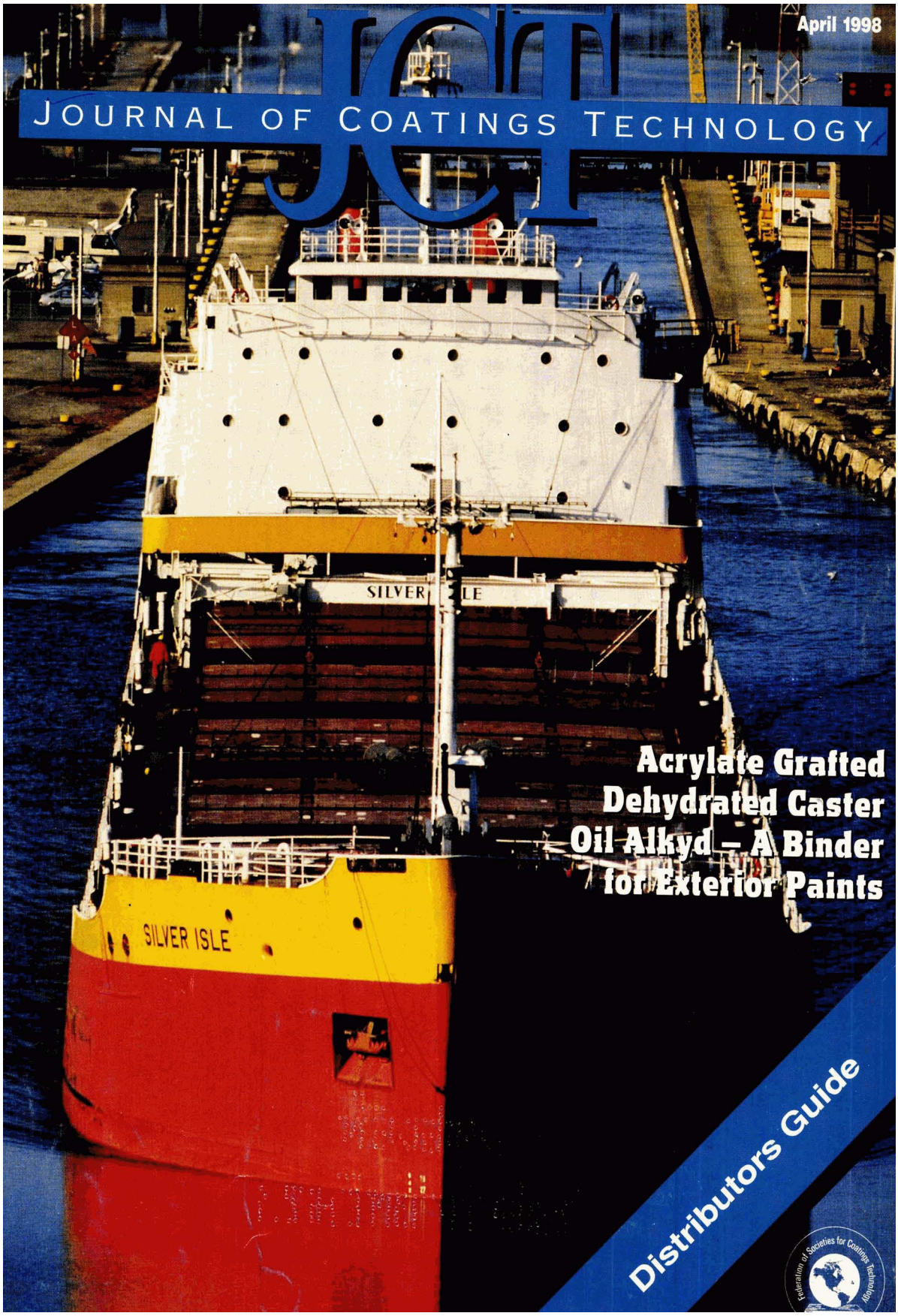
April 1998

JCT
JOURNAL OF COATINGS TECHNOLOGY



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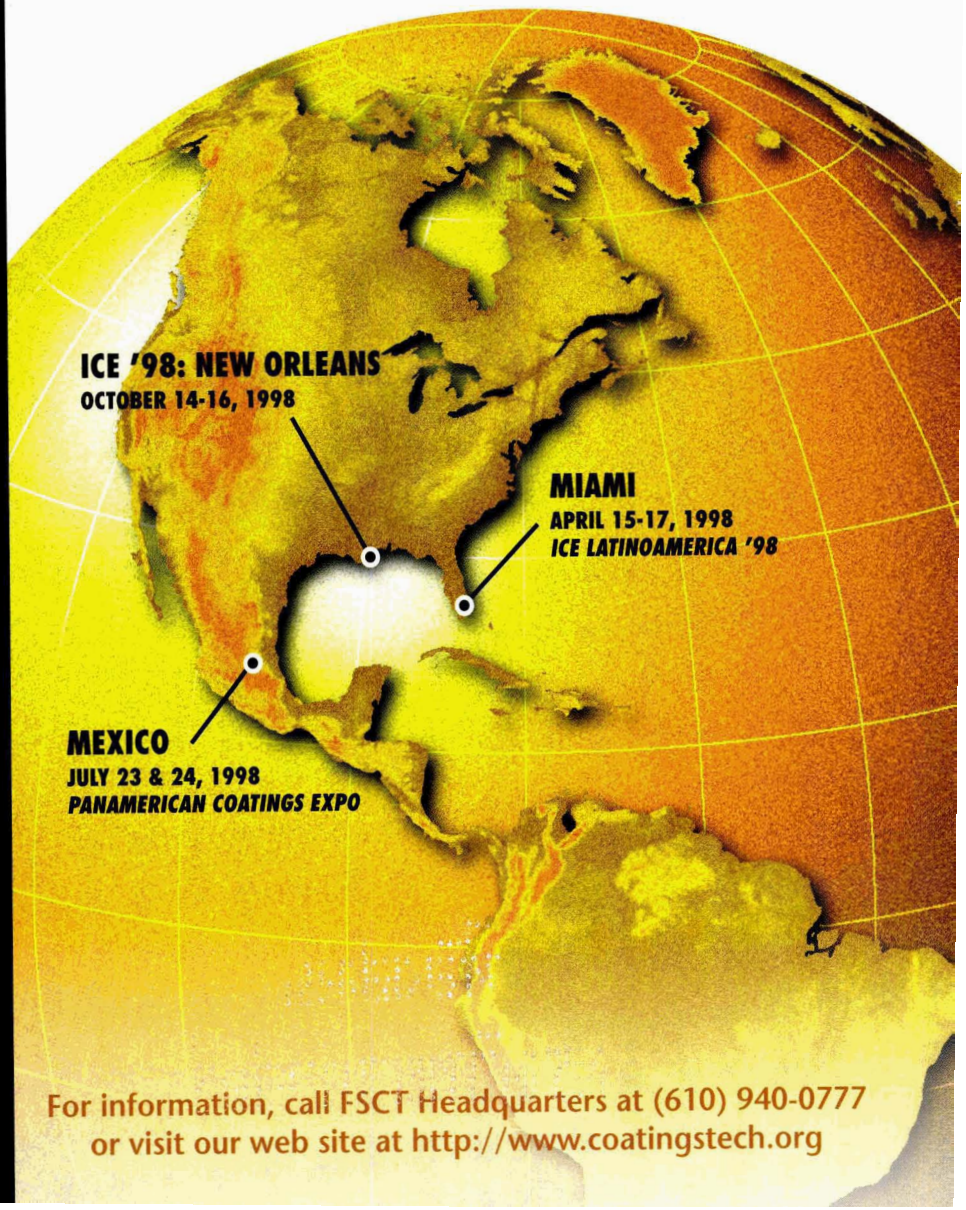

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APRIL 1998 VOL. 70, NO. 879

Technical Articles

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JOURNAL OF COATINGS TECHNOLOGY
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Guide for Authors

GENERAL

The JOURNAL OF COATINGS TECHNOLOGY is published monthly by the Federation of Societies for Coatings Technology for its membership of approximately 7,000 in 27 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headings *Open Forum*, *Technology Forum,* and *Letters to the Editor.* All manuscripts are assumed to be previously unpublished writing of the authors, not under consideration for publication elsewhere.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 is required to obtain permission for use from the copyright holders. When the organization with which the authors are affiliated requires clearance of publications, authors are expected to obtain such clearance before submission of the manuscript. Papers presented to associations other than the Federation must be released by written communication before they can be considered for publication in the JOURNAL OF COATINGS TECHNOLOGY. Authors are obligated to reveal any exceptions to these conditions at the time a manuscript is submitted.

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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 *Technology Forum.*

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. Copies should be addressed to Mike Bell, Director of Educational Services, FSCT, 492 Norristown Rd., Blue Bell, PA 19422.

...for Roon Foundation Award Competition

Ten complete copies of the manuscript are required, and should be submitted to Mike Bell at the address previously listed. (For complete details, see "Roon Awards" section of the JOURNAL in the January 1998 issue.)

MANUSCRIPT PREPARATION

In general, authors are advised to use the "The ACS Style Guide : A Manual for Authors and Editors," 2nd ed., published by the American Chemical Society as a guide to the preparation of manuscripts (available from FSCT or the American Chemical Society). 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. All papers are subjected to rigorous peer review for technical merit.

Papers in which proprietary products or processes are promoted for commercial purposes are specifically not acceptable for publication.

Original Research Papers: Original research papers are the main technical content of the JOURNAL O F COATINGS TECHNOLOGY. We seek original research papers that provide technically sound reports of theoretical and experimental work that advances the state of coatings science. Sufficient background information and references should be given to place the work in context and to make clear the significance of the work. Experimental methods and materials must be described in sufficient detail to allow the work to be reproduced. Work based on commercial or proprietary materials must include sufficient technical detail (including generic description) to allow the technical merit of the conclusions to be evaluated. The discussion should go beyond a merely factual description of results. It should provide a comparison with other work in the literature and a thoughtful analysis and interpretation of the results. Editors support the trend in scientific writing to a direct, less formal style that permits limited use of personal pronouns to avoid repetitious 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 solicited. Reviews that show how advances from other fields can beneficially be applied to coatings are also desired. Review papers should provide objective evaluation of improtant advances. While they need not provide an exhaustive listing of all publications in a given technical area, neither should they be limited to discussion of the work of a single author or group. Reviews that consist mainly of computer searches with little attempt to integrate or critically evaluate are not solicited.

Open Forum: Topics for this category need not be research papers and may be non-technical in nature, dealing with any aspect of the coatings industry. The subject may be approached informally. Editors encourage submission of manuscripts, including articles dealing with business and policy issues, that constructively address industry problems and their solutions.

Technology Forum: 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 also suitable topics. Process and production topics, i.e., paint manufacture, will be reviewed in this 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 must 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.

Electronic submissions are requested as a supplement to the hard copies and original figures normally required. The text should be

submitted on 3.5" disk formatted for IBM or Apple Macintosh (or compatible system). Text files should be saved in the word-processing format in which they were prepared. The file on disk MUST exactly match the accepted hard copy version. Graphics (figures, drawing, etc.) should be in a separate file. Submitted disks must be labeled with the author's name, paper title, computer platform type (e.g., IBM compatible), software and version used, and file names. Complete instructions for electronic submission can be obtained from the Editor.

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

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A 75 -100 word abstract must be part of the manuscript, and should be a concise statement of the key methods and 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 basic main headings are INTRODUCTION, EXPERIMENTAL, RESULTS, DISCUSSION, and SUMMARY or CONCLUSIONS. Sub-headings will be specific to the subject.

Only as much review as is necessary to set the work in context and to make clear the significance of the work presented should be given as 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.

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Metric system units should be used wherever applicable with the equivalent English units shown afterwards in parentheses. The ASTM Metric Practice Guide, E 380-72 (American Society for Testing and Materials, 1916 Race St., Philadelphia, PA 19108) is a convenient reference.

Tables, Graphs, Drawings, and Photographs

Tables, rather than descriptive text, should be used only when they are genuinely helpful. Each table should be typed on a separate sheet, rather than included in the text, and appended to the manuscript. Each table should be numbered and have a descriptive caption. Tables should be referenced in the text (e.g., "See *Table* 1"). In numerical data in tables, numbers less than one should have a zero before the decimal point.

Graphs should be on good quality white or nonphotographic blue-lined $8^1/2$ x 11 inch paper, each drawn and numbered on a separate sheet with the list of captions on a copy of the original graph.

Drawings should conform to the Graphs guidelines.

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, slides, and graphics are generally not acceptable, but the selective use of color will be considered on a case-by-case basis when required for unambiguous presentation of scientific information.

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

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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 and subscripts accurately. Avoid the use of superscripts in a manner that can lead to their interpretation as exponents.

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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.

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If used, acknowledgments should follow the summary.

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

(1) Pascal, R.H. and Reig, F.L., "Pigment Colors and Surfactant Selection," *Official* DIGEST, *36*, No. 475 (Part 1), 839 (1964).

(2) Davidson, H.R., "Use and Misuse of Computers in Color Control," JOURNAL OF COATINGS TECHNOLOGY, *54*, No. 691, 55 (1982).

(3) Stephen, H.G., "Hydrogen Bonding—Key to Dispersion?," *J. Oil & Colour Chemists' Assoc.*, *65*, No. 5, 191 (1982).

(4) Patton, T. (Ed.), *Pigment Handbook,* Vol. 1, John Wiley & Sons, Inc., New York, 1973.

(5) Henderson, W.A. Jr. and Singh, B. (to American Cyanamid Co.), U.S. Patent 4,361,518 (Nov. 30, 1982).

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

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FSCT Board of Directors—1997-98

COMMENT

Following the Plan

The mission of the Federation of Societies for Coatings Technology has been written many times on this page. The condensed version states that the purpose of the organization is to provide education to the members and the coatings industry. Two FSCT committees designed to facilitate this educational activity are the Professional Development and Annual Meeting Program Committees.

Both of these committees have created educational offerings to fulfill this mission. Chair Ronda Miles of the Dallas Society and the Professional Development Committee have developed a schedule of six courses and workshops for the coming year. This includes the following new offerings: "Switching From Solvent Based To Water Based: Understanding the Transition"; "Experimental Design And Data Analysis"; "Practical Rheology And Its Application Properties"; and "Understanding Extender Pigments." In addition, two Annual Meeting Technology conference workshops "Effective Technical And Scientific Writing" and "Winning Technical Presentations" will also be held.

The 1998 Annual Meeting Program Committee, under Chair Sue Farnsworth of the Chicago Society, has been hard at work for the last few months crafting both the Technology Conference and Technical Program for ICE '98 in New Orleans. In a change from the previous two years, the conference will be held on the three days prior to the exhibits. This year the conference will be held on Sunday, Monday and Tuesday, October 11-13, with ICE running from Wednesday through Friday, October 14-16.

This year's conference will include sixteen one- and two-day programs, designed for a diverse cross-section of coatings practitioners. The topics include: Back to Basics: Resins, Pigments, Solvents and Additives (two days); Crosslinking for the Coatings Chemist (two days); Surfactant Chemistry and Application; Spray Applications; Winning Technical Presentations; Finance for the Nonfinancial Manager; New Product Development (Executive Forum); Effective Negotiating Skills; Introduction to Management; Effective Technical and Scientific Writing; Global Commercialization (two days); Fundamental Ink Technology; Chemistry and Formulation of Powder Coatings; Introduction to Radiation Curing (two days); Bridge Coatings; and Marine Coatings.

The Annual Meeting Technical Program will also have an expanded look for 1998. The Program Committee has selected a wide variety of program sessions for New Orleans. These sessions will run concurrently with the exhibition, on Wednesday - Friday, October 14-16. The major adjustment between 1998 and previous years is that the Mattiello Lecture will be held during the Opening Session, which will take place on Wednesday morning, October 14.

The Annual Meeting Technical Program will consist of the following sessions: Mattiello Lecture; Technical Focus Lecture; Advanced Topics in Coatings Technology; Understanding the Internet (three sessions); APJ/Voss Award Competition Papers; Suppliers Spotlight (four sessions); Coatings Specification Roundtable; Poster Session Papers (two sessions); Roon Award Competition Papers; Women in Coatings; International Papers; Outstanding Corrosion Paper Competition Submissions; and General Coatings Technology Papers.

The members now have a wide selection of offerings from which to choose, either from the six Professional Development Courses offered throughout the country this year or the programming being run during the International Coatings Expo. This and future issues of the JCT will provide more detailed information on each of the offerings.

Michael G. Bell
Director of Educational Services

Technical Abstracts

Spanish translations provided by Marina Estévez, Technical Chief, Instituto Mexicano de Tecnicos en Pinturas y Tintas.(ANAFAPYT)

Acrylate Grafted Dehydrated Castor Oil Alkyd - A Binder for Exterior Paints—S. Majumdar, D. Kumar, and Y.P.S. Nirvan

JCT, Vol. 70, No. 879, 27 (Apr. 1998)

To meet the requirement of improved durability of alkyd resin for use in weatherwork paint for superstructure of ships, an attempt has been made to chemically modify a castor oil alkyd by graft copolymerization with methyl methacrylate and butyl methacrylate in view of their ability to provide polymers with good exterior durability. Characterization of the experimental resins, in respect to physical properties, was carried out using instruments such as a vapor pressure osmometer, rotational viscometer, universal tensile testing instrument (Instron 1123), and differential scanning calorimeter. Performance of the resins was evaluated using a fluorescent UV accelerated weatherometer and multi-head glossmeter.

The results reveal substantial improvement in drying and weather resistance properties of castor oil alkyd on graft copolymerization with both methyl methacrylate and butyl methacrylate. The improvement in these properties is marginally superior in the case of MMA grafted alkyds. MMA modification also enhances the mechanical properties of the grafted castor oil alkyd.

Un Vehículo Para Pinturas Exteriores. Acrilico Injertado Con un Alquidal de Aceite de Castor Deshidratado—S. Majumdar, D. Kumar y Y.P.S. Nirvan

Sabemos que se requiere mejorar la durabilidad de las resinas alquidales para aplicaciones de pintura al exterior en superestructuras de barcos, un intento fue hacer una modificación química a una resina alquidal de aceite de castor deshidratado mediante copolimerización con metil metacrilato y butil metacrilato en vista de la habilidad de proporcionar a sus polímeros buena durabilidad al exterior. La caracterización experimental de la resina con respecto a sus propiedades fisicas, fueron llevadas a cabo utilizando instrumentos tales como, osmosímetro de presión de vapor, viscosímetro rotacional, un instrumento universal de evaluación de tensión (Instron 1123) y colorimetro de barrido diferencial. El desempeño de la resina fue evaluado utilizando un equipo de intemperismo acelerado de luz U.V. fluorescente y un medidor de brillo de ángulo múltiple. El copolímero mostro relevantes resultados, se mejoró sustancialmente el secado y la resistencia a la intemperie.

Los resultado son mucho mejores que los obtenidos con alquidales modificados con metil metacrilato, la modificación con metil metacrilato mejora las propiedades mecánicas del alquidal de aceite de castor deshidratado.

Crosslink Density and Cure Window of Oligourethane Diol/ Melamine High Solids Coatings—S. Haseebuddin, K.V.S.N. Raju, and M. Yaseen

JCT, Vol. 70, No. 879, 35 (Apr. 1998)

Oligourethane diols were crosslinked with melamine formaldehyde, and their crosslink density was determined by using an equilibrium swelling method. In formulations containing primary or secondary hydroxylated diol the major part of the crosslinker is consumed by trans-etherification reactions and self-condensation. The aromatic nature of TDI imparts rigidity while the aliphatic IPDI results in flexibility of the backbone chain of oligomer. The profile of cure schedules has been determined in the form of a cure window which measures the extent of reaction in terms of crosslink density as a function of bake temperature. The experimentally determined properties like tensile strength and MEK rub-resistance have been taken into consideration for fixing the lower and upper limits of XLD in designing the cure windows of individual coating formulations. The baking schedules of coatings have also been expressed in the form of nominal and true cure windows.

Densidad de Reticulación y Ventana de Curado de un Recubrimiento Altos Sólidos a Base de un Diol Oligouretano y Melamina—S. Haseebuddin, K.V.S.N. Raju y M. Yaseen

Se hicieron reaccionar dioles de oligouretano con melamina formaldehido y se determino su densidad usando un método de equilibrio de desplazamiento. En las formulaciones se tienen dioles hidroxilados primarios o secundarios, la mayor parte de ellos fueron consumido en la reacción de trans-esterificación y la autocondensación. La naturaleza aromática del Toluen diisocianato imparte rigidez a diferencia de los isocianatos alifáticos como el Isoforon diisocianato IPDI que dan como resultado flexibilidad en la cadena principal del oligomero. Se determinó el perfil de curado en forma de la ventana de curado, la cual midió la extensión de la reacción en términos de la densidad de reticulación como una función de la temperatura de horneo. Experimentalmente se determinaron propiedades tales como resistencia a la tensión y resistencia a los frotes con MEK, los cuales se tomaron en consideración para fijar los límites superior e inferior del XLD en el diseño de la ventana de curado de cada formulación de recubrimiento individual. El programa de horneo del recubrimiento fue expresada en forma de la ventana de curado nominal y real.

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Chemoenzymatic Synthesis and Characterization of Urethane Oils for Surface Coatings—V.D. Athawale and M.D. Bhabhe

JCT, Vol. 70, No. 879, 43 (Apr. 1998)

Two-step chemoenzymatic synthesis of urethane oils has been studied. Initially, the partial esters were prepared by lipase-catalyzed transesterification of soybean and linseed oils with n-butanol. Partial esters were further reacted with different diisocyanates to obtain urethane oils. The composition of the partial esters was varied with reaction time in the transesterification step. Among all the lipases, the lipozyme was found to be the most suitable lipase for the transesterification reaction, yielding 80-85%. All of the urethane oils were of low molecular weights irrespective of the type of oil used in their preparation. Urethane oils, based on MDI, exhibited the best scratch resistance. All of the urethane oils showed good acid and alkali resistance and excellent solvent resistance. These oils also satisfactorily passed the impact resistance and the flexibility tests.

Síntesis Químico Enzimática y Caracterización de Aceites de Uretano Para Recubrimientos—V.D. Athawale y M.D. Bhabhe

Fue estudiada la síntesis de 2 pasos químico-enzimatica de los aceites de uretano. Inicialmente fueron preparados los ésteres mediante trans-esterificación cationica, catalizada en fase oleosa de los aceites de soya y linaza con n-butanol. Estos ésteres fueron hechos reaccionar parcialmente con diferentes isocianatos para obtener los aceites de uretano. La composición de los ésteres varió, con respecto al tiempo de reacción en el paso de trans-esterificación. La mayor cantidad de la fase oleosa se encontró como enzima oleosa lo que hizo más factible la reacción de esterificación, con una conversión del 80-85%. Todos las aceites de uretano fueron de bajo peso molecular debido al tipo de aceite usado en la preparación. Los aceites de uretano del tipo MDI presentan mejor resistencia al rayado. Todos los aceites de uretano mostraron excelente resistencia a los solventes y buena resistencia a los ácidos y a los álcalis. Estos aceites también tienen comportamiento satisfactorio en la pruebas de resistencia al impacto y de flexibilidad.

VOC Testing Comparison: EPA Method 24 Versus the Cal Poly Pomona Method—Los Angeles Society for Coatings Technology

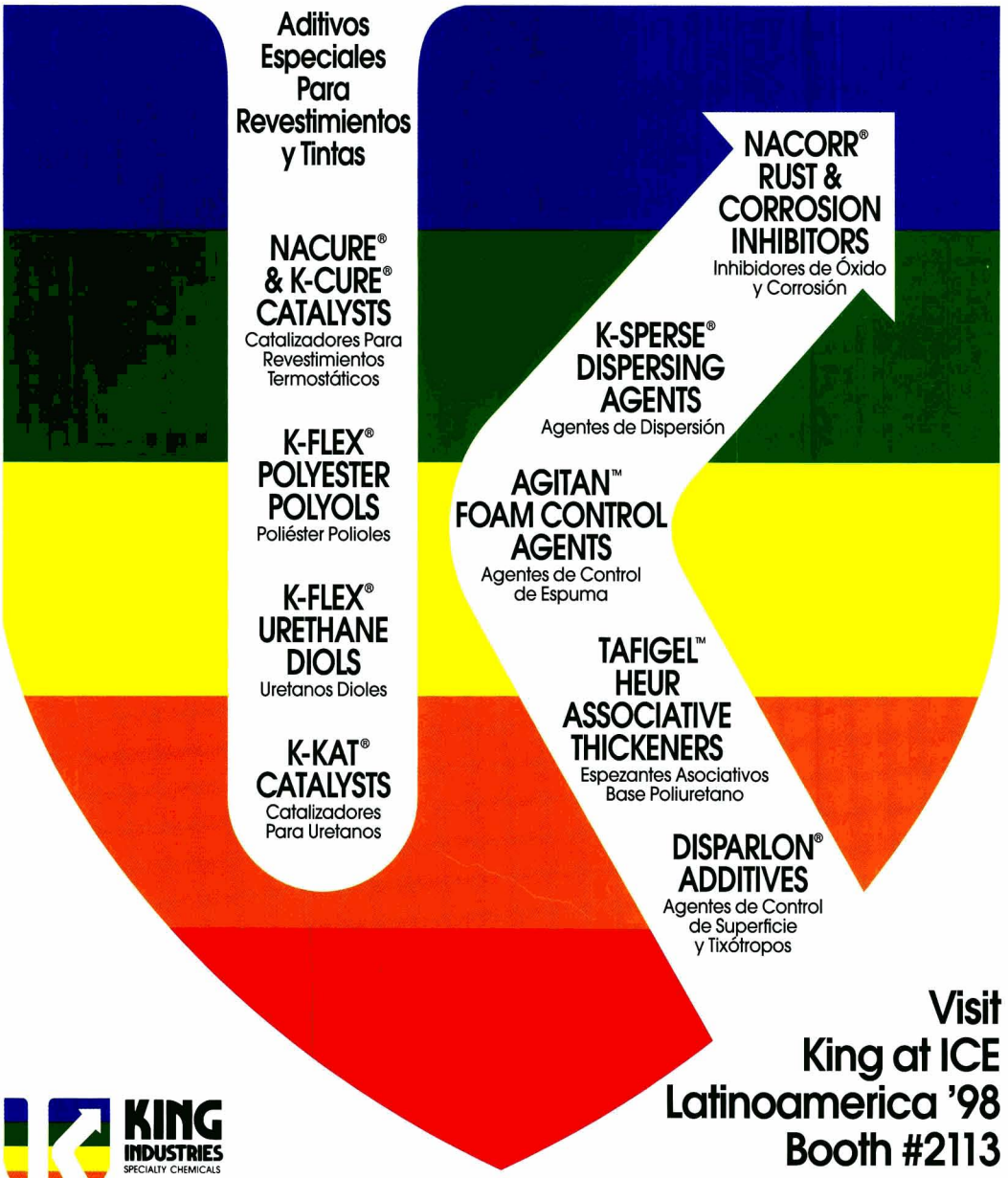
JCT, Vol. 70, No. 879, 49 (Apr. 1998)

A new method for water determination of latex paints that gives reliable and precise results is presented. This method agrees with the results obtained using the traditional Karl Fischer titrations of EPA Method 24; therefore eliminating the need for Karl Fischer titrations. Equipment needs are minimal and the procedure is performed quickly and conveniently. Hopefully, in the future EPA Method 24 will not be the only method accepted by regulatory agencies. Until that time, however, this new method will be useful for quality control and assurance, in-house regulatory compliance monitoring, and research and development purposes.

Comparación de Métodos Para Determinación de VOC: El Método 24 de la EPA Contra el Método Cal Poly Pomona—Del Comité Técnico de la Sociedad de Los Angeles de Tecnologia de Recubrimientos

Se presento un nuevo método para la determinación de agua en pinturas de látex el cual ofrece resultados muy precisos. Los resultados obtenidos con este método concuerdan con las del método tradicional de titulación Karl Fischer del Método 24 de la EPA, eliminando la necesidad de la titulación. Las necesidades de equipo son mínimas y el procedimiento es muy rápido y conveniente. Se espera que en un futuro cercano el Método 24 de la EPA no sea el único aceptado por las agencias certificadoras. Hasta este momento sin embargo este nuevo método puede ser útil para control de calidad, aseguramiento interno, monitoreo en caso de revisar que se cumplen las regulaciones y para propósitos de investigación y desarrollo.

High Performance Coatings Additives



Visit King at ICE Latinoamerica '98 Booth #2113

KING INDUSTRIES
SPECIALTY CHEMICALS

USA Science Rd. Norwalk, CT 06852 (203) 866-5551 FAX: (203) 866-1268
EUROPE Noordkade 64, 2741 EZ Waddinxveen, The Netherlands Tel: (0) 182-631360 FAX: (0) 182-621002

ICE '98 Update—90% of Booth Space Sold to Date

To date, over 254 companies have reserved space in nearly 88,300 sq. ft. of exhibit space for ICE '98—International Coatings Expo. The event, sponsored by FSCT, will be held on October 14-16 at the Ernest N. Morial Convention Center, in New Orleans, LA.

To be held in conjunction with the Federation of Societies for Coatings Technology's Annual Meeting and the International Coatings Technology Conference, the Expo will feature the products and services of supplier companies to the international coatings industry. For more information, contact FSCT at (610) 940-0777 or visit our web site at http://www.coatingstech.org.

The following exhibitors have reserved space.

A

ACT Laboratories
ACTI-Chem Specialties, Inc.
Advanced Software Designs
Air Products & Chemicals, Inc.
Akzo Nobel Resins
Alar Engineering Corp.
AlliedSignal Inc.
Alnor Oil Co.
ACS, Information & Services
American Colors, Inc.
Amer. Paint & Coatings Journal
Amoco Chemicals
ANGUS Chemical Co.
Anker Labelers USA Inc.
Aqualon-A Div. of Hercules Inc.
ARCO Chemical Co.
Arizona Instrument Corp.
Ashland Chemical Co. Drew Industrial Div.
Atlas Electric Devices Co.
Atotech USA Inc
Automation USA
Avestin Inc.
Aztec Peroxides, Inc.

B

B.A.G. Corp.
BASF Corp.
BatchMaster Software, Inc.
Blacoh Fluid Control, Inc
Bohlin Instruments, Inc.
Borden Inc.
Bowers Process Equipment Inc.
Brookfield Eng. Labs., Inc.
Buckman Laboratories, Inc.
Bulk-Pack, Inc.
Bulkcon Systems USA
Burgess Pigment Co.
BYK-Chemie USA
BYK-Gardner, Inc.

C

Cabot Corp., CAB-O-SIL & Special Blacks Div.
Calgon Corp.
Cardolite Corp.
CB Mills
CEM Corp.
Charles Ross & Son Co.
Chem-Tel Inc.
Chemical Market Report
Ciba Specialty Chemicals Corp. Additives, Pigments, & Polymers Divs.
Cimbar Performance Minerals
Clariant Corp.
Clawson Container Co.
CMI International
Color Communications, Inc.
Color Corp. of America
Columbian Chemicals Co.
Corob North America Div.
Cortec Corp.
CR Minerals Corp.
Cray Valley
Creanova Inc. (Huls America)
Crosfield Co.
Cuno, Inc.

D

D/L Laboratories
Datacolor International
DeFelsko Corp.
Degussa Corp.
DMG Business Media Ltd.
Dominion Colour Corp.
Dover Chemical Corp.
Dow Chemical Co.
Dry Branch Kaolin Co.
DuPont Nylon Intermediates & Specialties
DuPont Performance Chemicals

E

Eagle Zinc Co.
Ebonex Corp.
ECC International
Eckart America
Eiger Machinery, Inc.
Elementis
Elf ATOCHEM North America, Inc.
Engelhard Corp.
Engineered Polymer Solutions, Inc.
Erie Chemical Sales
Exxon Chemical Co.

F

Fawcett Co., Inc.
Federation of Societies for Coatings Technology
Ferro Corp.
Filterite/Memtec America Corp.
First Chemical Corp.
Fischer Technology Inc.
Florida Drum Co.
Floridin Co., Div. of ITC Industrials
Fluid Management
Formation Systems, Inc.
Franklin Industrial Minerals
Fuji Silysia Chemical
H.B. Fuller Co.

G

Gamry Instruments, Inc.
Paul N. Gardner Co., Inc.
Georgia Marble Co.
Georgia-Pacific Resins, Inc.
Gilson Co., Inc.
BFGoodrich Co.,Specialty Chem
The Goodyear Tire & Rubber Co.
Grace Davison
GretagMacbeth

H

Halox Pigments
Hansotech, Inc.
Heisler Industries, Inc.
Henkel Corp.
HERO Industries Limited
Heucotech Ltd. A N.J. Limited Partnership
Hi-Mar Specialties, Inc.
Hockmeyer Equipment Corp.
Hoover Materials Handling Group, Inc.
Horiba Instruments Inc.
J.M. Huber Corp. Engineered Minerals Div.
Huntsman Corp.

I

ICI Paints
ICI Surfactants
Ideal Mfg. & Sales Corp.
Indco, Inc.
Industrial Oil Products
INOUE USA
Interfibe Corp.
International Specialty Products
Italtinto America Inc.
ITT Marlow/ITT A-C Pump

J

SC Johnson Polymer
Journal of Coatings Technology

K

Kelly Chemical Corp.
Kenrich Petrochemicals, Inc.
King Industries, Inc.
Kline & Co., Inc.
Kowa American Co.
KTA-Tator, Inc.

L

Labelmaster
Langguth GmbH
LANSCO Colors
Laporte Pigments
LaQue Corrosion Services
Lawter International
The Leneta Co.
Liquid Controls Corp.
Littleford Day Inc.
Loeffler Filtration Group
Longview Fibre Co.

M

3M Performance Chemicals
Mallinckrodt Inc. Trimet Technical Products Div.
Malvern Minerals Co.
Michelman, Inc.
Micro Powders, Inc.
Microfluidics International Corp.
Micromeritics
Ming-Zu Chemical Industries
MiniFibers, Inc.
Mississippi Lime Co.
Morton International
Muetek Analytic Inc.
Myers Engineering

N

Nacan Products Ltd.
Nametre Co.
Neste OXO AB
Netzsch Inc.
Neupak, Inc.
Nichem Corp.
Nissan Chemical America Corp.
Norman International
North Dakota State University
NYCO® Minerals, Inc.

