE

Southern Society for Coatings Technology

Annual Meeting—"Waterborne Coatings—Riding the Wave to the Future"—April 21-23, 1993, Opryland Hotel, Nashville, TN.

Contact: Mary Finnigan, McCullough & Benton, Inc., 2900 G Carolina Center, Charlotte, NC 28208. Tel: (704) 392-2101.

TEXAS

Federation of Societies for Coatings Technology

Spring Week—"The Influence of Substrates and Application Methods/Techniques on Coatings Performance"—May 18-19, 1993. South Shore Harbour Resort and Conference Center, League City (Houston), TX.

Contact: Federation of Societies for Coatings Technology, 492 Norristown Road, Blue Bell, PA 19422. Tel: (215) 940-0777. Fax: (215) 940-0292.

Houston and Dallas Societies for Coatings Technology

Southwestern Paint Convention—"Back to the Future"—March 17-19, 1993, Four Seasons Resort and Club, Las Colinas, TX.

Contact: Steve Stephens, Ribelin Sales, Inc., P.O. Box 461673, Garland, TX 75046-1673. Tel: (214) 272-1594.

HunterLab

Color Matching Seminar—January 27-28, 1993, Radisson Hotel & Suites Dallas, Dallas, TX.

This course combines everything from building a color database unique to your own process through proper laboratory procedures. Gain a better understanding of how to select colorants as you create formulas for an accurate match. First day is lectures and presentations, second day individual consultations hands-on with samples and instruments. Fee: $395.

Contact: Joan Dorsch, Hunter Associates Laboratory, Inc., 11491 Sunset Hills Rd., Reston, VA 22090-5280. Tel: (703) 471-6870; Fax: (703) 471-4237.

National Association of Corrosion Engineers

12th International Corrosion Congress—Corrosion Control for Low-Cost Reliability—September 19-24, 1993. Houston, TX.

The goal of this congress is to stimulate and promote better corrosion control for increased reliability by discussion and dissemination of current corrosion science and technology from around the world. Fee: full congress registration, $425; one-day registration, $150; guest program registration, $85; student registration, $75; banquet tickets, $50.

Contact: NACE Membership Services Dept., P. O. Box 218340, Houston, TX 77218-8340. Tel: (713) 492-0535, Ext. 81. Fax: (713) 492-8254.

Kilgore College, Kilgore, Texas

Atmospheric Corrosion Control (CORR 2410)—August to December 1993.

An in-depth study of atmospheric corrosion control including coating types, selection, application, inspection and failure analysis. A lab is included. Atmospheric corrosion instruction includes coating theory and a separate laboratory period where students are exposed to hands-on sand blasting, spray painting, and inspection practices. Inspection includes measurement of surface contamination, surface profile depth, coating viscosity, wet and dry film thickness, temperature conditions, dew point readings, holiday detection, cure, and adhesion. Additional time is spent learning to write coating specifications to match the needs of various types of coatings.

Contact: Joe Miller, Kilgore College, 1100 Broadway, Kilgore, TX 75662. Tel: (903) 983-8159.

VIRGINIA

American Chemical Society

Polymer Chemistry: Principles and Practice—March 7-12, 1993; August 15-20, 1993; and December 5-10, 1993, Virginia Tech, Blacksburg, VA.

Gain hands-on experience by performing a variety of experiments in the field; learn from comprehensive coverage of almost every major aspect of polymer chemistry, learn how to diagnose and solve practical problems in polymer synthesis, and work with and learn from renowned authorities in the polymer field. Fee: ACS members, $1850; non-members, $2050.

Polymer Characterization: Thermal, Mechanical and Optical—May 9-14, 1993. Virginia Tech, Blacksburg, VA.

This course features strategies for understanding polymer synthesis techniques, new methods of polymer characterization, how to handle state-of-the-art analytical equipment, and practical, problem-solving ideas in polymer science, individual attention from instructors. Fee: ACS members, $1840; non-members, $1990.

Polymer Synthesis: Fundamentals and Techniques—May 16-21, 1993, Virginia Tech, Blacksburg, VA.

Features strategies for understanding polymer synthesis techniques, new methods of polymer characterization, how to handle state-of-the-art analytical equipment, and practical, problem-solving ideas in polymer science. Fee: ACS members, $1840; nonmembers, $1990.

Note: These courses have limited enrollment.

Contact: Pamela McInally, American Chemical Society, Dept. of Continuing Education, 1155 Sixteenth St., N.W., Washington, D.C. 20036. Tel: (800) 227-5558 or (202) 872-4508. Fax: (202) 872-6336.

National Paint and Coatings Association

Marine Coatings Conference—June 2-4, 1993, Virginia Beach Resort Hotel, Virginia Beach, VA. Open only to NPCA members.

Contact: Ken Zacharias, National Paint and Coatings Association, 1500 Rhode Island Ave., N.W., Washington, D.C. 20005. Tel: (202) 462-6272. Fax: (202) 462-8549.

Washington Paint Technical Group

Annual Symposium—April 13-14, 1993, Ramada Inn, Tyson's Corner, Virginia.

The Symposium will explore new technologies between industry and government.

Contact: Mark Padow, c/o National Paint and Coatings Association, 1500 Rhode Island Ave., N.W., Washington, D.C. 20005. Tel: (202) 462-6272. Fax: (202) 462-8549.

WASHINGTON

Pacific Northwest Society for Coatings Technology

Pacific Northwest Society Symposium—April 29-May 1, Red Lion Hotel, Bellevue, WA.

Contact: Richard C. Tomczak, Van Waters & Rogers, Inc., 8201 S. 212th, Kent, WA 98032. Tel: (206) 872-5097.

INTERNATIONAL

CANADA

Quebec Ministry of Education with the Montreal Society for Coatings Technology Educational Committee

Introduction Aux Techniques du Revetement—October 19-December 9, 1993, College Ahuntsic, Montreal, Que.

Provide specific information about protective coatings and a basic understanding of the raw materials used. *(The course is given in French.)* Techniques of formulation, manufacturing, quality control and methods of application of the most commonly used materials in the fields of industrial and trade sales paints. Fee: $130.

Contact: Alexandre Vignini, Tioxide North America, 9999 Cavendish Blvd., St-Laurent, Quebec, H4M 2X5, Canada. Tel: (514) 748-4319; Fax: (514) 747-6807.

George Brown College of Applied Arts and Technology, Toronto, Ontario, Canada

Evening and Saturday part-time courses in coatings and plastics technology are offered at the St. James Campus, convenient to downtown Toronto.

The courses, which are approved and certified by the College and the Toronto Society for Coatings Technology, are designed to be taken separately. Credits may be accumulated toward the Chemical Technician—Coatings Certificate.

Polymer Chemistry (CHEM 2101)—15 weeks. (Three hours per week.)

Introduces basic concepts of polymer science and discusses variables affecting properties of polymers.

Topics covered include: polymer classification; primary and secondary forces; theory of functionality; molecular weight and its distribution; configurations and conformations of polymer chains; morphology; polymer stabilization and degradation; polymer solutions; and solvent-pigment-binder interactions.

Resins "C" (COAT 2051)—15 weeks. (Three hours per week.)

This course is a study of raw materials, manufacturing methods, chemistry, film formation, properties and uses of lacquer and hydrocarbon, phenolic, amino, silicone and waterborne resins.

Introduction to Microcomputer Programming (PRGM 9251)—10 weeks. (Three hours per week).

This course covers the following topics: introduction to the microcomputer, hardware, software, terminology, and the language BASIC; writing, running, saving, and printing programs; program development, including documentation, editing, input and output techniques, decision-making and branching; arrays and READ/DATA statements.

Resins "A" (COAT 2041)—(Polyesters, Alkyds, Epoxies)—15 weeks. (Three hours per week)

This covers chemical structure of raw materials, formulating resins to achieve specified properties, additives, condensation-addition polymerization, curing mechanisms, compounding, patton K factor, properties of uncured and cured resins, advantages and disadvantages of each resin, applications in coatings and related industries.

The following laboratory courses are offered:

Resins "A" Laboratory (COAT 2141)

Prerequisite COAT 2041 or equivalent. Quality control, curing, properties of unsaturated polyester, alkyds, and epoxy resins. Enrollment limited.

Resins "C" Laboratory (COAT 2151)

Prerequisite COAT 2051 or equivalent. Quality control, curing, film formation, properties of: lacquer, hydrocarbon, phenolic, amino, silicone and waterborne resins. Enrollment limited.

Paint Flow and Pigment Dispersion Laboratory (COAT 2161)

Measurement of rheological properties of water and solvent borne systems using rheological additives with viscometers. Evaluation of factors affecting viscosity, brushing, leveling, settling. Dispersion of pigments using various dispersion techniques. Assessment of pigment dispersion in mill-base and let-down stage.

Polymer Chemistry Laboratory (CHEM 2201)

Prerequisite Chem 210 or equivalent. Synthesis of commercially available polymers; performing quality control tests. Determination of molecular weight and identification of various polymers.

Contact: Peter Rodak, George Brown College of Applied Arts and Technology, P. O. Box 1015, Station B, Toronto, Ontario M5T 2T9, Canada. Tel: (416) 867-2000 (Ext. 2202).

Toronto Society for Coatings Technology in Cooperation with George Brown College

Coating Technology—15 weeks per semester. Complete course consists of three semesters. September 3, 1992; January 7, 1993; and September 4, 1993, George Brown College, Toronto, Ont.

To provide comprehensive theoretical education in modern protective coating technology. The courses are directed primarily towards people already in the industry who want to improve their understanding of the technology, or those who are just entering the industry. It is a three semester course program. In the first, raw materials, the second, architectural (trade sales) coatings, and in the third, industrial coatings are studied. Upon completion of the three semesters and final tests, the college issues a certificate in Coating Technology. Fee: Approx. $85 Canadian per semester.

Course location: George Brown College, 200 King St. East, Toronto, Ontario.

Contact: Walter Fibiger, ITE Consultants, 86 Castlebury Cr. Unit 17, Willowdale, Ontario, M2H 1W8, Canada. Tel: (416) 490-9314.

GERMANY

European Coatings Show '93—March 16-18, 1993, Nuremberg, Germany. Exhibition and Congress.

Contact: Ina Fullkrug, Vincentz Verlag, Schiffgrben 41-43, D-3000, Hannover 1, Germany.

ITALY

Manchester Metropolitan University and University of Milan.

3rd International Congress on Polymer Photochemistry—September 5-10, 1993, Genova, Italy.

Contact: Emmezeta SRL, Via C. Farini, 70, 1-20159, Milano, Italy.

SWITZERLAND

Advances in Emulsion Polymerization and Latex Technology—August 16-20, 1993, Davos, Switzerland.

Sponsored by Georgia Institute of Technology and Emulsion Polymers Institute, Lehigh University, this course is designed for engineers and scientists who are actively involved in emulsion work as well as for those who wish to develop expertise in the area. A basic background in chemistry will be assumed. Fee: $900 a week or $300 per day.

Contact: Dr. Gary W. Poehlein, Interdisciplinary Programs, Georgia Institute of Technology, Atlanta, GA 30332-0370. Tel: (404) 894-4826; Fax: (404) 894-7339.

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1992 A.L. HENDRY AWARD PAPER

A Methodology for Evaluating The Total Performance of Coatings And Coating Systems

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Drexel University*

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Coatings technologists are frequently asked to develop or select an optimum coating or coating system for a specific application. In most cases the intended application places several demands on the coating(s) which in turn must display numerous properties. Even when several coatings meet all of the fundamental requirements, it is usually desirable to identify the material which will out-perform the others. This decision-making process becomes difficult when property trade-offs exist.

A methodology to quantitatively and consistently evaluate the cumulative effects of a number of coating (or coating system) properties on overall performance has been developed. This analysis is based on the Zero-Max Technique which converts property values to an equivalent scale for comparative purposes. A weighting value which is representative of property importance on overall performance is also determined and utilized to obtain an overall Total Performance Evaluation (TPE) rating. This approach has been demonstrated in the selection of an optimum binder system for a self-priming topcoat for military ground equipment. The demonstration illustrates that the TPE can be used to determine statistical differences between overall coating performance. The methodology is applicable to all areas of coating characterization and selection.

INTRODUCTION

Materials scientists and engineers, including those concerned with paints and coatings, are frequently faced with the task of selecting the "best" material for a specific function. In the paint industry, this occurs when the field engineer is selecting a coating for touch-up, when the equipment designer is determining a finishing system, and when the coatings formulator is screening or optimizing a coating in a development effort. This decision-making process includes: (1) identifying critical properties required for good performance and defining their relative importance, (2) selecting potential candidates to meet these requirements, (3) testing and evaluating the selected candidates, and (4) determining the performance trade-offs which exist between materials and subsequently selecting the "optimum" material.[1] For example, three essential properties for an aircraft exterior coating are flexibility, weatherability, and chemical resistance. Flexibility is required to minimize cracking of the coating system at panel seams and around fastener heads. Weather resistance is required for long-term exterior durability, and chemical resistance is necessary to withstand harsh operational fluids (fuel, engine oils, hydraulic fluids, deicing fluids, etc.). Unfortunately, formulation adjustments which cause a coating to be more flexible normally decrease its weatherability and chemical resistance.

This simplistic example illustrates a more complex dilemma frequently encountered by materials technologists. The difficulty arises when one tries to define and select the best or optimum coating. Even when several coatings meet all of the fundamental requirements, it usually is desirable to identify the material which will out-perform the others. This problem can be stated: "When property trade-offs exist, which material will exhibit the best overall performance and how does one select or determine this material?" No definitive answer to this question exists. In fact, the coatings literature

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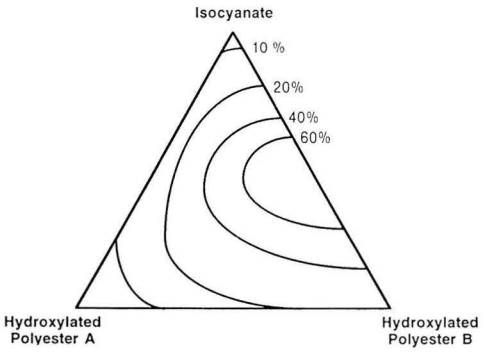


Figure 1—Example contour plot: impact flexibility (Federal Test Method 141C 6226)

contains numerous examples of researchers attempting to select a single coating with the best total performance for a given application. For the most part, these decisions are made using various qualitative and subjective approaches, many of which result in a simple ranking of coatings (best versus worst) in contrast to comparing performance levels.

The objective of the work discussed herein was to develop and demonstrate an analytical approach to quantitatively and consistently evaluate the overall performance of coatings and coating systems. We call this a Total Performance Evaluation (TPE).

DEVELOPMENT OF TPE METHODOLOGY

Background

A number of authors have described approaches to statistically design formulation and experimentation in order to streamline coating development and selection.[2–5] Other researchers have provided examples illustrating the use of these and alternate techniques.[6–9] In the case of coating development, one approach is to systematically select and analyze component mixtures and subsequently determine property responses to compositional changes. Two effective methods are a simplex screening design[2,3] and an extreme vertices design[3,4] which are statistical methods for determining compositions to be analyzed. In both approaches, a formulation "region" is analyzed by selecting, preparing, and testing compositions. Property responses to composition variation can then be efficiently determined by fitting the property data and compositional variables to obtain empirical relationships. These relationships are conveniently represented as contour plots which predict property values for a large range of formulation mixtures. *Figure* 1 is an example of one such contour plot.

These approaches enable the coatings formulator to quickly and efficiently determine the best formulation for a specific property. If requirements for two properties exist, the empirical equations and/or contour plots can be analyzed to determine potential formulations. However, in most cases a coating is required to display numerous properties. For example, a common aircraft topcoat specification describes requirements for over 15 physical properties. Analyzing contour plots or empirical relationships for all of these properties would be extremely difficult. *Figure* 2 illustrates an example of a formulation conflict: flexibility versus weatherability versus chemical resistance. In this case, improving flexibility is divergent from improving chemical and weather resistance, making it difficult to determine the formulation(s) which will provide the best overall performance.

A similar conflict occurs in test and evaluation efforts to select the best coating from a series of coatings under analysis. Rehfeldt[10] recently described a method for converting potentially subjective evaluations of a coating property to an objective, quantitative scale. This is done

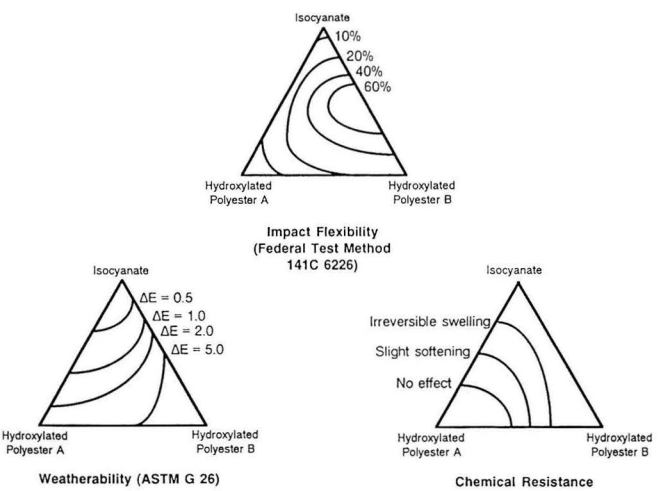


Figure 2—Contour plots illustrating formulation/performance conflicts between weatherability, chemical resistance, and flexibility

using the Rasch model which statistically compares the performance of paints under test and the probabilities of one paint out-performing other(s) in that particular property. This model can be used to analyze both qualitative (pass/fail, best/worst) and quantitative results. The author convincingly demonstrates the technique by applying it to stain resistance of several different polymers. Obtaining objective results for all properties is essential for making good and valid analytical decisions. However, the problem of selecting the "best" coating from a series of coatings with varying properties still remains.

Analytical Approach

One method to determine the contribution of multiple factors on overall quality is the Zero-Max Technique,[11,12] which is the basis for the TPE analysis. In contrast to optimizing one coating property, the TPE quantifies the contribution of multiple properties to the overall coating performance. It uses this determination to minimize property trade-offs and selects the optimum coating for a particular application. *Figure* 3 is a flow diagram of this process which is described in detail as follows.

The first step in comparing overall coating performance is to clearly define the intended application. After this is accomplished, it is essential that the "critical performance properties" representative of this application are selected. Identifying these properties can be accomplished by analyzing historical property-service performance relationships and/or utilizing existing specification requirements. The next step is to select potential candidates and obtain their critical performance property values. The consistency and success of the TPE are dependent upon the reproducibility of the test and evaluation procedures.

This selection and testing process results in a listing of properties and their respective values. Unfortunately, these values cannot be directly compared with each other. For example, if an aircraft coating exhibits an impact flexibility (Federal Test Method 141C, 6226) of 20% elongation, a slight color change (delta E = 2.0) during 1000 hr accelerated weathering exposure (ASTM G 26), and it is unaffected by hydraulic fluid and engine oil, there are no means of expressing the cumulative effects of these properties on overall performance. In order to determine this cumulative effect, the property values must be converted to an equivalent scale which we call standardized utility values. This is done by assigning values of 1 and 10 to the minimum and maximum property measurement, respectively. A relationship is then established between these end points to convert all possible property values to this equivalent scale of standardized utility values. Continuing this example, an aircraft coating specification may have an impact flexibility requirement of 20%. However, coatings with flexibilities greater than 20% will perform better in service. In this case, we assign standardized utility values (1 to 10) for impact flexibilities: 1 for 10%, 5 for 20%, 8 for 40%, and 10 for 60% elongations. A similar process is followed for weather resistance, chemical resistance, and the other critical performance properties required for aircraft coatings.

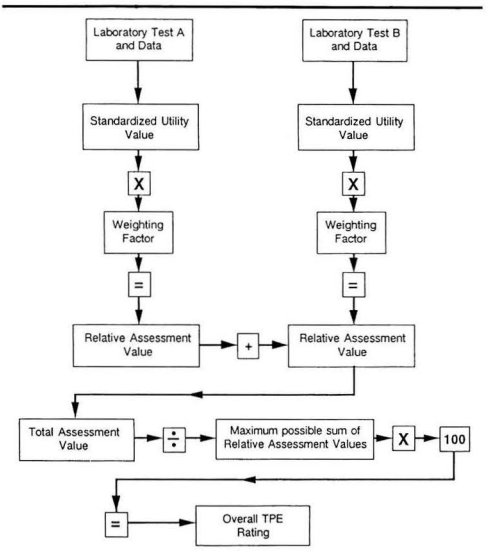


Figure 3—Flow diagram of the evaluation process

Although all of the properties selected are considered to be critical, not all of these properties are of equal importance. In the case of aircraft coatings, it would be beneficial to have excellent flexibility (60%) as opposed to simply adequate flexibility (20%). In contrast, excellent chemical resistance is not greatly preferred over adequate chemical resistance. Therefore, a weighting value must be determined and placed on each property to account for its relative importance. One approach for determining these weighting factors is to survey a group of experts in the area of interest. The weighing factors are multiplied by their respective standardized utility values to obtain relative assessment values (*Figure* 3). These relative assessment values for each property are summed to obtain a total assessment value. The TPE rating is obtained by normalizing the total assessment value by dividing the total assessment value by the maximum pos-

Table 1—Standardized Utility Values for Mandrel Bend Flexibility and Chemical Resistance

Impact Flexibility Test Result	Standardized Utility Value
60% elongation	10
40	8
20	5
10	1
Chemical Resistance	
No effect (pass)	10
Slight softening/color change (borderline pass)	7
Irreversible softening/color change (borderline fail)	3
Irreversible swelling (fail)	1

Weight Factor:	Test Name: Adhesion:	Substrate:	Range:	Lab Data:	Notes:	Standardized Utility Value	Relative Assessment Value	Maximum R. A. V.
0.0	Dry Scrape		0.5 - 10+ kg			0	0	0
0.0	Wet Scrape (24 hr/ RT)		0.5 - 10+ kg			0	0	0
0.0	Dry Tape "A" method		0 - 5 (A)			0	0	0
0.0	Wet Tape (24 hr/ RT)		0 - 5 (A)			0	0	0
	Fluid/ Corrosion Resistance:		(P)ass, BP BF, (F)ail					
0.0	Salt Spray (? hrs)		P, BP, BF, F			0	0	0
0.0	SO2 Spray (? hrs)		P, BP, BF, F			0	0	0
0.0	H20 resistance (7d / 150f)		P, BP, BF, F			0	0	0
0.0	Humidity Resistance		P, BP, BF, F			0	0	0
5.8	23699 Oil (24 hr/ 250f)	A	P, BP, BF, F	P		10	58	58
5.8	83282 Hydraulic (24hr/150f)	A	P, BP, BF, F	F	Coating is unacceptable	1	5.8	58
0.0	Hydrocarbon JP-5 (7d/ RT)		P, BP, BF, F			0	0	0
0.0	Solvent Resistance		P, BP, BF, F			0	0	0
0.0	Heat Resistance (?)		P, BP, BF, F			0	0	0
0.0	Filiform Corrosion		P, BP, BF, F			0	0	0
	Flexibility:							
0 0	GE Impact test (gloss)		0.5%-60%			0	0	0
9 0	GE Impact test (camo)	A	0.5%-60%	60	Excellent	10	90	90
0.0	Mandrel bend (-60f)		0.125" .0.75"			0	0	0
	Miscellaneous:							
5 5	Viscosity (admix, Ford #4 cup)		seconds			0	0	0
5.3	Pot life (viscosity after 2 hrs)		seconds			0	0	0
6 4	Drying Time (hrs)		hours			0	0	0
	Gloss (60°)							
	Gloss (85°)							

Figure 4—Illustration of the TPE spreadsheet

sible sum of total assessment values as displayed by a "perfect" coating. Normalizing the total assessment value allows one to perform a subset of tests as long as all coatings are compared in only these test properties. This final number can be used to compare the overall performance of a number of coatings on the basis of laboratory data.