O

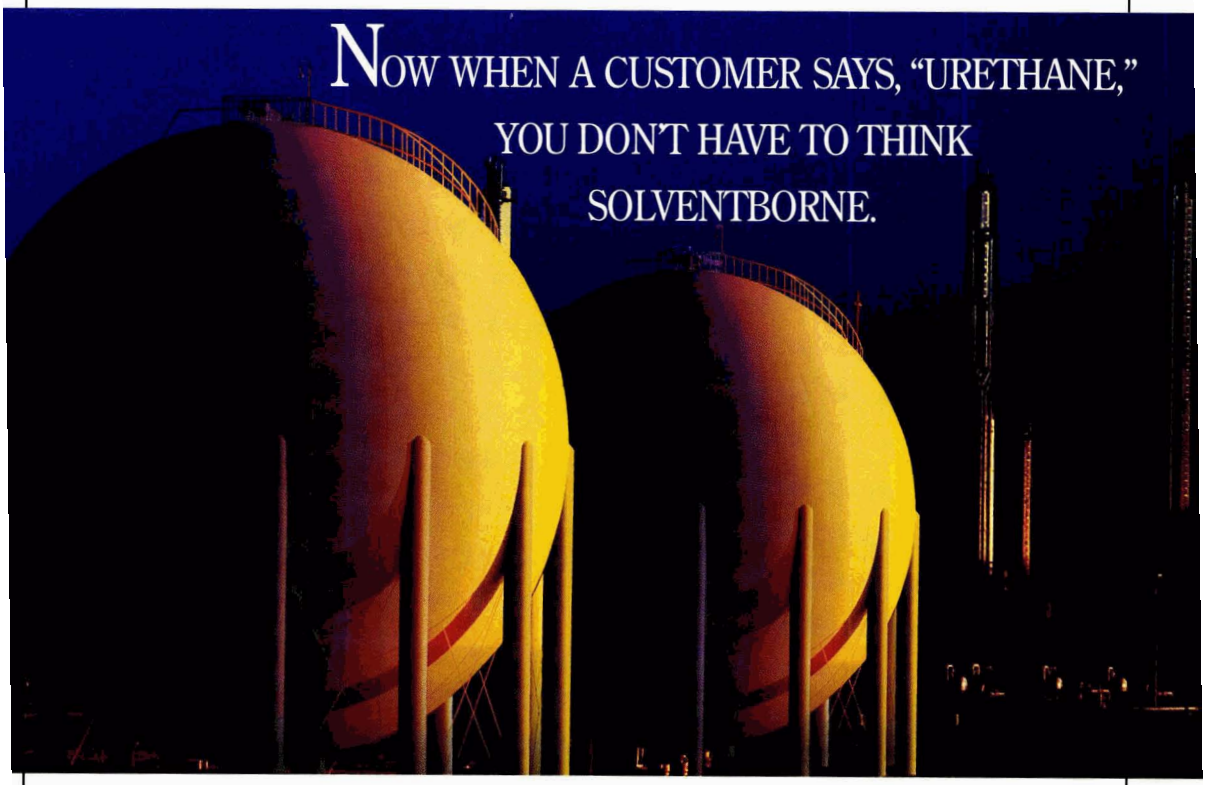
Oak Printing Co.
Occidental Chemical Corp.
Ocean Optics, Inc.
Ohio Polychemical Co.
Olin Corp.
Omnimark Instrument Corp.

P

Paar Physica, USA Inc.
Paint Research Association
Parasol Systems, Inc.
Particle Sizing Systems, Inc.
Peninsula Polymers
Phenoxy Specialties
Poly-Resyn, Inc.
PQ Corp./ Potters Industries
Premier Mill Corp.
Priority One Packaging
Purity Zinc Metals

Continued on page 15.

The waterborne revolution continues! With new Maincote® AU-28 acrylic polyol, formulators can now offer an industrial-strength waterborne urethane equal to the highest performing solventborne systems. Maincote AU-28 acrylic polyol crosslinks easily with a water-dispersible polyisocyanate (such as



Bayer's Bayhydur® XP-7063). This combination offers outstanding chemical and solvent resistance, gloss and tint retention, and mar and abrasion resistance. Plus it offers a friendlier VOC and cleanup than is possible with solventborne systems.

Designed for industrial maintenance, it is easily formulated for general finishing applications as well.

For more information and formulation guidelines, call toll free: 1-800-874-6917. Or write: Rohm and Haas Company, Industrial Coatings, 100 Independence Mall West, Phila., PA 19106.

ROHM AND HAAS
PHILADELPHIA, PA. 19106

INTRODUCING

MAINCOTE® AU-28

WATERBORNE ACRYLIC POLYOL FOR URETHANE SYSTEMS

Sponsored by the Federation of Societies for Coatings Technology
Developed by the FSCT Professional Development Committee

The Federation of Societies for Coatings Technology and its Professional Development Committee will conduct two programs, ***Switching from Solvent-Based to Water-Based: Understanding the Transition*** and ***Effective Technical and Scientific Writing Work-shop*** at the Hyatt Regency O'Hare in Chicago, IL on June 17-19, 1998.

Switching from Solvent-Based to Water-Based: Understanding the Transition

Wednesday - Thursday, June 17-18, 1998

Why You Should Attend

This course is designed to provide up-to-date information on the needs that applicators suddenly have and the limitations that now exist when the switch is made from solvent-based to water-based coatings. Attendees will learn about the changes required when formulating and manufacturing these coatings. Day One of the course will provide the attendees with the technology fundamentals of the topic, as related to the chemical properties, rheology, film formation, and surface tension issues. Information will also be provided on the contrasts related to manufacturing and application of solventborne vs. waterborne coatings. Day Two will be devoted to an in-depth look at the comparisons of solventborne vs. waterborne coatings as related to alkyds and polyesters, acrylics, epoxies, urethanes, and latex. Participants will also have the opportunity to discuss concerns and have any technical problems addressed by the program speakers during the Open Forum at the conclusion of the course.

Who Should Attend

Switching from Solvent-Based to Water-Based: Understanding the Transition is designed for all industrial coatings formulators, product development personnel, and bench chemists. Attendance at the course will enable them to have a richer understanding of customer needs, the mechanics of film formation and the chemistry and physics involved in engineering the changeover to waterborne coatings.

Wednesday, June 17, 1998
8:30 AM - 4:30 PM

Technology Fundamentals

- Properties of Liquids
  Jon Lawniczak, Eastman Chemical
- Film Formation
  Jon Lawniczak, Eastman Chemical
- Rheology: Solvent Based vs. Waterborne
  Dan Miller, King Industries
- Surface Tension Effects: Pigment Wetting and Dispersion,Substrate Wetting,Changes in Surface Tension During Drying and Defoaming
  Speaker to be determined
- Manufacturing Equipment Comparisons
  John Sneeringer, Premier Mill Corp.
- Application Comparisons
  Jerry Hund, Binks Manufacturing

Thursday, June 18, 1998
8:30 AM - 3:30 PM

Solvent vs. Waterborne Comparisons

- Alkyds and Polyesters
  Michael Coad, McWhorter Technologies
- Acrylics
  Speaker to be determined
- Urethanes
  Howard Bender, BFGoodrich
- Epoxies
  Dave Dubowik, Air Products
- Alkyds vs. Latex
  Andy Swartz, Rohm and Haas

Effective Technical and Scientific Writing Workshop

Sal Iacone, Instructor

Friday, June 19, 1998

Why You Should Attend

The ability to write memos, letters, reports, manuals, specifications and/or proposals is a routine part of most jobs in the coatings industry. In many cases, these reports can be completed quickly and effectively by employing the proper writing techniques. This course will provide one on one instruction and include in-class writing exercises to allow attendees to improve their writing skills to create concise, informational documents. Participants are encouraged to provide writing samples to the instructor in advance of the workshop for confidential review. The ***Effective Technical and Scientific Writing Workshop*** will again be conducted by Sal Iacone, who has successfully run the workshop at the previous two ICE Technology Conferences.

Who Should Attend

This workshop is designed for all levels of laboratory and R&D personnel, applicators, and anyone else who has writing responsibilities.

Workshop topics

Technical Writing Defined • Understanding the Readers Needs • Writing Patterns • Organization • the First Draft • Sentence Clarity and Precision • Technical Report Elements • Writing Abstracts • Illustrations • Formats • Preparing Manuals & Proposals • Editing Techniques

General Information for FSCT/PDC Seminars

Hotel Information

The Hyatt Regency O'Hare will host the FSCT Seminar Program. Located three miles from Chicago's O'Hare International Airport, the hotel offers four restaurants as well as an indoor pool, exercise room, and jogging paths. Complimentary shuttle transportation to and from O'Hare International Airport is offered by the hotel.

To obtain hotel accommodations, contact the FSCT Travel Desk at 1-800-448-FSCT and mention the FSCT June Seminar. The Travel Desk will provide you with a confirmation of your reservation.

Registration Information

Attendance is limited and registration will be accommodated on a first-come, first-served basis. To register, complete the accompanying form, provide your payment, and return it to:

Federation of Societies
for Coatings Technology
492 Norristown Road
Blue Bell, PA 19422-2350
— or —
For priority processing, pay by credit card and FAX your completed form to:
(610) 940-0292

Your payment must accompany the registration in order to be processed. Payment by check must be made in U.S. funds payable to FSCT.

Registration Fees

Switching from Solvent-Based to Water-Based: Understanding the Transition
(Wednesday-Thursday, June 17-18, 1998)

- $495 for FSCT members
- $595 for nonmembers

Effective Technical and Scientific Writing Workshop
(Friday, June 19, 1998)

- $395 for FSCT members
- $495 for nonmembers

Refreshment breaks and course materials are included with registration.

Please note that lunch is not included. There are restaurants located in the Hyatt Hotel.

Cancellation Policy

If cancellation is necessary, written notification to FSCT is required on or before June 10, 1998. A $25 processing fee will be applied. For cancellations received after June 10, a $60 processing fee will be applied.

Travel Arrangements

By Air:
The Chicago area is served by two major airports: O'Hare International Airport located three miles from the hotel; and Midway Airport located 30 minutes from the hotel. Complimentary shuttle transportation is provided from O'Hare International Airport only.

Special discounted fares to the FSCT Seminar have been arranged with United Airlines and USAirways. To receive these fares, you must contact the FSCT Travel Desk at 1-800-448-FSCT and mention the FSCT June Seminar.

By Car:
For directions to the O'Hare Hyatt Regency, call 1-847-696-1234 and request directions to the hotel.

Free FSCT Monograph!

If we receive your registration by May 22, we'll mail you one of the following titles:

- Introduction to Coatings Technology
- Film Formation
- Mechanical Properties

(See registration form on next page.)

ICE '98 Update *Continued from page 12.*

Q

Q-Panel Lab Products

R

Raabe Corp.
Ralston Colour Systems & Coatings
Ranbar Technology, Inc.
Readco Manufacturing, Inc.
Reichhold Chemicals, Inc.
Revelli Chemicals, Inc.
Rhodia, Inc.
Rohm and Haas Co.
Ronningen-Petter
Russell Finex, Inc.

S

San Esters Corp.
Sartomer Co.
Schenectady International, Inc. Polymer Div.
Schlumberger Industries
SEPR, Ceramic Beads & Powders
Shamrock Technologies, Inc.
Shell Chemical Co.
Siber Hegner North America
Silberline Mfg. Co., Inc.
Sivento Inc.
Solutia Inc. (formerly Monsanto)
Southern Clay Products, Inc.
Univ. of Southern Mississippi
Specialty Minerals, Inc.
Spectratek Corp.
Startex Chemical, Inc.
Stony Brook Scientific Ltd.
Sud-Chemie Rheologicals
Sun Chemical Corp.

T

Taber Industries
Tayca Corp.
Tech Pak, Inc.
Tego Chemie Service USA
Thomas Scientific
Tikkurila & McWhorter CPS
Toyal America, Inc.
Troy Corp.

U

U.S. Aluminum, Inc.
U.S. Zinc Corp.
Ultra Additives, Inc.
Unimin Corp.
Union Carbide Corp.
Union Process Inc.
United Mineral & Chemi. Corp.
United Soybean Board c/o Omni Tech International

V

Van Waters & Rogers, Inc.
VanDeMark Group
R.T. Vanderbilt Co., Inc.
Versa-Matic Pump Co.
Vianova Resins Inc.
Victaulic Co. of America
Viking Pump, Inc.
Viskon-Aire
Vorti-Siv Div., MM Industries, Inc.

W

Waardale Kjemiske Fabrikker A/S
Wacker Silicones Corp.
Warren Rupp, Inc. Unit of Idex
Western Equipment Co.
Wilden Pump & Engineering Co.
Witco Corp.

X

X-Rite, Inc.

Z

Zemex Industrial Minerals
Zeneca Resins/Zeneca Biocides

Registration Form

Switching from Solvent-Based to Water-Based: Understanding the Transition—June 17-18, 1998

Effective Technical and Scientific Writing Workshop—June 19, 1998

Hyatt Regency O'Hare, Chicago, IL

Name _____

Nickname (for Badge) _____

Company _____

Address _____

City _____ State _____ Zip _____

Phone _____ FAX _____

I am a member of the following FSCT Society _____

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

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

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

Method of Payment (Payable to FSCT)

Registration Fees:

❑ Switching from Solvent-Based to Water-Based (Wednesday-Thursday, June 17-18)
- ❑ FSCT Member — $495
- ❑ Nonmember — $595

❑ Effective Technical and Scientific Writing Workshop (Friday, June 19)
- ❑ FSCT Member — $395
- ❑ Nonmember — $495

☛ ❑ **Check here if you are interested in becoming a member of FSCT.**

Registration fee includes breaks and course materials.
Payment is due with the registration form.
Total amount due $ _____

Free FSCT Monograph!

If we receive your registration by May 22, we'll mail you one of the following titles (check one):

❑ Introduction to Coatings Technology
❑ Film Formation
❑ Mechanical Properties

Please check one:

❑ Enclosed is Check #_____ payable in U.S. Funds on a U.S. Bank to "FSCT"

❑ Charge to the following card: ❑ MC ❑ VISA ❑ AMEX Exp. Date: __/__ (Mo. Yr.)

Card No. _____

Signature _____

Please print Cardholder's Name _____

If cancellation is necessary, written notification to FSCT is required on or before June 10, 1998.
A $25.00 processing fee will be applied. For cancellations received after June 10, a $60.00 processing fee will be applied.

Return completed form with payment to: FSCT, 492 Norristown Rd., Blue Bell, PA 19422.
Credit card payments can be faxed to: 610-940-0292.

ATTENDANCE IS LIMITED AND REGISTRATIONS WILL BE ACCOMMODATED ON A FIRST-COME, FIRST-SERVED BASIS.

FSCT has the right to amend this program as necessary. In the event of a program cancellation, FSCT is not responsible for incidental costs incurred by registrants.

Regulatory Update

Federal Regulations
State Regulations
International Activity
Update Analysis

April 1998

This summary of current regulatory activity of interest to the coatings industry is published to inform readers of actions that could affect them and their firms, and is designed to provide sufficient data to enable those interested to seek further information. Material is supplied by the law firm of Swidler & Berlin, Chartered, in Washington, D.C. Although reasonable steps have been taken to ensure the reliability of this Regulatory Update, the FSCT and Swidler & Berlin cannot guarantee its completeness or accuracy.

Federal Regulations

Final Regulations

Environmental Protection Agency
February 18, 1998 - 63 FR 8126
Action: Final Rule
Subject: Approval of revision to Bay Area Air Quality Management District rule on VOC emissions from architectural coatings

Effective March 20, 1998, the EPA has issued final approval of a change in the Bay Area Air Quality Management District's rule governing VOC emissions from architectural coatings (Rule 8-3). This approved rule is incorporated into the approved California SIP.

For further information, contact Yvonne Fong, Rulemaking Office (AIR-4), Air Division, U.S. EPA, Region 9, 75 Hawthorne St., San Francisco, CA 94105; telephone (415) 744-1199.

Environmental Protection Agency
February 18, 1998 - 63 FR 8128
Action: Final Rule
Subject: Reclassification of Dallas/Fort Worth area as serious nonattainment area

Based on a finding that the Dallas/Fort Worth nonattainment area has not attained the one-hour ozone national ambient air quality standard (NAAQS) by the required attainment date, the area is being reclassified by operation of law as a serious nonattainment area as of March 20, 1998. As a result of this reclassification, the state will be required to submit a new SIP within 12 months, addressing attainment of the ozone standard by November 15, 1999.

For further information, contact Thomas Diggs or James F. Davis, Air Planning Section (6PD-L), EPA, Region 6, 1445 Ross Ave., Ste. 1200, Dallas, TX 75202; telephone (214) 665-7214.

Environmental Protection Agency
February 20, 1998 - 63 FR 8573
Action: Final Rule
Subject: Disapproval of Michigan SIP revision

EPA has issued a final rule disapproving Michigan's SIP revision concerning start-up, shutdown and malfunction (SSM) regulations applicable to all sources covered by the SIP. The Michigan rules, Rules 336.1913 and 336.1914, excuse excess emissions resulting from SSM providing that notice and reporting requirements are met. EPA disapproved the inclusion of these rules into the SIP based on its determination that the rules are not consistent with the Clean Air Act.

For further information, contact Kathleen D'Agostino, EPA, Region 5, Regulation Development Section, Air Programs Branch (AR-18), Chicago, IL 60604; telephone (312) 886-1767.

Environmental Protection Agency; Food and Drug Administration
March 4, 1998 - 63 FR 10718
Action: Direct final rule
Subject: Transfer of jurisdiction over food packaging

The EPA has issued a rule giving the Food and Drug Administration (FDA) sole jurisdiction under the federal Food, Drug, and Cosmetic Act for food packaging (*e.g.*, paper and paperboard, coatings, adhesives, and polymers) impregnated with an insect repellent. The change in jurisdiction takes effect on May 4, 1998, unless adverse comments are received by EPA by April 3, 1998. Currently, food packaging impregnated with an insect repellent is regulated by both agencies under the Act, with EPA required to establish an exemption for the material. In this rule, EPA is exempting the impregnated food packaging from the definitions of "pesticide chemical" and "pesticide residue" under the Act. EPA will retain its jurisdiction over such packaging material under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).

For further information, contact Robert Torla, Biopesticides and Pollution Prevention Division (7511W), Office of Pesticide Programs, EPA, 401 M St., S.W., Washington, D.C. 20460; telephone: (703) 308-8098;

Proposed Regulations

Environmental Protection Agency
February 25, 1998 - 63 FR 9464
Action: Proposed rule
Subject: Consolidated rules of practice

The EPA has issued a proposed rule that revises the Agency's consolidated rules of practice (40 C.F.R. Part 22) and applies those rules to most EPA actions for civil penalties and the issuance of compliance orders. This action will make the procedures for hearings and appeals generally consistent for all statutes under EPA's enforcement jurisdiction. The revised procedures are more streamlined than existing procedures and are intended to encourage quick resolution of enforcement cases.

For more information, contact Scott Garrison, Office of Enforcement and Compliance Assurance, Office of Regulatory Enforcement (2248A), EPA, Washington, DC 20460; telephone: (202) 564-4047.

Notices

Environmental Protection Agency
February 24, 1998 - 63 FR 9151
Action: Notice of Acceptability
Subject: Expansion of list of acceptable substitutes for ozone-depleting substances

EPA has issued an expansion of its list of acceptable substitutes for ozone-depleting substances for the refrigeration and air conditioning, foam blowing, aerosols, and solvent cleaning industrial sectors. For aerosols, petroleum hydrocarbon C5 was added to the list of acceptable substitutes for CFCs and HCFCs in aerosol solvents. For solvent cleaning, petroleum hydrocarbon C5 was added as an acceptable substitute for CFCs and HCFCs in semi-aqueous solvents and as a straight organic solvent. For both the adhesives, coatings and inks sector and the aerosols sector, EPA noted that a submission justifying the addition of n-propyl-bromide as an acceptable substitute had not been received. Therefore, all distribution and sale of the material into these sectors must cease until a complete submission is made and the mandatory 90-day review period has elapsed.

For further information, contact Carol Weisner, EPA, Stratospheric Ozone Protection Division, 401 M St. S.W., Mail Code 6205J, Washington, D.C. 20460; telephone (202) 564-9193; or contact the EPA Stratospheric Ozone Protection Hotline at (800) 296-1996.

Environmental Protection Agency
March 13, 1998 - 63 FR 12465
Action: Notice of Settlement and Related Upcoming Final Rule
Subject: Control of VOC emissions from paints and consumer products

EPA has announced that it will finalize regulations to control volatile organic compound emissions from paints and other consumer products by August 15, 1998. The announcement was in connection with a settlement agreement with the Sierra Club. Under the settlement, EPA must finalize rules for controlling VOC emissions from consumer products such as paints and glues, coatings used to refinish automobiles, and architectural coatings. EPA must also issue final "control techniques guidelines" by December 1, 1998 for wood refinishing coatings, aerospace coatings, and coatings used in ship building and repair. Control technique guidelines define reasonably available control technology (RACT) for a pollutant. Ozone nonattainment areas must require adoption of these controls by local industry. EPA is accepting comments on the settlement until April 13, 1998. For further information, contact Phyllis J. Cochran, EPA Air and Radiation Office (2344), Office of General Counsel; telephone (202) 260-7606.

Federal Legislation

Superfund

On March 5, the House Finance and Hazardous Materials Subcommittee held a hearing on H.R. 3000, a comprehensive Superfund reform bill. At the hearing, EPA Administrator Carol Browner warned that President Clinton would likely veto the bill if passed in its present form. Particularly troublesome to the administration are provisions that allow for the reopening of consent decrees and that remove the statute's current preference for permanent remedies.

Regulatory Improvement Act

On March 10, the Senate Governmental Affairs Committee passed the Regulatory Improvement Act of 1998 (S. 981), a risk and cost-benefit reform bill, in an 8 to 4 vote. The bill, discussed in the March *Update Analysis*, would require regulatory agencies to perform risk assessments and cost-benefit analyses on all major rules. The bill has been opposed by environmental groups who have argued that it will enable parties to stall rulemakings in court under the bill's judicial review provisions.

Current News and Upcoming Federal Developments

EPA Plans Release of Draft Policy on Lead-Contaminated Sites

EPA is planning to release a new national policy regarding the cleanup of lead-contaminated Superfund and RCRA sites. The draft policy will address when and how to investigate a site and how best to characterize such sites. EPA intends ultimately to establish new lead cleanup standards in order to address inconsistent remediation approaches in various EPA regions and states. The draft policy is still under review by states. Some industry representatives are concerned that the policy will contain more stringent lead cleanup standards.

For more information, contact Shahid Mahmud (703) 603-8789, or Larry Zaragoza (703) 603-8867.

New Final Rule on Lead Surveillance in Ambient Air Slated for May

EPA announced in early March that it intends to issue a new final rule in May on Ambient Air Quality Surveillance for Lead. EPA had issued a direct final rule on this subject in November 1997, but withdrew the rule in December after receiving adverse comments on the rule's policy of shifting the focus of lead monitoring from mobile sources to stationary sources.

For further information, contact Brenda Miller (919) 541-4036.

Upcoming Final Rule Exempting Methyl Acetate from VOC Classification

EPA staff has submitted to the Administrator for signature a final rule that would exempt methyl acetate, a compound with a potential for use as a solvent in paints, inks and adhesives, from being listed as a volatile organic compound. The final rule may be issued by the end of March.

For further information, contact Bill Johnson (919) 541-5245.

Proposed Hazardous Air Pollutant Rule on Polyether Polyols Expected in September

EPA announced in March that it expects to issue a proposed rule in September 1998 intended to reduce emissions of hazardous air pollutants from facilities that manufacture products using polyether polyols. Polyether polyols are used to make such materials as microcellular products, adhesives, sealants, fibers, and pharmaceutical and cosmetic products. The draft rule was published on September 4, 1997.

For further information, contact David Svendsgaard (919) 541-2380.

EPA to Establish Field Citation Program for Minor Clean Air Violations

EPA expects to issue a final rule by June establishing a program for field citations for minor Clean Air Act violations. As proposed, the rule would allow a federal inspector inspecting a facility on-site to write "tickets" imposing penalties of up to $5,000 per day for each observed violation.

For further information, contact Cary Secrest (202) 564-8661.

EPA May Soon Adopt New Mercury Detection Method

EPA appears to be close to adopting the use of a controversial new analytical method for detecting very low levels of mercury in water. Some believe that the use of this method will throw many dischargers out of compliance with their existing permit limits. Some states are considering offering variances from mercury limits to allow dischargers to remain in compliance. There is also concern that EPA is beginning to implement a new enforcement and compliance initiative targeting dischargers that violate their mercury permit limits.

For further information, contact the EPA Water Enforcement Division (202) 564-2240.

State Regulations

CALIFORNIA

Water Quality (Proposed Rule)—The California Water Resources Control Board (WRCB) has proposed to revise the rules regarding underground storage tanks by expanding the definition of motor vehicle fuel tank at 23 CCR Section 2611. Comments are due April 23, 1998 and a hearing is scheduled for April 23, 1998. For further information, contact Charles Nesmith, WRCB, (916) 227-4377.

Hazardous Substances (Emergency Final Rules)—The California Office of Emergency Services (COES) has promulgated emergency rules at 19 CCR Sections 2740.1 and 2740.2 to establish procedures for preventing the accidental release of regulated hazardous substances. The rules became effective upon promulgation February 11, 1998 and will expire June 11, 1998. For further information, contact Carol Horne-Hindmars, COES, (916) 464-3243.

Solid and Hazardous Waste (Final Rules)—The California Department of Toxic Substances Control (DTSC) has amended 22 CCR Sections 66260.10, 66261.2, 66261.4 to adopt federal recycling exclusions that exempt certain secondary materials from classification as a solid or hazardous waste when recycled in a specified manner. The rules as amended require those claiming secondary material recycling exclusions to provide documentation to demonstrate that they meet the terms of the exclusions. The rules became effective March 5, 1998. For further information, contact Joan Ferber, DTSC, (916) 322-7889

DELAWARE

Air Quality (Proposed Rule)—The Delaware Department of Natural Resources and Environmental Control (DNREC) has proposed revisions to its uncodified Regulation 38 regarding emission standards for hazardous air pollutants for source categories. Comments were due April 8, 1998 and a hearing was also scheduled for April 8, 1998. For further information, contact DNREC, (302) 739-4791.

FLORIDA

Solid Waste (Final Rule Repeal)—The Florida Department of Environmental Protection (DEP) has repealed FAC Chapter 62-707, Degradable Materials, in its entirety. The rules, which DEP repealed on the grounds that they were obsolete and unnecessary, included definitions of degradable materials, test criteria for degradability of polyolefins and other materials, and product approval requirements. The repeal took effect March 4, 1998. For further information, contact Bill Hinkley, DEP, (904) 488-0300.

Air Quality (Proposed Rule)—The DEP has proposed amendments to its regulations at FAC §. 62-204.800 to incorporate by reference recent federal regulations regarding air emissions compliance assurance monitoring. Comments were due April 6, 1998. For further information, contact Venkata Panchakarla, DEP, (850) 488-0114.

The DEP has proposed amendments to its regulations at FAC 62-213.440 regarding permit content and compliance assurance monitoring. Comments were due April 6, 1998. For further information, contact Venkata Panchakarla, DEP, (850) 488-0114.

ILLINOIS

Solid Waste (Proposed Rule)—The PCB has proposed amendments to its rules concerning procedural requirements for permitted landfills (35 IAC Chapter 813) and standards for new solid waste landfills (35 IAC Chapter 811). The amendments are intended to ease certain current requirements that the PCB believes increase costs without a proportionate environmental benefit, and to modify or eliminate existing requirements that are no longer technically sound. Comments were due April 13, 1998. For further information, contact Dorothy Gunn, Clerk of the PCB, (312) 814-6931.

LOUISIANA

Hazardous Substances (Proposed Rule)—The Louisiana Department of Environmental Quality (DEQ) has proposed to revise its chemical accident prevention regulations at LAC 33:III.5901 to include recently adopted changes to the U.S. EPA's Risk Management rule. Comments were due March 30, 1998. For further information, contact Patsy Deaville, Investigations and Regulation Development Division, DEQ, (504) 765-0399.

MARYLAND

Air Quality (Proposed Rules)—The Maryland Department of the Environment (MDE) has proposed to amend its rule on permit approvals at COMAR 26.11.02 and its regulations on volatile organic compounds from specific processes at COMAR 26.11.19. The proposed amendments: clarify that obtaining a Prevention of Significant Deterioration (PSD) or New Source Review (NSR) approval is separate from obtaining a general construction permit; add an alternative method allowing a source to achieve compliance with standards for paints, coatings or inks by using a water-based material containing less than 25 percent VOC by volume; and limit the VOC content of adhesives to 3.8 pounds per gallon when there is no other specific standard applicable. Comments were due March 4, 1998, and a hearing was also scheduled for March 4, 1998. For further information, contact Deborah Rabin, MDE, (410) 631-4414.

Air Quality (Proposed Rule)—The MDE has proposed to amend its rules on VOCs from specific processes at COMAR 26.11.19 by establishing VOC content limits for the decorative coating of plastic bottles that require such coatings to have the lowest possible VOC content consistent with maintaining necessary characteristics and adhesion. Comments were due March 4, 1998, and a hearing was also scheduled for March 4, 1998. For further information, contact Deborah Rabin, MDE, (410) 631-4414.

The MDE has proposed to amend its rules on VOCs from specific processes at COMAR 26.11.19 by exempting brake shoe coating operations from the generic miscellaneous metal coating standards and requiring use of the lowest possible VOC content coatings for brake shoes. Comments were due March 4, 1998, and a hearing was also scheduled for March 4, 1998. For further information, contact Deborah Rabin, MDE, (410) 631-4414.

The MDE has proposed to amend its rules on VOCs from specific processes at COMAR 26.11.19 by establishing a Reasonably Available Control Technology (RACT) standard for sources that coat large structural steel components. Comments were due March 4, 1998, and a hearing was also scheduled for March 4, 1998. For further information, contact Deborah Rabin, MDE, (410) 631-4414.

MICHIGAN

Air Quality (Proposed Rule)—The Michigan Department of Environmental Quality (DEQ) has proposed revisions to its rules concerning recordkeeping requirements for coating lines and graphic arts lines. Comments were due March 2, 1998, and a hearing was also scheduled for March 2, 1998. For further information, contact the Air Quality Division, DEQ, (517) 373-7069.

MINNESOTA

Water Quality (Final Rules)—The Minnesota Pollution Control Agency (MPCA) has adopted rules at MCAR Chapters 7050 and 7052 that prescribe water quality standards for the Lake Superior Basin. The rules became effective March 7, 1998. For further information, contact Judge Richard C. Luis, Minnesota Office of Administrative Hearings, (612) 349-2542.

MISSISSIPPI

Air Quality (Proposed Rule)—The Mississippi Department of Environmental Quality (DEQ) has proposed to amend its Air Emissions Operating Permit Regulations at APC-S-6. The amendment would eliminate the requirement to seek a modification of a Title V Operating Permit for each Title I modification performed. No comment deadline was provided in the notice published in Mississippi State Watch Digest March 6, 1998. For further information, contact Dwight Wylie, DEQ, (601) 961-5171.

NEW JERSEY

Water Quality (Announcement of Pilot Program)—The New Jersey Department of Environmental Protection (DEP) announced February 18 that the Passaic Valley Sewerage Commissioners (PVSC) has begun operation of a pilot program at its water treatment facility that would allow industrial dischargers to trade credits for reducing metal discharges. Under the PVSC program, a company reducing metal discharges below permitted levels may sell reduction credits to another company. The purchasing company may discharge additional amounts equal to 80% of the traded credit amount (thus ensuring at least a 20% reduction in the amount of the discharge). The program permits trading in cadmium, copper, lead, mercury, nickel, and zinc. DEP commissioner Bob Shinn, in a public statement, expressed the agency's hope that other publicly owned treatment works will consider such programs.

OKLAHOMA

Hazardous Materials Transportation (Proposed Rule)—The Oklahoma Department of Public Safety has proposed to adopt by reference, at OAC 595:35-1-4 through 35-1-7, federal regulations pertaining to motor carrier safety and hazardous materials transportation that were promulgated through January 1, 1998. Comments were due March 10, 1998, and a hearing was also scheduled for March 10, 1998. For further information, contact Terry Morris, DPS, (405) 425-2312.

TEXAS

Air Quality (Proposed Rule)—The Texas Natural Resource Conservation Commission (TNRCC) is proposing to repeal its rule on exemptions from permitting for Paints, Varnishes, Ink and Other Coating Manufacturing at 30 TAC 106.226 and promulgate a new rule in its place. The new rule would apply limits on rates of raw material use rather than direct emission limits. It would prohibit the use under the permitting exemption of the heavy metals strontium and cobalt in concentrations of more than 0.1% by weight. Use of the metals in higher concentrations would require a detailed review of the facility's operation, voiding the use of the permitting exemption. A hearing was scheduled for March 16, 1998. For further information, contact Kerry Drake, TNRCC, (512) 239-1112.

International Activity

CZECH REPUBLIC

Top environmental officials resign

The Czech Republic's two top environmental officials resigned in February, leaving significant concern for the future effectiveness of the country's Environmental Ministry. The two officials, Environment Minister Jiri Skalicky and Deputy Minister Vladislav Bizek, have been effective leaders in developing the country's environmental programs. Skalicky was successful in ushering through parliament several pieces of major environmental legislation. Bizek was a chief architect of the Ministry's environmental legislation framework and a driving force behind the Ministry's push toward harmonization with international environmental standards.

Bilateral agreement with Poland

The Czech Republic and Poland signed an agreement in January that will establish an environmental commission to coordinate the two countries' activities on environmental protection, particularly as they pertain to the nations' border regions. The Czech Republic has a similar agreement with Germany.

Dutch assistance on environmental issues

The Czech Republic and the Netherlands have signed

a bilateral agreement under which the Netherlands will give the Czech Republic assistance in the field of environmental protection. This assistance could include sharing of Dutch training and other expertise, assistance with developing environmental inspection procedures, and paying for pilot programs within the Czech Republic. Dutch environmental officials will review the Czech Inspectorate for the Environment and will offer support to ensure that Czech officials can attend enforcement workshops scheduled for 1998.

JAPAN

Environmental assessment program planned

Japan's Environment Agency announced in February its plan to launch a "public environment assessment" system in 1999 in which a government-certified assessment organization will examine and certify environmental measures taken by private-sector corporations. The proposed system will be the first time that a public-sector body will directly intervene in corporate environmental activities. Under the new system, companies will be asked to voluntarily prepare documents stating environmental policies, present conditions for discharges of waste and its management, noise emissions, and water treatment operations, as well as their environmental improvement measures and greenhouse gas reduction plans. The companies will present these documents to a certified environmental auditor who will evaluate the documents and make the evaluation results publicly available.