Spreadsheet/Program Description

The TPE program has been established on a Macintosh IIsi using Microsoft's Excel. Following the flow diagram of *Figure* 3, *Figure* 4 illustrates the spreadsheet layout and an example calculation. The initial input required to set up the spreadsheet is the test name, substrate material, and the weighting factor assigned to each test. The potential value range for each test can also be listed for reference purposes. For our assessment of aircraft coatings, possible results for chemical resistance are:

Property Value	Exposure Effect on Coating
Pass (p)	No effect
Borderline pass (bp)	Slight softening and/or color change
Borderline fail (bf)	Irreversible softening and/or significant color change
Fail (f)	Severe softening, swelling, and/or color change

Possible results for impact flexibility are: 0.5, 1, 2, 5, 10, 20, 40, and 60% elongation.

After testing, the results are entered onto the spreadsheet which utilizes this data to determine the standardized utility values on the equivalent scale for each test result. As previously described, this is done by assigning a standardized number (1 to 10) to all possible data points within acceptable ranges. *Table* 1 lists the standardized utility values for the chemical resistance and flexibility tests. The program multiplies these values by their respective weighting factor to obtain the relative assessment values. These values are summed to obtain the total assessment value for that coating. The program also calculates the maximum assessment value possible for a given test and sums these values for all of the tests performed. This is the value which would be obtained by the "perfect coating." The total assessment value is divided by the sum of the maximum assessment values to obtain the TPE rating. If a coating performs particularly well or poorly in any of the tests, the spreadsheet lists a default message highlighting this performance in the "Notes" column (*Figure* 4).

A demonstration of the TPE method in a coating development effort follows. However, before presenting this demonstration, several considerations must be discussed. There are potential biasing factors that must be considered in a comparative analysis. A bias, or confounding factor, is an extraneous variable that can alter the outcome of the analysis.[13] To avoid possible biasing factors in the TPE, it is necessary to properly:

(1) Define the desired product (aircraft coating, exterior house paint, etc.).

(2) Select appropriate performance criteria consistent with the desired product (flexibility, weather resistance, etc.).

(3) Obtain reproducible test results (substrate preparation, coating thickness, application procedure, testing and evaluation techniques, etc.).

(4) Convert test results to relative assessment values by selecting standardized utility scales and weighting factors which are representative of actual field importance.

The performance criteria of a desired product is affected by its service conditions. For instance, the properties that a coating must possess for a marine aircraft environment are quite different than the properties needed for a ground-based support equipment application. Not only will the physical service conditions be different, but the substrates to which the coating is applied will also vary. It is therefore necessary to carefully select testing procedures which are consistent with the service environment and performance criteria, and to keep the substrate, coating application method, and the coating thickness consistent throughout the testing and evaluation procedure. It should be noted that the performance of coatings used in different service conditions and evaluated with different test methods and performance requirements cannot be compared.

The validity of the TPE depends on the accuracy of the lab data. Reproducible results are necessary so that the evaluation can accurately compare a series of coatings. One solution that ensures reproducible results is to use the statistical theory of information content, or Fisher information, of the data.[10,14,15] This theory states that the more information that is gathered for a certain parameter, the smaller the variance. Therefore, by repeating the testing procedures several times for a single coating, an accurate description of the physical performance can be obtained.

Table 2—Test Procedures Used to Evaluate Coating Performance

Property	Test Method
Viscosity	Ford 4 cup (ASTM D 1200).
Adhesion	Scrape adhesion (ASTM D 2197).
	Dry tape test (ASTM D 3359, Method A).
	Wet tape test (ASTM D 3359, Method A) after 24 hr immersion in distilled water at 24°C.
Fluid resistance	Hydraulic fluid (24 hr immersion in MIL-H-83282 at 65°C).
	Engine oil (24 hr immersion in MIL-L-23699 at 121°C).
	Hydrocarbon (Seven day immersion in gasoline at 24°C).
Water resistance	Immersion in distilled water at 65° C for seven days.
Flexibility	Impact flexibility (Federal Test Method Standard 141C, method 6226).

Because coatings are application specific, it is necessary to assign a weighting factor to the laboratory tests for each specific application. The weighting factor of a property is representative of its importance in service conditions. In the following demonstration described, the weighting factors were derived from a survey that was administered to a team of experts on military coatings. Once the results were tabulated, averaged, and presented, certain trends were evident and agreed upon.

DEMONSTRATION OF TPE METHODOLOGY

The TPE methodology will be illustrated by applying it in an effort to develop a binder system for a self-priming topcoat (direct-to-metal) for military ground equipment. This particular demonstration was chosen because the polymer matrix for this application must exhibit numerous properties in order for the coating to be successful in

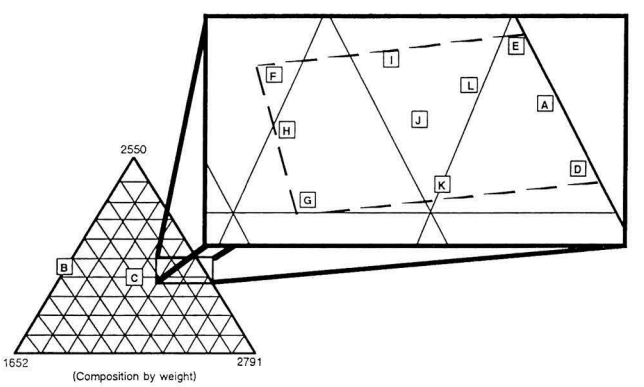


Figure 5—Formulation region of a binder on a tri-coordinate graph. (Dashed lines bound the formulation mixture region. Formulation designations: 2550A, B, C, etc.)

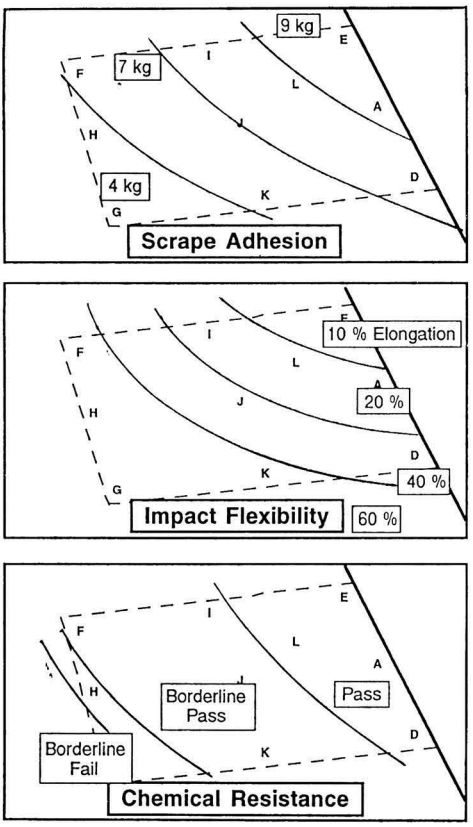


Figure 6—Performance trade-offs in the formulation region encountered during the binder evaluation

service. A preliminary screening phase identified two hydroxylated polyester resins (LS-2791 & 1652, Miles Inc., Pittsburgh, PA) and a hexamethylene diisocyanate based polyisocyanate (LS-2550, Miles Inc.) resin which could be mixed to yield a potentially useful binder. The objective at this point was to determine the specific concentration of each resin resulting in the "best" binder.

Table 3—Survey of the Importance (i.e., Weighting Factors) of Critical Properties for a Ground Equipment System (Primer and Topcoat, or Self-Priming Topcoat)

	Evaluator						
Test	1	2	3	4	5	Average	Std. Dev.
Viscosity	5	5	5	8	4	5.4	1.4
Scrape adhesion	10	9	8	9	8	8.8	0.8
Dry tape test	0	9	3	8	4	4.8	3.3
Wet tape test	10	9	10	10	10	9.8	0.4
Resistance to:							
Hydraulic fluid	5	8	5	5	4	5.4	1.4
Engine oil	5	8	5	5	4	5.4	1.4
Fuel	5	8	5	5	10	6.6	2.1
Water	8	10	10	8	8	8.8	1.0
Impact flexibility	5	5	5	2	7	4.8	1.6

Coating/Specimen Preparation and Experimental Procedures:

A formulation mixture region for the three resins was determined by identifying minimum and maximum concentration constraints on each component (*Figure* 5). An extreme vertices design[3,4] was used to select resin mixtures within this region for testing and subsequent determination of composition-property relationships. These resin mixtures are also identified in *Figure* 5. The coatings were prepared by mixing the appropriate amounts of each polyester resin and adding rutile titanium dioxide (TiO_2) (R960, DuPont, Wilmington, DE). The TiO_2 was added to obtain a 25% pigment volume concentration (PVC) in the formulated coating. A solvent blend (MIL-T-81772, THINNER, AIRCRAFT COATING) was added so that the final formulation had a volatile organic component (VOC) content of 340 g/L of paint. This mixture was milled in a glass jar with glass shot for 30 min to obtain a Hegman grind (ASTM D 1210) of approximately 7. After milling and just prior to application, the appropriate concentration of LS-2550 polyisocyanate resin was blended into each formulation.

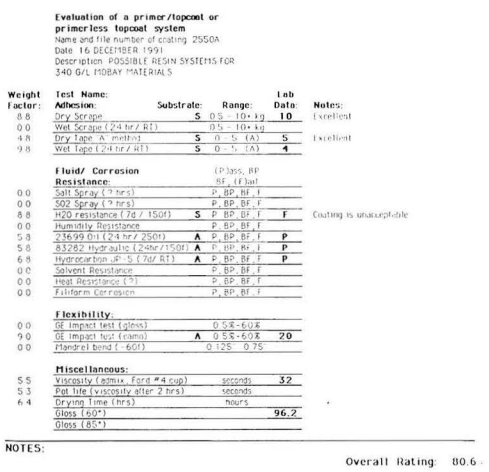
The steel specimens used in this study were cold-rolled, low carbon steel (SAE 1010, 1/4 hard, ASTM A 366) with a surface roughness of 381 to 635 nm (15 to 25 micro-in.). These specimens were zinc phosphate treated according to DOD-P-16232, Type Z, Class III. Flexibility tests were performed using 2024-0 temper aluminum alloy panels which were chromic acid anodized according to MIL-A-8625 Type I, Class I. Conventional air spray was used to apply the formulated coatings onto the steel and aluminum specimens to a dry-film thickness of 102 ± 13 microns (4.0 ± 0.5 mils). Following application, the coatings were allowed to cure at ambient laboratory conditions for seven days. At that time, the coatings were tested according to the procedures listed in *Table* 2. Formulations 2550A, B, C, and 7014A were prepared and tested four times while the remaining coatings were prepared and tested twice.

Experimental Results and Application of TPE:

Test results on the coatings showed obvious trends in composition-property relationships (*Figure* 6). Adhesion and chemical resistance were observed to increase with decreasing concentrations of 1652. In contrast, coating flexibility increased with increasing 1652. These individ-

Table 4—TPE Results for Formulations 2550A, B, C, and 7014A

	2550A	2550B	2550C	7014A
Replicate 1	85.5	47.2	40.2	60.3
Replicate 2	80.6	45.9	35.7	64.5
Replicate 3	95.9	35.4	30.6	52.3
Replicate 4	88.8	35.7	28.7	51.0
Average	87.7	41.1	33.8	57.0
Standard deviation	5.6	5.5	4.5	5.6



Evaluation of a primer/topcoat or primerless topcoat system
Name and file number of coating: 2550A
Date: 16 DECEMBER 1991
Description: POSSIBLE RESIN SYSTEMS FOR 340 G/L MOBAY MATERIALS

Weight Factor:	Test Name: Adhesion:	Substrate:	Range:	Lab Data:	Notes:
8.8	Dry Scrape	S	0.5 - 10+ kg	10	Excellent
0.0	Wet Scrape (24 hr / RT)		0.5 - 10+ kg		
4.8	Dry Tape "A" method	S	0 - 5 (A)	5	Excellent
9.8	Wet Tape (24 hr / RT)	S	0 - 5 (A)	4	
	Fluid/ Corrosion Resistance:		(P)ass, BP, BF, (F)ail		
0.0	Salt Spray (? hrs)		P, BP, BF, F		
0.0	SO2 Spray (? hrs)		P, BP, BF, F		
8.8	H2O resistance (7d / 150f)	S	P, BP, BF, F	F	Coating is unacceptable
0.0	Humidity Resistance		P, BP, BF, F		
5.8	23699.01 (24 hr / 250f)	A	P, BP, BF, F	P	
5.8	83282 Hydraulic (24hr/150f)	A	P, BP, BF, F	P	
6.8	Hydrocarbon JP-5 (7d/ RT)	A	P, BP, BF, F	P	
0.0	Solvent Resistance		P, BP, BF, F		
0.0	Heat Resistance (?)		P, BP, BF, F		
0.0	Filiform Corrosion		P, BP, BF, F		
	Flexibility:				
0.0	GE Impact test (gloss)		0.5"-60"		
9.0	GE Impact test (camo)	A	0.5"-60"	20	
0.0	Mandrel bend (-60f)		0.125" - 0.75"		
	Miscellaneous:				
5.5	Viscosity (admix, Ford #4 cup)		seconds	32	
5.3	Pot life (viscosity after 2 hrs)		seconds		
6.4	Drying Time (hrs)		hours		
	Gloss (60°)			96.2	
	Gloss (85°)				

NOTES:

Overall Rating: 80.6

Figure 7—Output of the TPE for 2550A

ual property trends were not unexpected since it is known that 1652 is flexible and less chemically resistant while 2791 is harder and more brittle. Unfortunately, these relationships present trade-offs between coating properties, making selection of the best binder system difficult. Therefore, the TPE was used to assist in the selection of the most promising binder system.

The first step in applying the TPE was to identify the relative contribution (i.e., weighting factor) of each property on in-service performance, in this case a self-priming topcoat for military ground equipment. These weighting factors were obtained by asking five experts to choose the critical properties of a coating system (primer/topcoat) for military ground equipment and to place a relative importance (1 to 10) on tests characterizing each property. *Table* 3 presents the results of this survey relative to binder system performance and selection. Consistencies in property importance were clearly evident and valid. Therefore these values were used as the respective weighting factors in the TPE spreadsheet.

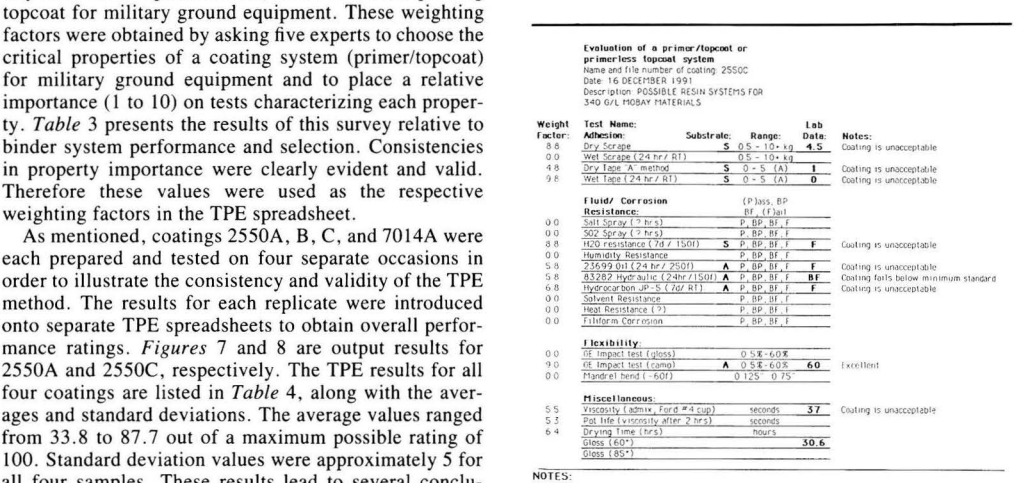
As mentioned, coatings 2550A, B, C, and 7014A were each prepared and tested on four separate occasions in order to illustrate the consistency and validity of the TPE method. The results for each replicate were introduced onto separate TPE spreadsheets to obtain overall performance ratings. *Figures* 7 and 8 are output results for 2550A and 2550C, respectively. The TPE results for all four coatings are listed in *Table* 4, along with the averages and standard deviations. The average values ranged from 33.8 to 87.7 out of a maximum possible rating of 100. Standard deviation values were approximately 5 for all four samples. These results lead to several conclusions. The relatively low standard deviations indicate that the TPE ratings are consistent. In addition, the results

Table 5—Remaining TPE Results

	Replicate 1	Replicate 2	Average	Standard Deviation
2550D	66.0	71.5	68.8	2.8
2550E	57.5	71.7	64.6	7.1
2550F	54.9	62.9	58.9	4.0
2550G	62.4	57.4	60.0	2.5
2550H	68.6	55.2	61.9	6.7
2550I	79.1	74.5	76.8	2.3
2550J	77.0	65.6	71.3	5.7
2550K	60.5	67.0	63.8	3.3
2550L	73.7	81.3	77.5	3.8

appear valid because testing of each replicate series of coatings resulted in the same ranking of coating performance. Applying these TPE ratings to a two-sided T test, it can be concluded with a 99% confidence limit that there is a significant difference between each of these four coatings. This clearly illustrates that the TPE can be used to determine statistical differences between overall performance of coatings. Based on the initial premises regarding the intended application, required coating characteristics, and the relative importance of these characteristics, it can be concluded that resin formulation 2550A is the best binder of these four formulations for further development of a self-priming topcoat for military ground equipment.

Additional evidence on the validity and usefulness of the TPE is provided in *Table* 5 which lists the results of the remaining nine coatings. These results were also consistent with relatively low standard deviations. It should be re-emphasized that these consistent results are at least partially due to careful, reproducible testing and evaluating. In addressing the objective of the development effort, the TPE results illustrate that, although there are property trade-offs with compositional changes in the



Evaluation of a primer/topcoat or primerless topcoat system
Name and file number of coating: 2550C
Date: 16 DECEMBER 1991
Description: POSSIBLE RESIN SYSTEMS FOR 340 G/L MOBAY MATERIALS

Weight Factor:	Test Name: Adhesion:	Substrate:	Range:	Lab Data:	Notes:
8.8	Dry Scrape	S	0.5 - 10+ kg	4.5	Coating is unacceptable
0.0	Wet Scrape (24 hr / RT)		0.5 - 10+ kg		
4.8	Dry Tape "A" method	S	0 - 5 (A)	1	Coating is unacceptable
9.8	Wet Tape (24 hr / RT)	S	0 - 5 (A)	0	Coating is unacceptable
	Fluid/ Corrosion Resistance:		(P)ass, BP, BF, (F)ail		
0.0	Salt Spray (? hrs)		P, BP, BF, F		
0.0	SO2 Spray (? hrs)		P, BP, BF, F		
8.8	H2O resistance (7d / 150f)	S	P, BP, BF, F	F	Coating is unacceptable
0.0	Humidity Resistance		P, BP, BF, F		
5.8	23699.01 (24 hr / 250f)	A	P, BP, BF, F	F	Coating is unacceptable
5.8	83282 Hydraulic (24hr/150f)	A	P, BP, BF, F	BF	Coating fails below minimum standard
6.8	Hydrocarbon JP-5 (7d/ RT)	A	P, BP, BF, F	F	Coating is unacceptable
0.0	Solvent Resistance		P, BP, BF, F		
0.0	Heat Resistance (?)		P, BP, BF, F		
0.0	Filiform Corrosion		P, BP, BF, F		
	Flexibility:				
0.0	GE Impact test (gloss)		0.5"-60"		
9.0	GE Impact test (camo)	A	0.5"-60"	60	Excellent
0.0	Mandrel bend (-60f)		0.125" - 0.75"		
	Miscellaneous:				
5.5	Viscosity (admix, Ford #4 cup)		seconds	37	Coating is unacceptable
5.3	Pot life (viscosity after 2 hrs)		seconds		
6.4	Drying Time (hrs)		hours		
	Gloss (60°)			30.6	
	Gloss (85°)				

NOTES:

Overall Rating: 30.6

Figure 8—Output of the TPE for 2550C

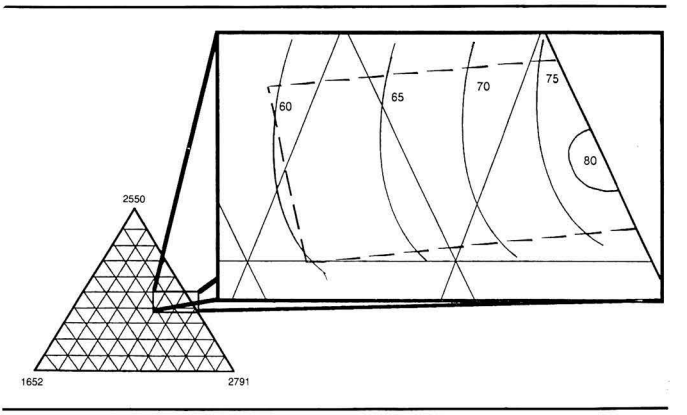


Figure 9—Contour lines of TPE ratings of coatings in formulation region

2550/2791/1652 resin system (*Figure* 6), a definite trend in overall performance exists. The TPE data was analzyed using a regression technique to obtain a quadratic equation which empirically related TPE ratings to resin composition. This equation was in turn used to generate the TPE contour plot as presented in *Figure* 9. Although one might intuitively consider that incorporation of a slight amount of flexible resin (i.e., 1652) would improve the binder system by increasing flexibility and toughness, the TPE results indicate this is not the case. In fact, this analysis indicates that the "best" resin composition for further development of a self-priming topcoat for military equipment is: 56% (by weight) 2791 and 44% 2550.

The use of the TPE has been demonstrated with the specific example described. This approach can be employed in the comparative analysis of materials for any specific application. Most relevant to this publication is that the TPE can be used by coating developers, finishing system designers, and field engineers to determine the best coating and/or coating system for all varieties of applications whether they be trade-sales paints, marine coatings, or high performance industrial coatings.

SUMMARY

A methodology has been developed to analytically determine the cumulative effects of a number of coating (or coating system) properties on overall performance in a specific application. This analysis is based on the Zero-Max Technique which converts property values to an equivalent scale for comparative purposes. A weighting value which is representative of property importance on overall performance is also determined and utilized to obtain an overall Total Performance Evaluation (TPE) rating. Based on the intended application, the TPE ratings of various coatings can be compared to statistically select the "best" candidate for success in service. This methodology can be used by developers, designers, consultants, and field engineers for all varieties of coating applications.

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THIS PAPER WAS AWARDED SECOND PRIZE
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Model Crosslinkers for Polyols. Kinetics of Transetherification of 2-Methoxy Cyclic Ethers

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A new and general method for analyzing the kinetics of reversible reactions which proceed via a common reactive intermediate is presented. The method is applied herein to acid-catalyzed transetherification of 2-methoxy cyclic ethers, which are model compounds for potentially useful crosslinkers for polyols.

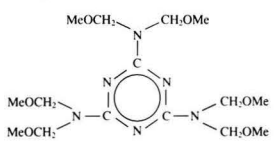
Three cyclic ether acetals, 2-methoxy-2H-tetrahydropyran (**2a**), 2-methoxytetrahydrofuran (**2b**), and 2-methoxy-2-methyltetrahydrofuran (**2c**), were synthesized and their acid-catalyzed transetherification reaction with equal concentrations of neopentyl alcohol was investigated by NMR analysis under reversible conditions. Extent conversions were determined as functions of acid concentration and temperature. A computer program was developed, based on regression analysis, which allowed kinetic analysis of the data.

The kinetic analysis afforded composite forward and reverse rate constants, as well as relative rates of reaction of the competing alcohols for the reactive intermediate, and the kinetic order in p-toluene sulfonic acid. Energies of activation and relative entropies of activation, which are useful parameters for estimating the temperature dependence of shelf life and cure, were determined for **2a** and **2b**. The reactivity of **2c** was too high for determination of these kinetic parameters by the NMR procedure.

The potential applicability of 2-methoxy cyclic ethers as crosslinkers for polyols prompted the synthesis of 2-methyl-2-methoxy-5-chloromethyltetrahydrofuran (**4a**) and its conversion into the previously unknown 5-phenoxymethyl derivative **4b**. This conversion serves as a model reaction for the synthesis of multifunctional analogs of **2c** by reaction of **4a** with phenolic resins. Accordingly, the readily available **4a** is a potentially useful synthon for preparation of polyol crosslinkers which possess the highly reactive 2-methoxy-2-methyltetrahydrofuran group.

INTRODUCTION

Etherified melamine-formaldehyde (MF) resins, such as hexamethoxymethyl melamine (HMMM) (**1**), are widely used crosslinking agents for hydroxy functional resins in thermoset coatings.



1

MF resins are activated ethers which undergo acid-catalyzed transetherification with polyols (POH), as shown in equation (1), where the MF resin is represented by part structure Mel-NCH_2OMe.

$$\text{Mel—NCH}_2\text{OMe} + \text{POH} \xrightarrow{\text{H}^+} \text{Mel—NCH}_2\text{—OP} + \text{MeOH} \quad (1)$$

Desirable characteristics of MF resins include low cost, well established utility in the formulation of coatings, and generally good film properties. On the other hand, good film properties generally require relatively vigorous cure schedules, ca 130°C for 20 min, and/or high levels of acid catalyst. Furthermore, MF coatings are relatively sensitive to hydrolytic degradation during exterior exposure, a problem which is exacerbated by high catalyst levels. Hydrolytic degradation generates formaldehyde, a known carcinogen, which is difficult to

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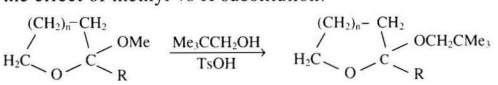
remove from MF resins themselves and is also produced during cure, particularly under humid conditions.

There is a widely-recognized need for formaldehyde-free crosslinking agents for hydroxy functional resins, as well as for thermoset coatings which cure at lower temperatures than MF-polyol coatings. Isocyanate functional resins represent an alternative class of crosslinkers for polyols; however, isocyanates also have associated toxicity hazards.

We envisioned that 2-alkoxy cyclic ethers should undergo acid-catalyzed transetherification with polyols, probably at lower temperature than MF resins, and without the associated problem of formaldehyde emissions. The expectation of lower reaction temperature for the cyclic ether acetals is based on their lower basicity, relative to N-containing MF resins. The lower basicity of acetals was expected to enhance their reactivity in acid-catalyzed transetherification and, thereby, reduce acid levels and residues. The utilization of 5- and 6-membered cyclic acetals was expected to minimize ring opening, which could lead to irreversible formation of aldehydes (or ketones in the case of ketals) by reaction with water.

Herein, we report a kinetic study on acid catalyzed, transetherification of three 2-methoxy cyclic ethers **2a-c** with neopentyl alcohol utilizing p-toluene sulfonic acid (TsOH) as the catalyst. Ethers **2a-c** were selected to determine the effect of ring size (5- vs 6-membered) and the effect of methyl vs H substitution.



2 **3**

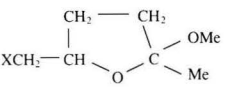
a) n = 2, R = H; b) n = 1, R = H; c) n = 1, R = Me

A kinetic rate expression for acid-catalyzed transetherification of 2-alkoxy cyclic ethers or of acetals, in general, was not found in the literature. Kinetic studies were found for acid-catalyzed transetherification of MF resins[1,2] and a model MF resin;[3] however, simplifying assumptions were made to facilitate analysis of the experimental data.

In the interest of obtaining a more complete kinetic profile of acetal transetherification, the unsimplified rate expression for specific acid catalyzed transetherification was integrated and linearized into a form which allowed determination of composite forward and reverse rate constants, as well as relative rates of reaction of reactive intermediates with the competing alcohols. Analysis of the experimental data from NMR spectral studies was facilitated by development of a computer program and utilization of regression analysis.

The kinetic study provided promising results regarding the potential applicability of 2-methoxy cyclic ethers in crosslinking reactions, which prompted exploratory efforts directed to the synthesis of multi-functional analogs. An approach involving the preparation of a chloro-functional synthon, which can be utilized to convert phenolic resins into multi-functional cyclic ether acetals, is also described herein.

Known 2-methyl-2-methoxy-5-chloromethyltetrahydrofuran (**4a**) was prepared and converted into the previously unknown 5-phenoxymethyl derivative **4b**. The ease of synthesis of **4a** from readily available starting materials makes this approach potentially attractive for multifunctional analogs of **2c** from synthon **4a** and phenolic resins.



4

a) X = Cl; b) X = PhO

EXPERIMENTAL

Materials and Analytical Methods

Methanol was distilled and dried over molecular sieves. Dioxane was distilled and dried over sodium metal. Tetrahydrofuran was refluxed with lithium aluminum hydride and distilled before use. Phenol, triethylamine, dichloromethane, and neopentyl alcohol were distilled before use. Clorox bleach was obtained locally and the content of sodium hypochlorite was determined by titration with sodium thiosulfate solution.[4] Iodine was sublimed and sodium thiosulfate was recrystallized before use. Allyl acetone, 2,3-dihydrofuran, 2,3-dihydro-2-methylfuran, 3,4-dihydro-2H-pyran, p-toluene sulfonic acid (TsOH), neopentyl alcohol, chloroform, and tetramethylsilane were used as received.

IR spectra were taken using a Perkin-Elmer 137 Spectrometer. ^{1}H-NMR spectra were measured using a Varian EM-390 (90 MHz) Spectrometer.

Synthesis of 2-Alkoxy Cyclic Ethers

2-Methoxy Cyclic Ethers **2a-c**: Preparation by acid catalyzed (TsOH) addition of methanol to the corresponding cyclic vinyl ethers was completed. Structures of the previously reported ethers were confirmed by IR and ^{1}H-NMR spectra; NMR data are provided in *Table* 1.

2-Methoxy-2H-Tetrahydropyran (THPOMe) (2a)—Synthesis by modification of a procedure used for tetrahydropyranylation of steroidal alcohols was accomplished.[5]

Methanol (95.2 g) and TsOH (0.3 g) were placed into a 300-mL round-bottom flask equipped with an addition funnel. The solution was cooled in an ice bath with magnetic stirring and 3,4-dihydro-2H-pyran (50 g) was added dropwise. After 3 hr in the ice bath, the reaction was neutralized by the addition of sodium bicarbonate (2 g) and filtered. The filtrate was concentrated utilizing a rotary evaporator, diluted with water (100 mL), and extracted with ether. The ether extract was washed with saturated NaCl solution, concentrated on a rotary evaporator, and distilled to yield THPOMe (**2a**) (34.6 g) (51% yield); b.p. 116-118°C, 740 mm Hg; lit. b.p. 125°C.[6]

2-Methoxytetrahydrofuran (THFOMe) (2b)—Synthesis by modification of a procedure used to prepare methyl 5-methoxy-3-furoates was achieved.[7]

Methanol (113 g) and TsOH (0.41 g) were placed into a 300-mL round-bottom flask equipped with an addition funnel. To this solution, cooled in an ice bath with magnetic stirring, was added 2,3-dihydrofuran (50 g) dropwise. The reaction mixture was, in turn, kept in an ice bath for 5 hr, neutralized by the addition of sodium bicarbonate (3.0 g), diluted with saturated NaCl solution (200 mL), and extracted with ether. The ether extract was washed with saturated NaCl, concentrated utilizing a rotary evaporator, dried in a desiccator over anhydrous calcium chloride, and distilled, b.p. 101-103°C, 752 mm Hg; lit. b.p. 104°C.[8] A 48% yield of THFOMe (**2b**) (34.6 g) was obtained.

2-Methoxy-2-Methyltetrahydrofuran (MTHFOMe) (2c)—Preparation by a procedure analogous to that used for THFOMe (**2b**) was completed. From 2-methyl-2,3-dihydrofuran (10 g), methanol (50 g), TsOH (50 mg), and sodium bicarbonate (2 g) (for neutralization), MTHFOMe (**2c**) (5 g) (36.5% yield) was obtained by distillation, b.p. 114-115°C, 746 mm Hg; lit. b.p. 114°C.[9]

2-Neopentyloxy Cyclic Ethers (**3a-c**): 2-Neopentyloxy cyclic ethers (corresponding to the 2-methoxy cyclic ethers) were prepared accordingly by acid catalyzed (TsOH) addition of neopentyl alcohol (NPOH) to the corresponding cyclic vinyl ethers. The reactions were carried out in NMR tubes and monitored by NMR spectra, which showed that the reactions proceeded cleanly to provide the desired neopentyl ethers as major products. These experiments were carried out to obtain NMR spectra of the neopentyl ethers, which were not isolated. NMR spectral data are provided in *Table* 1.

2-Neopentyloxy-2H-Tetrahydropyran (THPONP) (3a)—Neopentyl alcohol (34.7 mg), 2,3-dihydro-2H-pyran (45.3 mg), and chloroform-d (0.4 mL) were placed into a 5 mm diameter NMR sample tube with tetramethylsilane as the internal standard. The NMR spectrum of the mixture was recorded, following which, a small droplet of TsOH in 1,4-dioxane (10% wt/vol) was added, using a glass pipette; the mixture was shaken vigorously. The ^{1}H-NMR spectrum of THFONP grew in cleanly with time.

2-Neopentyloxytetrahydrofuran (THFONP) (3b)—^{1}H-NMR spectral assignments for THFONP were obtained accordingly by TsOH catalyzed addition of neopentyl alcohol to 2,3-dihydrofuran.

2-Methyl-2-Neopentyloxytetrahydrofuran (MTHFONP) (3c)—^{1}H-NMR spectral assignments for MTHFONP were obtained accordingly by TsOH catalyzed addition of neopentyl alcohol to 2,3-dihydro-2-methylfuran.

2-Methyl-2-Methoxy-5-Chloromethyltetrahydrofuran (**4a**): Synthon **4a** was prepared from 5-hexene-2-one (allyl acetone) via the intermediate chlorohydrin, 5-hydroxy-6-chloro-2-hexanone (**5**), by known procedures.[10,11] ^{1}H-NMR spectra are provided in *Table* 2.

Allyl acetone (15 g), potassium monohydrogen phosphate (27 g), and water (200 g) were placed into a beaker (1 L) equipped with a stirrer. The mixture was cooled to 0°C and 0.803 M sodium hypochlorite (bleach) (225 g) was added dropwise with the temperature held at 0°. After 5 hr at 0°, sodium bisulfite (1.6 g) was added (to decompose the excess hypochlorite), followed by sodium bicarbonate (20.6 g). The reaction mixture was filtered and extracted with ether, which was concentrated by rotary evaporation and dried in a desiccator. The residue (14.5 g) (63% yield) was relatively pure chlorohydrin **5** based on IR and NMR spectra.[10] Attempts to purify **5** further by vacuum distillation resulted in decomposition.

Chlorohydrin **5** (14.5 g) was added to a methanol solution (200 g) acidified with dry HCl (1 g), contained in a 500 mL round-bottom flask, equipped with a magnetic stirring bar. After stirring overnight at room temperature, the reaction was neutralized with sodium bicarbonate (3 g) and filtered. The filtrate was concentrated on a rotary evaporator, diluted with water, and extracted with ether. The ether extracts were washed with saturated NaCl solution, concentrated by rotary evaporation and dried in a vacuum desiccator. Synthon **4a** (8.84 g) (56% yield) was obtained by vacuum distillation, b.p. 30-34°C, 0.65-1.1 mm Hg; lit. b.p. 73.5°, 13 mm Hg.[12]

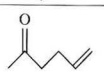
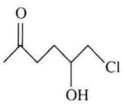
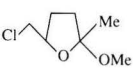
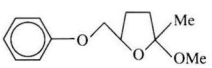
2-Methyl-2-Methoxy-5-Phenoxymethyltetrahydrofuran (**4b**): The phenoxymethyltetrahydrofuran **4b** was synthesized from the corresponding chloromethyl-

Table 1—NMR Spectra of Reactants and Products in Kinetic Study

Compound	Position	Chemical Shift[a]	Pattern[b]
NPOH	CH_2	3.30	s
	Me	0.91	s
THFOMe	MeO	3.33	s
	2-CH	5.05	s
	3,4-CH_2	1.7-2.1	m
	5-CH_2	3.8-4.1	m
THFONP	Me	0.88	s
	CH_2	2.87, 2.97 3.23, 3.33	ABq
	2-CH	5.08	s
	3,4-CH_2	1.6-2.1	m
	5-CH_2	3.8-4.1	m
THPOMe	MeO	3.42	s
	2-CH_2	4.53	s
	3,4,5-CH_2	1.35-1.90	m
	6-CH_2	3.5-4.0	m
THPONP	CH_2	2.93, 3.03 3.40, 3.50	ABq
	Me	0.94	s
MTHFOMe	MeO	3.23	s
	2-Me	1.45	s
	3,4-CH_2	1.60-2.20	m
	5-CH_2	3.77-4.05	m
MTHFONP	CH_2	2.93, 3.03 3.42, 3.52	ABq
	Me	0.88	s
	2-Me	1.44	s
	3,4-CH_2	1.60-2.50	m
	5-CH_2	3.77-4.05	m
MeOH	Me	3.45	s
TEA	Me	1.03 (J = 7.2 Hz)	t
	CH_2	2.57 (J = 6.9 Hz)	q

(a) In ppm relative to tetramethylsilane.
(b) Spin-spin splitting pattern: s = singlet, t = triplet, q = quartet, ABq = AB quartet, and m = multiplet.

Table 2—^{1}H-NMR Spectral Assignments of 4b and Intermediates

Compound	Position	Chemical Shift[a]	Pattern[b]
	1-Me	2.10	s
	3,4-CH_2	2.30-2.60	m
	5-CH	5.00 (J = 9 Hz)	t
	6-CH_2	5.60-6.00	m
	1-Me	2.10	s
	3-CH_2	2.60 (J = 9 Hz)	t
	4-CH_2	1.40-1.80	m
	5-CH	4.90-5.10	m
	6-CH_2	3.40-3.50	m
	2-Me	1.42, 1.43	s[c]
	2-OMe	3.33, 3.34	s[c]
	3,4-CH_2	1.70-2.30	m
	4-CH	4.15-4.40	m
	4-$ClCH_2$	3.80-4.10	m
	2-Me	1.42, 1.43	s[c]
	2-OMe	3.33, 3.34	s[c]
	3,4-CH_2	1.70-2.30	m
	4-CH	4.15-4.40	m
	4-$PhOCH_2$	3.80-4.10	m
	Phenyl	6.80-7.40	m

(a) In ppm relative to tetramethylsilane.
(b) Spin-spin splitting pattern: s = singlet, t = triplet, and m = multiplet.
(c) E-Z stereoisomers.

tetrahydrofuran synthon **4a** by modification of a procedure utilized to prepare phenoxyethyl vinyl ethers from chloroethyl vinyl ethers and phenol.[13]

Phenol (5.5 g), dimethyl sulfoxide (25 g), and sodium hydroxide (2.6 g) were placed into a 100 mL three-necked round-bottom flask equipped with a thermometer, condenser, dropping funnel, and nitrogen purging inlet. The mixture was held at 70-75°C for 1 hr with stirring and nitrogen ebullition. The temperature was then raised to 80°C and synthon **4a** (8.8 g) was added dropwise. After the addition, the temperature was raised further to 100°. After 3 hr at 100°, the reaction mixture was cooled to room temperature and poured into water (100 mL). The organic layer was separated and the aqueous layer was extracted with ether. The combined organic layers were washed with saturated NaCl solution, concentrated on a rotary evaporator, and dried in a desiccator. 2-Methoxy-2-methyl-5-phenoxymethyltetrahydrofuran (**4b**) (3.64 g) (30.6% yield) was obtained by vacuum distillation, b.p. 112-117°C, 2.4-2.6 mm Hg. The structure was assigned by IR and ^{1}H-NMR spectra. NMR spectral data are shown in *Table* 2.

Lower yields of **4b** were obtained when the chloromethyl analog **4a** was present at the outset. However, the 30% yield of **4b** should not be considered as optimized.

Kinetics of Transetherification by NMR Spectrometry

A solution of equimolar amounts of 2-methoxy cyclic ether (4.11-4.37 mol L^{-1}) and neopentyl alcohol (NPOH) was placed into a 5 mL flask, equipped with a rubber stopper and magnetic stirrer. The flask was placed in a constant temperature oil bath, held at 27, 47, or 62 (64) ± 1°C. An initial sample (0.1 mL) was withdrawn immediately into a 0.5 mL syringe, which was partially filled with a chloroform-d solution of triethylamine (3% wt/vol) to stop the reaction. The sample was set aside for NMR analysis.

Subsequently, a catalytic amount of TsOH (7.35×10^{-4} – 2.84×10^{-1} mol% relative to cyclic ether) in dioxane was added to the reaction flask and aliquots were withdrawn, as indicated previously, into the triethylamine solution, which was in excess (>100 times) of the TsOH. NMR spectra were recorded at periodic intervals.

Conversions were determined by measuring peak areas of selected non-overlapping ^{1}H-NMR signals of reactants and products.

For the reaction of THPOMe with NPOH, the peak area of the diminishing CH_2 signal of NPOH was measured and normalized relative to the total area of the unchanging 3-,4-, and 5-CH_2 signals of THPOMe. For the corresponding reaction of THFOMe and MTHFOMe, the peak area of the increasing CH_3 signal of methanol was compared with that of the unchanging 3- and 4-CH_2 signals of THFOMe and the unchanging 2-CH_3 group of MTHFOMe, respectively.

The kinetic runs were not replicated. However, five runs were carried out with each 2-methoxy cyclic ether: three different concentrations of TsOH and temperatures.

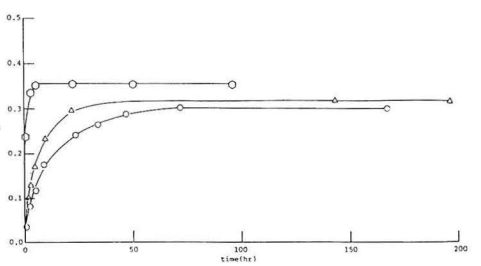


Figure 1—Extent of reaction (x) of THPOMe and NPOH at 27°C with varying TsOH concentrations. ○—[TsOH] = 1.24×10^{-3}M; △— [TsOH] = 2.55×10^{-3}M; and ○— [TsOH] = 1.18×10^{-2}M

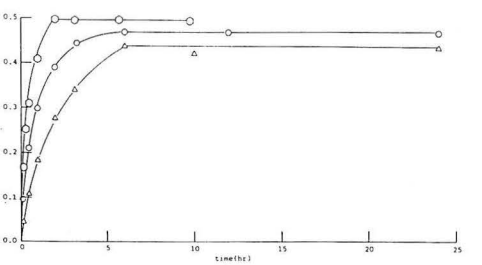


Figure 2—Extent of reaction (x) of THFOMe and NPOH at 27°C with varying TsOH concentrations. △—[TsOH] = 6.16×10^{-4}M; ○— [TsOH] = 1.32×10^{-3}M; and ○— [TsOH] = 2.71×10^{-3}M

The results provided smooth extent conversion plots in each case, as shown in *Figures* 1-3 (TsOH concentration changes) and 4-6 (temperature changes). The experimental error associated with the NMR spectral analysis is estimated as ± 10% for the extent conversions and ± 15-25% for the kinetic parameters derived from these values.

RESULTS AND DISCUSSION

Synthesis of 2-Methoxy Cyclic Ethers, Equilibrium Conversions, and Relative Transetherification Rates with Neopentyl Alcohol

The 2-methoxy cyclic ethers **2a-c** were synthesized by acid-catalyzed addition of methanol to the corresponding cyclic vinyl ether, as shown in *Scheme* 1. Subsequent conversion into the corresponding neopentyloxy ethers **3a-c** is also shown in *Scheme* 1.

Plots of extent conversion of methoxy cyclic ethers **2a-c** into the corresponding neopentyloxy cyclic ethers **3a-c** at 27°C with various concentrations of TsOH are provided in *Figures* 1-3, respectively. Relative rates are seen to increase in the order **2a** < **2b** < **2c**, indicating that five-membered THFOMe (**2b**) is more reactive than the six-membered analog THPOMe (**2a**). The 2-methyl substituent in MTHFOMe (**2c**) further enhances reactivity of the five-membered analog.

The observed order of reactivity of transetherification is consistent with related solvolysis studies. For example, solvolysis of five- and seven-membered 1-chloro-1-methylcycloalkanes occurs ca two orders of magnitude faster than with the corresponding six-membered ring analog.[14,15] These results have been attributed to relief of steric strain in going from sp^3-C to sp^2-C hybridization of the intermediate carbocation for the five- and seven-membered ring compounds, as compared to increase in steric strain for the six-membered ring analog. The higher reactivity of THFOMe relative to THPOMe may be attributed to the same factor.

The higher reactivity of MTHFOMe relative to THFOMe may be attributed to the well-established greater stabilization of carbocations by methyl groups relative to hydrogen. Both ring size and methyl substituent factors enhance formation of the intermediate carbocation with MTHFOMe.

By comparing times to 20% conversion with corresponding TsOH concentrations, it may be estimated that THFOMe is ca 40-50 times more reactive than THPOMe and that MTHFOMe is ca 40 times more reactive than THFOMe at 27°C.

As shown in *Figures* 1-3, increasing TsOH concentration resulted in faster rates of conversion to equilibrium for THPOMe and THFOMe, and, presumably, for MTHFOMe. In the case of MTHFOMe, equilibrium was reached for all TsOH concentrations essentially within the time of the first aliquot removal, ca 2 min.

Increasing TsOH concentrations also resulted in apparent increased conversions at equilibrium, ca 11-16% higher conversions for the highest compared to the lowest TsOH concentration. These results were not expected and are attributed, at least in part, to insufficient time for

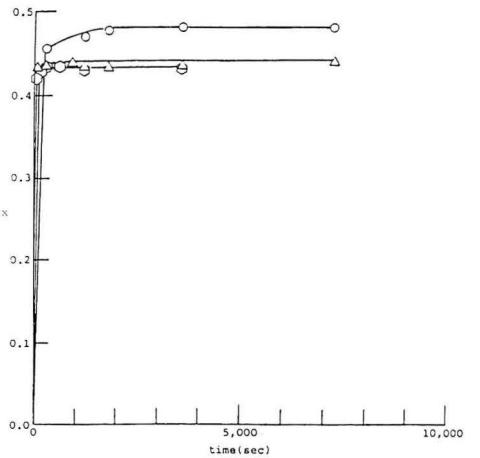
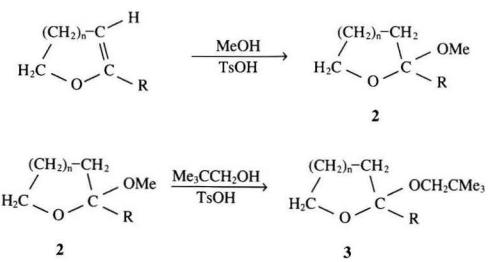


Figure 3—Extent of reaction (x) of MTHFOMe and NPOH at 27°C with varying TsOH concentrations. ○—[TsOH] = 1.20 × 10^{-4}M; △— [TsOH] = 6.04 × 10^{-5}M; and ⬡— [TsOH] = 3.00 × 10^{-5}M

reaching equilibrium with decreasing TsOH concentrations.