MEXICO

Proposed VOC standards for solvent-based air-dried paints promulgated

The Mexican National Institute of Ecology — the government entity under the Ministry of Environment, Natural Resources, and Fisheries ("SEMARNAP") that is responsible for drafting environmental standards — promulgated proposed volatile organic compound ("VOC") content standards for solvent-based, air-dried paints for domestic use. The proposed Mexican Official Norm ("NOM") referred to as NOM-123-ECOL-1997 was published in Mexico's Federal Register (the "*Diario Oficial*") on February 17, 1998 and is subject to a 90-day public comment period. The proposed NOM establishes maximum permissible VOC content levels for manufacturers and importers of solvent-based, air-dried paints for domestic use, and establishes the procedures for determination of VOC content in paints and coatings. The proposed NOM states that it is technically equivalent to the proposed Canadian standard for the reduction of VOC emissions from paint manufacturing. SEMARNAP officials state that they expect to propose and promulgate additional regulations addressing VOC emissions during the coming year.

Mexican government reaches agreement with maquiladora industry

The Mexican government announced in mid-March that it had reached an agreement with the maquiladora industry that will simplify the procedures for transboundary movement of hazardous waste. Maquiladoras are industries along the U.S.-Mexican border that import parts from the U.S., assemble them, and pay import duties only for the value added in Mexico. Under the North American Free Trade Agreement (NAFTA), maquiladoras must export any hazardous waste generated in their facilities back into the U.S. Under the existing procedures, maquiladoras had to obtain Mexican government approval for the export of these wastes, which could take up to two months. Under the new agreement, the movement of waste will be monitored through a computerized system and the maquiladoras will be required only to give a five-day notice of export through the computerized system. Also under the new agreement, maquiladoras will be allowed to dispose of their hazardous wastes in Mexico after 2000 if they change their legal status in Mexico, abandoning their "foreign company" tax classification.

INTERNATIONAL PROGRAM ON CHEMICAL SAFETY

Risk assessment methods for health effects in children to be developed

The International Program on Chemical Safety (IPCS), a joint project of the World Health Organization, International Labor Organization, and the United Nations Environment Program, announced in early March that it will launch in 1999 a project to develop internationally accepted chemical risk assessment methods specifically aimed at predicting health effects in children. The children's risk assessment project emerged from the 1997 meeting of the Group of Seven industrialized nations with Russia. The risk assessment project is expected to be completed by the end of 2000.

ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT

Commitment on harmonization of classifications and labels

In its February Joint Meeting, the Organization for Economic Cooperation and Development (OECD) announced its commitment to complete its ongoing work aimed at harmonizing classification systems for chemicals by November 1998 and harmonizing chemical labels by 2000. The OECD is a Paris-based intergovernmental organization consisting of 29 industrialized countries in Europe, North America, Asia and the Pacific. To date, the OECD has investigated only 109 of the 200 data-poor, high-production-volume chemicals scheduled for investigation by the end of 1998. Meeting participants also agreed to study potential ways to streamline the process by which companies notify governments of new chemicals in need of authorization.

International Program for manufacturing safer chemicals

The OECD has endorsed the development of an international program aimed at manufacturing safer industrial chemicals. The "Sustainable Chemistry Program" will encourage the design, manufacture, and use of environmentally benign chemical products and processes that prevent pollution, produce less hazardous waste, and reduce environment and human health risks. The first activity of the program will be a survey of OECD member nations to determine what types of activities are ongoing in this area.

UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE

Agreement to reduce emissions of metals and persistent organic pollutants

Officials from 28 European and North American counties and the European Commission have agreed

on two draft protocols that would reduce or eliminate emissions of a number of heavy metals and persistent organic pollutants (POPs). The agreement was reached at the February meeting of the United Nations Economic Commission for Europe after eight years of negotiations. The draft protocol on heavy metals focuses on reducing emissions of lead, cadmium, and mercury, and seeks to cut emissions from industrial sources of these pollutants through setting strict limits and imposing management measures. The protocol on POPs will cover 16 substances, including 11 pesticides, hexabromobiphenyl, polychlorinated biphenyls (PCBs), dioxins, furans, and polycyclic aromatic hydrocarbons (PAHs).

Update Analysis: OSHA's Final Respiratory Protection Rule

The Department of Labor's Occupational Safety and Health Administration (OSHA) published its final rule in Docket No. H-049 revising the respiratory protection standard on January 8, 1998 (63 Fed. Reg. 1152). The new rule replaces the standard adopted by OSHA in 1971 (29 40 C.F.R. § Section 1910.134 and 29 40 C.F.R. § Section 1926.103) and applies to general industry workplaces. The final rule takes effect on April 8, 1998, with the exception of certain provisions discussed in the following:

Written Program: The regulations require employers to develop and implement a written respiratory protection program, including workplace-specific procedures addressing the major elements of the program, whenever respirators are necessary to protect the health of the employee. In addition, a written program must be developed and implemented where an employer requires an employee to wear a respirator in the absence of a standard requirement to do so. Employers who provide respirators at the request of their employees or who allow their employees to bring their own respirators into the workplace must ensure that the respirator used does not present a hazard to the health of the employee. If the voluntarily-worn respirator is a filtering facepiece (such as a dust mask), the employer is not required to implement a written program.

The standard identifies specific elements that must be included in the employer's written program (*e.g.*, procedures for respirator selection, fit testing, and use), unless the particular element does not apply to the employer's workplace. In addition, the employer must designate an individual as program administrator and update the program when changes in the workplace or in respirator use make such updating necessary.

Selection of Respirators: Employers must select and provide an appropriate respirator based on the respiratory hazard(s) to which the worker is or will be exposed in the workplace. OSHA mandates that the employer identify and evaluate the respiratory hazards present, determine their physical state and chemical form, and assess the magnitude of the hazard they present to workers under normal conditions of use and in reasonably foreseeable emergency conditions.

The new standard does not require a written assessment each time a respirator is selected, because the agency believes that "employers should be free to adopt the best approach for justifying their respirator selections, based on the hazard assessment." In addition, the rule does not specify the number of sizes, models, and brands of respirators required, so that employers are given the greatest flexibility to choose the most appropriate respirator for the hazard.

Medical Evaluations: The standard mandates that every employee undergo a medical evaluation prior to fit testing and initial use of a respirator. The employers are required to select a physician or other licensed health care professional (PLHCP) to conduct the medical evaluation, which must consist of either the administration of a medical questionnaire (which may result in a follow-up medical examination) or an initial medical examination. The employee may not use the respirator until he has obtained a written recommendation from the PLHCP that he is medically able to do so. Additional medical evaluations must be conducted on the employee whenever there is any indication that a reevaluation is appropriate.

Fit Testing: Before an employee is required to use any respirator with a negative or positive pressure tight-fitting facepiece, the employee must be fit tested with the same make, model, style, and size of respirator that will be used. Fit testing can be either qualitative or quantitative, and must be conducted (1) according to specific protocols, (2) at specific intervals, and (3) on the occurrence of defined triggering events. For example, an employee must pass an appropriate fit test whenever a different respirator facepiece is used, if certain changes in the employee's physical condition occur, or, at a minimum, on an annual basis.

Use of Respirators: The regulations state that employers must establish and implement procedures for the proper use of respirators. Employers are prohibited from allowing respirators with tight-fitting facepieces to be worn by employees who have "facial hair that comes between the sealing surface of the facepiece and the face or that interferes with valve function." In addition, employers are required to ensure that corrective lenses, spectacles, and face protection devices do not block the seal of the respirator.

Training: The standard requires employers to provide effective training to any employees required to wear respirators.

Copies of this regulation are available on the Internet at "http://www.osha.gov/" or through OSHA's Office of Publications at (202) 219-8148.

Panamerican Coatings Expo Features Program Sponsored by the Mexico Society

The Panamerican Coatings Expo, co-sponsored by the Federation of Societies for Coatings Technology (FSCT), the Asociacion Nacional de Fabricantes de Pinturas y Tintas, A.C. (ANAFAPYT), and Instituto Mexicano de Tecnicos en Pinturas y Tintas (IMTPYT), will be held July 23-24 at the World Trade Center, in Mexico City, Mexico.

Expo hours will be Thursday, July 23—3:00 p.m.-8:00 p.m.; and Friday, July 24—11:00 a.m. - 8:00 p.m.

"Panamerican Coatings Technical Conference," a two-day program sponsored by the Mexico Society for Coatings Technology (IMTPYT), is scheduled for July 22-23. The tentative program is a follows:

Wednesday, July 22

8:00-10:00 a.m.—Registration

10:00-10:30 a.m.— Opening Session

10:30-11:00 a.m.—Presentation by Intersil, S.A. de C.V.

11:30 a.m.-12:00 Noon—Coffee Break

12:00 Noon-1:00 p.m.—"Advances in Water-Based Technology"—Robert Zeidewand, Zeneca Resins

1:00-2:00 p.m.—"Cationic UV Curable Coatings for Metal Substrates"—John K. Bradock, Union Carbide

2:00-3:30 p.m.—Lunch

3:30-4:30 p.m.—Presentation by Estéban Pérez, Bayer de Mexico

4:30-5:30 p.m.—"Water-Based Epoxy Systems"—Claudia Gutiérrez, CIBA Specialties

Thursday, July 23

9:00-10:00 a.m.—"Maximizing TiO_2 Dispersion and Performance"—James Sipe, DuPont, S.A. de C.V.

10:00-11:00 a.m.—"Wood Technology in UV and Its Advantages in Plant"—Oscar Valdez Aguilera, UCB Mexico

11:00-11:30 a.m.—Coffee Break

11:30 a.m.-12:30 p.m.—"Advances in Grinding Media Separation for the Horizontal Bead Mill"—Harry Wray, Netzsch, inc.

12:30-1:30 p.m.—"Dynamic Performance of Acetylenic Diols in Architectural Coatings"—Frank J. Lee, Air Products

1:30-3:00 p.m.—Lunch

3:00-8:00 p.m.—Panamerican Coatings Expo

Friday, July 24

11:00a.m.-8:00p.m.—Panamerican Coatings Expo

Registration Information

The registration fees for the technical conference are: Members (FSCT/Mexico Society/ANAFAPYT): $1,500 pesos + 15% IVA; Non-Members: $2,500 pesos + 15% IVA.

Registration includes the conference, proceedings, two lunches, and coffee breaks.

To register, please contact Jose Luis Rameriz at 011 52 5 682-7794; Fax 011 52 5 543-6488. Space is limited.

There is no fee to attend the Panamerican Coatings Expo.

Hotel Information

A block of guest rooms are available at the Sheraton Maria Isabel, Mexico City, at a group rate of $130 + 15% IVA.

Exhibiting Information

For exhibit information, contact FSCT Exhibit Management, Steve Kettelkamp, EMI, 10425 Old Olive Street Rd., Ste. 103, St. Louis, MO 63141-5940; Tel: (314) 994-9640; Fax: (314) 994-9650; or e-mail: expomanage@aol.com.

1998 Panamerican Coatings Expo List of Exhibitors

(as of March 25)

Air Products & Chemicals, Inc.
Bayer de Mexico, S.A. de C.V.
Bowers Processing Equipment
BYK-Chemie USA
BYK-Gardner, Inc.
Canbro Inc.
CB Mills
Ciba Especialidades Quimicos Mexico, S.A. de C.V.
Connor Comercial, S.A.
Creanova Inc. (Hüls America Inc.)
Degussa Mexico, S.A. de C.V.
Disti-Kleen, Inc.
DJB S.A. de C.V.
DuPont, S.A. de C.V.
Eastman Chemical Co.
ECC International
Eiger Machinery, Inc.
Elementis Specialties
Envirotronics
Exxon Chemical Co.
Federation of Societies for Coatings Technology
Fluid Management
Halox Pigments
Hitox Corp. of America
P.T. Hutchins
Interfibe Corp.
International Specialty Products (ISP)
Intertrade S.A. de C.V.
Journal of Coatings Technology
Kenrich Petrochemicals, Inc.
The Leneta Co.
Metapol, S.A. de C.V.
Micro Powders, Inc.
MM Industries, Inc. Vorti-Siv Div.
Moca Y Compania, S.A. de C.V.
Myers Engineering
National Starch & Chemical, S.A. de C.V.
Netzsch Incorporated
Possehl, S.A. de C.V.
Q-Panel Lab Products
Quimica San Diego S.A. de C.V.
Reacciones Quimicas S.A. de C.V.
Shamrock Technologies, Inc.
Simon Quimica, S.A. de C.V.
Solventes Y Productos Quimicos, S.A de C.V.
Sun Chemical Corp.
Tego Chemie Service Mexico
UCB Quimica de Mexico S.A. de C.V.
Union Carbide Corp.
Vorti-Siv, Div of MM Industries
Watson Phillips Y cia. Sucs. S.A. de C.V.
Zeneca Resinas Mexico

ASTM Celebrates 100th Anniversary

The American Society for Testing and Materials (ASTM), West Conshohocken, PA, marks its 100th Anniversary in 1998. It has been a century since its standards began to help companies improve their performance capabilities and enter new markets of trade. "For 100 years, ASTM has provided a system intended to improve the quality of life and the performance of materials and products through the development and application of technically credible, high quality standards. Although the issues requiring standardization have continued to grow in complexity, ASTM has demonstrated the ability to respond in a timely and efficient manner," says James A. Thomas, ASTM President.

What began June 16, 1898 when 20 engineers and professors gathered in Philadelphia, PA, to address safety concerns in the railroad industry, has grown into a society of more than 35,000 members from around the world. These members have developed more than 10,000 standards in 131 different fields affecting nearly every aspect of our lives.

Over the past century, ASTM has grown into a forum where stakeholders—producers, users, consumers, and academicians—share their knowledge in the development of voluntary consensus standards. These standards provide various industries with test methods, guides, specifications, practices, and terminology to help ensure the highest performance, service, and marketability worldwide.

Consumers may best recognize ASTM standards that address the toxicity of crayons, bicycle helmets, baby cribs, playgrounds, a variety of toys, and other consumer products. But many of ASTM's most successful standards are present in a broad range of industries including petroleum, thermal insulation, fire hazards, building construction, plastics, and more.

ASTM standards are well accepted and used because of the open process in which they are developed. Industry stakeholders identify a need for a standard, ASTM helps to bring interested audiences together, and when they agree on the need for particular standards, they write those standards based on their experience and the most current technology. A required balance of participants helps ensure that the development process is not dominated by any one party, and a rigid voting process provides each member interest a vote on each standard and requires a written response to negative votes.

Combining technology and resources, and overcoming lines of competition, the ASTM process is a partnership that transcends what the members could do individually. From bicycle helmets and bunk beds to building construction and petroleum, the standards improve quality, save money, facilitate both domestic and international trade, and ultimately create a healthier and safer world for all.

Albright & Wilson Purchases Remaining Equity in Mexico's A&W Troy Grupo Industrial

Albright & Wilson plc, Glen Allen, VA, will exercise its option to purchase the remaining 25% equity in the Mexican phosphate subsidiary, A&W Troy Grupo Industrial SA de CV. This will complete a series of transactions that give Albright & Wilson full ownership of the operations.

In August 1997, Albright & Wilson concluded terms with its partners to take its interest in A&W Troy to 75%. The agreement included an option to require Albright & Wilson to acquire the remaining 25% for US$35m (plus an adjustment factor of seven percent per annum calculated to the date of payment), together with a further amount not exceeding US$5m depending on sales and production performance of the business. The formal approval of the Mexican Anti-Trust Commission has been obtained and Albright & Wilson expects to conclude the acquisition of the remaining 25% of the equity by the end of March.

U.S. Polymers Buys CKU-2266 from Georgia-Pacific Resins

U.S. Polymers, Inc., St. Louis, MO, has purchased the CKU-2266 phenolic dispersion resin technology from Georgia-Pacific Resins, Inc., Atlanta, GA. Terms of the transaction were not disclosed.

U.S. Polymers will produce the resin in its St. Louis manufacturing facility and it will be marketed as Valtex® 2266 through its sales affiliate, Accurez Corp.

U.S. Polymers manufactures specialty polyesters, alkyds, epoxy esters, and dispersion resins for the paints and coatings and packaging industries.

December Resin Statistics Released by SPI

Production of plastics resins totaled 6.5 billion pounds in December 1997, an increase of 5.7% over the same month in 1996, according to statistics released by The Society of the Plastics Industry, Inc.'s Committee on Resin Statistics, Washington, D.C.

December 1997 production figures were up slightly (.02%) from those of the previous month. Production in 1997 year-to-date totaled 78.3 billion pounds, a 5.6% increase over the same 12-month period in 1996.

Sales and captive (internal) use of plastics resins in December 1997 totaled 6.5 billion pounds, a six percent increase over the same month one year ago. December 1997 sales and captive use was up four percent from the total of the previous month. Sales and captive use in 1997 year-to-date totaled 80.1 billion pounds, 4.4 % increase over the same 12-month period in 1996.

December 1997 figures are based on primary data on selected major plastics materials as compiled by Association Services Group, LLC.

Paint-A-Wish 5K Raises Over $41,000 for Make-A-Wish

The Second Annual Paint-A-Wish 5K Run/Walk, hosted by the California Paint and Coatings Association, in conjunction with the Los Angeles Society for Coatings Technology, raised over $41,000 this past August. The group, which raised a record breaking amount, donated the money to the Make-A-Wish Foundation and the Pediatric Cancer Research Foundation, a division of the Children's Hospital of Orange County.

This year's event raised $9,000 more than in 1996. In addition, the event had an increase in runners and walkers of more than 50% from the previous years.

Surfynol® grind aids make a little color go a long way.

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NPCA Responds to CARB Survey

According to a statement released by the National Paint and Coatings Association (NPCA), Washington, D.C., the California Air Resources Board (CARB) has issued a survey regarding architectural and industrial maintenance (AIM) coatings sold in California. CARB intends to assess the volatile organic (VOC) emissions from the use of AIM coatings using the information collected in the new survey.

In the accompanying cover letter that was sent with the survey, CARB noted that it had discussed the survey with NPCA, as well as several air pollution control districts and paint manufacturers and, where possible, incorporated their changes.

However, NPCA would like to clarify that not all of its suggested changes were incorporated into the CARB survey, and that the association did not help create, nor does it endorse, the survey as currently written.

According to NPCA's Bob Nelson, Director of Environmental Affairs, when NPCA received CARB's third draft of the survey late last year, the association reiterated the concern it had voiced throughout the survey's development about the size and complexity of the survey, particularly the requirements for detailed product formula ingredient information.

One of NPCA's main concerns with the survey is the required specification of ingredients down to .1% by weight of the product. NPCA had repeatedly pointed out that requiring speciation of ingredients down to the level of .1% is unreasonable and unrealistic since this information is neither readily available nor easily accessible. Even if the information were readily available, given the purpose of the survey, NPCA fails to understand how this information would provide any meaningful information to the agency.

CARB's final survey still asks manufacturers to list ingredients that amount to .1% or greater by weight of the final product, but does concede that if ingredients down to .1% are not available, then manufacturers can report ingredients that amount to one percent or greater by weight of the final product. NPCA feels that further clarification and simplification of the survey is necessary, and will continue a dialogue with CARB with this goal in mind.

NPCA's AIM Steering Committee met on March 12 to discuss this issue and develop guidance for members on how to comply with CARB's information request.

Witco Completes Two Business Transactions

Witco Corp., Greenwich, CT, has sold the assets of its aluminum chloride manufacturing facility at LaPorte, TX, to Gulbrandsen Technologies Inc. Terms of the sale were not disclosed. Witco will continue to operate manufacturing plants in Fort Worth, Houston, and Marshall, TX.

In other news, Witco has completed the sale of its Canadian detergents business, part of Witco Canada Inc., a wholly owned subsidiary, to JemPak Canada Inc., Ontario, Canada. The sale, for an undisclosed purchase price, includes plants in Brantford, Montreal, and Oakville, Canada.

Cabot Corp. Expands Distribution Network

Cabot Corp.'s, Naperville, IL, North American Distribution network will be able to provide customers with both the fumed metal oxides and pigment blacks. The decision to combine these two product lines into a single operating business, the Cabot Coatings Business Unit, is in response to ongoing market requests and part of Cabot's vision to become more market focused. The business unit was formed January 1, 1998.

ISO Certification

Atlas Material Testing Technology BV, Linsengericht/Altenhasslau, Germany, has been awarded ISO 9001 certification. This company manufactures the Xenotest line of Atlas weathering instrumentation products.

Creanova Inc., Somerset, NJ, has announced that its isophorone derivatives plant in Mobile, AL, has achieved QS 9000 certification.

Coil coatings producer **Hydro Coatings**, Deeside, Clwyd, United Kingdom, has received ISO 14001 accreditation for its environmental management system (EMS).

The Quality System of **Sentry Paint Technologies, Inc.**, Darby, PA, has received ISO 9002 certification.

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IBRG Meets to Develop Test Methods and Investigate Principles of Biodeterioration

The International Biodeterioration Research Group (IBRG) was originally founded under the auspices of the Organisation of Economic Co-operation and Development (OECD), Paris, in 1968. Its membership is made up predominantly of microbiologists from industrial users of biocides, biocide manufacturers, testing laboratories from both the private and government sector, and academic institutions. IBRG holds two meetings a year, each is usually sponsored by one of the member organizations. The most recent meeting was hosted by Troy Corp., in Newark, NJ.

The following are the Officers of IBRG: President—John Gillatt, Thor Chemicals (UK) Limited; Vice-President—Jenny Lunenburg, Akzo Nobel Decorative Products, Sassenheim; General Secretary—Pete Askew, Industrial Microbiological Services Limited; and Treasurer—Colin Hunter, Building Research Establishment Limited.

The Paints Working Group is one of four Working Groups of IBRG, the others deal with plastics protection, biodegradable plastics, and leather. In addition, the organization has a technical plenary for the discussion of possible new projects.

The main objectives of IBRG are in the field of test method development and work to investigate basic principles of biodeterioration. These objectives are met in a number of ways. First, by discussion at the meetings, second by carrying out and reporting on individual laboratory investigation, and most importantly, by organizing, performing, and reporting on collaborative experimental work or round-robin testing.

Paints Working Group

The Paints Working Group, one of the organization's oldest working groups is carrying out work in a number of areas.

Dry-Film Fungal Testing

From the mid 1970s, for a period of more than 10 years, a large number of projects were performed. Their objectives were to study all aspects of the growth of fungi on applied surface coatings and to develop a standard method of test. The desire was to produce a test that would allow the in-use fungicidal performance of paints to be evaluated in the laboratory.

Following extensive laboratory trials during which comparisons were made between filter paper/agar plate tests and solid substrate/humidity chamber methods, a large field trial/laboratory comparison took place. Panels were exposed at a number of outdoor sites and the growth compared with similar panels exposed in a laboratory test chamber. Close correlation was found between the two methods of test. The results of this work were published in *Journal of Oil and Colour Chemists' Association* and reported to the committee of the British Standards Institute. As a result, the IBRG humidity chamber test was accepted as BS3900 Par G6.

Further work is planned to develop a rapid efficacy test method.

Dry-Film Algal Testing

A similar process has been followed for the laboratory evaluation of paints intended to be resistant to algal growth. Various laboratory techniques were investigated and a vermiculite bed method, where test panels are laid on a moist substrate (vermiculite), inoculated with algae and incubated with standard illumination, was developed.

Field trials in which panels are being exposed at a number of external locations and the results compared with similar panels tested according to the IBRG laboratory method are currently taking place.

Wet-State Bacterial Testing

The third IBRG Paints Working Group project is to develop a laboratory test to enable comparisons of wet-state biocides in paints and to investigate the resistance of such products to bacterial infection. The group has recently carried out a large statistically designed comparison, resulting in their internal publication of a Draft 5 Test Method.

The method involves addition of biocide(s) to supplied preservative-free paint or a standard paint followed by three or more inoculations with a standard mixed bacterial suspension. At specified periods after each inoculation the performance of the biocide is evaluated by determination of surviving organisms using traditional methods or proven electrochemical techniques, e.g., impedance measurement.

The Draft 5 Test Method was discussed at the recent IBRG meeting in Newark, and it is expected that this will be published shortly with a final validation experiment being undertaken.

Testing of Polymer Emulsions

The final IBRG Paints Working Group deals with the testing of biocides in polymer emulsions and of polymer emulsions themselves. The work is similar to that of the wet-state bacterial paint testing project and has also recently published, internally, as Draft 5 Test Method. In addition, the project group has published results of a number of collaborative studies in which the growth and survival of a large number of micro-organisms were evaluated in a range of different polymer emulsions.

As with the wet-state paint project the polymer emulsion project's Draft 5 Test Method was discussed at the Newark IBRG meeting and further validation tests are planned.

Future IBRG Meetings

IBRG will meet on April 15-17 at the Grand Hotel, Lalahide, near Dublin with the Olin Corp. as hosts. On September 9-11, 1998, Thor Chemicals (UK) Limited will host the IBRG meeting in Chester .

For more information, contact the General Secretary, Pete Askew, IMSL, Pale Lane, Hartley Wintney, Hampshire, RG27 8DH.

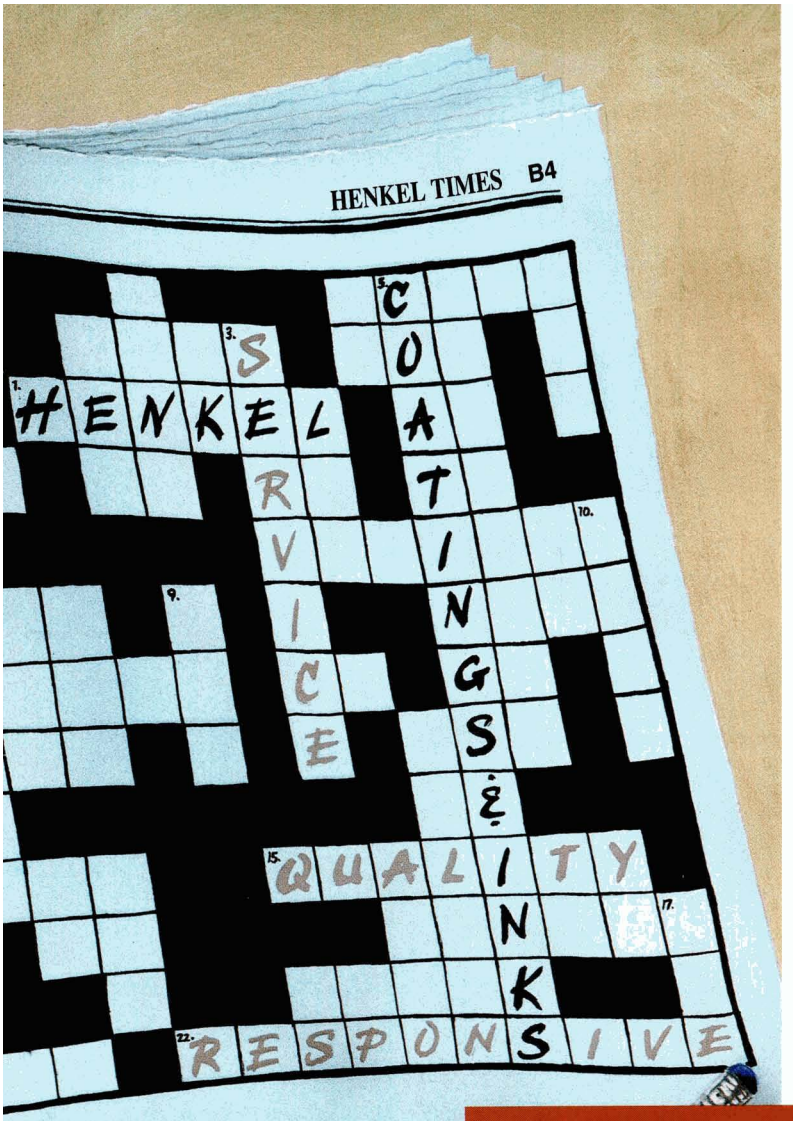
Labsphere Releases Schedule for Reflectance Seminar

Labsphere, Inc., North Sutton, NH, has released the schedule for its 1998 Reflectance Technology Seminar Series.

These seminars will cover diffuse reflectance materials and coatings, reflectance and calibration standards, integrating sphere theory and applications, radiometry, photometry, uniform source calibration and reflectance spectroscopy.

The seminar schedule is as follows: May 6—Burlington, MA; May 12—New Haven, CT; May 14—Cherry Hill, NJ; June 8—Cleveland, OH; June 10—Detroit, MI; June 12—Toronto, Ontario; September 2—Sacramento, CA; and September 3—Seattle, WA.

Contact Joan Beaulieu, Labsphere, Inc., P.O. Box 70, Shaker St., North Sutton, NH 03260; (603) 927-4266.



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NDSU to Conduct Intensive Coatings Science Course in June

An intensive coatings science course designed to provide an understanding of the principles that underlie coatings technology will be conducted by North Dakota State University, Fargo, ND, on June 1-12, 1998.

Although there is a one-week option available, the course is designed as a two-week event and attendance for the entire two weeks is strongly recommended.

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

The following topics will also be discussed: chain-growth and step-growth polymerization resins; acrylic, polyester, alkyds; film formation; amine-formaldehyde resins; crosslinking; epoxy resins; urethane coatings; pigments and pigment dispersions; solvents; coatings formulation; rheology; appearance of coatings; coatings performance; powder coatings; high solids; radiation curing; corrosion; and structure-property relationships.

NDSU

The registration fee for the two-week course is $2,700. The one-week option is available for $1,400. The fee includes lodging, meals, and other activities.

For additional information, contact Debbie Shasky, Program Coordinator, 54 Dunbar Hall, NDSU, Fargo, ND 58105; E-mail:nupoly@plains.nodak.edu.

Brookfield Releases Schedule for Rheology Seminars

Brookfield Engineering Laboratories, Stoughton, MA, is offering a series of rheology seminars for QC managers/supervisors, R&D managers/supervisors, process plant operators, lead technicians, and engineers/scientists.

The seminars will provide attendees with an overview of rheology including Newtonian and non-Newtonian flow, time-independent and time-dependent viscosity behavior, measuring techniques, and data analysis.

Instructors will teach the Brookfield Methodology for making viscosity measurements. Detailed information will be given on sample fluid mechanics, laminar flow, non-laminar turbulent flow, and the effects of shear rate, pressure, temperature, pH, and fluid density on viscosity.

The seminar schedule is as follows:

May 12—Detroit, MI
May 14—Memphis, TN
June 2—Atlanta, GA
June 4—Cleveland, OH.

For more information, contact Barbara Cunningham, Brookfield Engineering Laboratories, Inc., Dept. NR-132, 240 Cushing St., Stoughton, MA 02072; (508) 946-6200.

Additives and Instruments Highlight Free Seminar

BYK-Gardner USA, Columbia, MD, in conjunction with BYK-Chemie, Wallingford, CT, is offering free seminars on additives and instruments.

Dates and locations for the one-half day seminar are: April 28—Houston, TX; April 29—St. Louis, MO; April 30—Atlanta, GA; May 1—High Point, NC; October 6—San Diego, CA; October 7—Los Angeles, CA; October 9—Portland, OR; October 20—Minneapolis, MN; October 21—Chicago, IL; October 22—Detroit, MI; and October 23—Cleveland, OH.

Representatives of BYK-Chemie will cover additives, while BYK-Gardner representatives will discuss color and appearance measurement and provide hands-on testing of participant's samples.

To obtain additional information, contact BYK-Gardner USA, Rivers Park II, 9104 Guilford Rd., Columbia, MD 21046-2729; (301) 483-6500.

Finishing Technologies '98 Scheduled for May 19-21, in Toronto's International Centre

Topics critical to the overall efficiency of finishing operations are among the highlights of Finishing Technologies '98, slated for May 19-21, 1998, at the International Centre, in Toronto, Ontario.

Sponsored by *Coatings Magazine*, Oakville, ON, this biennial event will address new coatings developments, transfer efficiency, advances in automation, plastics finishing, pretreatment, maintenance, ISO planning and implementation, health and safety, and troubleshooting.

Running concurrently with the conference will be a trade show featuring more than 100 exhibitors. Attendees will have the opportunity to meet with suppliers of coatings, equipment, and services. Products and services on display will range from pretreatment systems, coatings, spray guns and booths to ovens, testing equipment, controls, and waste treatment processes.

The registration fee for the three-day conference is $385 Cdn. Single day admission is $224 Cdn. Contact *Coatings Magazine*, 406 North Service Rd., East, Ste. One, Oakville, Ontario, Canada L6H 5R2; (905) 844-9773.

Dr. Edward Schaller to Serve as Guest Speaker During Eastern Training Conference and Show

The Philadelphia Society-sponsored Eastern Training Conference and Show, slated for May 11-14, at the Valley Forge Convention Center, Valley Forge, PA, will feature Edward Schaller as a guest speaker. Dr. Schaller, the New Products Process Manager for Coatings at Rohm and Haas Co., will discuss "Anatomy of a Latex Paint."

This lecture will serve as an introduction to the application of synthetic latexes in paints. It is designed for newcomers to the paint industry, or those not directly involved with paint formulating, but who need to have a basic understanding of the factors involved.

For more information on the Eastern Training Conference and Show, contact Wayne Kraus, Hercules Incorporated, Research Center, 500 Hercules Rd., Wilmington, DE 19808; (302) 995-3435, or visit the FSCT web site: www.coatingstech.org.

Acrylate Grafted Dehydrated Castor Oil Alkyd—A Binder for Exterior Paints

Subhasri Majumdar, Dhirendra Kumar, and Y.P.S. Nirvan—Naval Materials Research Laboratory*

To meet the requirement of improved durability of alkyd resin for use in weatherwork paint for superstructure of ships, an attempt has been made to chemically modify a castor oil alkyd by graft copolymerization with methyl methacrylate and butyl methacrylate in view of their ability to provide polymers with good exterior durability. Characterization of the experimental resins, in respect to physical properties, was carried out using instruments such as a vapor pressure osmometer, rotational viscometer, universal tensile testing instrument (Instron 1123), and differential scanning calorimeter. Performance of the resins was evaluated using a fluorescent UV accelerated weatherometer and multi-head glossmeter.

The results reveal substantial improvement in drying and weather resistance properties of castor oil alkyd on graft copolymerization with both methyl methacrylate and butyl methacrylate. The improvement in these properties is marginally superior in the case of MMA grafted alkyds. MMA modification also enhances the mechanical properties of the grafted castor oil alkyd.

INTRODUCTION

Alkyd resins are used extensively as a binder for making exterior paints. This paint is applied on the superstructure of ships and remains exposed to UV radiation, thermal fluctuations, high humidity, and wind driven salt spray. Under such extreme conditions of marine atmosphere in the Indian tropical region, it shows considerable chalking, color fading, and loss of gloss within a period of 9-12 months. One way to increase the durability and enhance the service life of the exterior paint is to improve weather resistance through chemical modification of alkyd with urethane, silicone, vinyl, and acrylic resins.[1] This offers the possibility of combining the ease of application and film forming properties of alkyd with the exterior durability of vinyl and acrylic system due to their resistance to hydrolysis and UV degradation.[2]

The modification of alkyd resins by acrylation for improving their properties has been extensively investigated. Various methods have been employed by researchers for such chemical modifications. A method for the synthesis of acrylated alkyd was first attempted by F. Armitage and S. Kut.[3] Methods of synthesis of acrylate modified alkyd using esterification reaction between anhydride, carboxyl, or epoxide groups in preformed copolymer and hydroxyl and carboxyl groups of alkyds have been extensively reported by D.H. Solomon and co-workers.[4-7] Fletcher et. al[5] suggested a method involving reaction between a carboxyl group containing acrylic copolymer and a monoglyceride followed by polyol and dibasic acid to achieve further condensation. An alternative method for alkyd modification is the post-vinylation of resin with vinyl/acrylic monomers. This method involves the grafting of an acrylate segment to an unsaturated fatty acid in an alkyd resin through free radical chain polymerization.

Styrene and vinyl toluene have also been used for the modification of alkyds for improving their properties.[8-10] Such modifications provide alkyds with better color and improved drying characteristics as well as water and alkali resistance properties. These modified alkyds are applied mostly in very rapid air drying and low temperature baking finishes for industrial use. However, these modified alkyds have not been used for weatherwork paints of ships in view of poor resistance to weathering.[11] Further, styrenated alkyds require aromatic solvents and are not suitable for brushing finishes in view of their rapid drying properties. The paints for

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Table 1—Composition of Acrylated DCO Alkyd Resins

Composition	Concentration (% by wt) Alkyd	MMA	BMA
MA 1	80	20	—
MA 2	70	30	—
MA 3	60	40	—
MA 4	50	50	—
BA 1	80	—	20
BA 2	70	—	30
BA 3	60	—	40
BA 4	50	—	50

superstructure of ships are required to be brush applicable.

This paper reports on a study related to the modification of dehydrated castor oil (DCO) based alkyd resin by graft copolymerization with acrylate monomers. The aim of this work is to develop a suitable binder to formulate high performance exterior paints for use on marine platforms under tropical conditions. Therefore, methyl methacrylate (MMA) and butyl methacrylate (BMA) monomers were used in the study as they are reported to provide polymers with very good exterior durability compared to other conventional monomers.[2] In earlier literature,[4-7] improvement in the performance of acrylated alkyd films in comparison to unmodified alkyd films has been reported through qualitative testing of abrasion resistance, impact resistance, and humidity resistance. However, any information regarding the effect of weathering on gloss and mechanical properties of the films is scarcely available. This paper reports the improvement in performance of acrylated alkyd film focusing on the effect of weathering on gloss and mechanical properties.

Table 2—Molecular Weight and Viscosity of MMA Modified Alkyd Resins

Composition	Characteristics Molecular Weight	Viscosity at 30°C
Alkyd	2930	1069
MA 1	3700	904
MA 2	4950	868
MA 3	5796	764
MA 4	5940	687

Table 3—Drying Property of Acrylated DCO Alkyd Resins

Composition	Characteristics Hard Drying Time, hr	Nature of Dry Film
Alkyd	8	Tacky
MA 1	2	Tackfree
MA 2	1.5	Tackfree
MA 3	1.5	Tackfree
MA 4	1	Tackfree
BA 1	3.5	Tacky
BA 2	2.5	Tackfree
BA 3	2.0	Tackfree
BA 4	1.5	Tackfree

EXPERIMENTAL

Chemicals

The resin and all the reagents were used as received. Commercial grade DCO alkyd resin of oil length 55% and solid content 50% was used. AR grade of acrylic monomers methyl methacrylate, butyl methacrylate, and the initiator Di-t-butyl peroxide were obtained from Fluka Chemical, Germany. Benzyl alcohol - LR grade was supplied by E. Merck (I) Ltd.

Synthesis of Acrylated Alkyd

Two series of modified DCO alkyd resins were prepared using MMA and BMA in concentrations varying from 20 to 50% of solid alkyd resin. Compositions of modified alkyd resins are given in *Table* 1.

Alkyd resin and benzyl alcohol were heated together at 90-120°C for 30 min with continuous stirring in a four-necked flask fitted with a reflux condenser, thermometer, inlet tub, and stirrer. The monomer, premixed with the initiator (0.85% of the alkyd solid), was introduced into the reaction mixture gradually over a period of three to four hours maintaining the temperature at 90-120°C in an inert atmosphere of nitrogen. After complete addition of the monomer, the reactants were held at the same temperature for six to eight hours. When the solid content of the mixture reached the theoretically calculated value, the reaction mixture was cooled to room temperature.

Characterization of Acrylated Alkyd Resins

The experimental acrylated DCO alkyds were examined for iodine value, molecular weight, and viscosity using standard methods. For these determinations, MMA homopolymer was separated from the resin solution through precipitation using petroleum ether (60/80). The unreacted monomer and solvent were removed by drying under vacuum. The iodine value of the alkyd and 40% MMA grafted alkyd were measured employing ASTM D 1959.[12] Viscosity measurements were carried out with 50% alkyd solution in xylene (w/v) at 30°C using Haake Rotovisco RV 3 in accordance with the method described in British specification[13] at a shear rate of 1000 sec^{-1}. The average molecular weight of the modified alkyds was determined using the resin solution after diluting it in xylene at four different concentrations with a vapor pressure osmometer (Knauer Berlin 37) using Benzil as calibration standard.

Performance Evaluation of Acrylated Alkyd Films

Film characteristics of modified DCO alkyds have been evaluated to ascertain the improvement in properties of alkyd as a result of acrylic modification. For the following tests the acrylated alkyd resins were used as synthesized, without removing homopolymers. However, a requisite amount of driers was added to facilitate drying of the resin films.

The drying time of alkyd resin was determined by applying it to clean, degreased tin panels (127 × 50 mm)

and examining the film condition as per Indian specification.[14]

Free films of alkyd and modified alkyd resins were prepared using a motorized film applicator on glass plates precoated with methyl cellulose. First, one coat of resin solution was applied using a 250 µm applicator which was allowed to dry for 24 hr. Thereafter, the second coat of resin was applied employing a 300 microns applicator. The coated panels were stored in a dust free chamber for proper drying of the alkyd film. After 15 days of drying, the films were peeled off from the plates, washed thoroughly under running water to remove cellulose film, and dried at an ambient temperature.

Water vapor permeability measurements were carried out gravimetrically as per method described in ASTM D 1653.[15] Determination and average values were made using standard Payne cups of 10 cm^2 area in quadruplicate. Tensile strength and elongation properties of the film were determined as per the method given in ASTM D 882.[16] The test specimens were cut from cured film in the form of stripes measuring 100 × 15 mm in size and were conditioned at 50% relative humidity for 24 hr before examination using the Universal tensile testing instrument (Instron 1123) under strain rate of 20 mm/min. Ten specimens were examined for each composition and the average result of the six highest readings at peak load was reported as tensile strength. The strain values at the breaking point were used to obtain percent elongation.

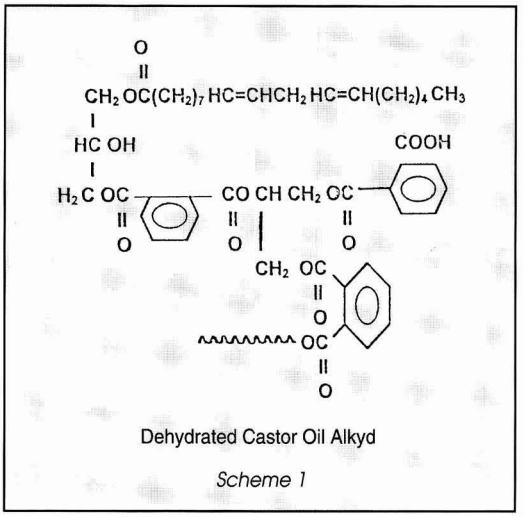
Weathering resistance of acrylated DCO alkyd was examined by exposing the resin coated aluminum panels (150 × 75 mm) to UV radiation (wavelength 285-315 nm) and high humidity condition in QUV accelerated Weatherometer.[17] A cycle comprised of four hours of UV exposure (temperature 60 ± 5°C) and two hours of condensation (temperature 45 ± 5°C) was maintained during the study. Gloss measurements, initial and after weathering, were carried out by the method described in British specification[18] using multi-head glossmeter at 20°.

Glass transition temperature (T_g) of MMA modified alkyd resins was examined with a differential scanning calorimeter (DuPont 910) using resin films cured for 15 days.

RESULTS AND DISCUSSION

A typical structure of DCO alkyd is shown in *Scheme* 1. In the DCO alkyd, besides the sites of unsaturation in fatty acid chains, graft copolymerization can be initiated on the active methylene group through hydrogen abstraction in presence of an initiator like di-t-butylperoxide. It initiates polymerization of the monomer to produce branches by grafting from mechanism (*Scheme* 2).

The measured iodine values of the parent alkyd and 40% MMA grafted alkyd are 72 and 43 g of I_2 per gram of resin, respectively. The theoretical iodine value of 40% modified alkyd comes to 43.2 gms of I_2 per gm of resin (72 × 60/100 = 43.2). This suggests no loss of unsaturation in alkyd during grafting providing support in favor

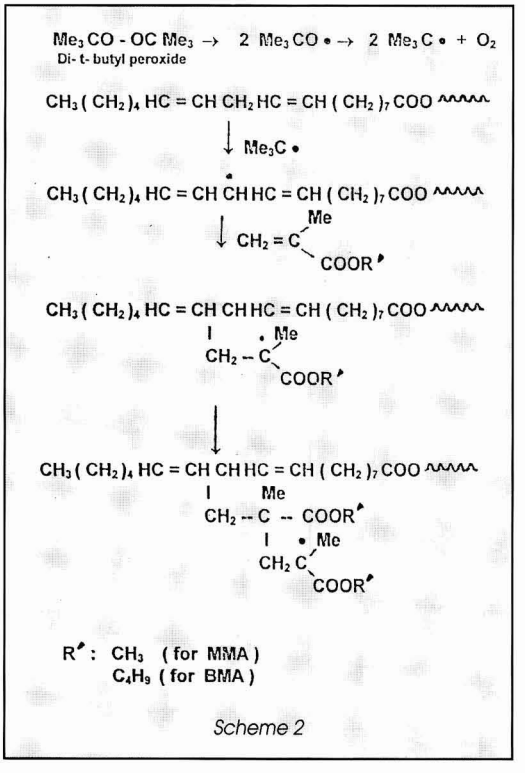


Dehydrated Castor Oil Alkyd

Scheme 1

of grafting from mechanism (*Scheme* 2) for the formation of acrylated alkyd.

Results in *Table* 2 show that on modification with methacrylates, molecular weight of DCO alkyd increases with a simultaneous decrease in solution viscosity. An increase in molecular weight normally leads to an increase in viscosity for linear chain polymers. On the other hand, for the same molecular weight, a branched polymer has a lower viscosity compared to a linear polymer, due to the introduction of stiffness and compact-



Scheme 2

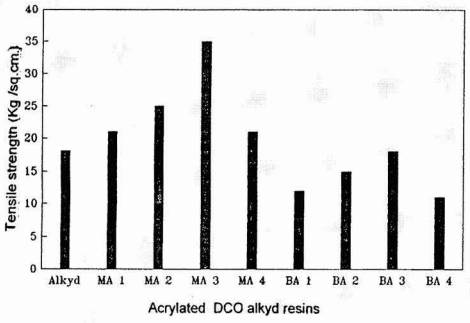


Figure 1—Tensile strength of acrylated DCO alkyd resins.

Table 4—Water Vapor Permeability of Acrylated DCO Alkyd Resins

	Water Vapor Permeability (mgm.mm/sq. cm./day)		
Composition	Initial	After 3 Months	After 6 Months
Alkyd	0.43	0.40	0.37
MA 1	0.39	0.35	0.33
MA 2	0.37	0.34	0.32
MA 3	0.30	0.25	0.23
MA 4	0.30	0.24	0.21
BA 1	0.40	0.36	0.34
BA 2	0.39	0.33	0.31
BA 3	0.36	0.31	0.27
BA 4	0.32	0.28	0.26

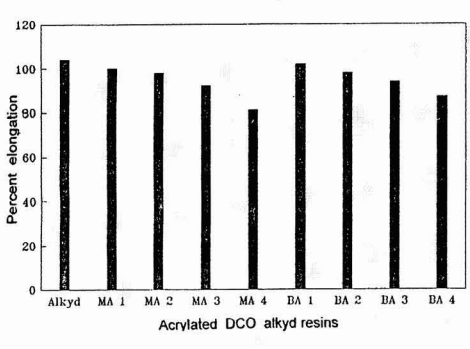


Figure 2—Flexibility of acrylated DCO alkyd resins.

Table 5—Glass Transition Temperature of MMA Modified Alkyd Films

Composition	Glass Transition Temp. (T_g)°C
Alkyd	12
MA 1	20
MA 2	32
MA 3	54
MA 4	25 & 26

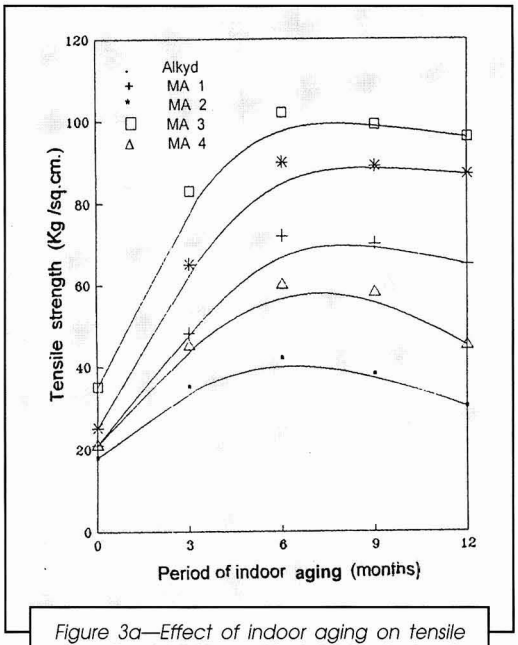


*Figure 3a—Effect of indoor aging on tensile strength of MMA modified DCO alkyd resin films. •—alkyd; +—MA 1; *—MA 2; □—MA 3; and Δ—MA 4.*

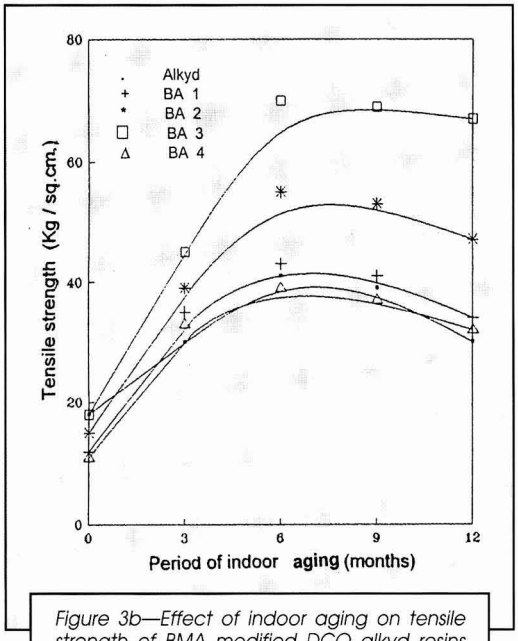


*Figure 3b—Effect of indoor aging on tensile strength of BMA modified DCO alkyd resins films. •—alkyd; +—BA 1; *—BA 2; □—BA 3; and Δ—BA 4.*

ness in the molecule by branches.[19] In the present case, the branches are chemically different from the main chain. The introduction of such branches has definitely increased molecular weight of the parent alkyd polymer but has resulted in considerable compactness. This seems to have overshadowed the influence of molecular weight increase, thereby decreasing the viscosity considerably.

Significant improvements in the drying property of the alkyd resins have been observed as a result of modification with acrylates. It has been found that drying time decreases with an increase in acrylic content, being minimum at 50% modification for both types of acrylate monomers (*Table* 3). Incorporation of MMA produces tack free films by modification at all concentrations, whereas BMA is effective at 30-50% concentration.

Water vapor permeability of alkyd resin films (thickness 90-100 μ) was measured in quadruplicate using Payne Cups of 10 cm^2 area. Permeation of water vapor from higher to lower concentration is governed by the kinetics of movement of absorbed water molecules under its vapor pressure gradient. With the increased incorporation of acrylates into the alkyd main chain through grafting the intramolecular packing of the alkyd chain increases, which reduces the rate of water vapor permeation through resin films[20] (*Table* 4). Similar studies were conducted with films weathered under normal laboratory conditions for three to six months. A gradual decrease in water vapor permeation has been recorded with the increase in period of indoor aging (*Table* 4). Further polymerization accompanied with crosslinking of the resin molecules is perhaps responsible for restricted migration of water vapor through weathered films.

Mechanical properties of modified DCO alkyd resins were evaluated by determining the tensile strength and elongation of the free films. These characteristics were also determined after aging the films indoor for one year in the laboratory as well as after exposure to accelerated weathering conditions. It can be seen from *Figure* 1 that the tensile strength of the acrylated alkyd resin film increases steadily with an increase in the MMA content of the alkyd up to the level of 40% modification. Contrary to this, modification with BMA causes reduction in the tensile strength of alkyd films. However, the value increases with BMA content, attaining the tensile strength equivalent to unmodified alkyd, at 40% concentration. Incorporation of BMA causes a plasticization effect in the alkyd due to the presence of bulky side groups. The increase in tensile strength with MMA modification can be ascribed to the increase in the cohesive strength of the molecules due to the formation of dense intermolecular packing as a result of intermingling of branches through grafting of MMA to the alkyd chain. Beyond the 40% level of modification, the formation of high proportion of homopolymer causes phase separation from the grafted alkyd and results in lower tensile strength of the resin films.

A similar effect can be observed in the case of T_g of acrylated alkyd which increases with the acrylate content (*Table* 5) due to the formation of a compact microstructure through the intermingling of branches. At a 50% modification level, glass transition occurs at two temperatures, 25° and 60°C, indicating phase separation

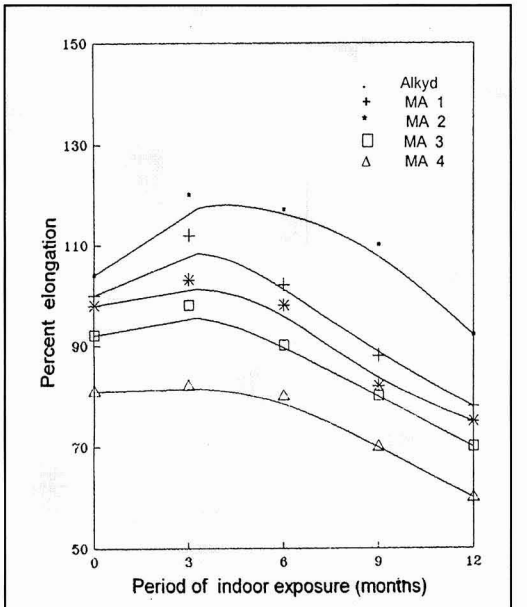


*Figure 4a—Effect of indoor aging on flexibility of MMA modified DCO alkyd resin films. •—alkyd; +—MA 1; *—MA 2; □—MA 3; and Δ—MA 4.*

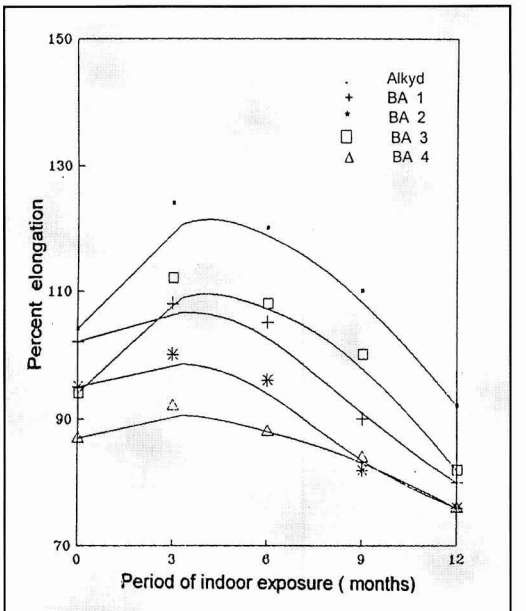


*Figure 4b—Effect of indoor aging on flexibility of BMA modified DCO alkyd resins films. •—alkyd; +—BA 1; *—BA 2; □—BA 3; and Δ—BA 4.*

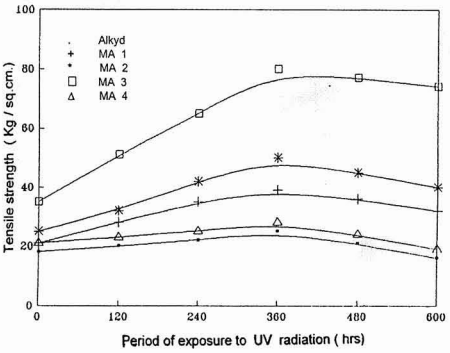


Figure 5—Effect of accelerated weathering on tensile strength of MMA modified DCO alkyd resin films. •—alkyd; +—MA 1; *—MA 2; □—MA 3; and Δ—MA 4.

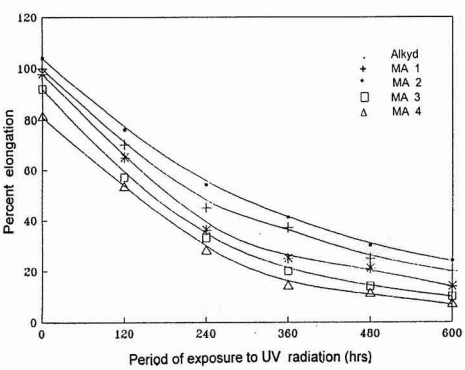


Figure 6—Effect of accelerated weathering on flexibility of MMA modified DCO alkyd resin films. •—alkyd; +—MA 1; *—MA 2; □—MA 3; and Δ—MA 4.

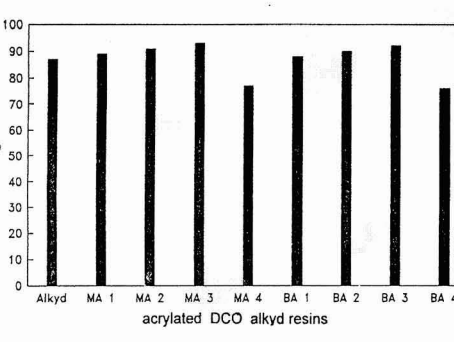


Figure 7—Initial gloss of acrylated DCO alkyd resins.

of homopolymer and grafted alkyd due to the formation of a large quantity of homopolymer.

On exposure of alkyd films to diffused light under indoor conditions, tensile strength steadily increases for six months followed by a very slow decrease during extended aging (*Figures* 3a and 3b). The initial increase in tensile strength for six months is attributed to the progressive crosslinking of alkyd molecules on exposure followed by degradation reactions causing a decrease in tensile strength. Among all the MMA modified alkyds, MA 3 resin possesses the maximum tensile strength, which is maintained even after 12 months of exposure.

Flexibility of alkyd resins generally decreases as a result of acrylate modification (*Figure* 2). The extent of decrease of percent elongation is greater for the MMA modified alkyd than that of the BMA modified alkyd. Flexibility increases during the initial three months of indoor aging, but decreases steadily thereafter (*Figures* 4a and 4b). This phenomenon is presumably due to build up of internal stresses caused by dimensional changes on prolonged exposure. Similar behavior has also been reported by Raju et al.[21] during their studies of indoor weathering on unpigmented alkyd films. As a matter of fact, substantiative yellowing was observed on the film after six months of aging, suggesting degradation of alkyd molecules.

Mechanical properties of the films exposed to the accelerated weatherometer were recorded at an exposure interval of 120 hr. It can be seen from *Figure* 5 that accelerated weathering leads to an increase in tensile strength of MMA modified alkyd resins up to 360 hr and is then followed by a gradual decrease. The resin with 40% MMA (MA 3) maintains a higher tensile strength during exposure as previously shown in indoor weathering experiments. Flexibility of the resins decreases steadily (*Figure* 6), as was observed in natural weathering, except for some initial changes which could be due to intense UV radiation, high humidity, and elevated temperature conditions maintained in the accelerated weatherometer which are not available in natural weathering.

Ability of a coating to retain its desired gloss during service is of great significance for maintaining an aesthetic appearance of the painted surface for longer periods. Acrylated alkyd resins synthesized in the present work were examined for their gloss retention characteristics by exposing resin coated aluminum panels in a QUV accelerated weatherometer. Initial gloss of coated panels and gloss values during weathering were measured every 100 hr for a total of 600 hr using a glossmeter at a 20° angle. Initial gloss of the resins has been improved up to 40% modification with both acrylates. Furthermore, increase in acrylic content led to a decrease in gloss which may be due to phase separation between the homopolymer and grafted alkyd, as discussed earlier (*Figure* 7). It can be seen from *Figures* 8a and 8b that on exposure to accelerated weathering, gloss retention property improves with an increase in acrylic content of the alkyd, maximum being at 40% level. At the end of 600-hr exposure, the acrylated alkyd with 40% acrylate content has a gloss value almost double to that of the unmodified alkyd.

CONCLUSION

Significant improvements have been observed in properties of DCO alkyd resin after modification with acrylates. The performance of the MMA modified alkyds has been found to be better than BMA modified alkyds. After modification with MMA, the glass transition temperature of alkyd has increased, resulting in improvement of drying time and mechanical properties of alkyd. Further, MMA modified alkyds possess better weather resistance compared to BMA modified resins. It is also concluded that incorporation of methyl methacrylate into the DCO alkyd in the range of 30-40% yields a binder suitable for formulation of high performance exterior paints. Beyond this level of modification, properties of the alkyd deteriorate due to phase separation of the homopolymer and grafted alkyd.

ACKNOWLEDGMENT

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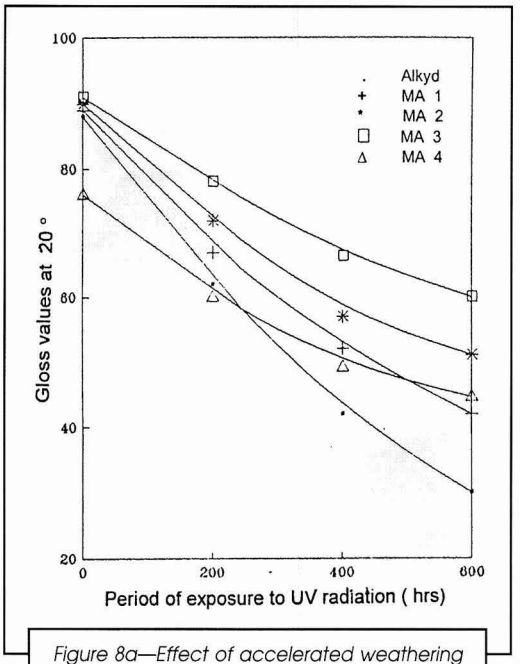

Figure 8a—Effect of accelerated weathering on gloss retention of MMA modified DCO alkyd resins. •—alkyd; +—MA 1; *—MA 2; □—MA 3; and Δ—MA 4.

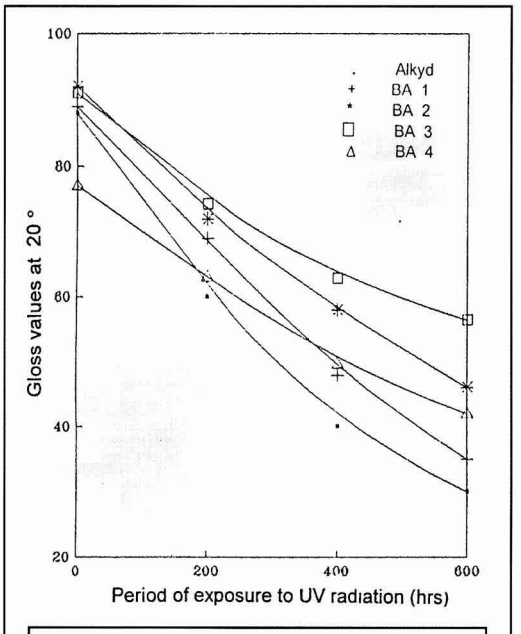

Figure 8b—Effect of accelerated weathering on gloss retention of BMA modified DCO alkyd resins. •—alkyd; +—BA 1; *—BA 2; □—BA 3; and Δ—BA 4.

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Crosslink Density and Cure Window of Oligourethane Diol/Melamine High-Solids Coatings

Syed Haseebuddin, K.V.S.N. Raju, and M. Yaseen—Indian Institute of Chemical Technology*

Oligourethane diols were crosslinked with melamine formaldehyde, and their crosslink density was determined by using an equilibrium swelling method. In formulations containing primary or secondary hydroxylated diol the major part of the crosslinker is consumed by transetherification reactions and self-condensation. The aromatic nature of TDI imparts rigidity while the aliphatic IPDI results in flexibility of the backbone chain of oligomer. The profile of cure schedules has been determined in the form of a cure window which measures the extent of reaction in terms of crosslink density as a function of bake temperature. The experimentally determined properties like tensile strength and MEK rub-resistance have been taken into consideration for fixing the lower and upper limits of XLD in designing the cure windows of individual coating formulations. The baking schedules of coatings have also been expressed in the form of nominal and true cure windows.

INTRODUCTION

In recent years there has been an active interest in determining cure schedules of high-solids coatings as well as correlating the findings with their performance. Parameters, like crosslink density, bake conditions, reactive components, stoichiometric resin/crosslinker ratio, and structure of network, are interrelated to the ultimate physical properties of coatings. They are adjusted according to quantitative and qualitative end application requirements set by the crosslink polymer network.

The high-solids, or solvent-free organic coatings currently in use contain low molecular weight resins in order to meet the application viscosity requirements of conventional spraying equipment. They have excellent outdoor durability, pronounced mechanical strength, stress relaxation, and reinforcement quality. The performance of such coatings in service can be understood better with knowledge of the chemistry of a crosslinking network.

Crosslinking Reactions Between Polyols and Melamine

Blank and co-workers[1,2] proposed several crosslinking reactions of amino resins but described the cure of oligomers with fully-alkylated melamine by a single crosslink reaction. A mixture of polyol and fully alkylated amino resin contains the desired application viscosity and excellent performance[3] properties when its coating is baked following a well established cure schedule. Bauer[4] suggests the following reaction involving the reactive groups.

$$HO\text{–}R + >NCH_2OR' \rightarrow \text{–}NCH_20\text{–}R + HOR'$$

where

R = oligourethane diol or oligomer
R′ = $\text{–}CH_3$, or $\text{–}C_4H_9$

Lazzara[5] and others[6,7] have split the possible crosslinking reactions between hydroxy functional polymer and melamine into two classes. The first is polyol-melamine condensation crosslinked via transetherification, and the second is melamine-melamine self-condensation.

Crosslink Density

In an ideal network structure, the ends of the chain react chemically to form 'bonds,' but in actual practice it may not happen if a few ends of the chain do not react at all or if only one end reacts. The effective bonds that occur between two reactive components are called

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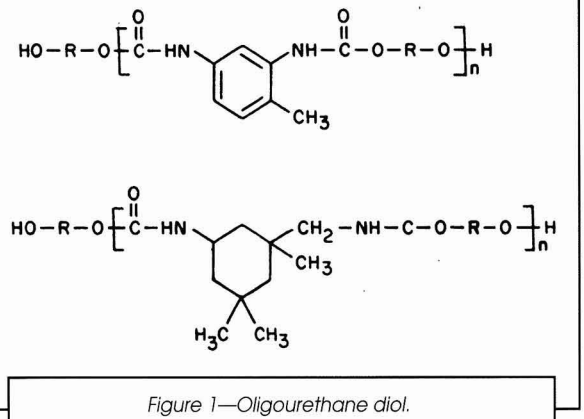


Figure 1—Oligourethane diol.

crosslinks. Their concentration, expressed as crosslink density (XLD), network parameter, crosslink index, or crosslinking coefficient, is the number of crosslinks per gram or per unit volume of polymer. A highly crosslinked film is inert and lacks flexibility, whereas the one having low crosslink density is soft and flexible but less resistant to chemical and solvent attack.

Techniques for the Determination of Crosslink Density

Earlier, crosslink density was determined by using data obtained from the measurement of physical properties.[2,8-12] Chu and Jones[13] adopted the conventional cure determination methods like pencil hardness, impact resistance, and solvent rub resistance of coatings after bake. They found acetone rub resistance the best indicator of crosslink density, although it was affected by T_g and other variables.

Later, Bauer and Dickie[14,15] used IR spectroscopy to follow the extent of reaction and calculated crosslink density by using a network model. Collette et al[16] also reported that physical measurements had severe limitations when used as a measure of cure. Blank[3] and Lazzara[5] used gas chromatography to determine crosslink density. Several workers[17,18] determined the extent of reaction by using data obtained from analysis of volatile products produced during curing.

In a recent publication, Hill[19] recommended determination of XLD by using a method based on dimensional changes of the cured film in a particular solvent under equilibrium swelling condition. He suggested that XLD can also be measured by DMA, which provides required modulus values with small deformations. However, Dr. Hill cautioned that in the case of systems having high T_g and (extent conversion) <1.00 additional reaction may occur during the DMA scan before the rubbery plateau is reached, which in turn influences the measured XLD values.

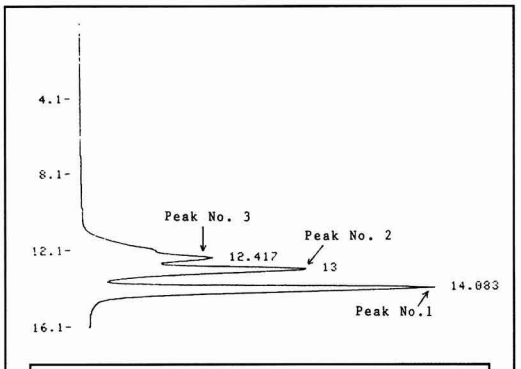


Figure 2—A representative plot of GPC chromatogram of oligourethane diol II.

Curing Aspects of High-Solids Coatings

Usually, high-solids coatings are baked to initiate the film formation process of organic coatings in which relatively low molecular weight materials are transformed via chemical reactions into a thermoset material possessing desirable properties. It is important that a coating cured in this process meets the expectations of the end product.

The determination of the cure conditions for a coating system is crucial. For example, if baking schedules do not produce sufficient crosslinking, the coating exhibits poor resistance to solvents, mar, or scratch and has poor durability/weatherability. A fast curing system may result in lack of flow and leveling, brush strokes, roller striations, orange peel, wrinkling, or yellowing. Even intercoat adhesion failure[20] occurs if the coating is baked at a high temperature for a long duration. In a slow curing process, the coating sags or runs[21] and exhibits swelling or blushing in humidity and cold cracking tests.

The extent of cure of a thermosetting coating is governed largely by condensation reaction. Establishing the curing schedules of high-solids coatings, especially to meet the requirements of a high quality performance to protect a substrate's aesthetic appearance, is a demanding task. Such formulations involve irreversible transformation of a low molecular weight resin into a crosslinked network.