The possibility that side reactions may occur and contribute to the increasing equilibrium conversions with TsOH concentration cannot be ruled out. However, the following considerations indicate that the occurrence of side reactions is minor. (1) Side products were not observed in NMR spectra taken during the course of the reaction of the methoxy ethers with neopentyl alcohol: the previously determined spectra of the neopentyl ethers grew in cleanly as the spectral shifts of the methoxy ethers decreased. (2) Although NMR spectral analysis involved monitoring the decrease in neopentyl alcohol with THPOMe and the increase in methanol with THFOMe and MTHFOMe, similar trends in reactivity as functions of TsOH concentration and temperature were observed in each case. These results suggest that any significant side reactions also involve the substitution of



Scheme 1—(a) n = 2 and R = H; (b) n = 1 and R = H; and (c) n = 1 and R = Me

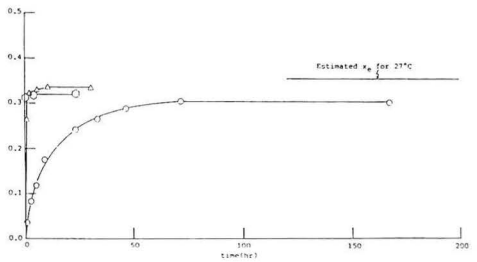


Figure 4—Extent of reaction (x) of THPOMe and NPOH with constant TsOH concentrations (1.24×10^{-3}M) at varying temperatures. ○—27°C; △—47°C; and ○—62°C

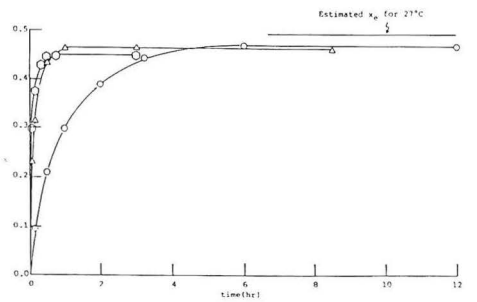


Figure 5—Extent of reaction (x) of THFOMe and NPOH with constant TsOH concentrations (1.24×10^{-3}M) at varying temperatures. ○—27°C; △—47°C; and ○—64°C

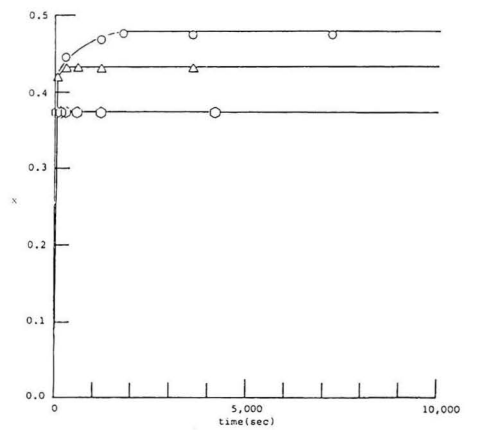


Figure 6—Extent of reaction (x) of MTHFOMe and NPOH with constant TsOH concentrations (1.24×10^{-3}M) at varying temperatures. ○—27°C; △—47°C; and ○—64°C

methanol by neopentyl alcohol. (3) From a mechanistic point of view, it appears unlikely that ring-opening of five- and six-membered cyclic ethers competes significantly with substitution of the pendant methyl and neopentyl ether groups.

Extent conversions at equilibrium (x_e) at 27°C were 0.355, 0.496, and 0.479 at the highest TsOH concentrations for THPOMe, THFOMe, and MTHFOMe, respectively. The respective equilibrium constants (K_e) of 0.303, 0.969, and 0.845 correspond to the equilibrium ratio of neopentyl to methyl acetal and are indicative of their relative thermodynamic stabilities. In each case, the methyl acetal is favored, which probably reflects greater steric crowding and destabilization by the neopentyl group. This destabilization effect is substantially greater in the six-membered (K_e = 0.303) as compared to the five-membered ring analogs. The somewhat larger K_e for THFOMe relative to MTHFOMe is consistent with the added steric congestion by the methyl substituent in MTHFOMe. These results from *Figures* 1-3 are summarized in *Table* 3.

Plots of extent conversions of the 2-methoxy cyclic ethers into the corresponding neopentyloxy ethers at various temperatures with constant TsOH concentration are provided in *Figures* 4-6. As shown, rates increase with increasing temperature for THPOMe and THFOMe. In the case of MTHFOMe, equilibrium was reached at all temperatures essentially within the time of the first aliquot removal, ca 2 min.

In the case of THFOMe, it is seen that equilibrium conversions (x_e) decrease with increasing temperature resulting in crossovers on the time conversion plots (*Figure* 5). This effect of decreasing conversion at equilibrium with increasing temperature is most apparent for MTHFOMe (*Figure* 6), in which case the highest TsOH concentration was utilized. The effect is not as apparent for THPOMe (*Figure* 4). However, in this case, the lowest TsOH concentration was utilized in the temperature studies and the discrepancy is attributed to insufficient time to reach equilibrium at the lowest temperature of 27°C. When the equilibrium conversion at the highest TsOH concentration from *Figure* 1 is superimposed onto

Table 3—Effect of TsOH Concentration on Conversions of Cyclic Ethers at 27°C[a]

	THPOMe (4.3 M)		
[TsOH] (M)	1.24×10^{-3}	2.55×10^{-3}	1.18×10^{-2}
x_e	0.305	0.322	0.355
K_e	0.193	0.226	0.303
	THFOMe (4.1 M)		
[TsOH] (M)	6.16×10^{-4}	1.32×10^{-3}	2.71×10^{-3}
x_e	0.438	0.470	0.496
K_e	0.607	0.786	0.969
	MTHFOMe (4.1 M)		
[TsOH] (M)	3.0×10^{-5}	6.0×10^{-5}	1.20×10^{-4}
x_e	0.430	0.440	0.479
K_e	0.569	0.617	0.845

(a) All k values were calculated based on x_e at highest TsOH concentration.

Figure 4, as shown, the trend of decreasing equilibrium conversion with increasing temperature is clearly indicated. The equilibrium conversion for THFOMe at the highest TsOH concentration (from *Figure* 2) is also superimposed on *Figure* 5, which further points up the general trend. These results from *Figures* 4-6 are summarized in *Table* 4.

The general trend of decreasing equilibrium conversions with increasing temperature indicates that the reverse reaction is favored with increasing temperature. This trend is in accord with the lower thermodynamic stability of the neopentyl acetals, which is indicated by K_c values less than one, and the tendency of the system to reduce steric congestion with increasing temperature by reversion of neopentyl into methyl acetals. Of course, in open systems such as curing compositions, volatilization of the methanol will drive the transetherification to completion.

Table 4—Temperature Effects on Conversion of Cyclic Ethers

Temp. (°C)	THPOMe (4.3 M), TsOH (1.24 × 10^{-3} M) 27	47	62
x_e	0.355[a]	0.335	0.320
K_e	0.303[a]	0.254	0.221
Temp. (°C)	**THFOMe (4.3 M), TsOH (1.32 × 10^{-3} M) 27**	**47**	**64**
x_e	0.496[a]	0.465	0.450
K_e	0.969[a]	0.755	0.699
Temp. (°C)	**MTHFOMe (4.1 M), TsOH (1.20 × 10^{-4} M) 27**	**47**	**64**
x_e	0.479	0.432	0.374
K_e	0.845	0.578	0.357

(a) These values correspond to x_e at highest TsOH concentration; see *Table* 3 for observed values.

Kinetic Analysis of Transetherification

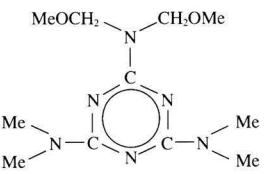
A literature search did not reveal kinetic rate expressions for acid-catalyzed transetherification of 2-alkoxy cyclic ethers or of acetals in general. Kinetic studies have been reported for irreversible acid-catalyzed hydrolysis of acetals,[16] including 2-alkoxy-2H-tetrahydropyrans.[17,18] These studies have established the A1 mechanism, which is equivalent to acid-catalyzed S_N1 reaction, involving protonation followed by rate-limiting elimination of alcohol and fast addition of water to the carbocation intermediate.

In view of the reasonable expectation that the same mechanism is involved in the initial steps of irreversible hydrolysis and reversible transetherification of acetals, we have adopted the A1 mechanism for transetherification of acetals **2a-c**. As shown in *Scheme* 2, this mechanism proceeds analogously to an intermediate carbocation. In reversible transetherification, the intermediate carbocation is partitioned between forward reaction with neopentyl alcohol and back reaction with methanol, as shown.

The A1 mechanism in *Scheme* 2 has also been utilized in mechanistic studies on transetherification of hexamethoxymethyl melamine (HMMM). At the outset of our studies, Meijer reported on transetherification of HMMM with optically active alcohols, which allowed the reaction to be conveniently followed by polarimetry.[2] The kinetic data were analyzed by equation (2), in which r_o, r_t, and r_{eq} represent optical rotations at 0 time, time = t, and at equilibrium, respectively. Equation (2) is applicable for first order kinetics, in accordance with the A1 mechanism, under conditions in which the reverse reaction does not occur significantly. These conditions are generally satisfied by having one of the reactants in large excess. However, stoichiometric concentrations of HMMM and alcohol were utilized in the polarimetric study in which the reactions were followed to equilibrium, similarly to the studies reported herein. These conditions invalidate the applicability of equation (2), which does not account for the reversible reaction.

$$(k_1 + k_{-1})\,t = \ln \frac{r_{eq} - r_o}{r_{eq} - r_t} \qquad (2)$$

An earlier kinetic study on the reaction of 2-hydroxymethyl tetrahydrofuran with N,N-dimethoxymethyl-N′,N′,N″,N″-tetramethyl melamine **6**, a model compound for HMMM, also neglected to account for the reversibility of the reaction.[3]



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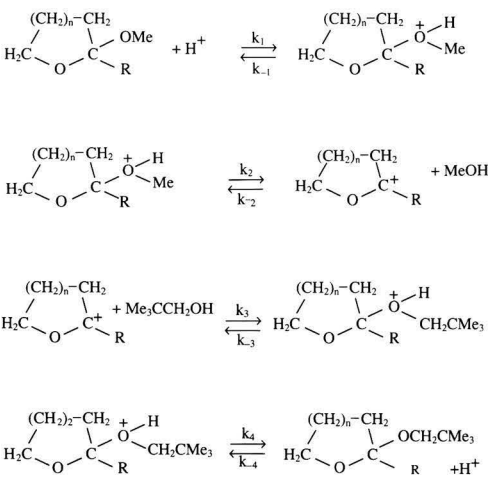

Scheme 2

In a comprehensive study in polymeric films, Bauer and Budde developed a kinetic model for transetherification of HMMM with an acrylic polyol in which extent conversions were monitored by disappearance of polyol hydroxyl groups at 3520 cm^{-1} in the IR spectral region.[1] The authors derived equation (3), in which the methoxy melamine, the acrylic polyol, and the transetherification product are represented by MOMe, ACOH, and MOAC, respectively. Equation (3) follows directly from the A1 mechanism in *Scheme* 2.

$$d(MOAC)/dt = -d(MOMe)/dt = \frac{(k_1k_2k_3/k_{-1})[H^+]}{k_{-2}[MeOH] + k_3[ACOH]} [MOMe][ACOH] - \frac{(k_{-2}k_{-3}k_{-4}/k_4)[H^+]}{k_{-2}[MeOH] + k_3[ACOH]} [MOAC][MeOH] \quad (3)$$

From extent conversion studies for the reaction of HMMM with acrylic polyol, Bauer and Budde determined that the back reaction with methanol could not be ignored. Integration of equation (3) was facilitated by making assumptions about the time dependence of methanol concentration. The kinetic analysis was facilitated further by assuming that: (1) both formation and reaction of the intermediate carbocation is independent of the reacting alcohol, that is, $k_2 = k_{-3}$ and $k_3 = k_{-2}$, respectively; (2) protonation is independent of the alcohol, that is, $k_1/k_{-1} = k_{-4}/k_4$; and (3) all six methyl ethers are equally reactive.

The corresponding rate expression for transetherification of the 2-methoxy cyclic acetals (ROMe) with neopentyl alcohol (NPOH) is shown in equation (4).

$$d(RONP)/dt = -d(ROMe)/dt = \frac{(k_1k_2k_3/k_{-1})[H^+]}{k_{-2}[MeOH] + k_3[NPOH]} [ROMe][NPOH] - \frac{(k_{-2}k_{-3}k_{-4}/k_4)[H^+]}{k_{-2}[MeOH] + k_3[NPOH]} [RONP][MeOH] \quad (4)$$

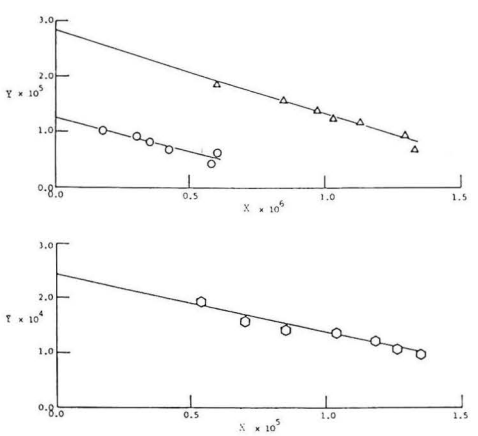

Figure 7—Linearized plots of THPOMe-NPOH reaction at 27°C with varying TsOH concentrations. {Y and X are defined in equations (10) and (11), respectively.} △—[TsOH] = 2.55 × 10^{-3}M; ○—[TsOH] = 1.24 × 10^{-3}M; and ◯—[TsOH] = 1.18 × 10^{-2}M

Our interest was to derive rate expressions for obtaining kinetic parameters from our experimental data without the necessity of making assumptions regarding the back reaction with methanol or the relative rates of formation and reaction of the intermediate carbocation (R^+). This objective was accomplished by linearizing the integrated form of equation (4) and utilizing a first order regression analysis[19] to obtain composite forward and reverse rate constants, as well as relative rate constants for the reaction of the intermediate carbocation with methanol and NPOH.

Equation (4) can be expressed in terms of extent reaction (x) for equal concentrations of reactants by equation (5). The derivation of equations which apply in general for variable reactant concentrations is provided in the appendix.

$$dx/dt = \frac{(k_1k_2k_3/k_{-1})[H^+]}{k_{-2}x + k_3(1-x)} (1-x)^2 - \frac{(k_{-2}k_{-3}k_{-4}/k_4)[H^+]}{k_{-2}x + k_3(1-x)} x^2 \quad (5)$$

Equation (6) is obtained by substituting symbols k'_1 and k'_{-1} for the composite forward and reverse rate constants, respectively, and r for the ratio of reactivity of the intermediate carbocation with MeOH and NPOH, that is, k_{-2}/k_3. The composite forward rate constant, $k'_1 = (k_1k_2/k_{-1})[H^+]$, corresponds to the rate of formation of the intermediate carbocation at a specific H^+ concentration. The corresponding composite reverse rate constant k'_{-1} equals $(k_{-2}k_{-3}k_{-4}/k_3k_4)[H^+]$, such that k'_1/k'_{-1} equals the overall equilibrium constant, K_e.

$$dx/dt = k'_1\frac{(1-x)^2}{(r-1)x+1} - k'_{-1}\frac{x^2}{(r-1)x+1} \quad (6)$$

Substituting for k'_{-1} by utilizing the equilibrium relationships shown in equation (7), followed by integration, gives equation (8), where x_e represents extent conversion at equilibrium.

$$K_e = k'_1/k'_{-1} = x_e^2/(1-x_e)^2 \quad (7)$$

$$k'_1t = \frac{x_e^2(r-1)}{2(1-x_e)}\left[\ln\frac{x_e}{x_e-x} - \frac{1}{1-2x_e}\ln\left\{\frac{(1-2x_e)x+x_e}{x_e}\right\}\right] + \frac{x_e}{2(1-x_e)}\ln\left\{\frac{(1-2x_e)x+x_e}{x_e-x}\right\} \quad (8)$$

Rearranging and dividing equation (8) by time **t** gives equation (9), which corresponds to the linear form, $Y = (1\text{-}r)X + k'_1$, where (1-r) and k'_1 represent the slope and intercept, respectively.

$$\frac{x_e}{2(1-x_e)t}\ln\left\{\frac{(1-2x_e)x+x_e}{x_e-x}\right\} = \frac{x_e^2(1-r)}{2(1-x_e)t}\left[\ln\frac{x_e}{x_e-x} - \frac{1}{1-2x_e}\ln\left\{\frac{(1-2x_e)x+x_e}{x_e}\right\}\right] + k'_1 \quad (9)$$

Accordingly, plots of X versus Y afford the composite forward rate constant k'_1 (corresponding to the intercept) and the ratio of reactivity (k_{-2}/k_3) of methanol and neopentyl alcohol with the intermediate carbocation (from the slope, 1-r, where $r = k_{-2}/k_3$). The composite reverse rate constant k'_{-1} is obtained, in turn, from k'_1 and K_e, using equation (7).

X-Y plots for transetherification of THPOMe with NPOH as functions of TsOH concentration and tempera-

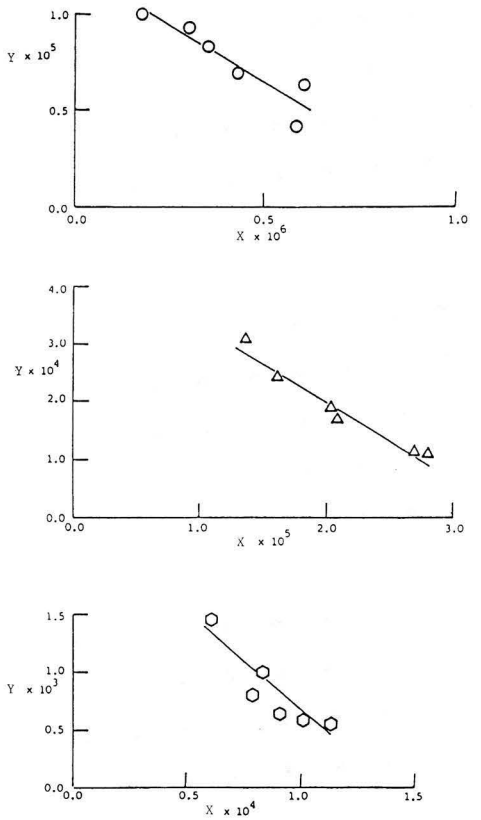

Figure 8—Linearized plots of THPOMe-NPOH reaction with constant TsOH concentration at varying temperatures. {Y and X are defined in equations (10) and (11), respectively.} ○—27°C; △—47°C; and ⬡—62°C

ture are provided in *Figures* 7 and 8, respectively. Corresponding plots for THFOMe are provided in *Figures* 9 and 10. The plots are reasonably linear in conformance with the analysis. The reaction with MTHFOMe was too fast for NMR spectral analysis.

The data points (X_i, Y_i) in *Figures* 7-10 were obtained from the experimentally determined extent conversion (x_i) with time (t_i) data sets, as shown in equations (10) and (11).

$$Y_i = \frac{x_e}{2(1 - x_e)t_i} \ln \left\{ \frac{(1 - 2x_e)x_i + x_e}{x_e - x_i} \right\} \quad (10)$$

$$X_i = \frac{x_e^2}{2(1 - x_e)t_i} \left[\ln \frac{x_e}{x_e - x_i} - \frac{1}{1\text{-}2x_e} \ln \left\{ \frac{(1 - 2x_e)x_i + x_e}{x_e} \right\} \right] \quad (11)$$

The corresponding slopes (1 − r) and intercepts (k'_1) were obtained from a first order regression analysis,[19] shown in equations (12) and (13), respectively.

$$1 - r = \frac{n[\Sigma(Y_iX_i)] - (\Sigma Y_i)(\Sigma X_i)}{n(\Sigma X_i^2) - (\Sigma X_i)^2} \quad (12)$$

Table 5—Rate Constants for Transetherification of THPOMe and THFOMe with Neopentyl Alcohol

Temp. (°C)	TsOH (M) × 10^{-3}	k'_1 (s^{-1}) × 10^{-4}	Half Life	k'_{-1} (s^{-1}) × 10^{-4}	k_{-2}/k_3
		THPOMe (4.3 M)			
27	1.24	0.125	15 hr	0.412	—
27	2.55	0.284	6.8 hr	0.938	—
27	11.8	2.29	50 min	7.55	9.9
47	1.24	4.01	29 min	15.8	12
62	1.24	23.7	4.9 min	107	18
		THFOMe (4.1 M)			
27	0.616	0.775	2.5 hr	0.800	—
27	1.32	2.22	52 min	2.29	—
27	2.71	4.86	24 min	5.02	5.3
47	1.32	19.0	6.1 min	25.1	7.2
64	1.32	51.8	2.2 min	77.4	13

$$k'_1 = \frac{(\Sigma Y_i)(\Sigma X_i^2) - (\Sigma X_i)(\Sigma(X_iY_i))}{n(\Sigma X_i^2) - (\Sigma X_i)^2} \quad (13)$$

The resulting composite forward and reverse rate constants, k'_1 and k'_{-1}, for THPOMe and THFOMe are provided in *Table* 5. Note that all the rate constants at 27°C were determined utilizing equilibrium conversion values (x_e) obtained at the highest TsOH concentration in equations (10) and (11).

In conformance with the relatively small equilibrium constants for THPOMe (see *Tables* 3 and 4), the reverse rate constants are substantially larger than the forward constants for THPOMe (about fourfold) as compared with THFOMe (< one and one-half fold).

Half-lives ($t_{1/2}$) corresponding to the composite forward rate constants are also provided in *Table* 5. These values, ranging from 2 min to 15 hr represent the times for 50% reaction of the cyclic methyl ethers with NPOH at the indicated concentrations of strong acid, and under conditions in which the methanol is volatilized faster than the reverse reaction can occur.

The relative reactivities (k_{-2}/k_3) of methanol/NPOH with the intermediate carbocation from both THPOMe and THFOMe are also provided in *Table* 5. The significantly higher reactivity of methanol relative to NPOH

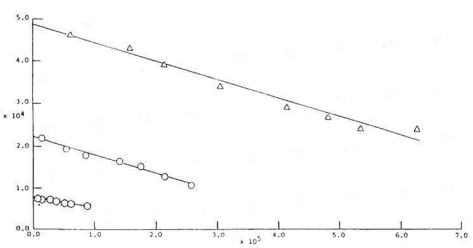

Figure 9—Linearized plots of THFOMe-NPOH reaction at 27°C with varying TsOH concentrations. {Y and X are defined in equations (10) and (11), respectively.} △ —[TsOH] = 2.71 × 10^{-3}M; ○—[TsOH] = 1.32 × 10^{-3}M; and ⬡—[TsOH] = 6.16 × 10^{-4}M

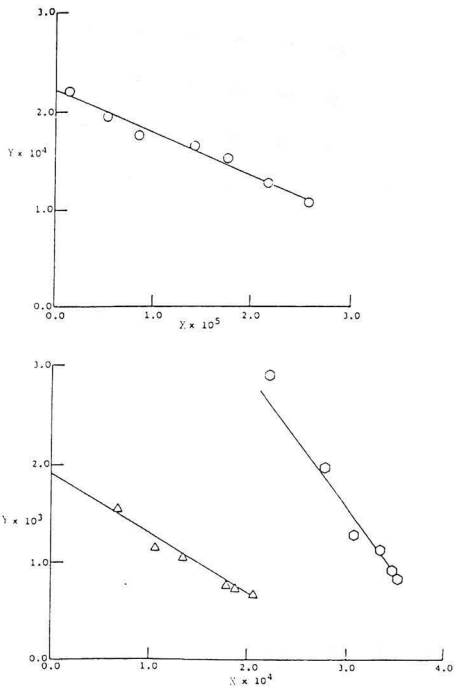

Figure 10—Linearized plots of THFOMe-NPOH reaction with constant TsOH concentration at varying temperatures. {Y and X are defined in equations (10) and (11), respectively.} ○—27°C; △—47°C; and ○—64°C

suggests that the proposed equal reactivity of alcohols with the corresponding intermediate carbocation from HMMM[1,2] may be unwarranted and merit reinvestigation.

The preference for reaction of the intermediate carbocation with methanol favors the back reaction, which conforms with the larger composite back rate constants as well as with the equilibrium conversions (x_e) of less than 0.5 and corresponding equilibrium constants (K_e) of less than 1. Our analysis does not yield k_2 and k_{-3} values, the rate constants for formation of the intermediate carbocations by dissociation of methanol and NPOH, respectively. However, it appears reasonable that dissociation of NPOH will be favored, corresponding to a large k_{-3}, owing to greater relief of steric strain, as proposed by Meijer with reference to primary versus secondary alcohols.[2] This factor will also tend to favor the back reaction when the reacting alcohol is bulkier than the alcohol which is eliminated. In curing compositions, these considerations are not expected to be significant in the early to mid stages of reaction when the reacting alcohol is in excess and the eliminated alcohol is readily volatilized. However, as the concentration of reacting alcohol decreases and volatility of the eliminated alcohol is reduced by decreasing mobility of the curing composition, the reverse reaction is expected to become increasingly significant, particularly at high conversions. Importantly, it is at high conversions that such compositions achieve optimum cure properties. Bauer and Budde provided evidence for the importance of back reaction with methanol in HMMM/acrylic polyol coatings.[1]

The k_{-2}/k_3 ratios, provided in *Table* 5, are seen to increase with temperature. The results indicate that the preference of the intermediate carbocation for methanol increases with temperature, thereby favoring the back reaction. This effect will tend to counteract the purpose of driving the reaction to completion by increasing the temperature. Note that the k_{-2}/k_3 ratio corresponding to the highest TsOH concentration at 27°C is provided in *Table* 5.