The degree of crosslinking is one of the key variables in determining the final structure of the network, the morphology, and mechanical properties. The aim of curing a coating after its application to a substrate is to achieve molecular crosslinking. The crosslink density is controlled by baking temperature, duration, and the amount of crosslinker, catalyst, and plasticizer. Together they define a profile of the cure cycle, which could be projected in the form of a cure window.

Cure Window

There is a range of crosslink densities around the optimum value of XLD wherein the coating has accept-

able properties. This range has been defined by Bauer and Dickie[20] as a "cure window." They suggest a method of determining the cure window of a coating by correlating the various stages of reaction with XLD. The cure window of a coating formulation can be expressed in terms of range of crosslink densities as a function of baking schedule. The molecular weight of reactive components, i.e., the diol and crosslinker used in the formulation, significantly alters the dimensions of the cure window of high-solids coatings.

The width of the cure window has direct application to paint cure uniformity and oven productivity in assembly ovens. The wider the cure window, the better the uniformity and the greater the potential productivity. It is advantageous to be knowledgable about cure schedules to optimize the performance of coating formulations as well as to prevent the occurrence of surface defects.[15] Therefore, it is worthwhile to determine the range of crosslink densities of oligourethane diol/melamine derivatives and to relate it to the range of bake conditions. In this way an established cure schedule can be projected in the form of a cure window, which may find practical application in the industry.

EXPERIMENTAL

Oligourethane Diol

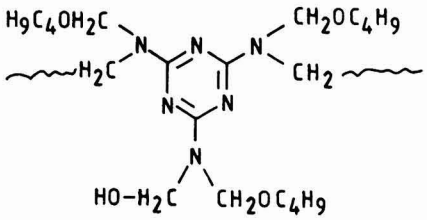
Oligourethane diols with the following general structural formulae were synthesized by reacting polyisocyanates and diols with a 1:2 mol ratio (*Figure* 1).

A major part (40-50%) of the adduct consists of diurethane diol, while the rest form higher molecular weight diols. For the sake of illustration, the gel permeation chromatogram of the oligourethane diol code No. 2 is given in *Figure* 2. In this figure peak No. 1 corresponds to the molecular weight of pure diurethane diol whereas peaks No. 2 and 3 refer to higher molecular weight oligomers.

The molecular weight and polydispersity index were obtained using a gel permeation chromatographic unit of Shimadzu C-R4A Chrotopac (using Phenomenex columns, polystyrene standards). The molecular weight, polydispersity, and the composition index of these adducts are given in *Table* 1. The details about the synthesis of diols are reported elsewhere.[22]

Melamine Crosslinker

Butylated melamine formaldehyde resin (Synthetics & Polymer Industries, Gujarath, India) having 60% weight solids in butanol is used to crosslink oligourethane diols. Its weight average molecular weight is 1555 with a polydispersity 1.46. The structural formula of the melamine crosslinker used is given in the following.



Melamine Formaldehyde Crosslinker

Coating Formulation

Oligourethane diol and melamine formaldehyde crosslinker were mixed well in a solvent blend of butanol:methyl ethyl ketone:cellosolve (5:3:2). Plasticizer (TTP, 20%), surfactant (Tagostab, 0.2%) and dodecyl benzene catalyst (0.5%), according to the weight of the total solids, were added. The mixture was left overnight to stabilize and rid itself of entrapped bubbles. Less than 25% of solvent blend was used to thin down the resin to application consistency.

Preparation of Free Film of Cured Resin

A coating of 100 mm wet thickness was cast on a smooth surface of tin foil using a power driven automatic film applicator. The coatings were allowed to dry at room temperature for about 30 min to minimize solvent popping. The coatings were then baked for 20 min in an air-circulating oven at 110, 120, 130, 140, 150, or 160°C. The supported coatings were placed in a clean mercury bath to amalgamate the tin substrate. The underside of the unsupported coating was cleaned of any mercury or amalgam adhering to it.[23] The dry film thickness of the coatings was in the range of 70-80 mm.

Table 1—Composition, Molecular Weight and Polydispersity of Oligourethane Diol

Oligourethane Diol Code No.	Oligourethane Diol	Diisocyanate	M_w	M_n	Polydispersity
1	1,4-Butanediol	TDI	1187	992	1.19
2	1,2-Propanediol	TDI	1142	1038	1.10
3	1,3-Butanediol	TDI	984	751	1.31
4	1,2-Propanediol	IPDI	1135	1010	1.12
5	1,2-Ethanediol	IPDI	1107	987	1.12
6	1,4-Butanediol	IPDI	1115	1015	1.10
7	1,3-Butanediol	IPDI	1125	1035	1.08

TDI: Toluene diisocyanate, IPDI: isophorone diisocyanate.

Procedure for the Determination of Crosslink Density

The solvent induced swelling method[24] was used to determine the crosslink density of baked films. The calculation procedure suggested by Flory[25] was used to determine XLD. Distilled dichloromethane (DCM), having a cohesion parameter, δ = 19.0 m.Pa (close to that of oligourethane diol), was used as the swelling solvent.

The equilibrium swelling experiment was conducted on a 1 mm square piece of the film (cut using a Microtomy Instrument, Ispicon SP-1120). It was placed on a micro slide and covered with a flat cover slip. The dimensions of the unswollen piece were measured in mm with a microscope equipped with a digital measuring device set at 100 magnification. Then a drop of DCM was placed at the slide/cover slip interface wetting the surfaces of the cover slip and slide, and reached the test specimen within a few seconds. In contact with the solvent, the test piece swelled rapidly in size in less than one minute when its dimensions were immediately measured. Determination on six individual pieces were conducted to arrive at an average of swelling equilibrium measurement. It is observed that a small piece of resin film facilitates rapid attainment of equilibrium.

The dimensions were simultaneously measured by projecting the magnified image of the test specimen onto a built in screen of the microscope.

Table 2—Values of Crosslink Density of Resins Cured at Different Temperatures

Bake Temp. °C	Crosslink Density x 10^3 mole/cc		
	Diol: Melamine		
	65:35	70:30	75:25
	Coating Formulation I		
110	0.182	0.193	0.199
120	3.300	3.158	2.872
130	7.140	5.927	4.808
140	7.927	6.737	5.584
150	10.660	8.011	5.620
160	12.081	8.905	6.050
	Coating Formulation II		
110	0.121	0.121	0.106
120	4.263	4.172	3.616
130	7.824	7.274	6.369
140	10.148	9.206	8.345
150	12.071	9.612	8.805
160	13.758	9.876	9.007
	Coating Formulation III		
110	0.115	0.107	0.006
120	5.943	3.022	2.637
130	9.823	8.206	7.510
140	11.932	9.392	8.843
150	12.978	9.986	9.329
160	13.524	10.593	9.532
	Coating Formulation IV		
110	0.104	0.101	0.103
120	3.412	4.814	4.103
130	5.257	5.145	3.158
140	7.065	5.923	4.061
150	8.945	6.189	5.439
160	10.505	6.323	5.654
	Coating Formulation V		
110	0.112	0.103	0.006
120	6.854	6.182	5.981
130	9.904	9.364	9.291
140	11.192	10.873	10.642
150	12.007	11.556	11.419
160	12.721	12.146	11.958
	Coating Formulation VI		
110	0.161	0.190	0.136
120	3.399	2.864	2.820
130	6.162	4.771	4.388
140	7.850	6.454	5.124
150	10.487	7.891	5.555
160	11.998	8.523	5.826
	Coating Formulation VII		
110	0.108	0.107	0.465
120	5.512	4.489	3.988
130	8.922	7.270	6.739
140	11.785	9.172	8.313
150	12.678	9.803	9.290
160	13.876	10.127	9.893

Calculation of Crosslink Density

The XLD, expressed in terms of parameter υ_e, was calculated by the following Flory Rehner's equation,[25,26] which relates the swelling ratio of crosslinked polymer by a solvent to its XLD.

$$\upsilon_e = \frac{\upsilon_e'}{V_o} = \frac{-[\ln(1-V_2)+V_2+\chi_1(V_2)^2]/V_1}{[V_2^{1/3}-V_2/2]} \quad (1)$$

where

υ_e = number of moles of elastically effective network chains per cubic centimeter

υ_e' = number of moles of elastically effective network chains in volume V_0 of unswollen film

V_2 = volume fraction of polymer in the swollen film at equilibrium swelling

V_1 = molar volume of solvent (DCM, 65 cm^3/mole at 25°C)

χ_1 = Flory-Huggins interaction parameter of solvent with network polymer (χ_1 = 0.45 reported in literature[27,28])

Swelling is expressed as fractional increase in edge length, f:

$$f = (x_2 - x_1)/x_1 \quad (2)$$

where

x_1 = edge length of the film before swelling

x_2 = edge length of the film after swelling

The parameter V_2 in equation (1) is calculated by assuming that swelling is isotropic. On the basis of geometric considerations V_2 is expressed:

$$V_2 = 1/(1+f)^3 \quad (3)$$

The values of υ_e, i.e., XLD, calculated by substituting the values of V_1, χ_1 and V_2 in equation (1) are reported in *Table* 2.

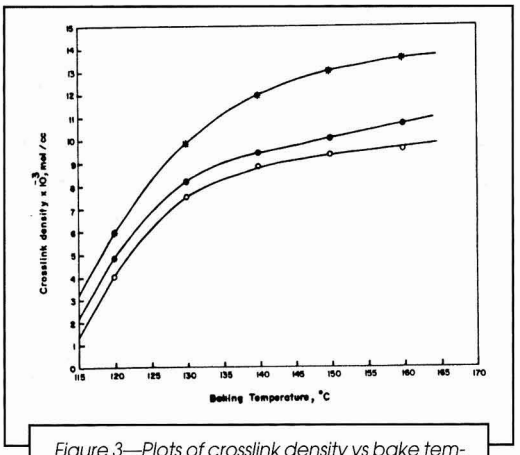


Figure 3—Plots of crosslink density vs bake temperature of oligourethane diol III crosslinked with melamine in ratios (*) 65:35; (•) 70:30; and (o) 75:25.

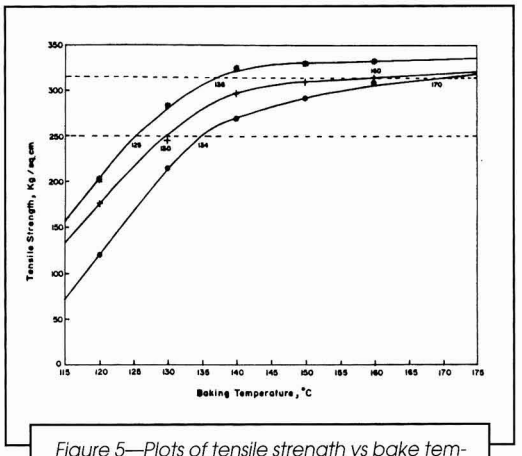


Figure 5—Plots of tensile strength vs bake temperature of oligourethane diol III crosslinked with melamine in ratios (*) 65:35, (+) 70:30; and (•) 75:25.

A particular formulation containing a crosslinker (MF) (25, 30, or 35%) and the corresponding percentage of a oligourethane diol (75, 70, or 65%) was baked at 110, 120, 130, 140, 150, or 160°C for a period of 20 min. The crosslink density of baked resins determined by using the equilibrium swelling method was used to characterize their extent of cure. Their tensile properties and solvent (MEK) rub resistance, determined by using reported procedures, have been correlated with the XLD of the individual formulations.

Tensile Properties

The tensile strength of baked coatings was determined experimentally by following the ASTM procedure. Films of uniform thickness (100 mm) were cut in the form of test specimens of 10 mm width and 80 mm length with a precision cutter. A 15 mm length on either ends of the test specimen was stuck with cellophane-tape leaving a clear 50 mm length for subjecting it to the tensile test. The taped ends of the test specimen provided better grip of the film in the jaws of the tensile machine. It also protected the specimen from breaking near the grip of the jaws.

The test specimen was pulled on a Universal Testing Machine (Instron Ltd. Table Model 1026, U.K.) at a cross head speed of 10 mm per min. Because of variability encountered in tensile tests conducted on thin resin films, more than a dozen test specimens of each material were used for one determination. The procedure described in ASTM D 2370 suggests discarding the lower values regardless of how they differ from the others. In most tests the specimens broke in the proximity of the center of the gauge length.

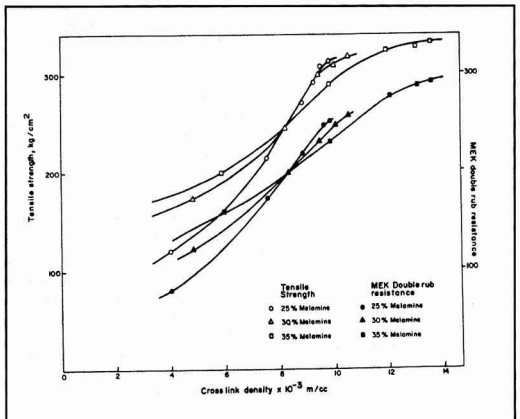


Figure 4—Plots of tensile strength and MEK double rubs versus crosslink density of oligourethane diol III crosslinked with 25, 30, and 35% melamine.

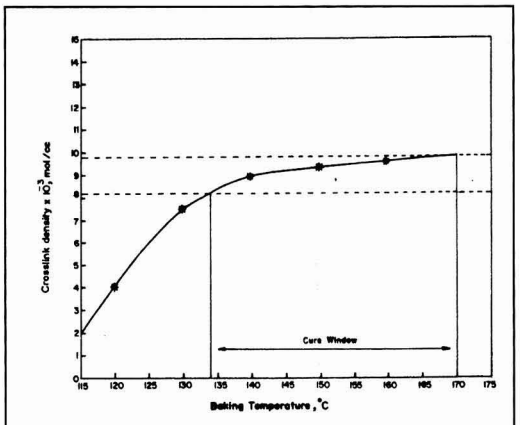


Figure 6—Cure window of coating formulation code No. 3 containing 75% oligourethane diol and 25% melamine.

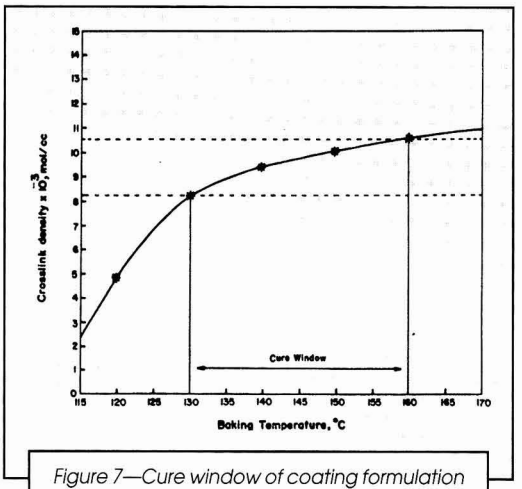


Figure 7—Cure window of coating formulation code No. 3 containing 70% oligourethane diol and 30% melamine.

Solvent (MEK) Rub Resistance

The solvent-rub resistance of the baked coating was determined to estimate the extent of cure by using methyl ethyl ketone (MEK). MEK was filled in with a hollow-barreled felt tip marker which made one back and forth stroke per second across the coating. The number of strokes (double rubs) required to remove the coating down to the substrate is recorded. An acceptable criterion for the performance requirements of high-solids coatings is 200 double rubs.[29]

DISCUSSION

Effect of Bake Temperature and Crosslinker Content of XLD

The variation of XLD of formulation code No. 3 as function of bake temperature has been illustrated in *Figure* 3 with respect to the crosslinker content. There is a steep rise in XLD with an increase in temperature during the initial stages of baking. At higher temperatures the increase in XLD is not as significant.

In the case of butylated amino resins used for crosslinking hydroxy containing oligomers, two types of reactions take place simultaneously; namely, the crosslinking (trans-etherification) and the amino self-condensation. In the formulation which contains 65% oligourethane diol and 35% crosslinker, there is a possibility of self-condensation of excessive amount of crosslinker apart from the trans-etherification reaction. Bauer and Budde[30] also reported similar observations wherein they observed an increase in the XLD of coatings with a high methoxy-to-hydroxy ratio.

Effect of Oligourethane Diol on Crosslink Density

The seven oligourethane diols reported in *Table* 1 differ from each other with respect to their reactivity. In the case of systems containing primary diols, the curing process results in chain extension, whereas, the secondary diols lead to the formation of a mostly three-dimensional network. In formulations which contain a primary hydroxylated diol, a major part of the crosslinker is likely to be consumed in trans-etherification reaction whereas in the case of a secondary hydroxylated diol a part of the crosslinker may undergo self-condensation. Yamamoto et al.[6] has also reported that the primary hydroxylated acrylic oligomer reacted more rapidly with the crosslinker than the secondary hydroxylated oligomer and the melamine-melamine self-condensation for the secondary hydroxylated polyol system.

The crosslink density of formulation code No. 5 (ethane diol/IPDI) and 6 (1,4-butane diol/IPDI), cured with 30% crosslinker and baked at 140°C, is 10.873×10^{-3} and 6.454×10^{-3} mole/cc, respectively. The difference in their crosslink density is due to the short chain length of the ethane diol used in formulation 5 in comparison to the 1,4-butane diol used in formulation 6.[31]

Influence of Isocyanates Used in Oligourethane Diols

Isocyanates (aromatic or aliphatic) used in the preparation of oligourethane diols influence the crosslinked network. In the process of crosslinking, the oligomer molecules take on configurations that are influenced by the aromaticity or aliphaticity of groups and the regularity of the chain. In respect to the backbone chain of oligourethane diols, the aromatic nature of TDI imparts rigidity whereas the aliphatic nature of IPDI results in flexibility. The observations indicate that coatings based on cycloaliphatic isocyanate possess a flexible network in comparison to one prepared using aromatic TDI.

Cure Schedules

Despite the differences in the composition of oligourethane diols, the crosslink density of cured films

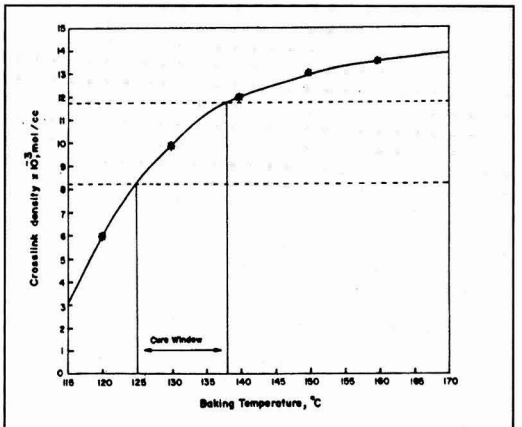


Figure 8—Cure window of coating formulation code No. 3 containing 65% oligourethane diol and 35% melamine.

has been found to correlate well with their physical properties, hence it is used to characterize the cure schedules of these formulations.

Out of the seven oligourethane diol/melamine systems listed in *Table* 2, formulation code No. 3 is selected for designing the cure windows of coatings.

Baking Schedules in Terms of Cure Window

The plots of tensile strength and MEK double rubs versus crosslink density in *Figure* 4 intersect each other at a tensile strength of 250 Kg/cm^2 at 200 MEK double rubs when the crosslink density is 8.2×10^{-3} mole/cc. On the basis of these observations, the experimentally determined properties of the coating, i.e., tensile strength of 250 Kg/cm^2 and MEK double rubs (200) are taken into consideration as the minimum acceptance criteria of cure.

In *Figure* 5, the tensile strength of coatings of formulation code No. 3 are plotted as a function of bake temperature. It is found that the tensile strength of 250 Kg/cm^2 of coatings which contain 25, 30, and 35% crosslinker correspond to bake temperatures of 134, 130, and 125°C respectively, at crosslink density 8.2×10^{-3} mole/cc. This value of XLD is the lower limit for designing the cure window with respect to bake temperature.

In *Figure* 4, the increase in tensile strength and MEK double rubs with respect to XLD is not so significant beyond 9.8, 10.4 and 11.7×10^{-3} mole/cc for coatings having 25, 30, and 35% crosslinker respectively. In plots of crosslink density versus bake temperature (*Figure* 3), it is found that the previously mentioned crosslink densities correspond to bake temperature of 170, 160, and 138°C of coatings. In tensile property measurements, the flexibility (percent elongation) of these coatings is found to decrease with an increase in bake temperature/tensile strength/crosslink density. When overbaked (at temperatures higher than those previously specified) the films shatter into pieces. Based on these observations, and to avoid overbaking, the bake temperatures 170, 160, and 138°C are the upper limits of cure window of coatings which contain 25, 30, and 35% crosslinker, respectively, in *Figures* 6, 7, and 8.

In *Figure* 6, which corresponds to the coating formulation having 25% crosslinker, the cure window is fairly wide (134-170°C) because the coating is less sensitive to curing at a lower temperature. In *Figure* 7, the cure window of coating is not so wide (130-160°C) because the coating is more sensitive to cure in the presence of 30% crosslinker. The plot in *Figure* 8 indicates that the range of cure window (125-138°C) is significantly narrowed down by using a higher amount of crosslinker.

Nominal and True Cure Window

Bauer and Dickie[20] demonstrated the effect of molecular weight on cure window for typical acrylic copolymer/melamine coatings. They appointed a nominal number average molecular weight of 2000 with batch variations ranging from 1500 to 3000. Provder[32] then considered the correlation of impact resistance with fractional conversion of epoxy-polyester powder coating at

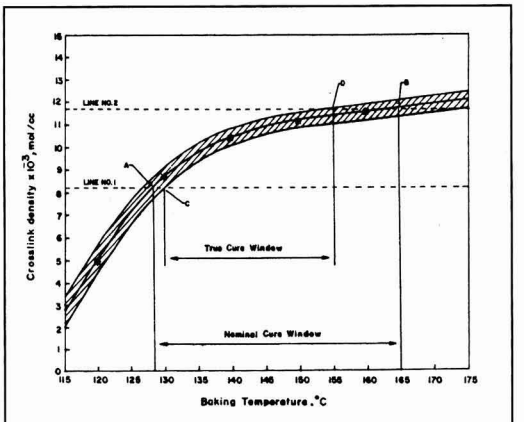


Figure 9—Nominal and true cure windows of coating formulation code No. 3.

various bake schedules as a measure of cure window. In this study, the correlation of crosslinker content with crosslink density of oligourethane diol/melmine coating, baked for 20 min at temperatures ranging from 110-170°C, has been used to plot nominal and true cure window.

For the sake of plotting the data, the average crosslink density is calculated by taking into account the lower and upper crosslink density of coating which contains 25 and 35% crosslinker. A band of average crosslink densities is determined with respect to each bake temperature, i.e., 110-170°C, and plotted as a function of corresponding temperature in *Figure* 9.

In the case of oligourethane diol/melamine coatings, an acceptable minimum figure of merit, with respect to bake temperature, is 8.2×10^{-3} mole/cc crosslink density which is illustrated by line No. 1 as lower limit. In order to avoid the development of brittleness in the coatings 11.93×10^{-3} mole/cc is taken as the upper figure of merit and is represented by line No. 2 in *Figure* 9. The points A and B at which the plot of average XLD intersects lines No. 1 and 2 (the lower and upper XLD limits), are taken for constructing the nominal cure window. The point C, at which line No. 1 intersects the lower plot, and point D, at which line No. 2 intersects the upper plot, have been considered to represent the true cure window. The oligourethane diol/melamine coatings are expected to have the desired degree of cure within the true cure window and acceptable end use performance properties.

CONCLUSION

The technique of equilibrium swelling is convenient, reliable, and economical in comparison to techniques which involve data obtained from DMA, DSC, TGA, FTIR, GC, etc. However, the application of this technique involves precautions such as the right choice of solvent with respect to the cohesion parameter of the

coating, the minimum extractable material in the cured film, and appropriate size of the test specimen.

It is preferable to use the information obtained from experimentally determined properties of the cured film for fixing the lower and upper limits of XLD in the design of cure windows. Depending on the requirement of the end product properties, the content of crosslinker and the bake temperature could be decided using the information obtained from nominal and true cure windows.

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Chemoenzymatic Synthesis and Characterization of Urethane Oils for Surface Coatings

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Two-step chemoenzymatic synthesis of urethane oils has been studied. Initially, the partial esters were prepared by lipase-catalyzed transesterification of soybean and linseed oils with n-butanol. Partial esters were further reacted with different diisocyanates to obtain urethane oils. The composition of the partial esters was varied with reaction time in the transesterification step. Among all the lipases, the lipozyme was found to be the most suitable lipase for the transesterification reaction, yielding 80-85%. All of the urethane oils were of low molecular weights irrespective of the type of oil used in their preparation. Urethane oils, based on MDI, exhibited the best scratch resistance. All of the urethane oils showed good acid and alkali resistance and excellent solvent resistance. These oils also satisfactorily passed the impact resistance and the flexibility tests.

INTRODUCTION

The use of urethane-based coating formulations in the surface coating industry has been well established,[1] as these materials offer several improved film properties such as gloss, abrasion resistance, balance of flexibility and hardness, chemical resistance and resistance to degradation from weathering. Urethane oils (oil-modified polyurethane) are generally prepared by reacting a diisocyanate with partial esters obtained from the transesterification of drying or semidrying oils with polyols. These materials are the polymers built up by urethane linkages containing polyunsaturated fatty acid radicals attached to the molecule through ester groups. Thus, the urethane oil can be considered an alkyd resin in which the phthalic anhydride is replaced by a diisocyanate. The film performance of these materials depends on the nature of the oil, polyol, and the diisocyanate used in the synthesis. To obtain practically isocyanate free and stable products, the urethane oils are generally formulated to have an NCO/OH ratio <1.

Vegetable oils of different origins have been utilized frequently as the oil components of urethane oils.[2-3] More recent investigation by Erciyes et. al., includes the synthesis of urethane oils based on Ecballium Elaterium (L.) A. Rich (family: Cucurbitaceae) and Prunus Mahaleb (L.) A. Rich (family: Rosaceae) seed oil,[4] which contain conjugated trienoic acids. P. Mahaleb seed oil of Turkish origin reportedly contains 38.7% α-eleostearic acid, 18.4% linoleic acid, 41.3% oleic acid, and 4.3% glycerol. The fatty acid composition of Ecbalium Elaterium seed oil from Turkey was reported at 7.41% palmitic acid, 6.12% stearic acid, 17.89% oleic acid, 48.73% linoleic acid and 19.84% punicic acid (cis, trans, cis-9, 11, 13-octadecatrienoic acid).[4] A gel-permeation chromatographic method[5] has also been developed for monitoring the formation of a precursor in the transesterification step of two-step chemoenzymatic synthesis of urethane oil, and subsequently molecular weight determination of the final product.

The advantages of the biocatalytic approach over commonly used high temperature base catalyzed transesterification step in the synthesis of castor oil-based urethane oils have already been established.[6] In the present work, the same biocatalytic approach has been employed for the synthesis of urethane oils based on soybean and linseed oils.

EXPERIMENTAL

Chemicals and Lipases

Methoxymelamine, soybean, and linseed oils were locally purchased and checked for purity on GPC prior to use.

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Table 1—Effect of Type of Lipase on Transesterifications of Soybean and Linseed Oils with n-Butanol

Soybean Oil

Time (Hours)	Triglyceride Percentage[a] PPL	CCL	HPL	LIPO
0	100.0	100.0	100.0	100.0
1	100.0	97.4	95.5	69.2
2	100.0	94.9	91.0	38.5
4	98.5	89.8	88.3	30.4
6	97.0	87.2	85.6	22.4
8	93.1	85.9	84.2	14.3

Linseed Oil

Time (Hours)	Triglyceride Percentage[a] PPL	CCL	HPL	LIPO
0	100.0	100.0	100.0	100.0
1	92.8	95.2	97.1	71.2
2	95.6	90.5	94.2	42.4
4	71.2	81.1	88.4	25.0
6	56.8	71.7	82.6	22.7
8	42.4	62.3	76.9	20.4

(a) Obtained from GPC analysis.

TDI (2,4-toluene diisocyanate), diphenylmethane diisocyanate (MDI), and hexamethylene diisocyanate (HMDI) were obtained from Fluka AG., Buchs, Switzerland. A reagent grade n-butanol was obtained from Aldrich Chemical Co Inc., USA, and all the solvents used were of analytical grade. Lipozyme (LIPO) (41 IUg^{-1}), a commercially available lipase from the fungus mucor miehei, immobilized on macroporous anion exchange resin, was obtained from Novo-Nordisk, Denmark. The lipase from hog pancreatic (HPL) (2.27 units/mg) was obtained from Fluka AG. A crude porcine pancreatic lipase (PPL) (35% protein) of activity 30-70 units/mg and Candida cylindrica lipase (CCL) (665 units/mg) were obtained from Sigma Chemical Co., USA.

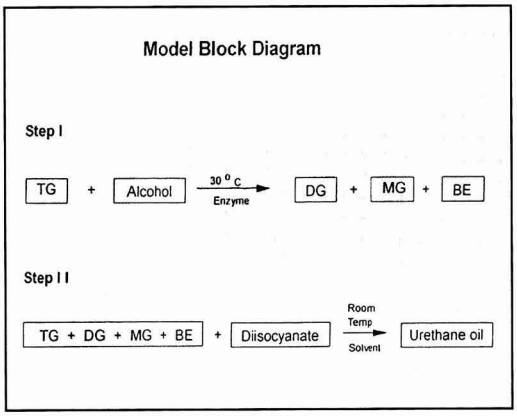

Figure 1—The model block diagram for chemoenzymatic synthesis of urethane oils, TG-triglyceride (vegetable oil), DG-diglyceride, MG-monoglyceride, BE-butyl ester, alcohol-primary alcohols such as n-propanol, n-butanol, n-pentanol, or n-hexanol, Dissocyanate-2,4-Toluene diisocyanate (TDI), diphenylmethane diisocyanate (MDI) or hexamethylene diisocyanate (HMDI).

Two-Step Chemoenzymatic Synthesis of Urethane Oils

Two-step chemoenzymatic synthesis of urethane oils, consisting of lipase catalyzed transesterification of soybean and linseed oils with n-butanol, and reaction of the resulting precursor (partial esters) with different diisocyanates, has been carried out in the laboratory as per standard procedure.[6] *Figure* 1 shows the model block diagram for chemoenzymatic synthesis of urethane oils.

Characterization of Urethane Oils

Hydroxyl values were determined by the standard pyridine-acetic anhydride method. Urethane oils have been characterized[6] by IR, ^{1}H-NMR spectroscopy, and GPC techniques using Perkin-Elmer 781 spectrophotometer, Bruker AC 80 pulse Fourier Transform NMR spectrophotometer, and Waters Associates Pump (730 data module) respectively.

IR Spectroscopy

The following significant peaks are observed in IR spectra: 3350 cm^{-1} (strong, –NH), 3300 cm^{-1} (broad, hydroxyl), 3010-3080 cm^{-1} (medium, aromatic, in TDI and MDI), 2850-3000 cm^{-1} (strong, aliphatic, in HMDI), 1710-1740 cm^{-1} (strong, urethane and ester carbonyl), and 1600-1625 cm^{-1} (weak, vinyl).

^{1}H-NMR Spectroscopy

The ^{1}H-NMR spectra showed the following characteristic peaks: δ 0.92 ppm (obsured triplet, $-CH_3$), δ 1.29 ppm (broad singlet, $-CH_2$), δ 2.06 ppm (broad singlet, $-CH_2-C=C$), δ 2.18-2.27 ppm (CH_3–Ph, in TDI), δ 2.27-2.34 ppm (triplet, CH_2-C-), δ 3.86 ppm (Ph–CH_2–Ph, in MDI), δ 4.06 ppm (two doublet, CH_2-O-C-), δ 4.8-5.0 ppm (broad triplet, CH–O–C–), δ 5.34 ppm (broad triplet, CH=CH), δ 6.39 and δ 6.6 ppm (two broad peaks, –OH and –NH), δ 7.09 ppm (two doublets, aromatic, in TDI and MDI), and δ 7.76 ppm (singlet, aromatic, in TDI and MDI).

Determination of Film Properties

Film properties such as scratch resistance, impact resistance, flexibility, acid, alkali, and solvent resistance were determined by standard methods.[7-10]

RESULTS AND DISCUSSION

The β-monoglyceride was isolated from the reaction mixture at the end of step 1 by column chromatography using a hexane:chloroform (95:5 v/v) solvent system. The separation of β-monoglyceride was confirmed by the presence of a ^{1}H-NMR spectral peak at δ 4.8-5.0 ppm due to CH attached to ester linkage in α position. It is the

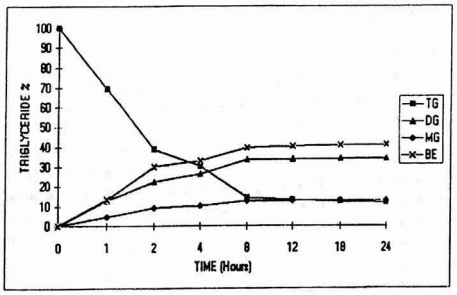

Figure 2—Kinetics of transesterification of soybean oil and product distribution as a function of time.

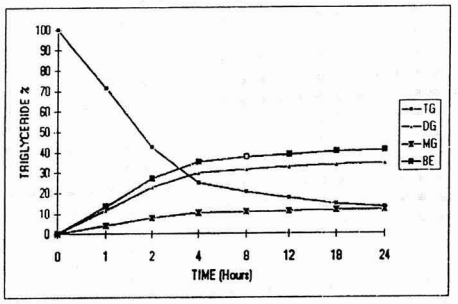

Figure 3—Kinetics of transesterification of linseed oil and product distribution as a function of time.

direct indication of 1,3-positional specificity of lipase which rules out the possibility of randomization[11] and facilitates the reaction of diisocyanates with partial esters (step 2).

Kinetics of Lipase Catalyzed Transesterification of Soybean and Linseed Oil

The kinetics of lipase catalyzed transesterification and product distribution, as a function of time for the model reaction of soybean and linseed oil with n-butanol in 1:1 proportion, is shown in *Figures* 2 and 3, respectively. The reaction was performed without solvent. Lipozyme was used as a biocatalyst at room temperature over a period of 24 hr. The samples were withdrawn during the course of the reactions in each case. The composition of the precursor (partial esters), formed along with TG consumption, was determined using GPC analysis of each sample in LC mode. The products of both the transesterification reactions consist of diglyceride (DG), monoglyceride (MG), and butyl ester (BE), as expected.

Figures 2 and 3 clearly exhibit the decrease in TG content with time in each case, which is associated with the corresponding increase in the DG, MG, and BE content of the reaction mixture.

It is known that the triglyceride oil is transesterified to DG first, and then further converted to MG, indicating the two-step reaction sequence.[5] It can be noted from *Figures* 2 and 3 that the TG content decreases rapidly up to eight hours in both cases, and subsequently, the consumption of TG slows down until the end of the reactions.