Rate Dependence on TsOH Concentration

The order in TsOH concentration for transetherification of THPOMe and THFOMe with NPOH was determined from log-log plots of the composite rate constants versus TsOH concentration in accordance with equation (14). The results are provided in *Figure* 11 and summarized as follows:

$$k' = m[\text{TsOH}]^n \qquad (14)$$

THPOMe: $k'_1 = 0.073\ [\text{TsOH}]^{1.30}$
$k'_{-1} = 0.239\ [\text{TsOH}]^{1.30}$

THFOMe: $k'_1 = 0.772\ [\text{TsOH}]^{1.24}$
$k'_{-1} = 0.797\ [\text{TsOH}]^{1.24}$

To the extent that these values are, in fact, greater than one, it is tempting to ascribe the higher order to the contribution of general acid catalysis. However, evidence for general acid catalysis has only been obtained with highly reactive acetals and not for 2-alkoxy-2H-tetrahydropyrans.[17,18] It appears more realistic to ascribe the divergence from first order dependence in TsOH to experimental error.

The apparent first order dependence suggests that TsOH is essentially completely ionized in the reaction medium. First order dependence on strong acid has been reported for hydrolysis of 2-alkoxy-2H-tetrahydro-pyrans,[17] as well as for transetherification of HMMM with acrylic polyols.[1] On the other hand, a kinetic order in TsOH of 2.5 was reported for transetherification of both

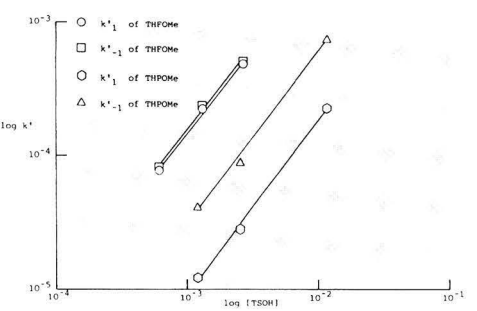

Figure 11— Log k' -log [TsOH] plots: kinetic order of [TsOH]

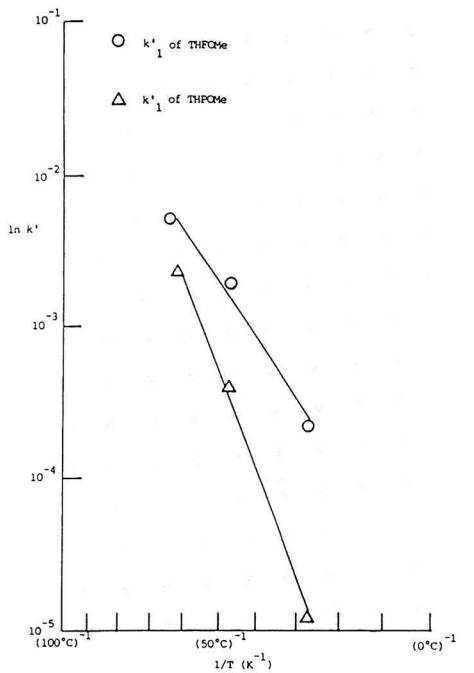

Figure 12— Arrhenius plots of composite forward rate constants (k'_1) for reactions of THPOMe and THFOMe with NPOH

HMMM and acetaldehyde diethyl acetal from polarimetric studies.[2] However, these results may be an artifact of utilizing an over-simplified rate expression; see equation (2).

Activation Parameter Considerations

Arrhenius plots, based on equation (15), of the composite forward rate constants, k'_1, for transetherification of THFOMe and THPOMe with neopentyl alcohol, are provided in *Figure* 12. The resulting E_a and relative A values are provided, together with corresponding values for the reverse rate constants k'_{-1}.

$$\ln k = \ln A - E_a/RT \qquad (15)$$

		E_a (kcal/mol)	A (time^{-1})
THFOMe:	k'_1	17.3	1
	k'_{-1}	19.3	32
THPOMe:	k'_1	30.2	1.4×10^8
	k'_{-1}	32.0	9.1×10^9

The results show that E_a values are substantially greater for THPOMe compared to THFOMe, which signifies higher sensitivity of reaction rate with temperature for the less reactive THPOMe. E_a values for reverse rates are slightly greater than for forward rates with both THPOMe and THFOMe in accordance with the temperature effect on equilibrium conversions and corresponding equilibrium constants, provided in *Table* 4.

Although absolute A values, which correspond to rates at infinite temperature, cannot be calculated for these composite rate constants, it is clear that A values are substantially greater for the THPOMe reaction and slightly greater for the reverse rates with both THPOMe and THFOMe.

The E_a and relative A values are derived from composite rate and equilibrium constants, as well as a term in acid concentration, which cancels out in the determination of E_a, but remains as a constant factor in the **A** value. This makes any mechanistic interpretation hazardous at best. However, the values are significant as an indication of the temperature effect on the overall forward and reverse reactions.

Reactivity Considerations

One of our specific interests is the potential utility of the 2-methoxy cyclic ethers in crosslinking reactions with polyols. For thermally-activated crosslinking systems, it is generally desirable that reactivity is low under ambient conditions to provide sufficient time for mixing and, preferably, long-term storage prior to application. On the other hand, it is also desirable that, following application, reactivity increases rapidly with temperature to minimize expenditure of energy and allow crosslinking to occur on heat-sensitive substrates. These requirements can be met with crosslinking reactions that exhibit relatively large E_a values, for rapid rate increase with temperature, together with large A values for allowing reactions to occur at moderately elevated temperatures.[20]

As shown in *Figure* 12, THFOMe exhibits higher reactivity than THPOMe at ambient temperatures. However, the reactivity of THPOMe increases more rapidly with temperature and extrapolation of the Arrhenius plots indi-

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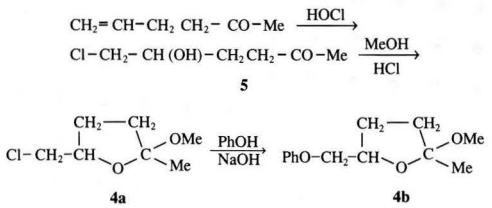

Scheme 3

cates that THPOMe reactivity will be higher at temperatures above 75°C. Therefore, multifunctional analogs of THPOMe may be more useful for thermoset compositions.

Multifunctional analogs of MTHFOMe (**2c**) will probably react too rapidly with polyols in the presence of acid to be useful for crosslinking systems. However, such analogs may be used with thermally or photochemically activated latent acid precursors.[21]

Synthetic Approach to Multifunctional Analogs of MTHFOMe

The known 2-methoxy-2-chloromethyl-tetrahydrofuran **4a,** which can be prepared from readily available starting materials, was chosen as a potential synthon for conversion of multifunctional phenols into multifunctional analogs of MTHFOMe. Accordingly, **4a** was synthesized and converted into the previously unknown phenoxy analog **4b,** as outlined in *Scheme* 3. These results indicate that intermediate **4a** may serve as a convenient synthon for the preparation of multifunctional analogs of MTHFOMe from multifunctional phenols.

SUMMARY

Three cyclic ether acetals, 2-methoxy-2H-tetrahydropyran (**2a**), 2-methoxytetrahydrofuran (**2b**), and 2-methoxy-2-methyltetrahydrofuran (**2c**), were synthesized and their acid-catalyzed transetherification reaction with equal concentrations of neopentyl alcohol (NPOH) was investigated by NMR analysis under reversible conditions. Extent conversions were determined as functions of acid concentration and temperature. Relative rates increased in the order **2a** < **2b** < **2c**, indicating that five-membered **2b** is more reactive than the six-membered analog **2a**, and that the 2-methyl substituent in **2c** further enhances reactivity. Extent conversions at equilibrium increased in the order **2a** < **2c** < **2b** within the temperature range of 27 −64°C. Under the reversible conditions, conversions at equilibrium decreased with increasing temperature for each of the cyclic ethers.

A kinetic rate expression for acid-catalyzed transetherification of 2-alkoxy cyclic ethers or of acetals in general, was not found in the literature. An appropriate expression was found for acid-catalyzed transetherification of hexamethoxymethyl melamine (HMMM); however, simplifying assumptions were made to facilitate analysis of the experimental data.

In the interest of obtaining a more complete kinetic profile of acetal transetherification, the unsimplified rate expression for specific acid catalyzed transetherification was integrated and linearized into a form which allowed determination of composite forward and reverse rate constants, as well as relative reactivity of carbocationic intermediates from both **2a** and **2b** with the competing alcohols. Analysis of the experimental data from NMR spectral studies was facilitated by development of a computer program and utilization of regression analysis. The reactivity of **2c** was too high for determination of kinetic parameters by the NMR spectrometric procedure.

The kinetic order in p-toluene sulfonic acid (TsOH) concentration for transetherification of **2a** and **2b** was found to be close to one, which is in accord with reported first order dependence of TsOH concentration in transetherification of HMMM with polyols in films. Kinetic analysis of the latter system was based on the assumption that rates of reaction of the intermediate carbocation with methanol and polyol are equal. However, our kinetic analysis provides evidence for substantially higher reactivity of methanol relative to NPOH with intermediate carbocations from both **2a** and **2b**. These results suggest that the proposed equal reactivity of alcohols with the corresponding intermediate carbocation from HMMM may be unwarranted and merit reinvestigation.

Energies of activation and relative entropies of activation, which are useful parameters for estimating the temperature dependence of shelf life and cure, were also determined for **2a** and **2b**. Whereas **2b** exhibits higher reactivity than **2a** at ambient temperature, the reactivity of **2a** increases more rapidly with temperature. Extrapolation of the Arrhenius plots indicates that **2a** will react faster at temperatures above 75°C. Therefore, multifunctional analogs of **2a** may be more useful for thermoset compositions.

Multifunctional analogs of **2c** will probably react too rapidly with polyols in the presence of acid to be useful for crosslinking systems. However, such analogs may be used with thermally or photochemically activated latent acid precursors.

The known 2-methoxy-2-chloromethyl-tetrahydrofuran **4a** was prepared and converted into the previously unknown 5-phenoxymethyl analog **4b**. This conversion serves as a model reaction for the synthesis of multifunctional analogs of **2c** by reaction of **4a** with phenolic resins. Accordingly, the readily available **4a** is a potentially useful synthon for preparation of polyol crosslinkers which possess the highly reactive 2-methoxy-2-methyltetrahydrofuran group.

We believe these studies constitute the first reported determination of important kinetic parameters for transetherification of acetals under reversible conditions. A related kinetic study, reported at the outset of our study, on reversible transetherification of HMMM with optically active alcohols (by polarimetry) utilized an inappropriate (over-simplified) rate expression to analyze the data. The approach, reported herein, appears to have general applicability for determination of reaction rate constants for

reversible reactions which proceed via a common reactive intermediate.

ACKNOWLEDGMENT

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APPENDIX

For unequal concentrations of reactant alcohol and activated ether of initial concentration a_o and b_o, respectively, equation (5) may be written as equation (16), wherein $p = b_o/a_o$.

$$\frac{dx}{dt} = \frac{(k_1k_2k_3/k_{-1})[H^+]}{k_{-2}x + k_3(1-x)}(p-x)(1-x) - \frac{(k_{-2}k_{-3}k_{-4}/k_4)[H^+]}{k_{-2}x + k_3(1-x)}x^2 \quad (16)$$

Accordingly, equation (6) becomes equation (17).

$$dx/dt = k'_1\frac{(p-x)(1-x)}{(r-1)x+1} - k_{-1}\frac{x^2}{(r-1)x+1} \quad (17)$$

Substituting for k'_{-1} by utilizing the equilibrium relationships provided in equation (18), followed by integration, gives equation (19). Equation (19) corresponds to equation (8) for equal concentration of reactants, where x_e corresponds to extent conversion at equilibrium.

$$K_{eq} = k'_1/k'_{-1} = x_e^2/(1-x_e)(p-x_e) \quad (18)$$

$$k'_1t = \frac{x_e^2(r-1)}{\{2p-(1+p)x_e\}}\left[\ln\frac{x_e}{x_e-x} - \frac{p}{p-(1+p)x_e}\ln\frac{[\{p-(1+p)x_e\}x+px_e]}{px_e}\right] + \frac{x_e}{2p-(1+p)x_e}\ln\frac{[\{p-(1+p)x_e\}x+px_e]}{p(x_e-x)} \quad (19)$$

Rearranging and dividing equation (19) by time t gives equation (20), which corresponds to the linear form, $Y = (1-r)X + k'_1$, where $(1-r)$ and k_i represent the slope and intercept, respectively.

$$\frac{x_e}{2p-(1+p)x_et}\ln\frac{[\{p-(1+p)x_e\}x+px_e]}{p(x_e-x)} = \frac{x_e^2(1-r)}{\{2p-(1+p)x_e\}t}\left[\ln\frac{x_e}{x_e-x} - \frac{p}{p-(1+p)x_e}\ln\frac{[\{p-(1+p)x_e\}x+px_e]}{px_e}\right] + k'_1 \quad (20)$$

Equation (20) corresponds to equation (9) for equal concentration of reactants. Accordingly, plots of X versus Y afford the composite forward rate constant k'_1 (corresponding to the intercept) and the ratio of reactivity ((k_{-2}/k_3) of reactant and product alcohol with the reactive intermediate (from the slope, $1-r$, where $r = k_{-2}/k_3$). The composite reverse rate constant k'_{-1} is obtained, in turn, from k'_1 and K_e, using equation (18).

The data points (X_i, Y_i) for X-Y plots are obtained from the experimentally determined extent conversion (x_i) with time (t_i) data sets, as shown in equations (21) and (22).

$$X_i = \frac{x_e^2}{\{2p-(1+p)x_e\}t_i}\left[\ln\frac{x_e}{x_e-xi} - \frac{p}{p-(1+p)x_e}\ln\frac{[\{p-(1+p)x_e\}x_i+px_e]}{px_e}\right] \quad (21)$$

$$Y_i = \frac{x_e}{2p-(1+p)x_eti}\ln\frac{[\{p-(1+p)x_e\}x_i+px_e]}{p(x_e-x_i)} \quad (22)$$

The corresponding slopes $(1-r)$ and intercepts (k'_{-1}) may be obtained from first order regression analysis utilizing equations (12) and (13) (in the text). More explicit details on the kinetic analysis herein may be found in reference (22).

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Society Meetings

MONTREAL ..... OCT.

Spouses' Night

The meeting's speaker was Lt. Col. Jacques Duchesneau, of the Montreal Police Department. He presented a talk on "CRIME PREVENTION: DRUGS."

Lt. Col. Duchesneau discussed the status of illegal drugs on the MUC (Montreal Urban Community) territory, organized crime and cocaine cartels, drug user and dealer profiles in the workplace, the consequences for using and dealing drugs, corporate solutions to drug problems, and police action.

ESTHER ROULEAU MCCARTHY, *Secretary*

MONTREAL ..... NOV.

"Concrete Substrates"

The meeting's speaker was Charles Kidd, of Sika Canada. His topic was "COATINGS FOR CONCRETE SUBSTRATES."

The speaker began by pointing out the importance of taking into account the physical properties of concrete: high compressive strength, low tensile strength (20-30 kg/cm^2), and high porosity.

Mr. Kidd stated that when choosing a coating, the following expectations for the coating should be considered: interior or exterior, or vertical or horizontal surface. Also, environmental considerations should be taken into account.

The primary types of concrete coatings were discussed, including: Portland cement, k urethanes, one-component acrylics, and two-component epoxies.

Mr. Kidd stressed the importance of a complete evaluation of the concrete surface. He said the type of admixtures, the water content, the ingredient mix, and surface finishing techniques at the time of original pouring are important. Also, the concrete must be tested for soundness, porosity, and surface bond strength. Mr. Kidd explained that the moisture content and calculation of the dew point must be determined because the epoxy will act as a vapor barrier.

Emphasis was placed on surface preparation and qualified applicators to repair and smooth surfaces.

In conclusion, Mr. Kidd stated that the future trends of concrete coatings will be affected by compliance (VOC) considerations, and the increase of waterborne and epoxy-cement hybrid systems.

Q. If adhesion is sound, how long will an epoxy floor coating last?

A. The floor life is traffic and system dependent. It also depends on the number of coats used along with the maintenance program. If a three-coat system is used, each with a different color to indicate worn areas for maintenance repair, then anywhere between five to ten years.

Q. Is epoxy suitable over internally heated concrete surfaces?

A. It depends on the degree of heat. However, it should be no problem for (moderate) interior radiant heat floor systems with suitable (flexible) coating and proper application.

ESTER ROULEAU MCCARTHY, *Secretary*

NEW ENGLAND ..... OCT.

"Fluorochemical Surfactants"

The meeting's first speaker was Jeffrey Linert, of 3M Company, who spoke on "FLUOROCHEMICAL SURFACTANTS—SOLUTIONS FOR YOUR PROBLEMS."

The speaker defined a surfactant as "a material which concentrates at the surface of a liquid in which it is dissolved, or at the interface of a liquid and another immiscible liquid or solid."

He discussed the three major benefits of using fluorocarbon surfactants, including effectiveness, efficiency, and stability. Dr. Linert also reviewed the defects that can occur at the coating/substrate interface, such as dewetting and crawling.

Q. What are the standard differences between the various grades of fluorosurfactants?

A. In general, the fluorocarbon tail is usually the same. The difference is in the polar groups. By tailoring the polar groups specifically, surfactants that are anionic, nonionic, or cationic are produced.

Q. Since fluorocarbons wet so well, is there any need to be concerned about fluorocarbons being left behind on the walls of mixing tanks?

A. Certainly with nonionics there is no problem. Cationics may be a concern in steel tanks as there may be an electrostatic attraction. We have not heard of anionics causing any problems.

The second technical presentation was given by Harry Way, of Netzsch Inc. His talk focused on "NEW TECHNOLOGY IN SMALL MEDIA MILLING."

The speaker discussed the typical problems associated with traditional closed, small media mills.

Mr. Way stated the benefits of using a recirculating media mill system, as follows: decreased batch time for typical difficult-to-disperse pigments (i.e., phthalo blue, carbon black, etc.); more uniform particle size distribution, resulting in increased transparency and gloss; easy operation and clean-up; and better for the environment since it is a fully enclosed system.

Q. Have you had any experience with a FAX paper coating in this type system?

A. Yes. We found that traditional horizontal mills get too hot, causing the wax additive to gel. The recirculating system, with its fast flow rate and lower resistance time, has much better temperature control.

Q. How long would it take to make a typical 100-gallon, 30% phthalo-blue grind with the recirculating mill?

A. Without sitting down and doing the calculations, probably about eight hours. A

NORTHWESTERN SOCIETY—WINNIPEG SECTION OFFICERS (from left)—Herb Smith, Irene Blair, Sandray Madray, Ron Chemerika, and Gary Batchelor

Constituent Society Meetings and Secretaries

BALTIMORE (Third Thursday—Martins West, Baltimore, MD). HELENE J. RANFONE, Duron, Inc.,10460 Tucker St., Beltsville, MD 20705.

BIRMINGHAM (First Thursday—Strathallan Hotel, Birmingham, England). D.C. MORRIS, PPG Industries (UK) Ltd., P.O. Box 359, Birmingham, B16 0AD, England.

CDIC (Second Monday—Location alternates between Columbus, Cincinnati, Dayton, and Indianapolis). JEFFERY I. BUCHMAN, Akzo Coatings, Inc, P.O. Box 147, Columbus, OH 43216-0147 .

CHICAGO (First Monday—Sharko's Restaurant, Villa Park, IL). NATU C. PATEL, Ace Hardware Corp., Paint Div., 21901 S. Central Ave., Matteson, IL 60443.

CLEVELAND (Third Tuesday—Brown Derby, Independence, OH in Nov., Mar., and Apr.; Cleveland Hilton, Cleveland, OH, in Feb.; Landerhaven, Mayfield Heights, OH, in May). CONSTANCE F. WILLIAMS, The Glidden Co., 801 Canterbury Rd., Westlake, OH 44145.

DALLAS (Thursday following second Wednesday—Holiday Inn Crowne Plaza, Dallas, TX). BENNY PUCKETT, Kelly-Moore Paint Co., Inc., 301 W. Hurst Blvd., Hurst, TX 76053.

DETROIT (Second Tuesday—meeting sites vary). JANE ALLEN, Reichhold Chemicals, Inc., 814 Commerce Dr., Oakbrook, IL 60521.

GOLDEN GATE (Monday before third Wednesday—alternates between Francesco's in Oakland, CA, and Holiday Inn in S. San Franscisco). RICHARD COOPER, Synergistic Performance Corp., 5801 Christie Ave., #590, Emeryville, CA 94608.

HOUSTON (Second Wednesday—Hobby Airport Hilton, Houston, TX). TOM FITZGERALD, Monarch Paint Co., P.O. Box 55604, Houston, TX 77255.

KANSAS CITY (Second Thursday—Cascone's Restaurant, Kansas City, MO). LAWRENCE J. MURPHY, Tnemec Co. Inc., 123 W. 23rd Ave., N. Kansas City, MO 64116.

LOS ANGELES (Second Wednesday—Steven's Steakhouse, Commerce, CA). JOHN C. KULNANE, Ameritone Paint Corp., 18414 S. Santa Fe Ave., P.O. Box 190, Long Beach, CA 90801.

LOUISVILLE (Third Wednesday—Executive West Motor Hotel, Louisville, KY). WILLIAM LEIGHTNER, C.L. McGuire & Co., 8134 Newlagrange Rd., Louisville, KY 40222.

MEXICO (Every fifteen days—Gabriel Mancera, Mexico City, Mexico). SERGIO ROJAS, Pinturas International, S.A. De C.V., Ganaderos 234, Col. Granjas Esmeralda, 09810 Mexico, D.F., Mexico.

MONTREAL (First Wednesday—Le Bifthèque Steakhouse, Ville St. Laurent, Quebec). ESTHER ROULEAU MCCARTHY, Stochem Inc., 1455 32nd Ave., Lachine, Que. H8T 3J1, Canada.

NEW ENGLAND (Third Thursday—Sheraton Lexington Hotel, Lexington, MA, and other locations in Massachusetts and Rhode Island). CHARLES SHEARER, ICI Resins US, 730 Main St., Wilmington, MA 01887.

NEW YORK (Second Tuesday—Landmark II, East Rutherford, NJ). GEORGE M. AMRICH JR., Benjamin Moore & Co., 134 Lister Ave., Newark, NJ 07105.

NORTHWESTERN (Jax Cafe, Minneapolis, MN). MICHAEL GRIVNA, Hirshfield's Paint Mfg., Inc., 4450 Lyndale Ave., N., Minneapolis, MN 55412.

PACIFIC NORTHWEST (PORTLAND SECTION—Third Tuesday; PUGET SOUND SECTION—Third Wednesday; VANCOUVER SECTION— Third Thursday). JOHN WESTENDORF, Lipscomb Chemical Northwest, 2627 NW Nicolai, Portland, OR 97210.

PHILADELPHIA (Second Thursday—Williamson's Restaurant, GSB Bldg., Bala Cynwyd, PA). ROBERT D. THOMAS, M.A. Bruder & Sons, Inc., 52nd & Grays Ave., Philadelphia, PA 19143.

PIEDMONT (Third Wednesday—Ramada Inn Airport, Greensboro, NC). DALE BAKER, Kohl Marketing, Inc., 3859 Battleground Ave., Ste. 203, Greensboro, NC 27410.

PITTSBURGH (Second Monday—Montemurro's Restaurant, Sharpsburg, PA). MARK A. HARLEY JR., PPG Industries, Inc., 4325 Rosanna Dr., P.O. Box 9, Allison Park, PA 15101.

ROCKY MOUNTAIN (Monday following first Wednesday—Zangs Brewery, Denver, CO). CHRISTINE LESCAMELA, Luzenac America, Inc., 8985 E. Nichols Ave., Englewood CO 80112.

ST. LOUIS (Third Tuesday—Salad Bowl Cafeteria, St. Louis, MO). CHUCK REITTER, American Paint Journal Co., 2911 Washington Ave., St. Louis, MO 63103.

SOUTHERN (GULF COAST SECTION—third Thursday; CENTRAL FLORIDA SECTION—third Thursday after first Monday; ATLANTA SECTION—third Thursday; MEMPHIS SECTION—bimonthly on second Tuesday; and MIAMI SECTION—Tuesday prior to Central Florida Section). JEFF SHUBERT, Shubert Paints, Inc., 2157 Mountain Industrial Blvd., Tucker, GA 30084.