Effect of Type of Lipase

Lipases from different sources were screened for the model transesterification reactions of soybean and linseed oils for eight hours. In the transesterification of soybean oil, conversions were faster and more complete using lipozyme, yielding 85% (*Table* 1). The maximum yields was limited to 7% using PPL, whereas, in case of CCL and HPL the maximum yield was 14-16%.

In the case of linseed oil, the yields obtained by PPL, CCL, HPL, and lipozyme were observed to be 57, 37, and 80% respectively. Thus, the lipozyme was found to be the best suitable lipase for the transesterification of both the oils (*Table* 1).

Effect of Temperature

The model reactions of soybean and linseed oils were performed for eight hours at five different temperatures: 20, 25, 30, 40, and 50°C using lipozyme as a biocatalyst. It was observed that the rate of the reaction increased with an increase in temperature, resulting in the proportionate increase in the diglyceride and monoglyceride content, as expected (*Table* 2).

However, at 50°C, the rate of transesterification of both the oils increased with time up to six hours and then slightly decreased in the next two hours. This result may be due to the denaturation of enzyme (deformation of active enzyme structural conformation) resulting in the marginal loss of enzyme activity.

Effect of Substrate to Nucleophile Ratio

The model transesterification reactions of soybean and linseed oils with n-butanol were carried out at room temperature using a fixed amount of lipozyme as biocatalyst, and different substrate to nucleophile ratios in the order 1:1, 1:2, 1:3, 1:5, 1:10, and 1:25, respectively.

It is observed that the amount of n-butanol has a profound effect on the initial rate of reaction and equilibrium conversion. The formation of partial esters was observed to increase with time and reach a maximum. Soybean oil reached a 1:2 ratio and linseed oil a 1:3. Each then tapered off slowly up to a 1:25 ratio (*Table* 3). The observation could be explained on the basis of the known behavior of alcohols[12] in inhibiting the lipase catalyzed transesterification, probably either by disturbing the water bound to the enzyme or deactivating the lipase through osmotic dehydration and/or disturbance of the intracellular pH of the whole cell.

Table 2—Effect of Temperature on Transesterifications of Soybean and Linseed Oils with n-Butanol

Soybean Oil

Time (Hours)	Triglyceride Percentage[a] at Different Temperatures				
	20°C	25°C	30°C	40°C	50°C
0	100.0	100.0	100.0	100.0	100.0
1	84.7	82.3	69.2	67.8	66.5
2	75.6	72.4	38.5	54.9	53.7
4	63.9	52.8	30.4	29.3	28.1
6	58.4	43.6	22.4	21.5	21.8
8	53.0	34.5	14.3	13.7	15.6

Linseed Oil

Time (Hours)	Triglyceride Percentage[a] at Different Temperatures				
	20°C	25°C	30°C	40°C	50°C
0	100.0	100.0	100.0	100.0	100.0
1	86.7	84.3	71.2	68.8	67.3
2	77.9	72.0	42.4	53.5	52.4
4	64.4	47.5	25.0	22.9	22.7
6	58.7	44.0	22.7	20.8	21.0
8	57.1	40.6	20.4	18.7	19.1

(a) Obtained from GpC analysis.

IR Spectroscopy

In general, the urethane oils, based on soybean and linseed oil, had more or less similar spectra. The characteristic broad band at 3300 cm^{-1} in IR spectra confirms the presence of residual hydroxyl groups in the urethane oils. A medium band due to aromatic –CH stretching at 3010-3080 cm^{-1} and a weak band due to carbonyl at 1710-1740 cm^{-1} also confirm the formation of urethane groups. The absence of a band at 2260-2280 cm^{-1} ruled out the presence of diisocyanate impurities in the urethane oils. A shoulder band at 3350 cm^{-1} due to the stretching to –NH further confirms the formation of urethane oils.

^{1}H-NMR Spectroscopy

All the urethane oils based on soybean and linseed oil showed more or less similar spectral patterns. The unsaturation of the oil part, exhibited at δ 5.34 ppm in ^{1}H-NMR spectra, remains unaffected due to the mild conditions used for the enzymatic transesterification step. In the case of TDI based urethane oils, the peak, due to aromatic proton adjacent to methyl group, generally appears at δ 7.1 ppm as a doublet; however, in the present case a multiplet is observed, which may be due to the mixture of 2,4 and 2,6 isomers of TDI used in the present study. The peak due to methylene protons flanked by two phenyl rings appearing at δ 3.86 ppm in

Table 3—Effect of Substrate of Nucleophile Ratio on Transesterifications of Soybean and Linseed Oils with n-Butanol

Soybean Oil

Time (Hours)	Triglyceride Percentage[a]					
	1:1	1:2	1:3	1:5	1:10	1:25
0	100.0	100.0	100.0	100.0	100.0	100.0
1	69.2	68.8	71.1	73.5	93.9	99.2
2	38.5	37.6	42.3	47.0	87.9	88.4
4	30.4	23.9	29.2	33.4	64.5	82.9
6	22.4	10.3	19.6	19.9	41.1	87.5
8	14.3	5.8	10.1	11.6	29.4	82.0

Linseed Oil

Time (Hours)	Triglyceride Percentage[a]					
	1:1	1:2	1:3	1:5	1:10	1:25
0	100.0	100.0	100.0	100.0	100.0	100.0
1	71.2	68.2	67.7	70.1	75.7	81.2
2	42.4	36.5	35.3	37.8	51.4	72.1
4	25.0	22.6	18.0	29.3	38.9	63.6
6	22.7	15.7	12.5	19.6	26.4	55.2
8	20.4	8.8	7.1	12.2	20.1	46.7

(a) Obtained from GpC analysis.

^{1}H-NMR spectra of MDI based urethane oils, can be ascribed to the electron withdrawing effect of both the rings. The presence of peak at δ 3.2 ppm due to methylene protons adjacent to the nitro group of urethane linkage in ^{1}H-NMR spectra, indicates the formation of HMDI based urethane oils. The two peaks due to methylene protons attached to the vinyl group and flanked by two double bonds appeared at δ 2.04-2.06 ppm and δ 2.8 ppm in ^{1}H-NMR spectra, respectively. All other peaks appeared at their respective positions as detailed in the Experimental Section.

Characterization and Film Properties of Urethane Oils

In the present study, the urethane oils based on soybean and linseed oil were prepared for their characterization and evaluation of film properties.

In the first step, the partial esters of different compositions were synthesized by lipase catalyzed transesterification of soybean and linseed oil with n-butanol in 1:3 molar ratio over a period of 4, 8, and 24 hr, respectively. In the second step, the partial esters were then reacted with 0.5 mole each of the different diisocyanates, such as TDI, MDI, and HMDI, to obtain respective urethane oils. The urethane oils were characterized by molecular weight, hydroxyl value and film properties. The molecular weight and molecular weight distribution data are summarized in *Table* 4.

It is evident from *Table* 4 that all the urethane oils are of low molecular weights. GPC analysis of soybean and linseed oil based urethane oils exhibit narrow and broad molecular weight distribution patterns, respectively. It is also observed that the molecular weight of all the urethane oils decreased when the MG% of the precursor (partial esters) increased.

The apparent discrepancy noticed between the hydroxyl value calculated from the $\overline{M}_n$ and the hydroxyl value determined for the urethane oils can be explained as follows: the molecular weight for the synthesized urethane oils was obtained by GPC using polystyrene as standard. The molecular weight values depend upon the hydrodynamic volume of the polymer in solvent (in the present case THF) and change with the tyr of solvent and experimental conditions used for GPC analysis. The molecular weights are reported without applying the difference in radii of gyration 'S' value between polystyrene and the synthesized urethane oils. Polystyrene is a linear polymer, whereas urethane oils have varying degrees of branching. Thus, molecules of urethane oils of identical molecular weight will have different radii of gyration and therefore appear at different elution volumes on GPC. Hence, the molecular weight values obtained by GPC are not absolute though certainly indicative, of the general trend of molecular weights. Therefore, one cannot compare them with those calculated from the hydroxyl values by end-group analysis.

The results of the characterization and film properties of urethane oils are listed in *Table* 5. It is clearly observed from *Table* 5 that the hydroxyl values of all the urethane oils based on soybean and linseed oil were found to be in the range of 115-185 and 110-175 mg KOH/g, respectively and were observed to increase with an increase in MG% in the precursor, as expected.

The film properties were tested seven days after their application to the panels. Among the different urethane oils derived from TDI, MDI, and HMDI, the product based on MDI showed the best scratch resistance (as per ASTM D 1474). The scratch resistance of the urethane oils increased with an increase in molecular weight irrespective of the type of oil used. All the urethane oils passed the impact resistance (as per ASTM D 2794) and

Table 4—Molecular Weight and Molecular Weight Distribution Data of Urethane Oils

Sr. No.	Urethane Oil Code	M_n	M_w	M_z	M_v	MWD	Intrinsic Viscosity (η)
1	STUO-1	1415	2057	02923	2057	1.4	0.0021
2	STUO-2	1276	1920	02915	1920	1.5	0.0019
3	STUO-3	1027	1477	02087	1477	1.4	0.0015
4	SMUO-1	1421	2800	04591	2799	2.0	0.0028
5	SMUO-2	1418	2432	04124	2431	1.7	0.0024
6	SMUO-3	1398	2078	03142	2077	1.5	0.0021
7	SHUO-1	1874	2341	02953	2340	1.3	0.0023
8	SHUO-2	1844	2253	02756	2252	1.2	0.0022
9	SHUO-3	1234	2037	02747	2037	1.6	0.0020
10	LTUO-2	0420	3235	16036	3235	7.7	0.0032
11	LTUO-2	0351	1820	06367	1819	5.2	0.0018
12	LTUO-3	0273	0672	02050	0672	2.5	0.0007
13	LMUO-1	0508	2774	11126	2773	5.5	0.0028
14	LMUO-2	0387	1376	05466	1375	3.6	0.0014
15	LMUO-3	0283	0918	04867	0918	3.2	0.0092
16	LHUO-1	0502	2775	1000	2775	5.5	0.0028
17	LHUO-2	0408	2184	08184	2183	5.4	0.0022
18	LHUO-3	0374	1140	03471	1140	3.1	0.0011

Note:
STUO-1: Urethane oil based on soybean oil and 2,4-toluene diisocyanate and last digit stands for sample number.
SMUO-1: Urethane oil based on soybean oil and diphenylmethane diisocyanate and last digit stands for sample number.
SHUO-1: Urethane oil based on soybean oil and hexamethylene diisocyanate and last digit stands for sample number.
Same abbreviations are applicable for LTUO-1, LMUO-1, and LHUO-1, respectively, where 'L' stands for linseed oil.

Table 5—Characterization and Film Properties of Urethane Oils

Sr. No.	Urethane Oil Code	Precursor Composition in Step I				Hydroxyl Value mg KOH/g	Scratch Hardness (g)
		TG (%)[a]	DG (%)[a]	MG (%)[a]	BE (%)[a]		
1	STUO-1	29.2	29.3	12.1	29.4	116	400
2	SMUO-1	29.9	29.3	12.1	29.4	142	500
3	SHUO-1	29.2	29.3	12.1	29.4	151	300
4	STUO-2	10.1	16.7	23.0	50.2	129	500
5	SMUO-2	10.1	16.7	23.0	50.2	163	600
6	SHUO-2	10.1	16.7	23.0	50.2	170	400
7	STUO-3	00.0	02.4	42.2	55.4	156	600
8	SMUO-3	00.0	02.4	42.2	55.4	174	700
9	SHUO-3	00.0	02.4	42.2	55.4	183	500
10	LTUO-1	18.0	23.4	15.6	43.0	112	600
11	LMUO-1	18.0	23.4	15.6	43.0	133	700
12	LHUO-1	18.0	23.4	15.6	43.0	145	500
13	LTUO-2	07.1	16.6	24.5	51.8	119	700
14	LMUO-2	07.1	16.6	24.5	51.8	154	900
15	LHUO-2	07.1	16.6	24.5	51.8	162	600
16	LTUO-3	00.0	02.1	42.3	55.6	148	800
17	LMUO-3	00.0	02.1	42.3	55.6	166	1000
18	LHUO-3	00.0	02.1	42.3	55.6	175	700

(a) Percentages were obtained by GPC.

Note:
STUO-1: Urethane oil based on soybean oil and 2,4-toluene diisocyanate and last digit stands for sample number.
SMUO-1: Urethane oil based on soybean oil and diphenylmethane diisocyanate and last digit stands for sample number.
SHUO-1: Urethane oil based on soybean oil and hexamethylene diisocyanate and last digit stands for sample number.
Same abbreviations are applicable for LTUO-1, LMUO-1, and LHUO-1, respectively, where 'L' stands for linseed oil.

all the urethane oils had good acid and alkali resistance (per ASTM D 1647), and flexibility (per ASTM D 522-41) tests were satisfactorily irrespective of the type of oil used in their synthesis. These oils had excellent solvent resistance (per ASTM D 1308) towards polar and non-polar solvents like n-butanol and mineral terpentine oil (MTO), i.e., no observable deterioration of the films. The films remained unaffected even after four months.

CONCLUSION

The extent of transesterification and the composition of the partial esters controlled by biocatalytic approach have a profound effect on the molecular weight and film properties of the urethane oils based on soybean and linseed oil.

The lipozyme was found to be the best suitable lipase for the transesterification of both the oils. When the reactions were carried out at 50°C, the rate of transesterification reaction of both oils slightly decreased in the last two hours as a result of marginal loss of enzyme activity at that temperature. The alcohol appears to inhibit the transesterification reaction at higher substrate to nucleophile ratio.

All the urethane oils are of low molecular weights. The MDI based urethane oils had the best scratch resistance. All the urethane oils passed the impact resistance and flexibility tests satisfactorily and had good acid and alkali resistance, and excellent solvent resistance, irrespective of the type of oil used in their synthesis.

The better potential to offer desired properties to the newly synthesized urethane oils may be ascribed to some sort of stereoregularity imparted to them by the chemoenzymatic approach as against the conventional chemical method.

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Technology Forum Article

VOC Testing Comparison: EPA Method 24 Versus the Cal Poly Pomona Method

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A new method for water determination of latex paints that gives reliable and precise results is presented. This method agrees with the results obtained using the traditional Karl Fischer titrations of EPA Method 24; therefore eliminating the need for Karl Fischer titrations. Equipment needs are minimal and the procedure is performed quickly and conveniently. Hopefully, in the future EPA Method 24 will not be the only method accepted by regulatory agencies. Until that time, however, this new method will be useful for quality control and assurance, in-house regulatory compliance monitoring, and research and development purposes.

In recent years the paint and coatings industry has come under pressure to develop new products and formulations that reduce environmental hazards. Much of the focus on achieving this goal has been on the development of waterborne products containing reduced levels of volatile organic compounds (VOCs). Both federal and local regulatory agencies have exerted pressure to develop low or zero VOC products. This regulatory push is illustrated, for example, in *Chemical and Engineering News*.[1] There was some early reluctance to move away from familiar solvent-based formulations which had proven to be effective. As much as 20 years ago, initial laboratory studies addressed the development of new waterborne products.[2] All areas of product development have come under scrutiny in the effort to reduce VOC levels, while retaining application and performance characteristics. Dougherty and Medina reported in the *European Coatings Journal*[3] on new surfactant technology for waterborne systems. These surfactants display desirably low intrinsic VOC contents of about 1.5% as measured by the EPA Method 24.[4] Howard and Manock have presented a discussion of polyurethane dispersions and high-solids waterborne systems which have zero VOC content.[4] The issue of rheology modifiers for low VOC bake coatings to help overcome the problem of increased sag encountered at elevated cure temperatures has been addressed.[5] These examples point to the level of activity within the industry to comply with ever more restrictive regulatory requirements.

Government agencies are constantly monitoring products to insure adherence to regulations. A major part of the monitoring process as carried out by agencies is the measurement of the water content of paints. The methods used to certify compliance demand that paints be analyzed for water content. EPA Method 24[6] and ASTM Practice D 3960[7] are the basis of the determinations as carried out by regulatory agencies. Integral to these procedures is the method developed by Karl Fischer[8] to measure water content in liquids and solids. An accurate determination of the water content is critical since this value enters into the equation used by EPA Method 24 to calculate the VOC content. The equation used to make this calculation is presented as equation (1) here.

$$C = \frac{[W \times D]}{[100\% - V]} \qquad (1)$$

C = VOC content in pounds per gallon less water

W = weight percent organic volatile compounds

D = paint density in pounds per gallon

V = volume percent water in paint

Our work focused on the determination of the volume percent water, V, found in equation (1). The goal was to develop a method to measure the water percentage by a method other than Karl Fischer (KF) titrations, due to the health risks associated with the use of typical KF reagent.[9] Even though modern imidazole modified KF reagents have been developed,[10] we felt that elimination of the need to do titrations would be worthwhile. The direct KF titration of typical waterborne paints presents practical problems not found in the analysis of other materials. The KF titration is carried out in a water-free medium. When a waterborne paint is introduced, the paint often forms large droplets from which the water must then be extracted into the KF solvent for reaction with the KF reagent to occur. This extraction process is not instantaneous, even if turbo mixers are used, and not every laboratory has turbo mixers available. The formation of droplets in the absence of turbo mixers can lead to end-points being difficult to achieve and thus potentially not as precise as might be desired. Analysis of raw paints also brings with it the issue of the effect of the many components of paint. The presence of these materials can lead to unwanted complications varying from the bothersome fouling of equipment, especially electrodes, to actual chemical interference. In particular the presence of amines, including ammonia, can present significant problems. One particularly vexing feature of amines is their ability to raise the pH of the medium. It is known that the optimum pH range for

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Table 1—Refractive Index Calibration Curve Experimental Data

Wt. Water, g	Wt. MPA, g	Wt.% Water	Refractive Index
0	4.2396	0	1.4029
4.8794	0	100	1.3337
2.8513	1.8130	61.13	1.3740
1.1609	1.9583	37.22	1.3910
0.7433	3.7192	16.66	1.4002
2.3029	0.9033	71.83	1.3643
4.0253	0.7538	84.23	1.3494
0.3474	3.8395	8.297	1.4021
2.9834	2.3678	55.75	1.3793
0.6890	0.5167	57.14	1.3761

KF titrations is approximately 5 to 7.[11] Clearly it would be a tremendous advantage to have a method available that could be performed easily and rapidly in-house. Even if the method yielded results which had some amount of error, a benefit could be realized through the savings of time and money especially in the R & D of new product lines and the routine quality control and assurance of established product lines.

Prof. Max Wills and his research group at California Polytechnic State University, San Luis Obispo, in association with the Technical Committee of the Los Angeles Society for Coatings Technology, has described a new method which overcomes many of the problems associated with the traditional KF titration.[12] They have described their method as the "Cal Poly Method." For clarity we will refer to their method as the "SLO Method" to distinguish it from work carried out at California State Polytechnic University, Pomona. We will refer to our work as the "Pomona Method."

The starting point for the work described here as the Pomona Method has its roots in the SLO Method. The SLO Method is based on an azeotropic extraction of water from paint samples using 1-methoxy-2-propanol (MPA). For a full description of the particulars of this method the reader is referred elsewhere.[12] Briefly, the SLO Method employs MPA to azeotropically extract water from the paint sample. The resultant mixture of water and MPA is then titrated with KF reagent in the traditional manner. The SLO method gives results which agree with those obtained via the EPA Method 24. The goal of the Pomona Method was to eliminate the need for KF titrations. A way to characterize the water content of the MPA/water mixture of the SLO Method was needed.

Our attention was eventually drawn to the use of refractive index measurement as a means to achieve our goal. The refractive index of liquid mixtures is often used to determine their composition through the use of calibration curves.[13] We describe below the procedure and results of our work on several commercial paints using refractive index measurements on MPA/water mixtures. Work is also being conducted on a variation based on the use of isopropyl alcohol (IPA), rather than MPA, to extract water from paint. Work is continuing on the IPA extraction technique but initial results appear to be promising. The use of IPA as an extraction solvent promises to show utility for analyzing paints which contain IPA as part of their formulation.

PROCEDURE

The actual laboratory procedures may be divided conveniently into several distinct parts as follows:

1. Calibration curve preparation
2. Azeotropic extraction
3. Sample size determination
4. Water content evaluation
   a. Karl Fischer titration
   b. Refractive index determination

Each of these four parts will be discussed separately. All of the glassware used was carefully cleaned. The major concern was to exclude all water. Our practice was to thoroughly clean all glassware according to standard laboratory procedure. After cleaning and rinsing with distilled water, a final rinse with acetone was followed by at least one hour in a 110°C drying oven. The glassware was routinely left in the drying oven until immediately before use. If storage is necessary, it is best to do so in an efficient dessicator if possible.

Preparation of Standard Calibration Curve

Ten mixtures of MPA and water were prepared by carefully weighing to the fourth decimal appropriate amounts of the MPA and water into separate containers having securely sealable tops. Five milliliter capacity glass vials with plastic stoppers are convenient. The series of mixtures prepared must cover the entire concentration range from pure water to pure MPA. A total mass of 2.0000 grams is convenient. For example, one solution may be prepared by placing 0.1000 grams of water and 1.9000 grams of MPA into a vial. This mixture will be 5.000% by weight water. In a similar fashion, additional mixtures were prepared to uniformly cover the entire concentration range. Once all mixtures were prepared the refractive index of each one was carefully measured. The refractive index of the pure water and the pure MPA used to make these mixtures was also measured. These data were then plotted with the weight percent water on the y-axis and the refractive index value on the x-axis. All refractive index measurements were made on azeotropic distillates at the same temperature used to construct the calibration curve, namely, 21°C plus or minus one degree. In this way no problems associated with temperature variations were encountered. It is best to use a computer and appropriate software to fit the data with a least squares linear regression line or some other similar statistical program.

Table 1 shows a set of experimental data used to construct the calibration curve shown in *Figure* 1. The data from *Table* 1 may also be fitted using the equation for a straight line rather than the quadratic equation which appears in *Figure* 1. The result is shown in *Figure* 2. Notice in *Figure* 2 the R^2 value of 0.940, while quite high, is not as high as the value of 0.987 shown in *Figure* 1. This indicates that the equation of *Figure* 1 should generate a more precise value for the weight percent of water in a mixture based on an experimentally measured refractive index. All of the results presented here are based on the use of the quadratic equation. In every case of the determination of a water percentage the measured refractive index value was substituted into the appropriate equation and the water percentage was calculated. In no case was the water percentage evaluated by visual interpolation from either of the curves.

Azeotropic Extraction Procedure

About 30 g of the paint sample was weighted to four decimal places and placed into a 250 ml round bottom one necked flask, which was fitted with a standard taper joint of 19/22 or 14/20 size containing a Teflon®-coated stir

bar. About 100 ml of dry MPA which had been dried over a molecular seive was added. The refractive index of the MPA should be measured before use to insure the purity. A reflux condenser was fitted to the round bottom flask. No packing material was used in the reflux condenser nor was water cooling used. At the top of the reflux condenser a three-way adapter was positioned to permit a thermometer to be inserted to monitor the vapor temperature. A condenser was attached to the horizontal arm of the three-way adapter. This condenser should have an adapter which permits it to be attached via a ground glass vacuum adapter to a 100 ml volumetric flask. In the absence of the vacuum adapter, there should be a suitable extension to the exit of the condenser to permit it to extend several centimeters into the volumetric flask. It is important to weigh the volumetric flask, including its stopper, on an analytical balance and record the weight. Once the apparatus containing the paint sample was assembled, it was fitted with a heating mantle and cooling water flow started in the condenser which empties into the volumetric flask. At this time the magnetic stirrer was started and adjusted to provide a reasonable amount of circulation without excessive splashing. The distillate was then collected in the volumetric flask while carefully monitoring the distilling temperature. In order to avoid collecting any methanol which might be present, collection of the distillate did not begin until the temperature reached 70°C. A distilling temperature in the neighborhood of 115°C is a good indication that all of the water has been removed from the paint since MPA boils at 115°C and water boils at 100°C. At this point the cooling water flow was stopped. An additional 10 ml or so of distillate was collected after turning off the cooling water in order to flush out any water which might remain within the apparatus. The distilling process typically required from 20 to 40 min depending on the particular apparatus used. Once the distillate had been collected, its refractive index was measured immediately before moisture could be absorbed. The total weight of the distillate was also measured and recorded.

Sample Size Determination

The quadratic equation shown in *Figure* 1 was used throughout. It is wise to insure that the measured parameter, the refractive index, displays maximum sensitivity to the water concentration while minimizing relative errors. An examination of *Figure* 1 shows that the approximate region from 15 to 50% water by weight corresponds to the range of maximum sensitivity. It is, therefore, desirable to arrange to have sufficient water in the original paint sample in order that the ultimate distillate falls in this range of refractive index; namely, from a refractive index of 1.3670 to 1.4000. For the typical waterborne latex paint whose water content is approximately 50%, the 30 g sample size specified is appropriate. If, however, the paint is significantly different, it may be necessary to scale the initial sample up or down as needed. For example, suppose an initial 30 g sample of paint generates a measured refractive index of 1.3500 which corresponds to a water concentration of about 85% by weight according to *Figure* 2. A reasonable refractive index to target might be 1.3800 which is about in the middle of the range corresponding to a distillate water concentration of about 45%. A simple ratio may be used to determine amount of paint to use to achieve this refractive index as shown in equation (2).

$$m = [45\%/85\%]\,[30g] = 16\ g \qquad (2)$$

m = desired paint sample size in grams.

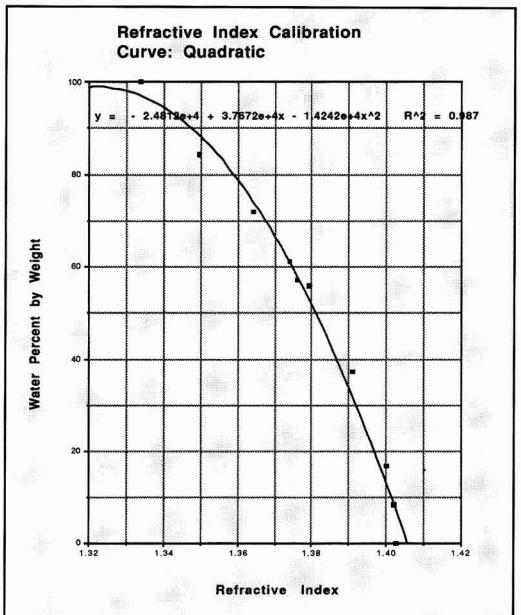

Figure 1—Calibration curve showing weight percent water in MPA/water mixtures as a function of refractive index. Data fitted with quadratic equation.

Legend—Refractive index calibration curve: quadratic.

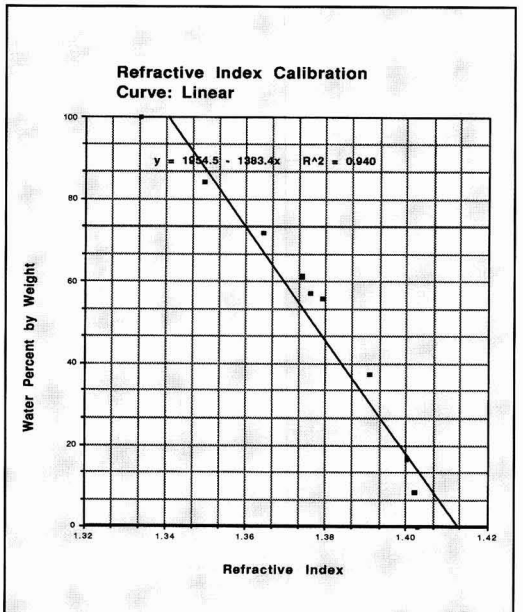

Figure 2—Calibration curve showing weight percent water in MPA/water mixtures as a function of refractive index. Data fitted with a straight line equation.

Legend—Refractive index calibration curve: linear.

Water Content Evaluation

The following calculations illustrate the process of taking an experimentally measured refractive index value and calculating from it the actual VOC content of an original paint sample. One calculation is based on the use of the linear equation of *Figure* 2 and one calculation is based on the quadratic equation in *Figure* 1. It is interesting to note the comparison of the two results. Based on such a comparison, it is obvious that the linear equation is quite good and should suffice for all but the most exacting of circumstances. Nevertheless, all of the results presented in this paper have been obtained using the quadratic equation. The experimental data from an actual determination are shown in the following. The paint density and percent by weight total solids were obtained by customary standard methods which are straightforward and need no further comment here.

weight of original raw paint sample = 30.8404 grams
weight of azeotrope collected = 61.5677 grams
refractive index value measured = 1.3974
raw paint density = 11.91 lbs/gal (1.406 g/ml; "weight per gal cup determination"
weight percent total solids = 51.42% (weight loss upon oven drying)

Using the linear equation the calculation proceeds as follows:

wt% water in azeotrope = 1954.5 – 1383.4 [1.3974] = 21.34%
weight water in raw paint = [61.5677 g azeotrope] [0.2134] = 13.14 g water total
wt% water in raw paint = [13.14 g water] / [30.8404 g paint] × 100% = 42.60%

Using the quadratic equation the calculation proceeds as follows:

wt% water in azeotrope = $-24812 + 37672[1.3974] - 14242[1.3974]^2$ = 20.12%
weight water in raw paint = [61.5677 g azeotrope] [0.2012] = 12.39 g water total
wt. % water in raw paint = [12.39 g water] / [30.8404 g paint] × 100% = 40.17%

We now have all of the information to use in equation (1) in order to evaluate the VOC content of this paint. Equation (1) is shown again here for reference.

$$C = \frac{[W \times D]}{[100\% - V]}$$

Before doing the calculation, however, it is necessary to convert the weight percent water of the raw paint into volume percent water, V. To do this requires knowledge of the total volume of the water and the raw paint sample.

volume of water = [12.39 g water]/ [1.000 g/ml] = 12.39 ml water
volume raw paint = [30.8404 g paint]/ [1.406 g/ml] = 21.93 ml paint
V = [12.39 ml] / [21.93 ml] x 100% = 56.50 volume percent water

Equation (1) also requires the weight percent volatile organic compounds, W, which is easily calculated as

W = 100% – 40.17% water – 51.42% solids = 8.41% volatile organic

Using these data in equation (1) gives the following

$$C = \frac{[8.41 \times 11.91\ \text{lb/gal}]}{[100\% - 56.50\%]} =$$

2.30 lb/gal VOC less water

C = 276 g/lit VOC less water

RESULTS

The sample calculations have been carried out to evaluate the actual VOC content in order to illustrate the entire process. The main point of discussion in this paper, however, is the development of a method to measure the water content of paint. The role played by the water content in calculating the VOC content is clear from these sample calculations. Therefore, the results of applying the Cal Poly, Pomona refractive index method of water determination may simply be reported here as the appropriate water by weight percentages. These results are presented in *Table* 2 for three commercial paints. Each paint listed in was also analyzed by the KF titration method. The results of the KF titrations are included in *Table* 2 for comparison.

Table 2—Results of Water Determinations Using Cal Poly, Pomona Refractive Index Method with Comparison to Karl Fischer Titration Method

Calibration Equation	Paint 1	Paint 2	Paint 3
Linear (*Figure* 2)	48.97%	41.22%	49.40%
Standard deviation	1.29%	1.88%	2.13%
Quadratic (*Figure* 1)	47.07%	38.70%	46.73%
Standard deviation	2.13%	2.87%	3.03%
KF titration	52.16%	45.52%	52.26%
Standard deviation	2.33%	1.94%	2.90%

DISCUSSION

The information presented in *Table* 2 is convincing evidence of the utility of using refractive index measurements to determine the water content of the latex paints tested. In this study all samples were analyzed by both the traditional KF method and the refractive index method. In this way the KF data serves as a standard for determining the accuracy of the refractive index method. When the standard deviations of the various measurements are taken into account, the values obtained using refractive index measurements agree with those obtained using the traditional KF titration method which is integral to the EPA Method 24. For example, consider paint 1 in *Table* 2. The refractive index method gives a water percentage, using the quadratic equation calibration, in the range of 44.94 to 49.20%. Using the linear equation calibration the water percentage falls in the range of 47.68 to 50.26%. These two ranges overlap one another suggesting that there is no significant difference between the two variations of the refractive index method. The KF titration method gives a range of 49.83 to 54.49% for the water content in paint 1. The KF titration method and the refractive index method using the quadratic calibration equation generate overlapping results. The linear calibration curve of the refractive index method produces results which do not overlap the ranges of either the KF method or those obtained using the quadratic calibration curve of the refractive index method. This is not unanticipated as was pointed out in the Procedure Section.

A more detailed comparison of the refractive index method and the KF method based on the information in *Table* 2 is useful. For each paint the KF method gives a value which is higher than both variations of the refractive index method. There are several ways to interpret this observation. Within plus or minus one standard deviation unit, the quadratic equation calibration method and the KF method produce results which are in agreement. Therefore, statistically the KF method and the refractive index method using the quadratic calibration curve are indistinguishable. Alternatively, since the KF method gives results uniformly higher than either of the refractive

index method variations it might be argued that the refractive index methods are not influenced by the presence of compounds in the paint other than water. The presence of such compounds, which can react with the KF reagent, may lead to higher values for the water content as measured by Karl Fisher titrations. This problem might be avoided by the refractive index method since only water is quantitatively removed by distillation leaving interfering compounds behind. Continued work to determine whether the apparent differences between the two methods are real or simply statistical artifacts, as well as an attempt to assess the influences of impurities which may be present in raw materials is underway.

Table 3 contains the results of experiments that attempt to determine the influence of impurities in propylene glycol used to prepare three different paints. Each of the paints was formulated identically except for the total water percentage. The as-prepared water percentages are indicated in *Table* 3. The propylene glycol used contained an unknown impurity which imparted a distinct yellow color to the propylene glycol. The azeotropic extractions were also found to have a distinct yellow color, indicating that the impurity was co-distilled with the MPA and water. As can be seen in *Table* 3, the water determination shows unacceptably large variation when the refractive index method is used. In the presence of this impurity, even the KF method shows untypically large variation in the water percentages. Regardless of whether the refractive index method or the KF method was used, the result was seriously high compared to the actual as prepared water percentage. The inference is that the impurity is showing up as water independent of the analysis method. Since the nature of the impurity in the commercially obtained propylene glycol was unknown nothing definitive can be concluded based on this set of experiments other than that the purity of raw materials is important. Work is progressing to identify methods to accommodate the problems associated with these impurities.