TORONTO (Second Monday—Cambridge Motor Hotel, Toronto). BOB C. NG, Hoechst Canada Inc., 100 Tempo Ave., Willowdale, Ont. M2H 2N8, Canada.

WESTERN NEW YORK (Third Tuesday—meeting sites vary). MARKO MARKOFF, 182 Farmingdale Rd., Cheektowaga, NY 14225.

lot would depend upon the size of the mill, and the grade of phthalo blue.

CHARLES SHEARER, *Secretary*

NEW YORK .....SEPT.

"Foam and Foam Control"

A moment of silence was observed in memory of Temple C. Patton who died recently. Mr. Patton was well known for his textbooks on rheology, pigment dispersion, and numerous other subjects.

The following Society officers were sworn in: President—Michael C. Frantz, of Daniel Products Company; Vice President—Armand J. Stolte, of RHEOX, Inc.; Secretary—George M. Amrich Jr., of Benjamin Moore & Company; and Treasurer—Cary Grobstein, of Cardinal Color & Chemical, Inc.

Also, the members of the Board of Directors, with terms expiring in 1994, are: E. Robert Cardin, of Rohm and Haas Company; Robert W. Schroeder, of Minwax Company, Inc.; and Jerry H. Wilner, of D/L Laboratories.

Richard J. Himics, of Daniel Products Company, will continue to serve as the Society Representative to the FSCT's Board of Directors.

Michael Granito, of D.H. Litter Company, presented the Hüls America gavel to Mr. Frantz. He also received a copy of Roberts' Rules of Order from Irwin H. Young, of Jesse S. Young Company, Inc.

Mr. Frantz presented the Past-President's Pin to Jeffrey C. Kaye, of MacArthur Petro & Solvent Company.

Miland Vaidya, of Polytechnic University, was presented with the Mattiello Scholarship of $1,100. Mr. Vaidya's research is focusing on base operations for blends of polymers for anti-static resins.

Ad-Hoc Regulatory Committee Chairman Alfred A. Sarnotsky, of Spraylat Corporation, talked about OSHA and its Process Safety Mass Standards. The regulation applies to those companies that manufacture flammable liquids of more than 10,000 pounds in one room. Mr. Sarnotsky reported that there are 14 points to the regulation.

The meeting's technical speaker was Andrew A. Romano, of Drew Chemical Corporation. His topic was "FOAM AND FOAM CONTROL IN WATERBORNE COATINGS,"

The speaker discussed foam defects and how to fix them. He also reviewed the basic factors which contribute to film stability, and defoaming problems in high gloss paints.

Q. What is the correlation between the Red Devil shaker test and application test?

ROCKY MOUNTAIN SOCIETY OFFICERS (from left)—J. Dick Mullen, John A. Delmonico, Edward F. McCarthy, Christine LesCamela, Lou Hartnell, and Richard Crandell

A. In general, the results are marginal when comparing the shaker test to application results.

GEORGE M. AMRICH JR., *Secretary*

NORTHWESTERN ..... OCT.

"Adhesion to Chalky Surfaces"

The first presentation was delivered by Phil Scearcy and Richard Kingston, of the St. Paul Ramsey Medical Center. They focused on the "POISON CENTER HOTLINE FOR CHEMICAL PRODUCT EXPOSURE, HAZCOM/RTK/DOT EMERGENCY RESPONSE."

The speakers explained that the hotline program was started to allow companies to use an 800 number on product labels and MSDS. This system would put emergency response victims in contact with the proper professionals.

According to the speakers, the Poison Center Hotline is designed to satisfy manufacturers and employers needs with an OSHA approved Right-To-Know program. The 800 number is staffed by pharmacists enhanced with computerized optical image systems for MSDS storage and retrieval. The operators have access to foreign language interpreters, additional O/E toxicological references, and computer databases. Additional staff training, immediate and quarterly reporting to chemical manufacturers or employers, fee-for-service reimbursement mechanisms, and additional liability insurance coverage also are included as part of the hotline program.

The second speaker was Krishan C. Sehgal, of Union Carbide Emulsion Systems. His topic was "ADHESION TO WEATHERED CHALKY SURFACES."

Dr. Sehgal began his presentation by stating that the most important aspect of a coating is its adhesion. He said that coatings can be designed to have good adhesion.

According to the speaker, the principle of adhesion is the formation and rupture of a bond. He explained that the observed adhesion is the sum of the interfacial and mechanical bonds. Dr. Sehgal said for this reason, the mode of failure should be specified along with a value when testing for adhesion.

Also, he explained that the nature of the substrate plays a major role in adhesion. Furthermore, a high contact angle of the coating to the surface equates to a low surface energy which is harder to wet. The speaker reported that with a chalky alkyd, the contact angle changes with time to adsorption, which can lead to varying adhesion results.

Dr. Sehgal stated that the bulk viscoelastic transfer, or speed of the test, affects the observed adhesion. Other factors which can affect adhesion are lower temperatures, moist conditions, and the substrate.

It was explained that because of all the variables that affect adhesion, and the mode of failure, different tests can give different adhesion results.

In conclusion, Dr. Sehgal said that latex top coats can give excellent adhesion to new and weathered substrates. However, in doing so, the coating and the application properties must be balanced.

MICHAEL GRIVNA, *Secretary*

PHILADELPHIA ..... OCT.

"Rheology Control Additives"

President-Elect J. Brian O'Connor, of McWhorter, Inc., announced his resignation and offered his thanks and appreciation to the membership for their support.

J. Richard "Dick" Kiefer, Jr., Society Honorary Member, presented the Nomination Committee report requesting that Secretary Robert D. Thomas, of M.A. Bruder & Sons, Inc., become President-Elect for the remainder of the 1992-93 year. The membership granted its approval of the Nomination Committee request.

Jim Stephanadis, of The Lubrizol Corporation, discussed "CALCIUM SULFONATE-BASED RHEOLOGY CONTROL ADDITIVES FOR HIGH SOLIDS COATINGS."

The speaker said that calcium sulfonate-based rheology control additives function through the attraction and networking provided by van derWaals forces, and not

ST. LOUIS SOCIETY OFFICERS (from left)—James Lindsley, Donald J. Gibson, Michael Schnurman, Dennis Cahill, Terry Gelhot, Robert B. Phelps, and Chuck Reitter

MONTREAL SOCIETY OFFICERS (from left)—Standing: Gordon L. Simpson, Daniel Létourneau, Gilles Bélisle, Jean J. Brunet, Luc Pépin, Alex F. Vignini, Jacques Brouillette, Jason G. Hart, Michael J. Montagano, and Nathalie Rochon. Seated: Bruce R. Bridges, Robert Benoit, David E. Doughty, Richard P.E. Bordeleau, Esther Rouleau McCarthy, and Horace S. Philipp

through hydrogen bonding as the majority of the other rheology control additives do. He stated that because of this, the additives do not affect the apparent viscosity of the system, but do provide thixotrophy by withstanding the forces present in the sag and settling areas of the rheology profile. According to Mr. Stephanadis, it is necessary to use block catalysts with these additives to avoid neutralization.

The speaker stated that thixotrophy provided during baking cycles is another benefit.

ROBERT D. THOMAS, *Secretary*

ST. LOUIS .....SEPT.

McDonnell-Douglas Tour

Approximately 40 members toured the aircraft assembly operation of McDonnell-Douglas prior to the scheduled monthly meeting.

Vice President Michael Schnurman, of Kop-Coat Inc., announced the scholarship award winners: Sally Byron, of Carboline Company; Robert A. Harrington Jr., of Akzo Resins, Inc.; and Ellen Murphy, of Walsh & Associates.

Also, Mr. Schnurman read two letters of thanks written by University of Missouri-Rolla students who were awarded Society scholarships.

CHUCK REITTER, *Secretary*

ST. LOUIS .....OCT.

"Corrosion Improvement Factors"

President Dennis Cahill, of Archway Sales, presented a Society scholarship award to Robert A. Harrington Jr.

The meeting's technical speaker was New York Society member Edward W. Orr, of BYK-Chemie USA. His topic for presentation was "CORROSION IMPROVEMENT FACTORS FOR DIRECT-TO-METAL AND PRIMER COATINGS."

The speaker began by stating that two-thirds of wetting/dispersion additives can cause a decrease in corrosion resistance. However, only about one-fifth of them improve corrosion resistance. He discussed anionic and electroneutral types of wetting/dispersion additives.

According to Mr. Orr, whatever additives are used for anticorrosive properties must be properly wet, ground, and stabilized to achieve the desired results.

Furthermore, the speaker explained that the more complex the wetting and dispersing additives, the more they contribute to corrosion resistance. He said that among the structural factors that improve corrosion resistance are hydrophobic structural elements, polyfunctionality, and inhibitive chemical structures. Mr. Orr said that these factors create hydrophobic effects and chemical incorporation, and improve adhesion.

Four wetting and dispersing additives that improve anticorrosive properties were discussed. They include: alkyl ammonium salt of a polycarboxylic acid (electronetural), polyamino amide salt of a polycarboxylic acid (electroneutral), unsaturated polycarboxylic acid (anionic), and alkanolamine salt of a polycarboxylic acid (anionic).

Mr. Orr stated that polycarboxylic acids with multifunctional structures are useful because they are easily incorporated into resin systems. Also, he said that additives with zinc phosphate work well and form a very stable metal substrate-zinc phosphate-additive-resin complex.

He explained that deflocculated-type structures are very powerful and can react with many materials. Mr. Orr stated that adding too much pigment is counterproductive.

In conclusion, the speaker provided some information and data on formulation regarding the amount of additive dosage on corrosion properties of primers.

CHUCK REITTER, *Secretary*

WESTERN NEW YORK SOCIETY OFFICERS (from left)—Standing: Gerald F. Ivancie, Eric K. Karlsen, Edward L. Walker, and Marko K. Markoff. Seated: Jane Malwitz and Joanne Augustine

Future Society Meetings

Baltimore

(Mar. 18)—Technical Committee.

(Apr. 15)—Educational Committee. Nominations.

(May 20)—Manufacturing Committee. Elections.

Birmingham

(Mar. 4)—"Rheology and Its Implications for the Coatings Industry"—M. Power, Carri-Med Ltd.

(Apr. 1)—"Recent Advances on the Issue of Chrome VI Replacement in Metal Pretreatment Processes"—J. Roberts, Henkel Metal Chemicals Ltd.

(May 6)—64th Annual General Meeting.

CDIC

(Mar. 8)—"Water-Based Polyurethanes"—Paul J. Hoffman, Miles, Inc.

(Apr. 12)—"Waterborne Resins"—Richard Johnson, Cargill, Inc.

(May 10)—Speaker to be announced, King Industries, Inc.

Chicago

(Mar.1)—"Expert Systems in the Chemical Industry and Their Ability to Improve Productivity for Sales, Production, and Lab Functions"—Harold Small, MTL Computer Systems, Inc.

(Apr. 5)—"Solvent Selection for Waterborne Industrial Coatings"—Ronald K. Litton, Eastman Chemical.

(Mar. 7)—Annual Awards Banquet.

Cleveland

(Mar. 16)—"Formulating Color Without Heavy Metal Pigments"—Jim Delaney, CIBA-GEIGY.

(Apr. 20)—"Carbon Black Microdispersion—Effect on Jetness and Undertone in Coatings"—Jerry Rogers, Columbian Chemicals.

(May 18)—To be announced—Richard Ressmeyer, Intermuseum Conservatory.

Dallas

(Apr. 15)—"Complying with Emissions Regulations—A Raw Material Suppliers' View"—Daniel N. King, Exxon Chemical Co.

(May 13)—"Color Perception and Measurement"—Romesh Kumar, Hoechst Celanese Corp.

Golden Gate

(Mar. 15)—"Silicones in the Coatings Industry: The Influence of Chemical Structure Upon Properties"—Edward Orr, Byk-Chemie.

(Apr. 19)—"The Foam Story"—Jay W. Adams, Tego Chemie.

(May 17)—"Statistical Design in High Solids Polyurethane Coatings"—Sherri L. Bassner, Air Products and Chemicals, Inc.

(June 14)—Manufacturing Committee Seminar.

Houston

(Apr. 14)—"Complying with Emissions Regulations—A Raw Material Suppliers' View"—Daniel N. King, Exxon Chemical Co.

(May 12)—"Color Perception and Measurement"—Romesh Kumar, Hoechst Celanese Corp.

Montreal

(Mar. 3)—"Techniques for the Analysis and Identification of Coatings for Legal Purposes"—Speaker from the Royal Canadian Mounted Police, Forensic Labs.

(Apr. 7)—Technical Committee Presentation—Daniel Letourneau, Chateau Paints.

(May 5)—Past-Presidents' Night. Manufacturing Committee Presentation—Gerard Paradis, BASF Canada.

New England

(Mar. 18)—"Meeting the Challenge of the Nineties with VOC Compliant Silicones"—Lee Hertz, Wacker Silicones.

(May 25-26)—Tech Expo '93.

New York

(Mar. 9)—Mini Workshop. Presentations on: "Waste"—Kevin Reed, Orr & Boss; "Plant Safety"—Marvin Specht, Hercules, Incorporated; "Wet Adhesion"—Tammy Maver, Rohm and Haas Company; and "Anatomy of a Paint"—Donald E. Brody.

(Apr. 13)—"Modern Trends in Organic Pigment Technology"—Hugh M. Smith, Sun Chemical.

(May 11)—PaVaC Meeting. To be announced—Frank Jones, Eastern Michigan University.

Philadelphia

(Apr. 16)—Awards Night Dinner Dance.

(Mar. 11)—"Filtering Those Difficult High Solids Paints"—Pete Scovic, Ronnigen Petter.

(May 13)—Manufacturing Committee Presentation. "ISO 9000"—Speaker to be announced.

Pittsburgh

(Mar. 8)—"Theory and Application of Defoamers"—Alfred A. Lamy, Ultra Additives.

(Apr. 12)—Environmental Symposium.

(May 10)—"Psychology of Color"—Andrea Piontelc, PPG Industries, Inc.

St. Louis

(Mar. 16)—Manufacturing Night.

(May 18)—"Pigments for High Solids and Water Borne Coatings"—Speaker from CIBA-GEIGY.

(June 4-5)—Joint Meeting with Kansas City Society. Holiday Inn, Lake of the Ozarks, MO.

Toronto

(Mar. 8)—Annual Symposium.

Elections

BIRMINGHAM

Active

Aspin, Stuart—Croda Resins, Rossendale, Lancs.

CHICAGO

Active

Anderson, Brian T.—Morton International, Woodstock, IL.
Buckner, Randy A.—PPG Industries, Inc., Gurnee, IL.
Contos, Nick G.—Essential Industries, Merton, WI.
Hale, Carla D.—The Valspar Corp., Kankakee, IL.
Korenkiewicz, Steve M.—The Valspar Corp., Wheeling, IL.
Mitchell, Jay R.—The Valspar Corp., Kankakee.
Sthay, Gerald P.—James B. Day & Co., Carpentersville, IL.
Swanson, Roger L.—The Valspar Corp., Kankakee.
Wenske, Wayne J.—Kohler Co., Kohler, WI.
Williams, Bosie M.—The Valspar Corp., Kankakee.

Associate

Baker, John C.—Du Pont Co., St. Charles, IL.
Bojarski, Suzette—McWhorter Inc., Carpentersville, IL.
Carlton, Doug—Micro Motion, Bolingbrook, IL.
Elsner, Thomas—Van Waters & Rogers, Schaumburg, IL.
Fox, John M.—Sun Chemical Corp., Des Plaines, IL.
Kubera, Gary L.—McWhorter Inc., Carpentersville.
Morrison, Larry J.—Avery Dennison, Lockport, IL.
Nix, Patrick O.—Reichhold Chemicals Inc., Oak Brook, IL.
O'Toole, Joseph M. Jr.—RHEOX Inc., Schaumburg, IL.
Sanzo, Edward—Lewis Chemical, Berkeley, IL.
Scienski, Patricia E.—Northern Container, Bedford Park, IL.

LOS ANGELES

Active

Avakian, Nairi—Courtaulds Aerospace, Burbank, CA.
Murphy, Thomas P.—Coatings Resource, Huntington Beach, CA.

Associate

Croul, Spencer—Behr Process, Santa Ana, CA.
Kercher, Doug G.—Harcros Pigments, Oakley, CA.
Waterman, Susie L.—Contico Container, Norwalk, CA.

NEW ENGLAND

Active

Mancuso, Curt—Hoechst Celanese, Coventry, RI.
Robichaud, Kenneth T.—Presstek Inc., Hudson, NH.

NEW YORK

Active

Ginez, Andres R.—Engelhard Corp., Iselin, NJ.
Hartie, Brian J.—Con-Lux Coatings, Inc., Edison, NJ.
Hoyte, Wayne M.—M. Grumbacher, Cranbury, NJ.
Johler, Elaine M.—Rhone-Poulenc Inc., Cranbury.
Takahashi, Toshiya—Dai Nippon Toryo Co., Ltd., Hillsborough, NJ.
Tilara, Navin K.—Benjamin Moore & Co., Newark, NJ.

Associate

Brown, Lori R.—ICI Americas, Wilmington, DE.
Lester, Tom Jr.—Southern Clay Products, Garland, TX.

Retired

Briggs, Cortlandt P.—Scarsdale, NY.

NORTHWESTERN

Active

Lundquist, Susan H.—The Valspar Corp., Minneapolis, MN.
Mooney, Raymond M.—Cargill Inc., Minneapolis.
Prenosil, Michael B.—Pentaxt Consultant, Roseville, MN.
Rupp, Michael A.—Diamond Vogel Paints, Osceola, WI.
Wentzel, Kent—Crow River Industrial, Annandale, MN.

Associate

Beckert, Carol M.—Aqualon Company, Palatine, IL.
Wolk, Thomas N.—Chemcentral, Lakeville, MN.

Educator/Student

Zhu, Jiandong—North Dakota State University, Fargo, ND.

PACIFIC NORTHWEST

Active

Adams, George R.—Adams Industrial Coatings, Battle Ground, WA.
Badertscher, Shawn M.—Burkes Paint Co., Inc., Washougal, WA.
Boyce, R. David—Morton International, Salem, OR.
Koric, Milislav K.—Powertech Labs., Inc., Surrey, B.C.
Lambert, Darald W.—Ames Paints Ltd., Victoria, B.C.
Linquist, Robin E.—Rodda Paint Co., Portland, OR.
Macausland, David B. Jr.—Sun Frog Products, Inc., Gladstone, OR.
McMonigal, Susan U.—Akzo Coatings, Inc., Salem.
Miller, Larry D.—Akzo Coatings, Inc., Salem.
Shields, Darin A.—Forrest Paint Co., Eugene, OR.
Smith, David R.—Forrest Paint Co., Eugene.
Stewart, David P.—Acroma Sales, Richmond, B.C.
Temple, David—Akzo Coatings, Inc., Salem.
Tendick, Roger A.—Laurence-David Inc., Eugene.
Vockler, Larry D.—ICD, Vancouver, WA.

Associate

Cinoman, Douglas S.—Rohm and Haas, Federal Way, WA.
Fox, James W.—U.S. Can Co., Los Angeles, CA.
Hoff, David K.—ChemCentral, Portland, OR.
Lillyman, Janet M.—Debro Chemicals, Burnaby, B.C.
Telfer, G. Ronald—Witco Canada Inc., Delta, B.C.
Warriner, Bob J.—Mackenzie & Feimann, Delta.
Witt, Monica E.—SCM Chemicals, Sante Fe Springs, CA.

People

Marcy S. Baugh has been appointed Manager/Market Development, Paint and Coatings, for Specialty Minerals Inc., a division of Minerals Technology Inc., Easton, PA. In this capacity, Ms. Baugh's duties will include market development for precipitated calcium carbonate, ground limestone, and talc. She will also serve as a Technical Service Manager. Ms. Baugh was previously employed by Luzenac America, where she was a Technical Manager. She is a Past-President of the Rocky Mountain Society.

M.S. Baugh

Datacolor International, Lawrenceville, NJ, has named **Tom Palazzolo** to Director of Technical Operations. In this position, Mr. Palazzolo will direct operations of the company's recently expanded Lawrenceville Manufacturing and Technical Centers.

Anthony S. Grzemski has accepted the position of Account Manager for PPG Industries' Silica Products Business Unit based in Memphis, TN. Having been with PPG since 1986, Mr. Grzemski previously served as a Sales Representative/Silica Products.

Also, PPG's Chemicals Group, in Pittsburgh, PA, has named **Michael E. Gilchrist** as Sales Manager/Silica Products. In this position, Mr. Gilchrist will be responsible for all of the company's silica product sales to non-tire markets in North America, including Canada and Mexico. He has been with the company since 1974.

In addition, **James W. Craig** has been elected President and Chief Operating Officer of PPG Canada Inc., a subsidiary of PPG Industries, Toronto, Ontario, Canada. He succeeds **J.L. (Jack) MacMillan**, who returns to PPG's Pittsburgh headquarters on special assignment.

Paul Kearney has been named Corporate Purchasing Manager specializing in frit, color, and powder coatings, for Ferro Corporation, Cleveland, OH. Mr. Kearney joins Ferro after holding various purchasing and materials management positions with Figgie International, Clark Equipment Company, and Ford Motor Company.

Liquid Carbonic's Supercritical Processing (SPC) Group has promoted **Raymond Robey** to General Manager, **Robert (Bud) Carter** to National Sales and Marketing Manager, and **Richard Novak** to Manager/Technology. Mr. Robey, who has 15 years of experience in supercritical technology development, previously served as the SPC group's Manager of Process Development. Mr. Carter joined Liquid Carbonic in 1986 as a marketing specialist, and most recently served as Sales Manager for the firm's freezing systems. Mr. Novak has been the SCP group's Senior Principal Engineer since 1990.

Sartomer Company, Exton, PA, has named **Martin Cellerier** Senior Vice President/Finance, Planning, and Acquisitions. Mr. Cellerier will oversee all financial planning, acquisition, purchasing, MIS, and accounting functions in this capacity.

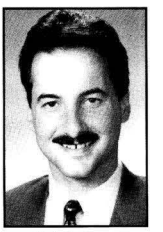
Thomas J. Lucas has assumed the responsibilities and title of Group Vice President/Commercial Packaging Inks, for Flint Ink Corporation, Warminster, PA. **John F. Jordan** will replace Mr. Lucas as Vice President/Sales and Marketing for the group.

Halox Pigments, Hammond, IN, has appointed **Robert Halvorsen** to the new position of Sales Director. Mr. Halvorsen will direct the sales efforts of the Halox headquarters sales operations as well as those of the company's network of 16 U.S. and 14 international distributors. Also, he will direct marketing, customer service, and communications programs which support the firm's worldwide sales and service requirements. Mr. Halvorsen is a member of the Chicago Society.

R. Halvorsen

The Dexter Corporation's Packaging Products Division, Waukegan, IL, has appointed **Patricia Parks** to the position of Director of Human Resources. In this capacity, Ms. Parks will develop and manage programs focusing on training, recruiting, communication, and performance appraisal.

Bob Skarvan has accepted the promotion to Western Regional Sales Manager for McWhorter, Inc., Carpentersville, IL. In this capacity, Mr. Skarvan will oversee the management and sales activities of the West Coast and its surrounding areas. He is a member of the Golden Gate, Los Angeles, and Rocky Mountain Societies.



B. Skarvan

Russell A. Battilana has accepted the position of National Sales Manager for Hanlon & Goodman, Conshohocken, PA. In his new position, Mr. Battilana will oversee management of the national sales force, as well as coordinate the company's marketing, promotion, and merchandising activities.

The position of Vice President/ ChemCare™ for Van Waters & Rogers, Inc., Kirkland, WA, has been accepted by **Michael E. Efting**. A 14-year veteran of the company, Mr. Efting has served Van Waters in a number of sales and managerial positions. Most recently he was Area Manager for Atlanta, GA.

The National Decorating Products Association, St. Louis, MO, has elected its 1993 Board of Directors. Elected as Officers of the association are: President—**Robert Perschon**, Salt Lake City, UT; Vice President—**Jan Satrom**, Grand Forks, ND; and Treasurer—**Ed Makarenko**, Red Deer, Alberta, Canada. New Directors include: **Ross Brandman**, Norwalk, CT; **Russell Bruette**, Wilmington, DE; **Marlene Pearce**, Riverview, New Brunswick, Canada; and **Phil Wyant**, Lexington, KY.

In addition, **Nicholas R. Cichielo** has been named the new Executive Vice President of the Eastern Decorating Products Association. Mr. Cichielo, who was the Executive Vice President of the Decorating Product Dealers Association of New York, Inc. for 14 years, will coordinate activities with EDPA President **Ross Brandman**.

Raymond D. Kushner has joined the staff of Ranbar Technology Inc., Glenshaw, PA, as Midwest Regional Sales Manager. Formerly Manager/Business Development with the Sterling Group in Sewickley, PA, Mr. Kushner will be responsible for the sales and marketing of the company's organic polymers used in the manufacture of paints, coatings, and varnishes. In addition, he will support the field representatives for Ranbar in Ohio, Michigan, Kentucky, Indiana, and Missouri.

R. Kushner

Amoco Fabrics and Fibers, Atlanta, GA, has appointed **Frank G. Andrusko** President. Mr. Andrusko joined Avisun Chemical Company in 1960. He became an Amoco employee in 1968 when Amoco Chemical acquired Avisun. Since that time, Mr. Andrusko has advanced through the ranks in a number of managerial positions including his most recent assignment as Vice President of Business Management/Polymers for Amoco Chemical.

Randy Thesken and **David Ward** have joined the sales team of Hunter Associates Laboratory, Inc., Reston, VA. Mr. Thesken will represent the firm's products and services in Ohio, western Pennsylvania, Indiana, Kentucky, and West Virginia. He is replacing **Tom Coulton** who has been promoted to HunterLab's European office. The states of Georgia, Mississippi, Alabama, northern Florida, Tennessee, and Louisiana will be serviced by Mr. Ward.

Phillip D. Ashkettle has been named President and Chief Executive Officer for Reichhold Chemicals Inc., Research Triangle Park, NC. He succeeds **Thomas Mitchell**, who will take an early retirement in April 1993. Prior to joining Reichhold in 1981, Mr. Ashkettle was Manager/Materials and Transportation, for the Resins and Coatings Division of Owens-Corning Fiberglas Corporation.

Arco Chemical Company, Newtown Square, PA, appointed **Alan D. Kornfeld** as Vice President/Styrenics for Arco Chemical Americas, with responsibility for the styrene, polystyrene, and engineering resins business. For the past five years, Mr. Kornfeld has been based in Seoul, Korea, as Executive Vice President and Joint Representative Director of Yukong Arco Chemical, Ltd.

The Industrial Wood Coatings Business Unit (BU) of Akzo Coatings Inc., Louisville, KY, has named **Gary L. Fulk** Manager. He will be located at the BU's world headquarters in High Point, NC.

Also, the following have been named to the BU management team: **Rad C. Darby**—Sales/Marketing Manager; **Gerald A. Bryant**—Manufacturing/Engineering Manager; **Gerry M. Currier**—Technical Manager; **S. Wyatt Ware**—Finance/Control Manager; and **William R. Willets**—Human Resources Manager.

In addition, the following have been appointed Managers of the Industrial Wood Coatings manufacturing operations: Mr. Darby—High Point, NC (includes Roanoke, VA and Lenoir, NC); **William K. Poole**—Clinton, MS; **Wayne M. Brown**—Salem, OR; **Hugh J.S. Shane**—St. Jerome, Quebec, Canada; **Wes W. Fournier**—Langley, British Columbia, Canada; **Robert P. Scanga**—Somerset, NJ; and **William R. Jenkins**—Singapore.

Obituary

Carlton (Carl) Huntington, Past-President of the Pacific Northwest Society, died December 28, 1992. He was 68 years old.

After graduating from the University of Washington with a B.S. Degree in Chemistry in 1950, Mr. Huntington joined McCloskey Varnish of the Northwest in Portland, OR. After serving six years in the company's laboratory, he became McCloskey's Northwest Salesman, a position he occupied until he was made President of the company in 1975. After the reorganization of the company, Mr. Huntington joined Chemical Distributors in 1983 as Sales Representative and Advisor. He retired in 1987 after serving 37 years in the coatings business.

C. Huntington

Mr. Huntington was President of the Pacific Northwest Society in 1965. He served three terms as the Society's Representative on the Federation's Board of Directors and served on many local and FSCT committees. Mr. Huntington was also President of the Portland Paint and Coatings Association in 1975. He was a charter member of the Portland Industrial Chemists' Association.

Mr. Huntington is survived by his wife, Barbara.

Jack Haslett, of BASF Canada, Ltd., Richmond, British Columbia, Canada, died December 5, 1992.

Mr. Haslett originally worked for ICI in England, then moved to ICI in Canada. He most recently was employed by BASF Canada, Ltd.

Mr. Haslett was a member of the Pacific Northwest Society.

Rheology, Dispersion, and Adhesion Courses Scheduled for Kent State University

The Rheology and Coatings Laboratory at Kent State University, Kent, OH, will be conducting its three short courses, "Applied Rheology for Industrial Chemists," April 26-30; "Dispersion of Pigments and Resins in Fluid Media," May 10-14; and "Adhesion Principles and Practice for Coatings and Polymer Scientists," May 24-28.

* * * *

The rheology lecturers will discuss fundamentals, instrument selection and meaningful measurements, processing and performance problems, and the use of stress or strain controlled measurements. Course schedule is as follows:

Monday, April 26

"Rheometry"—Irvin M. Krieger, of Case-Western Reserve University

"Fundamentals of Linear Viscoelasticity"— Irvin M. Krieger

"Rheology of Dispersions"—Irvin M. Krieger

"Rheological Instruments and Selection"—Edward A. Collins, of E.A. Collins, Inc.

Tuesday, April 27

"Meaningful Rheological Measurements"—Edward A. Collins

"Application of Rheology to Processing Problems"—Charles L. Rohn, of Rheometrics, Inc.

"Application of Rheology to End-Use Performance Problems"—Charles L. Rohn

"Rheology Measurements: Control Stress or Control Strain, Which to Use?"—Abel Gaspar Rosas, of Physica USA, Inc.

Wednesday, April 28

"Rheology of Fluid Coatings: Application, Flowout, and Defect Formation"—Clifford K. Schoff, of PPG Industries, Inc.

"Rheology in the Protective and Decorative Coatings Industry"—Richard R. Eley, of The Glidden Co.

"Thermal Mechanical Properties of Coatings"—Daniel J. Skrovanek, of Miles Inc.

"Physical/Chemical Characterization of the Cure Process by Thermal/Mechanical/FTIR Analysis"—Theodore Provder, of The Glidden Co.

Thursday, April 29

"Rheological Additives for Flow Modification"—Sharad Thakkar, of Eastman Kodak

"Correlation of Film Morphology with Drying Behavior"—John W. Vanderhoff, of Lehigh University

"Rheology of Latexes"—John W. Vanderhoff

"Chemorheology of Thermosetting Coatings"—Richard R. Eley

Friday, April 30

"Control and Rheological Measurement of Crosslink Density in Films"—Loren W. Hill, of Monsanto Chemical Co.

"Application of Rheology to Engineering Problems"—Donald Bigg, of Battelle-Columbus Laboratories

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The dispersion course introduces surface chemistry fundamentals necessary for dispersion; dispersing agent selection; dispersion of inorganic, organic, and carbon black pigments and the measurement of dispersion quality by rheology and particle size analysis. The program will consist of the following lectures:

Monday, May 10

"Fundamentals of Surface and Colloid Chemistry I"—Richard J. Ruch, of Kent State University

"Dispersant Selection Based on Pigment Functionality"—Robert F. Conley, of Mineral Resource Technology

"Fundamentals of Surface and Colloid Chemistry II"—Richard J. Ruch

"Wetting and Dispersing Agents in Aqueous and Non-Aqueous Systems"—Robert W. Vash, of BYK-Chemie USA

Tuesday, May 11

"Mineral Pigment Processing Parameters and Their Influence on Polymer Properties"—Robert F. Conley

"Pigment Dispersion"—Theodore Vernardakis, of Sun Chemical Corp.

"White Pigments—Processing and Rheology"—Robert F. Conley

"Carbon Black Pigments: Production, Properties, Application, and Dispersion"—Maria Nargiello, of Degussa Corp.

Wednesday, May 12

"Introduction to Dispersion Rheology"—Richard R. Eley

"Determining Dispersion Quality by Rheological and Related Methods"—Richard R. Eley

"Overview of Dispersion Equipment for Inks and Coatings"—Ramon Pineiro, of Daniel Products Co.

"Particle Size Analysis of Coatings Systems"—Theodore Provder

Thursday, May 13

"Primary Mixing and Blending"—Leo Dombrowski, of Gibraltor Chemical

(Continued on page 86.)

State University of New York Offers Three Intensive Short Courses

The State University of New York, New Paltz, NY, is offering three intensive short courses to be held at the Fairmont Hotel, in New Orleans, LA.

"Polymer Blends and Alloys: Phase Behavior, Characterization, Morphology, Alloying Technology," will be held March 21-23.

On March 21-24, the course entitled, "Pigment Dispersions: Science and Technology," will take place. This program examines, in-depth, the principles of colloid and interface science that are relevant to the various stages—incorporation, wetting, disagglomeration, flocculation—involved in the overall process of dispersing pigments into liquid media, and their technological application.

"Emulsion Polymerization: Mechanism and Kinetics, Surfactant Effects, Latex Characterization and Uses," designed as an introduction into the field, will be held March 22-24. Recent developments in critical areas, along with practical applications will be discussed.

Other courses to be offered by the university throughout the year include:

—Fundamentals of Adhesion: Theory, Practice, and Applications, October 3-5, New Orleans, LA

—Electrically Conductive Polymers, October 3-5, New Orleans

—Polymer Colloids/Emulsion Polymers, October 10-12, Orlando, FL

—Principles in Stabilization and Controlled Degradation of Polymers, October 10-12, Orlando

—Scanning Electron Microscopy and X-Ray Microanalysis, October 25-29

Additional information may be obtained by writing Angelos V. Patsis, Director, State University of New York New Paltz, NY 12561.

Fundamentals of Color Seminar To Be Sponsored by Macbeth

Macbeth, Division of Kollmorgen Instruments Corporation, Newburgh, NY, has announced the 1993 schedule of the "Fundamentals in Color" seminar.

The two-day seminar is designed to serve as an introduction to the basic principles of color science. The program is oriented toward people involved in the design, production, quality control, or inspection of materials for which color is important. A general understanding and appreciation of the theory and practice of the science of color is the main objective by course end. Lectures and practical demonstrations in the use of visual standards are also included.

Seminar dates and locations are: March 4-5, Dallas, TX; March 25-26, San Francisco, CA; April 15-16, Cherry Hill, NJ; May 6-7, Washington, D.C.; May 27-28, Schiller Park, IL; June 10-11, Bridgeton, MO; and June 24-25, Newton, MA.

Additional information is available from Wanda F. Smith, Macbeth, 405 Little Britain Rd., New Windsor, NY 12553-6148.

SSPC to Hold Its Two-Day Tutorial on "Industrial Lead Paint Removal and Abatement"

The Steel Structures Painting Council, Pittsburgh, PA, will be presenting an updated two-day tutorial on the fundamentals of lead paint removal and abatement. The program is intended for facility owners (e.g., bridges, water towers, process facilities, etc.) engineers, specifiers, consultants, regulators, industrial hygienists, and other who need to learn the most recent techniques in all facets of abating and removing lead paint from industrial structures.

The tutorial will consist of the following topics:

—Legal and Regulatory Overview

—Worker Protection

—Compliance with Air, Soil, and Water Regulations

—Compliance with Solid and Hazardous Waste Regulations

—Coating Removal Methods

—Design, Construction, and Ventilation of Containment

—Alternative Maintenance Strategies

—Developing Specifications for Lead Abatement

—Project Management

Dates and locations for the program are as follows: March 13-14, Hyatt Regency, Cincinnati, OH; March 22-23, Sheraton Inn Bossier City, Shreveport, LA; April 14-15, Airport Hilton and Towers, Los Angeles, CA; and June 6-7, Marriott Astrodome, Houston, TX.

For additional information, contact SSPC, 4516 Henry St., Ste. 301, Pittsburgh, PA 15213-3728.

Member of

New England Society's 1993 Scholarship Program Underway

The New England Society for Coatings Technology will be awarding up to $2,500 in scholarships to qualified applicants in the coatings industry.

For further information, contact Rudolph D. Deanin, NESCT Educational Chairman, c/o University of Massachusetts/Lowell, Plastics Engineering Dept., Lowell, MA 01854. Deadline for applications is March 1.

Washington Paint Group Hosts 33rd Annual Symposium

"Facing the Future . . . Technology for the 90s," is the theme of the 33rd Annual Symposium presented by the Washington Paint Technical Group. The meeting is scheduled to be held April 13-14 at the Ramada Hotel, Tyson's Corner, VA.

New technologies for regulatory compliance, approaches to regulatory compliance, and VOC-compliant technologies will be among the topics discussed.

For further information, write Mark Padow, National Paint and Coatings Association, 1500 Rhode Island Ave., N.W., Washington, D.C. 20005-5597.

Coatings Science Courses To Be Offered by USM in 1993

The University of Southern Mississippi, Hattiesburg, MS, will be offering its Coatings Science Short Courses during 1993.

The following programs are scheduled to be held: "Coatings Science for Coatings Technicians"—May 17-20; "Coatings Science for Coatings Formulators"—June 7-10; "Coatings Science for Coatings Chemists"—June 14-17; and "Coatings Science of Powder Coatings"—August 9-12.

Contact Shelby F. Thames, University of Southern Mississippi, Southern Station, P.O. Box 10076, Hattiesburg, MS 39406-0076, (601) 266-4080, for further details.

NACE's Corrosion/93 Scheduled For New Orleans, LA, March 7-12

The National Association for Corrosion Engineers (NACE), Houston, TX, will be presenting Corrosion/93 on March 7-12, 1993, at the New Orleans Convention Center, in New Orleans, LA. The international forum is devoted exclusively to the protection and performance of materials, and is designed to offer registrants a comprehensive overview of the latest developments in evaluating materials performance in corrosive environments, new corrosion-resistant materials, and emerging materials protection systems.

The conference will be the focal point for many of the organization's technical activities and committee functions, including technical symposia, open forums, poster sessions, and technical committee meetings. The conference runs concurrently with the 1993 Materials Performance and Corrosion Show where more than 250 exhibiting companies will display a comprehensive range of products and services.

Scheduled to appear in conjunction with Corrosion/93 is a symposium on "Corrosion Research in Progress," sponsored by the Research Committee of NACE. The program, which will be held March 8-10, will focus on the latest developments in fundamental understanding in four selected areas of high-research interest, namely modelling of electrochemical processes, environmental cracking, nucleation phenomena, and corrosion of advanced materials.

For more information on Corrosion/93 and conference registration, contact the NACE Membership Services Dept., NACE, P.O. Box 218340, Houston, TX 77218-8340.

Datacolor International Announces 1993 Industrial Color Technology Seminar Schedule

Color seminars focusing on practical problem solving in industrial applications are being sponsored by Datacolor International, Lawrenceville, NJ. The two-day seminars will cover topics on: colorimetry and factors affecting color; spectrophotometry and metamerism; colorant characteristics and elements of formulation; color differences; Kubelka-Munk turbid media theory application; and more.

Mr. Ralph Stanziola, President of Industrial Color Technology, is the seminar lecturer. Mr. Stanziola is a member of the JOURNAL OF COATINGS TECHNOLOGY Editorial Review Board, and was the 1981 recipient of the Federation's Armin J. Bruning Award.

The 1993 Industrial Color Technology Seminar schedule is as follows: April 26-27, Los Angeles, CA; April 29-30, Seattle, WA; May 18-19, Cleveland, OH; June 22-23, Minneapolis, MN; September 28-29, Lawrenceville, NJ; October 25-26, Atlanta, GA; and November 9-10, Springfield, MA.

For registration infomation, contact Donna Shirey, Marketing Dept., Datacolor International, 5 Princess Rd., Lawrenceville, NJ 08648.

Rheology, Dispersion, and Adhesion Courses Scheduled for Kent State

Continued from page 81.

"High Viscosity Dispersion and New Dispersion Techniques"—James White, of White Chemical Equipment Co.

"Small Media Milling and Dispersion Technology"—Leo Dombrowski

"Principles of Ball and Pebble Milling"—Warren Fuller, of Paul O. Abbe, Inc.

"Attritor Grinding and Dispersing Equipment"—Arno Szegvari, of Union Process, Inc.

Friday, May 14

"Dispersing Fine-Particle Material-Determining Equipment Requirements (and Choices Based on the Ingredients)"—David G. Bosse, of Maginet-Projects.

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Surface chemistry and rheology relevant to adhesion, fracture mechanics of glassy and elastomeric adhesives, surface preparation, tack and adhesion promoters will be presented in the adhesion course. Scheduled topics include:

Monday, May 24

"Interfacial Energies and Their Role in Adhesion"—Richard J. Ruch

"Deformation and Fracture of Elastomeric Adhesives"—Gary R. Hamad, of The University of Akron

"General Rheology and Its Application to Adhesion"—Donald L. Hunston, of National Institute of Standards and Technology

"Fracture Behavior of Glassy Adhesives"—Donald L. Hunston.

Tuesday, May 25

"Fracture Mechanics and Bond Durability Considerations"—James Koutsky, of University of Wisconsin

"Etching, Cleaning, and Surface Modification of Polymer and Other Surfaces"—James Koutsky

"Principles of Elastomer Tack"—Gary R. Hamed

"Organofunctional Silanes as Adhesion Promoters and Crosslinkers"—Bruce A. Waldman, of Union Carbide Corp.

Wednesday, May 26

"Principles, Practical Operation and Application of Major Forms of Adhesion Testers"—Richard Riegert, of Adhesion International

"Microscopic/Spectroscopic Studies in Adhesion of Metals and Composites"—John G. Dillard, of Virginia Tech

"Application of Surface Analysis to Adhesion of Coatings"—Kenneth D. Bomben, of Perkin-Elmer Physical Electronics Laboratories

"Bonding and Chemistry of Structural Adhesives"—Kurt C. Frisch, Jr., of 3M Co.

Thursday, May 27

"Corrosion Aspects of Paint Adhesion and Adhesive Bond Durability"—Ray A. Dickie, of Ford Motor Co.

"Surface Chemistry of Release"—Michael J. Owen, of Dow Corning Corp.

"Fundamental and Practical Aspects of Pressure Sensitive Adhesives, Caulks, and Sealants"—Krishan C. Sehgal, of Union Carbide Corp.

"Formulation, Application and Evaluation of Adhesives in Web Form"—James A. Miller, of Chemsultants International Network.

Friday, May 28

"Bonding Plastics and Elastomers"—Edward M. Petrie, of ABB Transmission Technology Institute

"Adhesive Application Methods"—Edward M. Petrie.

For further details, contact Carl J. Knauss, Director, Cooperative & Continuing Education, Kent State University, P.O. Box 5190, Kent, OH 44242-0001.

Literature

Polyglycol

A new literature series providing an overview of a line of polyglycols has been printed. The six-part series consists of an eight-page, four-color brochure and a technical data sheet for each of the highlighted applications—foam control, synthetic lubricants, pharmaceutical, cosmetics and personal care, and rubber and plastics. To receive a copy of the overview brochure and one or all of the technical data sheets, contact The Dow Chemical Co., 100 Larkin Center, 1650 N. Swede Rd., Midland, MI 48674.

Circle No. 1 on the Reader Service Card

Polymer

An aliphatic waterborne urethane polymer with a combination of hardness and extensibility is the subject of literature. The polymer is designed to be crosslinked and applied using all conventional techniques; it is also compatible with many commercial emulsion polymers. Contact Michelle Chevarie, Sales Coordinator, Sanncor Industries, Inc., 300 Whitney St., Leominster, MA 01453-3209, for further details on Sancure® 898 polymer.

Circle No. 2 on the Reader Service Card

Tinting Guide

A new six-page tinting guide has been printed. A complete color spectrum of dispersions in various tint strengths is featured, as well as physical properties and comparative data charts. For a copy of the tinting guide on COLORTREND® Machine Colorants and AQUATREND® II In-Plant Colorants, write Hüls America Inc., Colorants and Additives Div., 80 Centennial Ave., Piscataway, NJ 08855-0456.

Circle No. 3 on the Reader Service Card

Portable Mixer/Disperser

The availability of a portable in-line mixer/disperser for high-shear performance has been announced. The compact unit features simplicity of design for easy cleanability and a small "footprint" for operation where space is limited. For more in-depth details on the MaxShear™ mixer/disperser, write Premier Mill Corp., One Birchmont Dr., Reading, PA 19606.

Circle No. 4 on the Reader Service Card

Yellow Pigment

A yellow pigment, developed to give outstanding performance in solvent liquid inks and in paints, is the subject of a data sheet. When used in combination with an opacifying pigment, it can provide economical green-shade yellow paints based on organic pigments. Contact Jeff Cox, Marketing Manager, Dominion Colour Corp., 1800 Ironstone Manor, Unit #2, Pickering, Ont., Can. L1W 3J9 for more information on DCC 1260 yellow pigment.

Circle No. 5 on the Reader Service Card

Pearlescent Pigments

A new technical information bulletin on pearlescent pigments has been released. The literature outlines procedures to follow, recommends thixotropic additives and suggests solvent formulas to help prevent settling, and to keep the pearlescent pigment in suspension. For a copy of the bulletin, "Prevention of Settling of Pearlescent Pigments in Solvent Coating Systems, write The Mearl Corp., 41 E. 42nd St., New York, NY 10017.

Circle No. 6 on the Reader Service Card

Glass Extraction Columns

Selection and benefits of glass pulsed columns for extraction applications are discussed in a guide. The eight-page brochure provides details on the construction, performance, and design of pulsed columns. Copies of the selection guide, "Corning Process Columns," are obtainable by contacting William Jackson, Corning Inc., Corning Process Systems, P.O. Box 56, Corning, NY 14830.

Circle No. 7 on the Reader Service Card

Architectural Coatings

A formulary of a complete architectural coatings product line is now available. Offered in a three-inch binder, the formulary includes product data sheets and the latest formulations for the company's complete line of products for interior and exterior wood finishes, and concrete and mineral surface coatings and sealers. For a copy of the formulary, contact Zeneca Resins (formerly ICI Resins US), 730 Main St., Wilmington, MA 01887.

Circle No. 8 on the Reader Service Card

Waterborne Coatings

A product release highlights a family of waterborne coatings designed to deliver superior corrosion resistance and adhesion. These coatings are intended for use in a variety of industries including automotive, home appliance, HVAC, and leisure products. Further details on these waterborne coatings are obtainable from Man-Gill Chemical, 23000 St. Clair Ave., Cleveland, OH 44117.

Circle No. 9 on the Reader Service Card

Filter Housing

Literature has been released on a new process line filter housing. Available in seven sizes, holding from 18 to 255 10 inch filter cartridges, and two materials (carbon steel and 304 stainless steel), the housing is intended to provide a durable and economical choice to the industrial filter user. For more in-depth information on the new process line filter housing, write Cuno Inc., 400 Research Pkwy., Meriden, CT 06450.

Circle No. 10 on the Reader Service Card

Kaolin Extender

The introduction of a predispersed, coarse particle size extender pigment has been made through a product release. The hydrous kaolin is designed to be used primarily in water-based coatings, especially exterior tint bases and contractor coatings. For additional details on ASP® LO hydrous kaolin, write Engelhard Corp., Specialty Minerals and Colors Group, 101 Wood Ave., Iselin, NJ 08830.

Circle No. 11 on the Reader Service Card

SITUATIONS WANTED

Coatings Chemist experienced in formulation of water and solvent systems. Experience in formulation and application of pigment dispersions and color for multi-product end use. Has hands-on plant and quality control management experience for large as well as small volume production sites. Environmental reporting for federal and state agencies including generation of MSDSs and other materials. Northern and central New Jersey locations preferred. Edward Baird, 160 Linden Ave., Verona, NJ 07044.