Table 3—Influence of Propylene Glycol Impurities on Water Percentage Determination

Method		Paint I	Paint II	Paint III
Refractive index (linear curve)	exp 1	51.71	49.42	48.70
	exp 2	63.67	56.41	50.73
Refractive index (quadratic curve)	exp 1	42.52	41.21	42.94
	exp 2	60.75	52.52	45.70
Karl Fischer	exp 1	56.79	54.93	50.66
	exp 2	60.91	55.77	50.99
Actual water percentage		60.00	50.00	40.00

SUMMARY

This new method to determine the VOC content of latex paints is based on a solvent extraction of water from the paint using 1-methoxy-2-propanol (MPA) in an azeotropic distillation. This azeotropic extraction method provides several advantages compared to the traditional ASTM Method D 4017, which is a Karl Fischer titration based technique. In this new method, the water content is determined through the use of refractive index measurements and the use of a calibration curve. Typically only one to two hours is required to complete an individual determination. When combined with the measurement of percent solids, it is possible to determine the VOC content of latex paints.

This new method was used to analyze several actual paints and the results of the water determination were compared to the values obtained using the accepted KF method. In each case the two methods generated results which agree to within experimental error. This new refractive index method appears to have several advantages over other methods available. A significant advantage is the elimination of the use of the KF reagent which is a costly and hazardous substance requiring proper disposal procedures. This method requires only a relatively common and affordable Abbe refractometer as opposed to the expensive Karl Fischer titrators and chromatography equipment needed for other methods. Using this new refractive index method it is possible to quickly perform analyses that are particularly useful for purposes of quality control and assurance, compliance monitoring, and research and development activities.

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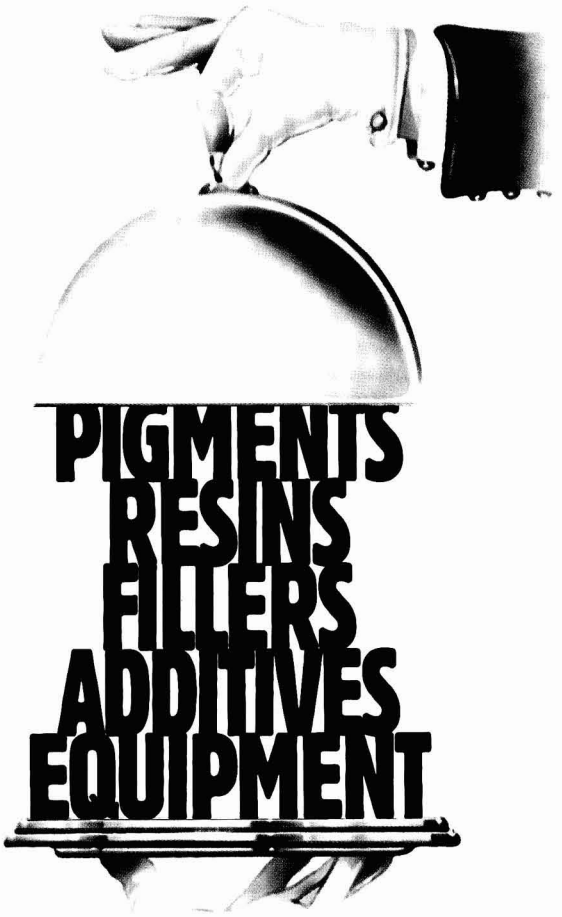

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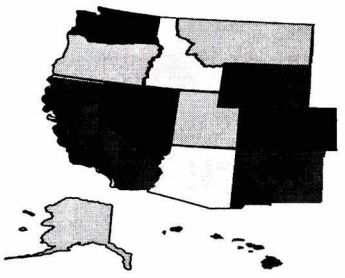

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- Chartwell International
- Ciba Specialty Chemicals
- International Speciality Chemicals
- Keil Chemicals, Div. of Ferro Corp.
- King Industries, Inc.
- Kromachem Ltd.
- K.J. Quinn & Co.
- Ruco Polymer Corp.
- Solvay Interox, Inc.
- U.S. Borax Inc.
- UOP
- Wacker (USA)

U.S. Container
2465 Fruitland Ave.
Vernon, CA 90058
Phone: (213) 589-1000
Fax: (213) 589-9194
Craig Elzinga, V.P. Sales; Gilbert Monarrez, Sales Mgr.
- 1675 Brandywine Ave., Ste. E
  Chula Vista, CA 91911
  Phone: (619) 482-2900
  Fax: (619) 482-2903
  Rick Aikin, Branch Mgr.

Vivion Inc.
929 Bransten Rd.
San Carlos, CA 94070
Phone: (415) 595-3600
Fax: (415) 595-2094
Edward Polesilli, President

Westco Chemicals, Inc.
11312 Hartand St.
N. Hollywood, CA 91605
Phone: (213) 877-0077
Fax: (818) 766-7170
Representing:
- Akzo Nobel
- BK Ladenburg Corp.
- Chemtech Corp.
- Clariant Corp.
- Hoechst Celanese Corp.
- Solvay Inc.

Western Star Color & Chemical Corp.
6377 Drexel Ave.
Los Angeles, CA 90048
Phone: (213) 935-2229
Fax: (310) 594-8880
E-Mail: bkrantz@juno.com
B. Krantz, President
Representing:
- GCI Chemical
- UK Seung Chemical

Whittaker, Clark & Daniels, Inc.
24422 Avenida de La Carlota, # 265
Laguna Hills, CA 92653
Toll Free: (800) 843-1935
Fax: (833) 325-1794
Representing:
- See Corporate Headquarters in New Jersey

Colorado

G-3/Archway Sales, Inc.
14901 E. Hampden Ave., Ste. 155
Aurora, CO 80014
Phone: (303) 690-6776
Fax: (303) 693-6069
John T. Baumstark, President; Gregg M. Peckham; William F. Gleason; E. Randolph Beckman
Representing:
- CasChem, Inc.
- Ciba Additives
- Ciba Plastics
- Columbian Chemical Corp.
- Cookson Pigments
- Disti, Inc.
- Georgia Marble Co.
- Georgia Pacific Resins
- Henkel Corp.
- Heucotech Ltd.
- Hoover Color Corp.
- ICI Polyurethanes
- 3M
- Malvern Minerals Co.
- Mapico Ind.
- Micro Powders, Inc.
- Midwest Zinc
- Millennium Chemicals
- Mountain Mnerlas Co.
- Neville Chemical Co.
- Olin Corp.
- OMG/Mooney Chemicals
- Peninsula Polymers
- Tioxide America, Inc.
- U.S. Borax & Chemical
- Universal Color Dispersions
- R.T. Vanderbilt Co., Inc.
- Wacker Chemicals (USA)
- Witco Organics Div.
- Zeeland Industries Corp.
- Zeneca, Inc.

George C. Brandt, Inc.
1720 S. Bellaire St., Ste. 912
Denver, CO 80222
Phone: (303) 584-0717
Fax: (303) 584-9915
Craig Hansen, Sales Mgr.; Wally McClellan, Sales
Representing:
- ADM Lecithin
- Buckman Laboratories, Inc.
- Central Can Co.
- DuPont Co.
- Eckart America
- Engelhard Corp./Harshaw
- Ferro Chemicals Corp.
- Georgia Marble Co.
- Hoover Color Corp.
- MM Industries, Inc.
- Millennium Inorganic Chemicals
- NYCO Minerals Inc.
- Raybo Chemical
- Reichhold Chemicals, Inc.
- Southcorp Packaging

Harcros Chemicals Inc.
5035 E. 39th Ave.
Denver, CO 80207
Phone: (303) 321-3802
Fax: (303) 322-6387
Michael Freeman, District Mgr.
Representing:
- See Corporate Headquarters in Kansas

New West Sales Corp.
P. O. Box 470130
Aurora, CO 80047
Phone: (303) 368-5140
Fax: (303) 368-8879
Lou Hartnell, President

Walsh & Associates, Inc.
10190 Bannock St., #212
Denver, CO 80221-6051
Phone: (303) 457-3111
Fax: (303) 457-9943
Representing:
See Corporate Headquarters in Missouri

Connecticut

K & S Industries Ltd.
73 Redding Rd.
P.O. Box 297
Georgetown, CT 06829
Phone: (203) 544-9887
Fax: (203) 544-9980
Ken E. Dempsky; Robert K. Dempsky; Brandon R. Dempsky

Robert I. Webber Co., Inc.
35 Corporate Dr.
Trumbull, CT 06611
Phone: (203) 452-3080
Fax: (203) 452-3085
David Webber, V.P.; Dee Whittaker, Secy-Treasurer
Representing:
Cinkarna
Dematco
Metaland International, Inc.
Metasa
OMYA, Inc.
Pluess-Staufer California Inc.
Progressive Fillers
Pyosa/Pyosa Oxides
Westdry Industries, Inc.
Zinc Nacional, S.A.

Delaware

Ray Lyman & Co.
10 Union Station Rd.
Newark, DE 19711
Phone: (302) 234-9355
Ray Lyman
Representing:
Canada Square Resins
Resinall

Thornley Company
1500 E. Newport Pike, Ste. 204
Wilmington, DE 19804
Phone: (302) 993-8300
Fax: (302) 993-8308
Representing:
Avarea Aromatics
Engelhard
Enviro Resins
BFGoodrich
J.W. Hanson
Hi-Mar Specialties
Horizon Aromatics
Mona Industries
Nipa Hardwicke
Specialty Industrial Products
Witco Corp.

Florida

Andes Chemical Corp.
10850 N.W. 30th St.
Miami, FL 33172
Phone: (305) 591-5601
Fax: (305) 591-5607
Fernando Espinosa, President
Representing:
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Akcros Chemicals
ANGUS Chemical Co.
Caschem, Inc.
Catalyst Systems
CR Minerals Corp.
Eastman Chemical Co.
J.M. Huber Corp.
Lipo Chemicals
Luzenac America
McWhorter Technologies, Inc.
Millennium Inorganic Chemicals
Oxy Petrochemicals
Rohm and Haas Co.
Schold Machine Co.
Sud-Chemie Rheologicals
Toyal America
Troy Chemical Corp.

Azalea Color Co.
National Distribution Center
2000 N. 62nd St.
Tampa, FL 33619
Toll Free: (800) 245-2877
Fax: (800) 722-8223
Representing:
See Corporate Headquarters in Georgia

Burks, Incorporated
10951 Brightside Dr.
Tampa, FL 33624
Phone: (813) 968-8306
Fax: (813) 968-8206
Representing:
See Corporate Headquarters in North Carolina

Chemo International Ltd.
13501 S.W. 128th St., Ste. 116
Miami, FL 33186
Phone: (305) 255-0745
Fax: (305) 233-6368
E-Mail: sales@chemo.com
Rob Sajet, President; Joost Sajet, Sales Mgr.; Isreal de la Torre, Purchasing Mgr.
Representing:
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Akzo Nobel, Holland
Burgress Pigment Co.
Canbro, Inc.
CB Mills
Creanova Inc. (Huls)
Datacolor International
Day-Glo Color Corp.
Degussa Canada Ltd.
Dominion Colour Corp.
Dussek Campbell Ltd./OMG
Fluid Management
Paul N. Gardner Co.
Ishihara Kaisha, Ltd.
Keith Machinery
Larand Chemical Corp.
Larvik, Norway
Lightnin
Metaltro, S.A.
Multiquimica Dominicana
Nederlandsche Benzol M., B.V.
Neville Chemical Co.
Nipa Laboratories Ltd.
Nitro Quimica Brasileira
Nordox AS, Norway
Norwegian Talc
Nubiola Pigmentos, S.A.
OMYA, Inc.
Oxidos Rojos de Malaga, Spain
Oxiquim S.A., Chile
Rhodia Inc. (Rhone-Poulenc)
John L. Seators & Co.
SIVA
Union Miniere
U.S. Aluminum, Inc.
U.S. Bronze Powders
U.S. Silica Co.
Vorti Siv

Color Instruments, Inc.
319 Mola Ave.
Ft. Lauderdale, FL 33301
Phone: (954) 525-6044
Fax: (954) 525-5963
James M. Mudge, President

DEEKS & CO., INC.
7601-A Industrial Ln.
Tampa, FL 33617
Phone: (813) 987-9000
Fax: (813) 987-9027
Representing:
See Corporate Headquarters in Georgia

G.L.C. Associates
P.O. Box 789
Ponte Vedra Beach, FL 32082
Phone: (904) 280-9979
Fax: (904) 280-2008
Jerry Chait, President
Representing:
Inoue USA

Gulf Coast Chemical Corp.
101 Wayne Pl.
Tampa, FL 33619
Phone: (813) 623-5471
Fax: (813) 620-0462
Daryl A. Allen, President
Representing:
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Creanova Inc. (Huls)
ECC International
Fawcett Co., Inc.
Ferro Corp.
Fillite North America, Inc.
Filter Technology
Franklin Industrial Minerals
Goodyear Tire & Rubber Co.
Hoover Color Corp.
Polypack, Inc.
Ranbar Technology, Inc.
Reichhold Chemicals, Inc.
Ronningen-Petter
Schold Machine Co.
Shell Chemical Co.
Southern Clay Products
United States Can Co.
Unimin Specialty Minerals, Inc.
R.T. Vanderbilt Co.
Zinc Corp. of America

Harcros Chemicals Inc.
5132 Trenton St.
Tampa, FL 33619
Phone: (813) 247-4531
Fax: (813) 247-7917
Rick Kumming, District Mgr.
Representing:
See Corporate Headquarters in Kansas

Inmark, Inc.
600 Suemac Rd., Ste. 4
Jacksonville, FL 32254-2700
Phone: (904) 786-4991
Fax: (904) 786-4995
Representing:
See Corporate Headquarters in Georgia

JLM Marketing, Inc.
8675 Hidden River Pkwy.
Tampa, FL 33637
Phone: (813) 632-3300
Fax: (813) 632-3301
A. Gwilliam, Product Mgr.
Representing:
Caffaro
Denka
DSM
GE
Sasol

MAJEMAC ENTERPRISES INC.
P. O. Box 5613
Clearwater, FL 34618
Phone: (813) 797-8806
Fax: (813) 791-7291
John P. McMahon; Elizabeth E. McMahon
Representing:
Akzo Nobel
Bronco Mfg. Co.
BYK-Chemie USA
BYK-Gardner Inc.

Colony Industries, Inc.
Columbian Chemicals Co.
Custom Metalcraft
Degussa Corp.
Dry Branch Kaolin Co.
Eagle-Picher
Eagle-Zinc
Floridin
Franklin Industrial Minerals
BFGoodrich Specialty Chemicals & Polymers
Hoover Group
Kaopolite
Kerr-McGee Chemical Corp.
Mayzo
Micro Powders, Inc.
Morton International/Universal Color Dispersions
NYCO Minerals Inc.
Progressive Recovery Inc.
Shepherd Chemical Co.
Silberline Mfg. Co.
Zemex Industrial Minerals

MCCULLOUGH & BENTON, INC.
15822 Fairchild Dr.
Tampa, FL 33647
Phone: (813) 977-6730
Fax: (813) 977-6720
Representing:
See Corporate Headquarters in Georgia

Ocean Optics, Inc.
1237 Lady Marion Ln.
Dunedin, FL 34698
Phone: (813) 733-2447
Fax: (813) 733-3962
E-Mail: Info@OceanOptics.com
Leeward Bean, V.P., Sales/Marketing; Bob Kearton, OEM Development Mgr.

Ribelin Sales Inc.
5129 Causeway BLvd.
Tampa, FL 33619
Toll Free: (800) 374-1603
Phone: (813) 247-1603
Fax: (813) 248-2468
Linda Immel
Representing:
Brockway Standard, Inc.
Bronco
Day-Glo Color Corp.
Eckart America
Elementis Pigments (Harcros)
Engelhard Corp.
Fabricated Metals
Fawcett Co.
Great Lakes Chemical Corp.
Harcros Pigments
ICI Polyurethanes
Ideal Mfg. & Sales Co.
Kronos, Inc.
McWhorter Technologies
Neville Chemical Co.
Olin Corp.
OMYA CalCarbs
Plasticolors Inc.
Rhodia Inc. (Rhone-Poulenc)
Ropak
Schold Machine Co.
Sud-Chemie Rheologicals Inc.
Troy Corp.

Smith Container Corp.
300 S. Pine Island Rd., Ste. 3033
Plantation, FL 33324-2621
Phone: (954) 476-4664
Fax: (954) 476-4661
2901 Titan Row, Ste. 120
Orlando, FL 32809-5690
Phone: (407) 851-8310
Fax: (407) 826-4038
201-B Kelsey Ln.
Tampa, FL 33619-4333
Phone: (813) 620-0013
Fax: (813) 620-0030
Representing:
See Corporate Headquarters in Georgia

Superior Materials Inc.
Southeast Div.
1231 Fairlake Trace #612
Weston, FL 33326
Phone: (954) 473-6973
Representing:
See Corporate Headquarters in New York

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7210 N.W. 77 St.
Medley, FL 33166
Phone: (305) 882-0026
Fax: (305) 885-6756
Viriato Carrillo, President
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Hi-Mar Specialties
Norac (Mathe Div.)
PQ Corp.
PPG Industries
Rheox Inc.
Rhodia Inc. (Rhone-Poulenc)
Toyal America
Westbridge Industries

C.L. Zimmerman Co., FL
913-C S. Parsons Ave.
Brandon, FL 33511
Phone: (813) 681-4414
Fax: (813) 653-0710
Thomas L. Leverone, President; Mike Fitzgerald, V.P., Sales
Representing:
Barretts Minerals
Burgess Pigments
Crosfield Chemicals
Custom Grinders
KT Feldspar
Mineral Mining
OMG/Mooney
K.J. Quinn
Reynolds Metals
Specialty Minerals
Thibault & Walker

Georgia

Alchemy-South, Ltd.
1345 Owenby Dr.
Marietta, GA 30066
Phone: (770) 427-1234
Fax: (770) 427-1857
W.G. Welch, CEO; H.L. Stanton, V.P.; T.H. Welch, President
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Admark International
Amirox Iron Oxides
Arylessence, Inc.
BYK-Chemie USA
BYK-Gardner USA
Columbian Chemicals Co.
ColorMate Dispersions
Genesis Dispersions
Kalama Chemicals
Lancer Dispersions
New Brook International
PolyResyn, Inc.
Rockland React-Rite
Westbridge Industries

Azalea Color Co.
1122 Milledge St.
East Point, GA 30344
Toll Free: (800) 245-2877
Fax: (800) 722-8223
E-Mail: azalea@azaleacolor.com
Keith Standbridge, V.P. Sales; David R. Durr, President
Hewitt and Day Warehouse
1122 Milledge St.
Atlanta, GA 30344
Toll Free: (800) 245-2877
Fax: (800) 722-8223
Representing:
Allied Colloids, Inc.
Arizona Oxides, Inc.
Buckman Laboratories, Inc.
Dominion Colour Co.
Ferro Corp.
Floridin
Kemira Pigments, Inc.
Merisol Antioxidants
Reagens Comiel
Rebus, Inc.
Sachtleben Corp.
Union Camp Corp.
Union Miniere

Baychem, Inc.
3200 Moon Station Rd.
Kennesaw, GA 30144
Phone: (770) 429-1405
Fax: (770) 425-9141
Robert Foley, President; Chris Wescott, V.P. Sales; Mary McGuire, Dir. Purchasing; Bruce W. Pieper, CASE Marketing Mgr.
Represenitng:
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ADM Lecithin
Air Products & Chemicals, Inc.
Akzo Nobel
AlliedSignal
Amspec
Arcadian
Arco Chemical
Aristech
BP Chemicals
Chartwell International
Ciba Polymers
CPS Chemicals
Elf ATOCHEM North America Inc.
FMC
Fairad Technology
Franklin Limestone
Floridin Co.
GE Silicones
Glucona America
Grain Processing Corp.
Huntsman
Koch
Lonza
Mineral Mining
Morflex, Inc.
Nichem
Occidental Chemical Corp.
Penreco
Phillips 66
Rhodia Inc. (Rhone-Poulenc)
Soltex
Solvay Interox
Tego Chemie Service
Tetra
Union Carbide Corp.
Unocal
UOP
U.S. Silica
Velsicol Chemical
Vulcan Chemicals

Burks, Incorporated
P.O. Box 43026
Atlanta, GA 30336
Phone: (404) 691-7640
Fax: (404) 691-4985
Representing:
See Corporate Headquarters in North Carolina

Chempro Specialties, Inc.
1325 Land O'Lakes Dr.
Roswell, GA 30075
Phone: (770) 992-4957
Fax: (770) 594-7605
E-Mail: jiwarsh6837@aol.com
S. Samkowiak
Representing:
Eastron Chemicals
Floridin /ITC
IMV Nevada
Interfibe Corp.
New Riverside Ochre
Pelron Corp.
Phenoxy Associates

DEEKS & CO., INC.
4748 Lewis Rd.
Stone Mountain, GA 30083
Phone: (770) 938-3100
Fax: (770) 491-6238
E-Mail: atlmikebue@aol.com
C.M. Buerkle, V.P.
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Allegheny Chemical
Asheville Mica Co.
Brockway Standard, Inc.
Cleveland Steel
Color Corp. of America
CR Minerals Corp.
Crosfield Co.
DuPont White Pigments
Ferro Corp.
H.B. Fuller Co.
Goodyear Tire & Rubber Co.
Gulf Reduction
Huber Engineered Minerals
New England Plastics
OMYA, Inc.
Reichhold Chemicals, Inc.
Ross Chem
Ross & Rowe
Silberline Mfg. Co. Inc.
Southcorp Packaging
Thor
Unimin Specialty Minerals
U.S. Oxides
R.T. Vanderbilt Co.
Wayne Pigment Corp.
Zinc Corp. of America

Delta Colours
5060 N. Royal Atlantic Dr., Ste. 22
Tucker, GA 30084
Phone: (770) 491-6981
Fax: (770) 934-4376
Shawn Hayes, President; Abe Louw, General Mgr.

Delta Resources, Inc.
5060 N. Royal Atlantic Dr., Ste. 22
Tucker, GA 30084
Phone: (770) 491-6981
Fax: (770) 934-4376
Shawn Hayes, President; Joe Keating, CFO
Representing:
Cimbar Performance Minerals
Delta Colours
Nubiola
Polar Minerals
Rolfes International

Harcros Chemicals Inc.
4030 Farnbrough Dr.
Powder Springs, GA 30217
Phone: (770) 943-8956
Fax: (770) 943-1340
Don Darnell, District Mgr.
See Corporate Headquarters in Kansas

Harwick Standard Distribution Corp.
5380 Peachtree Ind. Blvd., Ste. 210
Norcross, GA 30071
Phone: (770) 368-4033
Fax: (770) 368-8962
Representing:

See Corporate Headquarters in Ohio

Inmark, Inc.
220 Fisk Dr., S.W.
Atlanta, GA 30336
Toll Free: (800) 646-6275
Fax: (404) 267-2021
E-Mail: inmark@mindspring.com
Tim Dooley, Product Mgr.; Kail Jordan, Hazmat Coordinator
Representing:
- Brockway Standard, Inc.
- CKS
- Nalgene
- Rieke

Kinsmen Corp.
214 Permalume Pl., NW
Atlanta, GA 30318
Phone: (404) 355-9550
Fax: (404) 355-2509
James P. Walsh, Jr., President; Terrence J. Walsh, V.P.; John R. Justus, Treasurer
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- Colormate, Inc.
- BFGoodrich Co.
- Kerr-McGee Chemical
- Neupack, Inc.
- Organic Pigments, Inc.
- Raybo Chemical Co.
- Schold Machine Co.
- Shamrock Technologies, Inc.
- Synthetic Products, Co.
- 3V Chemical Co.
- U.S. Aluminum
- U.S. Bronze
- Ziegler Chemical Co.

Kohl Marketing, Inc.
1103 Bombay Ln.
Roswell, GA 30076
Phone: (770) 753-4979
Fax: (770) 753-4980
John M. Behan, V.P.
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- Akzo Nobel, Inc.
- Baerlocher USA
- BYK-Chemie USA
- Campine SA
- Caschem Inc.
- Creanova Inc. (Huls)
- Degussa Corp.
- ECC International
- G.H. Chemicals Ltd.
- Hoover Color Corp.
- Lawter International, Inc.
- Mil International, Inc.
- Milwhite, Inc.
- Polymer Additive Groups
- Scott Bader, Inc.
- Sequa Chemicals, Inc.
- Soluol Chemical Co., Inc.
- Tioxide Americas Inc.
- Ultra Additives, Inc.

LOMAS INTERNATIONAL
P.O. Box 10225
Macon, GA 31297
Toll Free: (800) 652-9297
Fax: (912) 784-1745
E-Mail: lomas@lomas.com
Tom Hilnson, President; Dennis Gillespie, V.P. Sales
Representing:
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- Arizona Chemical Co.
- Bioneer Technologies
- Cardinal Color
- Cimbar Performance Minerals
- Cytec Industries Inc.
- Elf ATOCHEM North America, Inc.
- Everlight Chemical
- K-T Feldspar
- Kentucky-Tennessee Clay
- KMG Minerals
- Lockhart
- Laporte Pigments
- Luzenac America
- Millennium Inorganic Chemicals
- Peninsula Polymers
- Southern Clay Products, Inc.
- Swada Ltd.
- Wacker Silicones
- Zeneca Resins

MCCULLOUGH & BENTON, INC.
1746 N.E. Expressway
Atlanta, GA 30329
Phone: (404) 325-1606
Fax: (404) 329-0208
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- Arde-Barinco
- Bayer, Coatings & Urethane Group
- Bayer, Wolff Walsvode Group
- Bayer Pigments (Bayferrox)
- Burgess Pigments
- CB Mills, Inc.
- Cabot Corp.
- Cabot Corp. (Carbon Blacks)
- CW Brabender
- Datacolor International
- Dianal America, Inc.
- Dow Chemical Co.
- EM Industries, Inc.
- EMI (Eastern Mixers, Inc.)
- Fawcett Co., Inc.
- Fluid Management
- GE Silicones
- General Carbon
- Henkel
- Henkel (Coatings & Inks)
- Henkel (Oleochemicals/Fatty Acids)
- Henkel Plastics
- Henkel Care Chemicals
- Lambiotte & Cie
- Lansco Pigments
- MM Industries/Vorti-Siv Div.
- Marathon Pumps
- Metal Products Co.
- Micro Powders
- Mississippi Lime Co.
- Morton Int'l/UCD Div., Resins
- Morton Int'l./UCD Div., Pigments
- Mountain Minerals
- Myers Engineering
- Neville Chemical Co.
- The Norac Co. (formerly Mathe)
- Pasco
- Raitech
- Sachleben Chemie
- Shell Chemical Co.
- Testing Machines, Inc.
- Thiele Engineering Corp.
- World Minerals (formerly Celite)
- Zircon

Olinger Co., Inc.
P.O. Box 993
Lilburn, GA 30226
Dean Olinger
Representing:
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- Clawson Container
- Custom Packaging
- Eastern Color & Chemical
- Knight Corp.
- Patco Defoamers
- Ranbar Technology
- Schold Machine
- Tytanpol-TiO_2

R.B. Patterson Co., Inc.
6753-C Jones Mill Ct.
Norcross, GA 30092
Phone: (770) 449-3494
Fax: (770) 449-8882
John Segreti, Sales
Representing:
- See Corporate Headquarters in Texas

Ribelin Sales Inc.
5570 Tulane Dr., SW
Atlanta, GA 30336
Toll Free: (800) 374-5570
Phone: (404) 699-5570
Fax: (440) 699-5575
Joe Barber; Jim Goodman
Representing:
- Air Products & Chemicals, Inc.
- Brockway Standard Inc.
- Bronco
- Day-Glo Corp.
- Eckart America
- Elementis Pigments
- Engelhard Corp.
- Fabricated Metals
- Fawcett Co.
- Great Lakes Chemical Corp.
- ICI Polyurethanes
- Ideal Mfg. & Sales Corp.
- Kronos, Inc.
- Lee Industries
- 3M/Zeelan Industries
- McWhorter Technologies
- Midwest Zinc
- Olin Corp.
- OMYA CalCarbs
- Plasticolors, Inc.
- Rhodia Inc. (Rhone-Poulenc)
- Ropak
- Schold Machine Co.
- Solutia Inc.
- Sud-Chemie Rheologicals Inc.
- Troy Corp.

Scientific Polymers Inc.
1534 Dunwoody Village Pkwy., # 225
Atlanta, GA 30338
Phone: (770) 394-3990
Fax: (770) 394-2690
Representing:
- AmSolv
- Chemstar Products Co.
- Damron Chemicals Co., Inc.
- Morton International
- Penn-Carbose, Inc.
- Quimica-Amtex

SEEGOTT INC.
70 Mansell Ct.
Roswell, GA 30076
Toll Free: (888) 733-4688
Phone: (770) 594-5353
Fax: (770) 594-5344
David B. Meier, V.P.; Russ Brewer, Area Sales Mgr.
Representing:
- Akzo Nobel Chemicals
- BASF Corp., Colorants
- BASF Corp., Dispersions
- BASF Corp., Polyurethanes
- CFF, Cellulose Filler Factory
- Calgon Corp.
- Cardolite Corp.
- General Electric Silicones
- Hampshire Chemical Corp.
- Hitox Corp. of America
- Inolex Chemical
- OxyChem, Durez Div.
- PolySat Inc.
- Rhodia Inc. (Rhone-Poulenc)
- U.S. Silica Co.
- Witco Corp.

Ed Simal & Associates, Inc.
1356 Milledge St.
Atlanta, GA 30344
Phone: (404) 761-7961
Fax: (404) 761-7274
Representing:
- American Lecithin Co.
- Blue Ridge Talc Co.
- Dexter Chemical Co.
- Disti-Kleen Inc.
- Draiswerke Mannheim
- Eagle Zinc
- Elementis Specialties
- EPS Polymers
- Fanning
- J.M. Huber Corp.
- King Industries Inc.
- Malvern Minerals Co.
- NYCO Minerals Inc.
- Shepherd Chemical Co.
- The Sherwin-Williams Co.
- Spencer Machine & Tool Co., Inc.
- United Mineral & Chemical Corp.
- Western Equipment Co.

Smith Container Corp.
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Millennium Inorganic Chemicals
NYCO Minerals Inc.
OM Group Inc.
OMYA, Inc.
Quackenbush Co.

Scholle Corp.
Solutia Inc.
The Sherwin-Williams Co.
Solvay Interox Ltd.
Toyo Ink America Inc.
Wilkinson Kaolin Associates, Inc.
Zinc Corp. of America

D.A. Campbell & Co., Inc.
6001 Cochran Rd., #A-202
Solon, OH 44139
Phone: (216) 498-9100
Fax: (216) 498-9105
Gary Whewell, President; Tom Dressel, V.P.; Mike Wright, Sales; George Bless, Exec. V.P.; Dave Morris, Sales
Representing:
Alcoa Powder Div.
Aluchem
Arizona Oxides, Inc.
Aspect Minerals
Cabot Corp.
Carborundum
Chartwell International Inc.
Colloids (Rhone-Poulenc)
Cookson Pigments
Dianal America, Inc.
DuPont
Dussek Campbell Ltd.
Fibertec
ECC International Inc.
Interfibe Corp.
KT Clay Co.
Magnesium Elektron, Inc.
Metsa-Serla
Milwhite
Resinall
Rhodia Inc. (Rhone-Poulenc)
Silberline Mfg. Co. Inc.
Silbrico
Suzorite Minerals Products
Thibaut & Walker Inc.
Unimin Specialty Minerals
Ur-Cryl Polymer Corp.

R.E. Carroll, Inc.
1779 Mavvo Dr.
Akron, OH 44306
Phone: (330) 724-8284
Representing:
See Corporate Headquarters in New Jersey

Chem-Materials Co., Inc.
16600 Sprague Rd.
Cleveland, OH 44130-6318
Phone: (440) 243-5590
Fax: (440) 243-1940
R. Morsek, President
Representing:
Alcan Chemicals
Arakawa Chemicals
Aztec Peroxides Inc.
Caffaro
Elementis Specialties
Expancel
Fillite
General Carbon Co.
Lucas Meyer
Mathe-Norac
Ogleby-Norton
Piqua Materials
Schnectady Canada
Songwon Color
Tego Chemie Service USA
R.T. Vanderbilt Co.

DAR-TECH, INC.
16485 Rockside Rd.
Maple Heights, OH 44137-4336
Phone: (216) 663-7600
Fax: (216) 663-8007
Walt Walburn, President; Jim Benduhn, V.P., Sales/Marketing
Representing:
ADM Lecithin
Automation
Burgess Pigment
BYK-Chemie USA
BYK-Gardner, Inc.
Cimbar Performance Minerals
Creanova Inc. (Huls)
CVC Specialty Chemical
Dominion Colour Corp.
Eagle Picher
Fawcett
Hampshire Chemical
K-T Feldspar Corp.
KMG Div., Franklin Industrial Min.
Lonza Inc.
Luzenac America
3M/Zeelan
Micro Powders Inc.
Ohio Polychemical Co.
PPG Industries, Inc.
SEPR Quartz Prod.
Tioxide America Inc.

DEEKS & CO., INC.
6615 Corporate Dr.
Cincinnati, OH 45242
Toll Free: (800) 489-6654
Phone: (513) 489-1300
Fax: (513) 489-1303
G. Neal Overbey, President; Neil J. Stubbers, V.P., Sales/Marketing
1303 Rustic Trail
Parma, OH 44134
Toll Free: (800) 489-6654
Phone: (440) 884-1339
Fax: (440) 884-1339
Representing:
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American Tartaric
Asheville Mica
Borden Chemical (Graphic Div.)
Cargill Inc.
Central Can Co.
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Crosfield Co.
Crucible Chemical Co.
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Dussek Campbell
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Leneta Co.
Letica Corp.
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Silberline Manufacturing Co.
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Synthron Specialty Chemicals
Universal Color Dispersions
R.T. Vanderbilt Co.
Wayne Pigment Corp.
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Deery Chemical, Inc.
19615 Lake Rd.
Cleveland, OH 44116-1847
Phone: (440) 331-0350
Fax: (440) 331-7197
J. Roger Deery
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Durr Marketing Associates Inc.
Wisco Warehouse

2525 E. 93rd St.
Cleveland, OH 44104
Toll Free: (800) 937-3877
Fax: (412) 829-7680
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Cincinnati, OH 45242
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Fax: (513) 984-8883
Jim Flanagan, President
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Etna Products, Polyester Resins
Paar Physica USA, Rheometer
Patco Defoamer, Additives Div.