Acrylic Polymers

A new product catalog detailing the company's line of acrylic polymers for VOC compliant coatings has been printed. The product listings are consolidated by technology and market area. These include acrylic emulsions for industrial and architectural coatings, acrylic polyols for high solids, thermoset and urethane coatings, and solid grade acrylic resins for powder coatings. Contact S.C. Johnson Polymer, 1525 Howe St., Racine, WI 53403-5011, for more information.

Circle No. 12 on the Reader Service Card

Water-Based Primer

A new gray water-based epoxy primer is highlighted through literature. This primer reportedly has zero VOCs and complies with the stringent regulations of California, Texas, New York, New Jersey, and other states. It also meets OSHA regulations and has minimal odor. For technical data, contact Beth Higgs, ITW Philadelphia Resins, Box 309P, 130 Commerce Dr., Montgomeryville, PA 18936.

Circle No. 14 on the Reader Service Card

Costing Module

A costing module which provides cost analyses of products is the subject of a product release. Total product cost includes materials, loss, containers, overhead, labor, and more. The module is also designed to reformulate mixtures automatically to meet a desired target material cost. For a free demonstration diskette of BatchMaster® Version 3 Costing Module, write Pacific Micro Software Engineering, 1500 Pacific Coast Hwy., Ste. E, Seal Beach, CA 90740.

Circle No. 16 on the Reader Service Card

Solvent Recovery System

A solvent recovery system for small generators of waste solvents is highlighted in a data sheet. The system reportedly reclaims expensive solvents such as acetone, methanol, and trichloroethylene. For more technical details on the Sidewinder Solvent Recovery System, write CB Mills, 1225 Busch Pkwy., Buffalo Grove, IL 60089.

Circle No. 13 on the Reader Service Card

QC Software

A two-page data sheet on quality control software has been issued. The literature provides full-color photographs of available screens, including elliptical tolerancing, flexible output and reports, customized displays, and comprehensive statistics. To receive a free data sheet on Spectra Systems Color Management's Spectra QC Software, write Minolta Corp., Instrument Systems Div., 101 Williams Dr., Ramsey, NJ 07446.

Circle No. 15 on the Reader Service Card

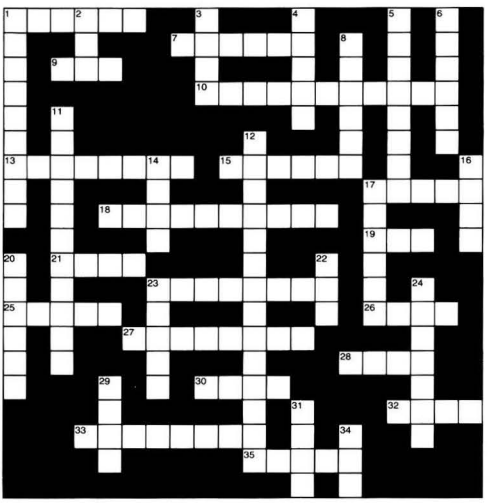
Atomic Spectroscopy

A complete line of high-quality pure standards for atomic spectroscopy is described in a 12-page brochure. The standards are prepared gravimetrically from high-purity metals and salts, using high-purity reagents and acids. For a copy of the brochure on PE Pure Standards, write The Perkin-Elmer Corp., 761 Main Ave., Norwalk, CT 06859-0012.

Circle No. 17 on the Reader Service Card

CrossLinks

by Earl Hill



Solution to be Published in March Issue

No. 52

ACROSS

1. Stick-to-it tiveness
7. Non-paint penetration hardness test
9. Type of stain
10. To absorb heat
13. Famous acrylic tradename
15. Flatting agent
17. Like 7 Across, but for paint
18. Measure viscosity with this
19. _aboratory _nstrument _anagement system
21. Light, reddish color
23. A type of reddish blue dyestuff; Queen's name
25. To bake a paint (Br.)
26. What is the word for "undiluted" when referring to liquid chemicals?
27. A metal used to make waterproofing soaps and gelling agents from fatty acids
28. Viscosity cup; American car
30. Finish resulting from using 15 Across in a paint
32. Referring to water droplets on a paint surface
33. Another type of 23 Across, P_____
35. Reaction product of bisphenol A and epichlorohydrin

DOWN

1. A sterilizing apparatus found in the lab
2. Cgs unit of energy
3. Corrosion engineer's society (Abr.)
4. Natural mineral used as roof shingles
5. 37% Aqueous solution of formaldehyde used as a starting material in the manufacture of U/F resins
6. Common red pigment, partly iron oxide
8. An iron oxide color from Italy
11. Chemical group that gives rise to color in a molecule
12. DNA, for long
14. What is the oxide of element no. 26?
16. Tradename for 35 Across
17. Temperature scale involved in color
20. A light tint
22. What is a type of dye?
23. Hue, _____, chroma
24. Well known equipment vendor to the coatings industry
29. Name for a drawdown bar
31. Paintbrush or screwdriver, e.g.
34. A type of floor finish, generally over wood

Coming Events

FEDERATION MEETINGS

For information on FSCT meetings, contact Federation of Societies for Coatings Technology, 492 Norristown Rd., Blue Bell, PA 19422 (215) 940-0777, FAX: (215) 940-0292.

1993

(May 16-19)—Federation "Spring Week." Board of Directors Meeting on the 16th; Incoming Society Officers Meeting on the 17th; Spring Seminar on the 18th and 19th, "The Influence of Substrates and Application Methods/Techniques on Coatings Performance." South Shore Harbour Resort and Conference Center, League City (Houston), TX.

(Oct. 27-29)—71st Annual Meeting and 58th Paint Industries' Show. World Congress Center, Atlanta, GA.

1994

(May 12-15)—Federation "Spring Week." Spring Seminar on the 12th and 13th; Incoming Society Officers Meeting on the 14th; Board of Directors Meeting on the 15th. Marriott City Center Hotel, Minneapolis, MN.

(Oct. 12-14)—72nd Annual Meeting and 59th Paint Industries' Show. New Orleans Convention Center, New Orleans, LA.

1995

(Oct. 9-11)—73rd Annual Meeting and 60th Paint Industries' Show. Cervantes Convention Center, St. Louis, MO.

SPECIAL SOCIETY MEETINGS

1993

(Feb. 24-26)—20th Annual Waterborne, Higher-Solids, and Powder Coatings Symposium. Cosponsored by the Southern Society for Coatings Technology and the University of Southern Mississippi (USM). Hyatt Regency Hotel, New Orleans, LA. {Robson F. Storey or Shelby F. Thames, Dept. of Polymer Science, USM, Southern Station Box 10076, Hattiesburg, MS 39406-0076; (601) 266-4868/4080}.

(Mar. 10)—Piedmont Society Mini-Technical Symposium and Exhibition. "Compliance: Plain and Simple." Holiday Inn Market Square, High Point, NC. {Robert C. Matejka, Akzo Coatings Inc., 1431 Progress St., P.O. Box 2124, High Point, NC 27261; (919) 841-5111}.

(Mar. 10-June 17)—"Understanding the Basics of Coatings II." Cosponsored by New York Society for Coatings Technology and MNYPCA. Fairleigh Dickinson University, Rutherford, NJ. {Mildred Leonard, 520 Westfield Ave., Rm. 208, Elizabeth, NJ 07208; (908) 354-3200}.

(Mar. 17-19)—Southwestern Paint Convention. "Back to the Future." Dallas and Houston Societies. Four Seasons Resort and Club, Las Colinas (Irving), TX. {Steve Stephens, Ribelin Sales, Inc., P.O. Box 461673, Garland, TX 75046-1673; (214) 272-1594}.

(Mar. 23-25)—Western Coatings Societies' 21st Biennial Symposium and Show. "Visions—Opportunities—Challenges." Golden Gate, Los Angeles, Pacific Northwest, and Rocky Mountain Societies. Disneyland Hotel and Convention Center, Anaheim, CA. {Donald I. Jordan, Cargill, Inc., 2801 Lynwood Rd., Lynwood, CA 90262; (213) 537-9935; or Sandra L. Dickinson, Synergistic Performance Corp., 17821 E. 17th St., Ste. 190, Tustin, CA 92680; (714) 544-8200}.

(Apr. 13)—Pittsburgh Society Symposium. "An Environment Responsible 90s." Airport Marriott, Pittsburgh, PA. {William C. Spangenberg, Hammond Lead Products Inc., 1910 Cochran Rd., Pittsburgh, PA 15220; (412) 344-5811}.

(Apr. 21-23)—Southern Society Annual Meeting. "Waterborne Coatings—Riding the Wave to the Future." Opryland Hotel, Nashville, TN. {Mary Finnigan, McCullough & Benton, Inc., 2900 G Carolina Center, Charlotte, NC 28208; (704) 392-2101}.

(Apr. 29-May 1)—Pacific Northwest Society Symposium. Red Lion Hotel, Bellevue, WA. {Richard C. Tomczak, Van Waters & Rogers, Inc., 8201 S. 212th, Kent, WA 98032; (206) 872-5097}.

(May)—Philadelphia Society Seminar. "Waterborne Coatings Formulations." Airport Hilton, Philadelphia, PA. {Peter C. Kuzma, V.I.P. Products Corp., 3805 Frankford Ave., Philadelphia, PA 19124; (215) 535-3025}.

(May 4-5)—New York Society Symposium. "Recent Advances in Additives & Modifiers for Coatings." Holiday Inn North, Newark Airport, Newark, NJ. {Mildred Leonard, 520 Westfield Ave., Rm. 208, Elizabeth, NJ 07208; (908) 354-3200}.

(May 25-26)—New England Society. Tech Expo '93. Sheraton Tara, Danvers, MA. {Joanne Monique, Ashland Chemical, Inc., 400 Main St., Tewksbury, MA 01876; (800) 962-5388}.

(June 4-5)—Joint Meeting of the Kansas City and St. Louis Societies. Holiday Inn, Lake of the Ozarks, MO.

(June 14)—Golden Gate Society. Manufacturing Committee Seminar.

OTHER ORGANIZATIONS

1993

(Feb. 21-26)—16th Annual Meeting of The Adhesion Society, Inc. Williamsburg Lodge, Colonial Williamsburg, VA. (Louis H. Sharpe, 28 Red Maple Rd., Hilton Head Island, SC 29928, or F.J. Boerio, Dept. of Materials Science and Engineering {ML 12}, University of Cincinnati, Cincinnati, OH 45221).

(Feb. 24-25)—"Industrial Lead Paint Removal and Abatement." Tutorial sponsored by Steel Structures Painting Council (SSPC). Marriott's Pavilion, St. Louis, MO. (SSPC, 4516 Henry St., Pittsburgh, PA 15213-3728).

(Mar. 7-12)—Corrosion/93. Sponsored by the National Association of Corrosion Engineers (NACE). New Orleans Convention Center, New Orleans, LA. (NACE, P.O. Box 218340, Houston, TX 77218-8340).

(Mar. 8-12)—"Basic Composition of Coatings." Short course sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (UMR Coatings Institute, 142 Schrenk Hall, Rolla, MO 65401).

(Mar. 13-14)—"Industrial Lead Paint Removal and Abatement." Tutorial sponsored by Steel Structures Painting Council (SSPC). Hyatt Regency, Cincinnati, OH. (SSPC, 4516 Henry St., Pittsburgh, PA 15213-3728).

(Mar. 15-17)—"Coating Process Fundamentals." Short course sponsored by the University of Minnesota. Antwerp, Belgium. (Jackie O'Brien, Dept. of Chemical Engineering & Materials Science, University of Minnesota, 421 Washington Ave. SE, Minneapolis, MN 55455).

(Mar. 15-19)—"Introduction to Paint Formulation." Short course sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (UMR Coatings Institute, 142 Schrenk Hall, Rolla, MO 65401).

(Mar. 16-18)—European Coatings Show '93. Exhibition and Congress. Nuremberg, Germany. (Ina Füllkrug, Vincentz Verlag, Schiffgraben 41-43, D-3000, Hannover 1, Germany).

(Mar. 20-21)—Eastern Decorating Products Show. Sponsored by the National Decorating Products Association (NDPA). World Trade Center, Boston, MA. (Teri Flotron, NDPA, Marketing Communications Director, 1050 N. Lindbergh Blvd., St. Louis, MO 63132-2994).

(Mar. 21-23)—"Polymer Blends and Alloys." Course sponsored by the State University of New York (SUNY) at New Paltz. New Orleans, LA. (Angelos Patsis, Institute of Materials Science, SUNY, New Paltz, NY 12561).

(Mar. 21-24)—"Pigment Dispersion." Course sponsored by the State University of New York (SUNY) at New Paltz. New Orleans, LA.

(Angelos Patsis, Institute of Materials Science, SUNY, New Paltz, NY 12561).

(Mar. 22-23)—"Industrial Lead Paint Removal and Abatement." Tutorial sponsored by Steel Structures Painting Council (SSPC). Sheraton Inn Bossier City, Shreveport, LA. (SSPC, 4516 Henry St., Pittsburgh, PA 15213-3728).

(Mar. 22-24)—"Emulsion Polymerization." Course sponsored by State University of New York (SUNY) at New Paltz. New Orleans, LA. (Angelos Patsis, Institute of Materials Science, SUNY, New Paltz, NY 12561).

(Mar. 22-26)—Davos Recycle '93 Forum and Exhibition. Sponsored by Maack Business Services. Davos, Switzerland. (Maack Business Services, Moosacherstr. 14, CH-8804, AU/Zürich, Switzerland).

(Mar. 23-25)—International Symposium on Advanced Infrared Spectroscopy (AIRS). Sponsored by The Spectroscopic Society of Japan. Sanjo Conference Hall, The University of Tokyo, Tokyo, Japan. (Hirokazu Toriumi, AIRS Organizing Committee, Dept. of Chemistry, College of Arts and Sciences, The University of Tokyo, Komaba, Meguro, Tokyo 153, Japan).

(Mar. 27-31)—American Chemical Society (ACS) Spring Seminar on "Raw Materials." Pittsburgh, PA. (ACS, 1627 K St., N.W., Suite 1000, Washington, D.C. 20006).

(Mar. 28-31)—Adhesive and Sealant Council, Inc. Spring Convention. Pittsburgh Hilton, Pittsburgh, PA. (The Adhesive and Sealant Council, Inc., 1627 K St., N.W., Ste. 1000, Washington, D.C. 20006).

(Apr. 12-15)—Surface Coating '93. The Chemical Coaters Association International's (CCAI) Annual Conference and Exhibition. Amway Grand Plaza Hotel and Grand Center, Grand Rapids, MI. (CCAI, P.O. Box 54316, Cincinnati, OH 45254).

(Apr. 12-16)—Spring Meeting of the Materials Research Society. San Francisco Marriott Hotel, San Francisco, CA. (Materials Research Society, Meetings Dept., 9800 McKnight Rd., Pittsburgh, PA 15237).

(Apr. 13-14)—"Facing the Future . . . Technology for the 90s." Washington Paint Technical Group 33rd Annual Symposium. Ramada Hotel, Tyson's Corner, VA. (Mark Padow, National Paint and Coatings Association, 1500 Rhode Island Ave., N.W., Washington, D.C. 20005).

(Apr. 14-15)—"Industrial Lead Paint Removal and Abatement." Tutorial sponsored by Steel Structures Painting Council (SSPC). Airport Hilton and Towers, Los Angeles, CA. (SSPC, 4516 Henry St., Pittsburgh, PA 15213-3728).

(Apr. 18-21)—Inter-Society Colour Council (ISCC) Annual Meeting and Symposium. Doubletree Hotel, Newport, RI. (Romesh Kumar, Program Chairman, 1993 ISCC Annual Meeting, Hoechst Celanese Corp., 500 Washington St., Coventry, RI 02816).

(Apr. 18-23)—"Durability of Coatings." Symposium sponsored by American Chemical Society, Division of Polymeric Materials: Science Engineering, Denver, CO. (Jonathan W. Martin, NIST, Bldg. 226, Rm. B348, Gaithersburg, MD 20879; David Bauer, Ford Motor Co., SRL-E3198, P.O. Box 2053, Dearborn, MI 48121; F. Louis Floyd, Glidden Research Ctr., 16651 Sprague Rd., Strongsville, OH 44136).

(Apr. 20-21)—"Color Pigments, Regulations, and the Environment." Symposium cosponsored by the Dry Color Manufacturers' Association (DCMA) and the Inter-Society Color Council. Newport, RI. (DCMA, P.O. Box 20839, Alexandria, VA 22320-1839).

(Apr. 20-22)—Surface Treatment '93. "Computer Methods and Experimental Measurements for Surface Treatment Effects." International Conference sponsored by Wessex Institute of Technology. Novotel, Southampton, United Kingdom. (Sue Owen, Conference Secretariat, Wessex Institute of Technology, Ashurst, Southampton, Hants, United Kingdom So4 2AA).

(Apr. 26-30)—"Applied Rheology for Industrial Chemists." Short course sponsored by Kent State University (KSU), Kent, OH. (Carl J. Knauss, Director, Cooperative & Continuing Education—Chemistry, KSU, P.O. Box 5190, Kent, OH 44242-0001).

Advertisers Index

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'Humbug' from Hillman

Darin Everhart who apparently enjoys his morning "Kellogg's Frosted Flakes," sent us a photocopy of the back panel of the box, quoted below. Darin writes, "If this is all there is to making paints, then there is no job security for paint chemists!" The panel:

Fun "Factivities"

From the editors of the World Book = Childcraft

Did you ever wonder where paint comes from?

Paint is made from pigments, or color. The pigments are mixed with binders that make the paint spread and stick to the surface being painted. Let's make our own paint and see how it's done.

First you need some pigment. Get one teaspoon of powder from the bottom of a bag of charcoal and place it in a bowl.

Now you need your binder. Get one teaspoon of vegetable oil and mix it with your powder. That's all there is to it!

Now you are ready to pick up your paint brush and draw a picture?

* Ask permission first!

Humbug's message to all moms—"Oy vey!!!!

From the *New York Times Supplement*—"Fall Review of Computers" November 8, 1992:

Get with the Lingo

As any close-knit group is prone to do, users of online bulletin boards have developed a shorthand all their own. These code words take two forms. The first are simple acronyms such as BTW for "By the Way." The second are emoticons, symbols formed on the keyboard that express emotions or nuances that may not be apparent in the written words. For example, :-(means that the writer is frowning or sad. Finally, online communications has spawned some entirely new, and very useful, words. Know what E-mailers call those letters that arrive in your mailbox? "Snailmail."

We can't imagine why you'd want to use some of these devices—for instance, IITYWIMWYBMAD OR "If I Tell You What It Means Will You Buy Me A Drink?" But rest assured that you can communicate quite effectively online without knowing any of them.

:-D	Writer talks too much
:-#	Writers lips are sealed
:-o	Writer is surprised
:-&	Writer is tongue tied
:-@	Writer is screaming
:-)	Writer is smiling or happy
ALL CAPS	Writer is shouting
"word"	Writer adds emphasis
word	Writer adds emphasis
<g>	Writer is grinning
INMHO	In My Humble Opinion
IOW	In Other Words
OTOH	On the Other Hand
PITA	Pain in the %##!

O.K.—Mr. Typesetter, I know where I stand.

A tourist spending the night in a small Vermont town joined a group of men sitting on the porch of the general store. After several attempts to start a conversation, he finally asked, "Is there a law against talking in this town?"

"No law against it," answered one Vermonter, "but there's an understandin' that no one speaks unless he can improve on silence."

Two single ladies set up farming in the country, although they knew nothing about it. Well, they decided to raise pigs. Since they had a single sow, they loaded it in a wheelbarrow and took the sow down the road to a farmer who had a boar. They brought the sow back after servicing but after some time didn't see any signs of pregnancy. So they loaded the sow in the wheelbarrow and repeated the trip. No results. So they again decided to cart the sow off again and when they went out to catch her, there she was sitting in the wheelbarrow.

"For so many years, I know you and I always ask for your family. You never once ask me how things are with me."

"All right, so how are things with you?"

"Don't ask."

A search through the "get back to it sometime file" turned up the following, contributed by Max Saltzman some years ago:

Heller's Law—The first myth of management is that it exists.

John's Axiom—When your opponent is down, kick him.

John's Collateral Corollary—In order to get a loan, you must first prove you don't need it.

Franklin's Rule—Blessed is he who expects nothing, for he shall not be disappointed.

Canada Bill Jones Motto—It's morally wrong to allow suckers to keep their money.

Canada Bill Jones Supplement—A Smith and Wesson beats four aces.

From Barber's Laws of Backpacking—The remaining distance to your chosen campsite remains constant as twilight approaches.

—When you arrive at your chosen campsite, it is full.

—The local density of mosquitos is inversely proportional to your remaining repellent.

—Published by Logical Machine Corporation

—Herb Hillman
Humbug's Nest
P.O. Box 135
Whitingham, VT 05361

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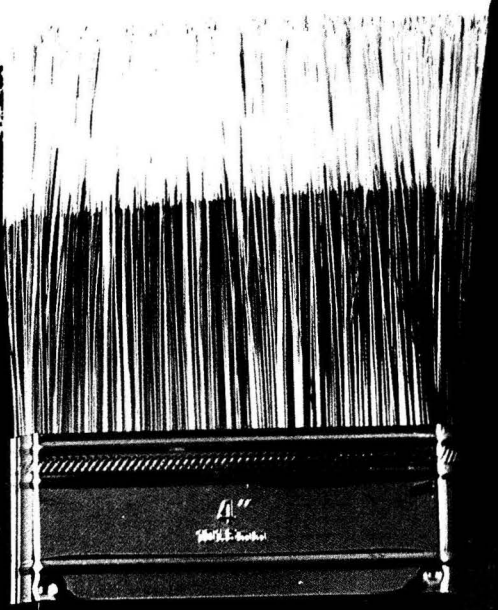
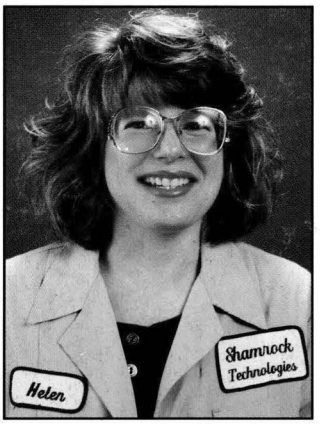


Helen, help us?



Helen Matheney, Micronized Powder Technologist. Nine years with Shamrock.

Dear Helen:

I'm supposed to be selling sailing sloops, but my sales prospects keep sliding off my slippery decks. I like selling, but it's hard to close sales when your giving mouth to mouth resuscitation. I need a little more bite on my poop deck. Any thoughts?

Breathless

Dear Breathless:

You may have a little texture in your deck coating, but obviously the big ones are getting away. Shamrock has a great Texture Coating Series that can satisfy the most unique size requirements for both air dry and baked coatings. We haven't seen a particle size requirement we couldn't satisfy. We formulate the perfect grit for lasting grip.

Helen

Dear Helen:

We have a low solids water base clear acrylic emulsion. But, when we try to add wax, the wax will not remain stable in our coating. The problem seems to be grounded in a time-space relationship

Albert Einstein

Dear Al:

You need a truly stir-in product for this application. Change your luck with Shamrock's Neptune. Our Neptune series are truly wettable polyethylenes and PTFE's. And you'll love its suspendability. All you need is a propeller mixer. And, Al, lighten-up.

Helen

Dear Helen:

I need flow improvement in solvent high solids coating. Silicones create foam and I lose my recoatability.

Suds

Dear Suds:

Go for the flow with Shamrock's Versaflow Base. It's a 100% N.V. liquid. Send me a sample of your coating and I'll mix you up a real winner with Versaflow.

Helen

Dear Helen:

I am being transferred to Pango Pango to sell coatings for plywood port-o-potties to the pygmies in the rainforest. What do you think will be the most important quality necessary for my success?

Indiana Ed

Dear Indiana Ed:

Any structure exposed to tropical weather (especially your product) will need an exterior and interior coating with long term hydrophobobicity. I suggest you add Shamrock's Hydropel to extend the life of your coating for years and years. Hydropel is available in 4 grades for all types of coatings.

Helen

To get in touch with Helen, or to speak to another Shamrock Coatings Specialist, just ask for The Coatings Laboratory.

Shamrock

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