Harwick Standard Distribution Corp.
60 S. Seiberling St.
Akron, OH 44305
Phone: (330) 798-9300
Fax: (330) 798-0214
Kurt S. Nygaard, V.P. Sales & Marketing; John E. Semdnin, V.P. Technical
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Ferro Polymer Additives Div.
Flexsys America
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Grace Davison
Hercules Inc.
Huber Engineered Minerals
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Natrochem Inc.
U.S. Borax

J.H. Hinz Co.
2001 Crocker Rd.,Ste. 350
Westlake, OH 44145
Phone: (440) 871-3333
Fax: (440) 871-3333
E-Mail: jhhinz@msn.com
Gary E. Peacock, President; Tami L. Furlong, Office Mgr.
3552 Stonecreek Rd., Ste. B
Cincinnati, OH 45209
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Fax: (513) 321-9914
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Flavormatic Industries
Goldmont International Corp.
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Itochu Specialty Chemicals
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Millenium Specialty Chemicals
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Solvay Performance Chemicals
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Tayca Chemical Co.
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Fax: (330) 948-4067
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Freeman Environmental
W.T. Golding
Hukill Chemical
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Lakewood, OH 44107
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Fax: (216) 221-0552
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American Aromatics
Century Container
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U.S. Bronze
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20800 Center Ridge Rd.
Rocky River, OH 44116
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Fax: (440) 356-0503
E-Mail: RLajack@aol.com
Representing:
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Compass
Grovhac
Ideal Manufacturing Co.
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Kwality Equipment Co.
PC Lecithin
PCI Group
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MAROON INC.
26145 First St.
Westlake, OH 44145
Phone: (216) 892-3900
Fax: (216) 892-2008
Anthony Maroon, President; Mark Reichard, Senior V.P.; Mark Maroon, V.P.; Michael Maroon, V.P.
Sales Offices: Cleveland, OH; Cincinnati, OH; Louisville, KY; Chicago, IL; Detroit, MI; Lansing MI
Distribution Center: Cleveland, OH; Pittsburgh, PA; Cincinnati, OH; Buffalo, NY; Chicago, IL; Detroit, MI
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Allstate Can Co.
Aldoro
Alphachem
Buckman Laboratories
CCP Inc.
Chemie Uetikon
Central Can Co.
Cellulose Filler Factory
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Cytec Industries, Surfactants Div.
Cytec Industries
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Dicalite Div., Grefco
Dicaperl Div., Grefco
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Kemira Pigments OY
Kumyang Co., Ltd.
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Phenoxy Specialties
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Neuman Associates, Inc.
911 Beachside Ln.
Huron, OH 44839
Phone: (419) 433-2530
Fax: (419) 433-4419
E-Mail: eneuman@neumanassoc.com
Emil C. Neuman, President
Representing:
Chemionics Corp.
Itochu Specialty Chemicals
Key Polymer
NKK Mica
Quaker Color
Tayca Corp.
Toyal Aluminum
United Color Technology
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Palmer Supplies Co.
3607 W. 56th St.
Cleveland, OH 44102-5796
Phone: (216) 631-2200
Fax: (216) 631-3543
Web: www.palmersupplies.com
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Bayer Corp.
Baerlocher USA LLC
Brockway Standard Inc.
Calgon Corp.
Cray Valley, Ltd.
Degussa Corp.
Dow Chemical
Halox Pigments
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ICI Polyurethanes
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Ideal Mfg. & Sales Corp.
Kronos, Inc.
MD-Both Industries
Schold Machine Co.
Scott Bader, Inc.

Southcorp Packaging USA Inc.
Southern Clay Products, Inc.
TML Industries Ltd.
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12080 Best Pl.
Cincinnati, OH 44102-5796
Phone: (513) 772-0800
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Web: www.palmersupplies.com
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American Colors Inc.
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Dow Chemical
Halox Pigments
Huber Engineered Minerals
ICI Polyurethanes
ICI Surfactants
Ideal Manufacturing & Sales Co.
Krete Industries
Kronos, Inc.
Lander-Segal Color Co.
M.D. Both Industries
Schold Machine Co.
Scott Bader, Inc.
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Cincinnati, OH 45211
Toll Free: (800) 755-7795
Phone: (513) 574-0220
Fax: (513) 574-5479
E-Mail: roettker@frontiernet.net
Donald Roettker, President; Richard Roettker, V.P.
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Cimbar Performance Minerals
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ECCI Performance Minerals
Evans Clay Co.
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Schabel Products Corp.
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Cleveland, OH 44135
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Fax: (216) 267-4248
Norman G. Schabel, Jr., President
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West Chester, OH 45069
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Fax: (513) 755-1117
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CPS Chemical
Dock Resins Corp.
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Glitterex Corp.
Global Stone
Intercorp
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Mountain Minerals Co.
OMYA Canada
Southern Clay Products
U.S. Gypsum Co.
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Schibley Chemical Co., Inc.
3136 W. 63rd St.
Cleveland, OH 44102
Phone: (216) 631-4280
Fax: (216) 631-8282
Paul Asadorian
7659 Montgomery Rd.
Cincinnati, OH 45236
Phone: (513) 891-8850
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Hampshire Chemical Co.
McWhorter Technologies
Rhodia Inc. (Rhone-Poulenc)
Unichema
Venus-Gusmer
Witco Corp.

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10040 Aurora-Hudson Rd.
Streetsboro, OH 44241
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Phone: (330) 528-0808
Fax: (330) 528-0675
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BASF Corp, Dispersions
BASF Corp., Polyurethanes
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CasChem, Inc.
Celite Corp.
DuPont, PTFE (TEFLON®)
DuPont, TiO_2
Eckart America
Elementis Pigments, Inc
General Electric Silicones
Goodyear Chemical
Inolex Chemical Co.
OxyChem, Durez Div.
PPG Industries/Mazer Chemicals
Raybo Chemical Co.
Rhodia Inc. (Rhone-Poulenc)
Schuller International
Shell Chemical Co.
Specialty Minerals Inc.
UOP
U.S. Polymers
U.S. Silica Co.

Sexton & Co., Inc.
1850 West Galbraith Rd.
Cincinnati, OH 45239
Phone: (513) 931-1925
Fax: (513) 931-7455
E-Mail: sextoninc@juno
Ronald R. Sexton, President; Timothy A. Sexton, V.P.
Representing:
Acro, Inc.
Aqueous Concepts
BAG Corp.
Decorative Color & Chemical
FIBC Recycling
BFGoodrich SP&C
New Riverside Ochre
Shamrock Technologies
Shepherd Chemical Co.
Union Camp Corp., Chem. Div.

Donald McKay Smith, Inc.
26016 Detroit Rd., Ste. 7
Westlake, OH 44145
Phone: (440) 808-6060
Fax: (440) 808-6070
Michael J. Grady, President
Representing:
T.J. Bell, Inc.
Cargill, Inc.
Cleveland Container Recycling
Corrostabil International
Florida Chemical Co.
H & C Industries
Hoover Color Corp.
International Resources
MiniFIBERS, Inc.
K.J. Quinn, Inc.
Werner G. Smith, Inc.
P.L. Thomas & Co., Inc.
Troy Corp.
Unimin Corp.
Universal Color Dispersion

Western Reserve Chemical Corp.
4837 Darrow Rd.
Stow, OH 44224
Phone: (216) 650-2244
Fax: (216) 650-2255
E-Mail: wrccstow@worldnet.att.net
Ronald Anderson, President; David Jividen, V.P.; Maria Baughman, Customer Service
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Cortec Corp.
Globtrade
G.H. Chemical
Hedman Resources
Lindau Chemicals
Martin Marietta
Polysat
Rockland React-Rite
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Wininger & Associates
28450 Bradner Rd.
Millbury, OH 43447
Phone: (419) 836-5151
Fax: (419) 836-5151
Bob Wininger, President
Representing:
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Century Container Co.

C.L. Zimmerman Co.
5493 Union Centre Dr.
West Chester, OH 45069
Phone: (513) 860-9300
Fax: (513) 870-5210
Web: www.clz.com
John Stephens, President; Mark Leverone, V.P. Sales & Marketing; Mike Davis, Operations Mgr.
183 Clearwater Dr.
Brunswick, OH 44212
Phone: (330) 273-0046
Fax: (330) 220-4350
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Addiment
American Fillers & Abrasives
Arizona Chemical Co.
Berry Plastics
Central Can
Crandall International
Creanova, Inc. (Huls)
Crystal
Custom Grinders
Custom Package Co.
Custom Metalcraft
Degen Oil
Degussa Corp.
Eckart Aluminum
Elf ATOCHEM North America
Elementis Pigments
Engelhard Corp.
Filter Technology
Glen Mills
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Kimtech
Olcott Plastics
Phoenix Container
Potters Industries
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Rieke Corp.
RLM Industries
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Saskatchewan Minerals
Specialty Minerals
SST Industries
U.S. Can
Zemex Mica
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Oklahoma

Crozier-Nelson Sales, Inc.
5400 N. Grand Blvd., Ste. 100-R
Oklahoma City, OK 73112
Phone: (405) 943-4120
Fax: (405) 943-4765
Representing:
See Corporate Headquarters in Texas

Harcros Chemicals Inc.
3909 S. Meridian Ave.
Oklahoma City, OK 73119
Phone: (405) 685-7741
Fax: (405) 685-0626
3810 South Elwood
Tulsa, OK 74107
Phone: (918) 446-1555
Fax: (918) 446-1304
William Ardey, District Mgr.
Representing:
See Corporate Headquarters in Kansas

Smith Container Corp.
3685 S. 73rd East Ave.
Tulsa, OK 74145-3216
Phone: (918) 663-7265
Fax: (918) 663-7268
Representing:
See Corporate Headquarters in Georgia

Oregon

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2727 N.W. Industrial
P.O. Box 10763
Portland, OR 97210
Phone: (503) 243-1082
Fax: (503) 243-1162
Donald J. Cruickshank, President
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Burgess Pigment Co.
Cargill Technical Oils
Columbia River Carbonates
Columbian Chemicals Co.
Creanova Inc. (Huls)
Dianal America, Inc.
Dominion Colour Co. Ltd.
Dover Chemical Corp.
Ferro Corp., Polymers Additives
Floridin Co.
Franklin Ind. Minerals, KMG Div.
ndustrial Containers Ltd.
Interfibe Corp.
Luzenac America
Morton Water Based Polymers
Mountain Minerals Co. Ltd.
OMYA/Pluess Staufer
PG Lecithin
PQ Corp.
K.J. Quinn & Co., Inc.
Solomon Colors, Inc.
Tioxide Americas Inc.
Toyal America, Inc.
Unimin Specialty Minerals, Inc.
U.S. Can Co.
Wacker Silicones corp.
World Minerals, Inc.
Zinc Corp. of America

Cordano Chemical Co.
3460 NW Industrial
P.O. Box 10103
Portland, OR 97210
Phone: (503) 228-8369
Fax: (503) 228-9124
William C. Cordano, President
Representing:
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Arizona Oxides
BYK-Chemie

BYK-Gardner
Central Can
CED Process Minerals
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Degussa Corp.
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Engelhard Corp.
Garrison Industries
Hitox Corp.
Ishihara
Keil Chemical
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OMG
Poly Resyn
Reichhold Chemical
Royce Associates
Southcorp Packaging
Southern Clay Products
Southline Metal Products

E.T. Horn Company
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Fax: (716) 670-6851
E-Mail: ethorn@ethorn.com
Air Product-Surfynols
American Lecithin Co.
Arizona Chemical
Bayer-Baylith
Bayer-Coatings Div.
Bayer-Iron Oxides
Cyprus Foote Mineral Co.
Dodwell
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Goldschmidt Corp.
Goodyear Chemical Co.
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Ohio Polychem
Phenoxy Specialties
Progressive Fillers Int'l. Inc.
Shin-Etsu Silicones
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Union Carbide Corp.
Velsicol Chemical
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3M/Specialty Additives
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8040 NE Sandy
Portland, OR 97213
Phone: (503) 288-2577
Fax: (503) 280-7917
Representing:
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PACIFIC COAST CHEMICALS CO.
2720 N.W. 35th
Portland, OR 97210
Phone: (503) 241-8241
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3339 NW 26th Ave.
Portland, OR 97210
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7631 N. Upland Dr.
Portland, OR 97203
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Phone: (503) 222-1303
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2627 NW Nicolai
Portland, OR 97210
Phone: (503) 241-3520
Fax: (503) 241-8040
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Drew Industrial
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BFGoodrich
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Milwhite Inc.
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Shamrock Technologies Inc.
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Tego Chemie Service (USA) Inc.

Pennsylvania

Blue Bell Chemical Corp.
60 S. Trooper Rd.
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Phone: (610) 630-8040
Fax: (610) 630-8843
John Paytas, President; Jerry Hurlbrink, V.P.
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Chamber & Ella Sts.
McKees Rocks, PA 15136

MCC Warehousing, Inc.
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Bridgeport, PA 19405

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Degussa Corp.
Floridin/ITC Industrials
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Kemira Pigments, Inc.
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Merisol Antioxidants
Neville Chemical Co.
PPG Industries, Inc.
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Rebus, Inc.
Sachtleben Corp.
U.S. Silica Co.
Union Camp Corp.
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5700 Tacony St.
Philadelphia, PA 19135
Fax: (215) 537-8575
Toll Free: (800) 423-7423
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CPS Chemical
Cabot Corp.
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Ceepree Products
Cellulose Filler Factory
Dover Chemical
E.I. DuPont
Eastman Chemical Co.
Franklin Industrial Minerals
GE Silicones
Georgia Pacific
Huber Chemical
Huntsman Corp.
3M Engineer Materials
McWhorter Technologies
Mountain Minerals
NYCO, Inc.
Penreco
Phenoxy Specialties
Solutia
Specialty Minerals
U.S. Gypsum
U.S. Silica
Union Camp
Union Carbide Corp.
Vianova Resins
Witco Corp.

FBC Chemical Corp.
Box 599
Mars, PA 16046
Phone: (724) 625-3116
Fax: (724) 625-1640
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Hi-Mar
Huntsman Chemical Co.
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Mason Chemical
Millennium Specialty Chemicals
Oxychem Corp.
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Rhodia
Shell Chemical Co.
Tomah Products
Union Camp Corp.
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101 Surrey Rd.
Melrose Park, PA 19027-2931
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Kady International
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Potters Industries, Inc.
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Red Devil Dispensers & Shakers
Reliance Universal Nitro/Soln
Russell Finex Inc.
SEFA Steel Balls
Shamrock Technologies, Inc.
Sheen Instruments
Taber Engineering
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317 Davisville Rd.
P.O. Box 1066
Willow Grove, PA 19090
Phone: (215) 657-6800
Fax: (215) 657-6244
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Borden Chemical Co.
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Protective Lining Corp.
R.T.D. Chemicals Corp.
Royal Oak Enterprises, Inc.
U.S. Aluminum
U.S. Bronze Powders
U.S. Coatings Technology
Wright Corp.

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1103 Roberts Ave.
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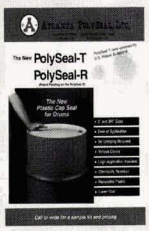
Atlanta Polyseal, Ltd., manufactures plastic cap seals for metal, plastic, and steel drums. The PolySeal-T and PolySeal-R are designed for use on steel drums. A PolySeal-U is being developed for universal use on most plastic drums. The caps are available in 2 in. and 3/4 in. sizes and can be applied without the use of a crimping tool. This product is made of recyclable plastic and is chemically resistant.



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Super Liqua-Bin®

FABRICATED METALS INC.

Fabricated Metals Inc. has introduced the Super Liqua-Bin®, pressurized IBC with a working pressure of 12 psi, all stainless steel construction. Other features include: UN31A label and specifications, 350 gallon capacity, dished and flanged top and bottom, center discharge with two-inch SS ball valve, 18-in. manway w/pressure/vacuum vents, two-inch bung and plug, interlocking four-way fork entry, and stainless stacking guard: bins stack three high.

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All-Purpose Drums

SKOLNIK INDUSTRIES, INC.

A series of all-purpose, 14-in. diameter drums is being offered by Skolnik Industries, Inc. Designed for a wide range of shipping, storing, and handling needs, the Series 14 drums are available in a variety of gallonages. Included is a new 5-gal capacity for basic packaging and lab packs; 8- and 10-gal sizes with bottoms which are not necked in; and a UN-tested 16-gal size.

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Can Crusher

TEEMARK CORP.

The new Super 6P-J Can Crusher from TeeMark Corp. empties and ejects cans and pails in sizes ranging from one to six gallons. In one continuous and automatic cycle, the crusher pierces the can or pail, squeezes out the contents, crushes it flat, and tosses it into a container. Crusher cycle times of 12 to 20 sec. are available. The explosion proof crusher is powered by a standard 115/230 volt single phase electrical circuit, with a 230/460 three-phase motor option for high-speed applications. An air powered unit is also available.

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TeeMark Corp.

TEEMark

New Can and Pail Crusher

From half pints to 110 gallons, TeeMark Crushers help prepare containers and their contents for recycling or disposal.

'eeMark is pleased to introduce a **NEW CRUSHER FOR CANS AND 'AILS**.

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So there is no need to pry off can ids or remove crushed containers. 'hat means higher throughput, less ness and reduced injury potential.

Manufacturers can now reprocess heir unusable paint or ink without ›aying disposal fees for empty cans. 'he other good news is that eeMark customers are selling their rushed cans to scrap dealers.

All five TeeMark can and pail rushers are automatic and completely explosion-proof for ***safe and fficient*** operation.

:all us today about all of your ontainer crushing needs!

Super 6P-J automatically ejects crushed cans and pails. 1-gallon and larger cans and pails are crushed and ejected by the Super 6P-J. Ejection system proven on millions of cans!

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KANSAS CITY—JANUARY

"Raw Material Cost Savings"

President Curry Sanders, of Tnemec Co., Inc., announced that ICE '98 is scheduled for October 14-16 in New Orleans, LA.

Technical Committee Chair Yasmine Sayed Sweet, of CCP, invited all members to attend the Society's one-day symposium on March 17.

Educational Committee Chair Robert Risner, of Weskem-Hall Inc., announced that he is seeking volunteer judges for the Science Fair.

Randy Ehmer, of Walsh & Associates, Inc., announced that the joint meeting between the Kansas City and St. Louis Societies will be held on June 5-6 in Lake of the Ozarks, MO.

Piedmont Society member Jan Weernink, of Zeneca Pigments and Additives, was the evening's speaker. He explained methods of raw material cost savings and increased productivity.

Mr. Weernink reported on a method that uses an effective dispersant for implementation. Finding the correct dispersant will increase pigment wetting, aid in mechanical separation of the pigment agglomerates, and stabilize the paint. This results in higher tint and hiding strength. In addition, using the correct dispersant will increase your gloss and lower haze.

TOM HILTON, *Secretary*

NORTHWESTERN—FEBRUARY

General Membership Meeting

President Michael Coad, of McWhorter Technologies, announced that the Technical Symposium will be held March 10, at the Airport Marriott. The topic is "Surfactants for Formulating Waterborne Coatings."

Rebecca Alm, of the Minneapolis College of Art and Design, discussed "THE FICKLE NATURE OF COLOR."

Constituent Society Meetings and Secretaries

BALTIMORE (Third Thursday—Martin's West, Baltimore, MD). STEPHANIE ROTHENBERG, Thomley Co., 1500 E. Newport Pike, Ste. 204, Wilmington, DE 19804.

BIRMINGHAM (First Thursday—Strathallan Hotel, Birmingham, England). GRAHAME W. FOWKES, Technivelopments Co., 14 Wells Close, Chippenham, Wilts. SN14 0QD, England.

CDIC (Second Monday—Location alternates between Cincinnati, Columbus, Dayton, and Indianapolis). BRIAN P. MARZANO, Sun Chemical Corp., 5020 Spring Grove Ave., Cincinnati, OH 45232.

CHICAGO (First Monday—The Ambassador Restaurant, Elmhurst, IL). SUSAN A. SIMPSON, Chemcept Services, 2 South 902 Heritage Glen Ct., Batavia, IL 60510-5100.

CLEVELAND (Third Tuesday—Monthly meeting site to TBA). PATRICIA WAGLE, The Flood Co., 1212 Barlow Rd., Hudson, OH 44236.

DALLAS (Second Thursday following first Wednesday—Dallas Medallion Hotel, Dallas, TX). JOSEPH HILBUN, The Sherwin-Williams Co., 2802 W. Miller Rd., Garland, TX 75041.

DETROIT (Second Tuesday—meeting sites vary). NAOMI SUSS, PPG Industries, Inc., 5875 New King Ct., P.O. Box 3510, Troy, MI 48007.

GOLDEN GATE (Monday before third Wednesday—alternates between Francesco's in Oakland, CA, and Bertolucci's in S. San Franscisco, CA). TIMOTHY G. SPECHT, Flecto Co., 1000 45th St., Oakland, CA 94608.

HOUSTON (Second Wednesday—Medallion Hotel, Houston, TX). STEVEN RAGSDALE, Intercoastal Paint, P.O. Box 38114-433, Houston, TX 77238.

KANSAS CITY (Second Thursday—Cascone's Restaurant, Kansas City, MO). THOMAS HILTON, Weskem-Hall, Inc. 1424 Atlantic Ave., N. Kansas City, MO 64116.

LOS ANGELES (Second Wednesday—Maggie's Pub, Santa Fe Springs, CA). DARIN EVERHART, Behr Process Corp., 3400 W. Barry St., Santa Ana, CA 92704.

LOUISVILLE (Third Wednesday—Executive West Motor Hotel, Louisville, KY). CAROL WINSLOW RAPP, Dar-Tech, Inc., 101 Glenmill Rd., New Albany, IN 47150.

MEXICO (Every fifteen days—Gabriel Mancera, Mexico City, Mexico). MANUEL MAESTRO NAVARRO, DuPont, S.A. de C.V., Km. 9.5 Via Dr. Gustavo Baz, Col. Barrientos, 54110 Tlalnepantla, Edo de Mexico, Mexico.

MONTREAL (First Wednesday— Restaurant Le Bifthèque, St. Laurent, Quebec). ROBERT BENOIT, Kronos Canada Inc., 3390 Marie Victorin, Varennes, Que., J3X 1T4 Canada.

NEW ENGLAND (Third Thursday—Best Western TLC, Waltham, MA). GARY SMALL, Zeneca Resins, 730 Main St., Wilmington, MA 01887-3366.

NEW YORK (Second Tuesday—Landmark II, East Rutherford, NJ). E. ROBERT CARDIN, Rohm and Haas Co., 16 Meadowview Dr., Colts Neck, NJ 07722.

NORTHWESTERN (Second Tuesday—Jax Cafe, Minneapolis, MN). ROBIN L. NORCUTT, George C. Brandt, Inc., 2975 Long Lake Rd., St. Paul, MN 55113.

PACIFIC NORTHWEST (PORTLAND SECTION—Tuesday before third Wednesday—Saylors Old Country Kitchen; SEATTLE SECTION—Third Wednesday—All City Diner; VANCOUVER SECTION—Thursday after third Wednesday—Abercorn Inn, Richmond, B.C.). KELVIN HUGET, Imasco Minerals, Inc., 19287 98A Ave., Surrey, B.C. V4N 4C8, Canada.

PHILADELPHIA (Second Thursday—Doubletree Guest Suites, Plymouth Meeting, PA). NEIL R. SHEARER, Andek Corp., P.O. Box 392, Moorestown, NJ 08057.

PIEDMONT (Third Wednesday—Woman's Club of High Point, High Point, NC). RANDOLPH G. COX, Akzo Nobel Coatings Inc., 1431 Progress St., P.O. Box 2124, High Point, NC 27261.

PITTSBURGH (Second Monday—Montemurro's Restaurant, Sharpsburg, PA). JOHN GILLEN, J.M. Gillen Co./Van Horn, Metz & Co., 681 Millers Run Rd., P.O. Box 428, Cuddy, PA 15031.

ROCKY MOUNTAIN (Monday following first Wednesday—DelMonico Hall, Denver, CO). GEORGETTE SIPARSKY, TDA Research, 12345 W. 52nd Ave., Wheat Ridge, CO 80033.

ST. LOUIS (Third Tuesday—The Salad Bowl Restaurant, St. Louis, MO). NICHOLAS HALL, U.S. Paint Corp., 831 S. 21st St., St. Louis, MO 63103.

SOUTHERN (GULF COAST SECTION—third Tuesday; 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). DALE KENKNIGHT, Akzo Nobel Coatings Inc., 6369 Old Peachtree Rd., Norcross, GA 30071-1780.

TORONTO (Second Monday—Speranza Restaurant & Banquet Hall Convention Centre, Brampton, Ont., Canada). FRANS GROOTVELD, Ciba Pigments, 6860 Century Ave., Mississauga, Ont., L5N 5N3, Canada.

Western New York—Marko Markoff, 182 Farmingdale Rd., Cheektowaga, NY 14225.

Ms. Alm explained the basics of color perception and how light strikes objects, absorbs and/or reflects different color waves, and how our eyes receive these sensations. In addition, the speaker covered color blends, color shift, and simultaneous contrast based on background contrast, etc.

ROBIN NORCUTT, *Secretary*

PHILADELPHIA—FEBRUARY

"New Product Development"

President Pat Peterson, of ARCO Chemical Co., reminded the members that the Eastern Training Conference and Show is scheduled for May 11-14, at the Valley Forge Convention Plaza, in King of Prussia, PA. Ms. Peterson stressed the need for volunteers to help with registration.

John Bard, of the Aqualon Division of Hercules Incorporated, presented "NEW PRODUCT DEVELOPMENT USING THE STAGE-GATE PROCESS."

According to Dr. Bard, companies in the early '90s that focused on cost control shifted their focus to growth by acquisition and new product development in the late 90s. Dr. Bard described a new product development process that involves 13 steps from initial screening to market launch. At each step of development, progress is measured to assess quality and thoroughness of the project. These steps are known as stage gates. Key process elements are cross-functional teams, high-level cross functional gatekeepers, established gate criteria, formal idea submission system and process managers. The gatekeepers who are resource holders control whether an idea passes each of the 13 gates. Gate criteria include a clear product concept, whether it fits the corporate mission, positive customer response (intent to purchase), good market characterization, meets financial hurdles, intellectual property strategy, environmental and regulatory issues, product stewardship, and finally the action plan.

NEIL R. SHEARER, *Secretary*

JCT JOURNAL OF COATINGS TECHNOLOGY

Future Society Meetings

Baltimore

(May 21)—Manufacturing—Speaker to be Announced.

Birmingham

(May 1)—68th Annual General Meeting.

Chicago

(May 8)—Annual Awards Banquet.

Cleveland

(May 19)—"COLORFUL ART PAINTING"—Kenneth Be, Cleveland Museum of Art.

Golden Gate

(May 18)—"PERFORMANCE ENHANCEMENTS THROUGH CONTROL OF SPECIAL INTER-PIGMENT PHENOMENA"—Edward Orr, BYK-Chemie.

Kansas City

(May 14)—Education Night.
(June 5-6)—Joint Meeting with St. Louis Society. Holiday Inn, Lake of the Ozarks, MO.

Los Angeles

(May 13)—"PERFORMANCE ENHANCEMENTS THROUGH CONTROL OF SPECIAL INTER-PIGMENT PHENOMENA"—Edward Orr, BYK-Chemie.

Montreal

(May 6)—"POST-CONSUMER PAINT: STATUS ON PROPOSED LEGISLATION"—CPCA.

Phoenix

(May 12)—"PERFORMANCE ENHANCEMENTS THROUGH CONTROL OF SPECIAL INTER-PIGMENT PHENOMENA"—Edward Orr, BYK-Chemie.

Pacific Northwest

Portland Section

(May 19)—"PERFORMANCE ENHANCEMENTS THROUGH CONTROL OF SPECIAL INTER-PIGMENT PHENOMENA"—Edward Orr, BYK-Chemie.

Seattle Section

(May 20)—"PERFORMANCE ENHANCEMENTS THROUGH CONTROL OF SPECIAL INTER-PIGMENT PHENOMENA"—Edward Orr, BYK-Chemie.

Vancouver Section

(May 21)—"PERFORMANCE ENHANCEMENTS THROUGH CONTROL OF SPECIAL INTER-PIGMENT PHENOMENA"—Edward Orr, BYK-Chemie.

Rocky Mountain

(May 11)—"PERFORMANCE ENHANCEMENTS THROUGH CONTROL OF SPECIAL INTER-PIGMENT PHENOMENA"—Edward Orr, BYK-Chemie.

Special Society Meetings—1998

(May 1-2)—"Maximizing Performance Properties and Minimizing Production Problems of Waterborne Coatings." 51st Annual Technical Symposium. Sponsored by the Pacific Northwest Society. Doubletree Inn at the Quay, Vancouver, WA. (Debra Severson, Miller Paint Co., 12730 NE Whitaker Way, Portland, OR 97230; 503-255-0190).

(May 11-14)—Eastern Training Conference II and Show. Sponsored by the Philadelphia Society. Valley Forge Convention Center, King of Prussia, PA. (Wayne Kraus, Hercules Incorporated, Research Center, 500 Hercules Rd., Wilmington, DE 19808; (302) 995-3435).

(June 5-6)—Joint Meeting of the St. Louis and Kansas City Societies. Lake of the Ozarks, MO. (Randy Ehmer, 500 Railroad Ave., N. Kansas City, MO 64116; (816) 842-3014).

FSCT Publications

Publication Title	Item #	Member Price	List Price
ACS Style Guide: A Manual for Authors & Editors	ACS-SG1	$26.95	$26.95
Basics of Technical Communicating	ACS-TC1	$36.95	$36.95
Benchmarking: The Search for Industry Best Practices That Lead to Superior Performance	ASQC-BSPI	$34.95	$34.95
Coatings Encyclopedic Dictionary			
Hard Cover	TV1-H	$105.00	$135.00
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3. Index of Flame Retardants	GOW-FR1	$150.00	$150.00
Glossary of Color Terms	TV3	$12.00	$20.00
Handbook of Paint & Coating Raw Materials			
2-Volume Set	GOW-RM1	$425.00	$425.00
CD-ROM	GOW-RMCD1	$495.00	$495.00
Industrial Surfactants Handbook	GOW-IS1	$450.00	$450.00
Infrared Spectroscopy Atlas for the Coatings Industry	TV2	$150.00	$200.00
The Internet: A Guide for Chemists	ACS-IG1	$25.95	$25.95
ISO 9000 Guidelines for the Chemical and Process Industries, 2nd Ed.	ASQC-ISOG2	$27.00	$27.00
ISO 9000 Implementation for Small Business	ASQC-ISOSB1	$38.00	$38.00
Let's Work Smarter, Not Harder: How To Engage Your Entire Organization in the Execution of Change	ASQC-WS1	$26.00	$26.00
Paint & Coatings Testing Manual	ASTM-QC1	$220.00	$220.00
Paint Problem Solver	PDCA-PS1	$70.00	$70.00
Painting and Decorating Craftsman's Manual	PDCA-PD1	$140.00	$140.00
Pictorial Standards of Coating Defects	PS-CPM	$100.00	$100.00
Principles and Practices of TQM	ASQC-TQM1	$28.00	$28.00
The Quality Audit Handbook	ASQC-QAH1	$45.00	$45.00
Remedies for Common Paint Problems	PDCA-RP1	$50.00	$50.00
SciQuest	SCIQUEST	$750.00	$800.00
SPC Essentials and Productivity Improvement	ASQC-MA1	$35.00	$35.00
TQM: A Step-by-Step Guide to Implementation	ASQC-TQMI1	$39.00	$39.00
Understanding Chemical Patents, 2nd Ed.	ACS-CP1	$31.95	$31.95
Writing the Laboratory Notebook	ACS-LN1	$26.95	$26.95
FSCT Series on Coatings Technology			
Full Series	FS	$405.00	$675.00
Adhesion Aspects of Polymeric Coatings	FS26	$15.00	$25.00
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JCTPUB98

People in the News


D.P. Stanko

David P. Stanko has been named the Director of Marketing for Silberline Manufacturing Co., Inc., Hometown, PA. In this capacity, Mr. Stanko will be responsible for the development and implementation of programs, policies, and strategies related to the company's growth in trade maintenance, general industrial, inks, plastics, and powder coatings markets. He is a member of the Philadelphia Society.

Randall L. Russell has been named Director of Marketing for Ranbar Technology Inc. and Ranbar Electrical Materials, Inc., Manor, PA. Mr. Russell, a member of the Pittsburgh Society, will be responsible for all marketing activities.

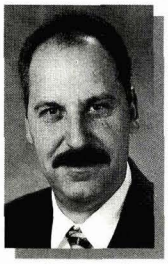
In addition, **Robert McCourt** and **James Matyi** have joined Ranbar Electrical Materials, Inc. as Manufacturing Manager and Plant Chemical Engineer, respectively.

In other news, **Terry Villella** has been named Director of Purchasing for the Ranbar family of companies.

Calvin Shen has joined the Coatings, Adhesives, Sealants, and Encapsulants (CASE) Group of ICI Polyurethanes, West Deptford, NJ, as Senior Technical Specialist. In this position, Dr. Shen will provide technical service and product development, primarily for coatings and adhesives.

Cardolite Corp., Newark, NJ, has promoted **Paul M. Nowak** to the newly created position of Director of Sales and Marketing Americas. Mr. Nowak will be responsible for the sale and marketing of all Cardolite® products in North and South America.

Creanova Canada Inc., has promoted **Carmine Bonacci** to Plant Manager at the Colorants plant in Brampton, Ontario, Canada. Mr. Bonacci, a member of the Toronto Society, is responsible for the overall management, direction and coordination of plant operations.


C. Bonacci

Elementis Specialties, Colorants and Additives Business, Jersey City, NJ, has announced the following organizational changes: **Martin L. Feldman** was named Vice President of Sales; **Michael C. Frantz** was named Vice President of Marketing; **Arthur Kroll** has been appointed Purchasing Manager; and **Enrique Diaz** has been named Operations Process Coordinator. Messrs. Feldman and Frantz are members of the New York Society.

Witco Corp., Greenwich, CT, has named **Giao Nguyen** as its Outstanding Scientist for 1997. Mr. Nguyen was honored for his notable contributions to improved process and technology in the production of certain of the company's industrial surfactants produced by its Performance Chemicals Group. He is currently lead chemist at Witco's Houston, TX, R&D laboratory.

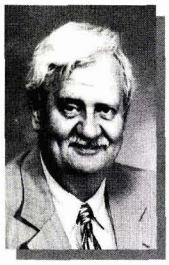
Thomas W. Himmel has assumed the position of Market Manager—Industrial Surfactants. Mr. Himmel will be responsible for identifying opportunities and managing business development programs.

In other news, **Margaret M. Contessa** has accepted the position of Vice President—Human Resources.

Buhler Inc., Minneapolis, MN, has promoted **Mike Hendley** to Group Vice President. Mr. Hendley will be responsible for the Protech Division, which handles the non-food activities of grinding and dispersion, mechanical conveying and dry and solid stating of plastic.

Convenience Products, Fenton, MO, has announced the addition of **Jane Leonard** as Director of the company's marketing division. Ms. Leonard will oversee all marketing and public relations programs.

Deeks and Co., Cincinnati, OH, has announced the promotion of **John A. Avery** to the position of Louisville Sales Coordinator. Mr. Avery began his career at Deeks in 1978 and was promoted to Senior Account Manager in 1996. He is a member of the Louisville Society.


J.A. Avery

Jacob J. Ferro has been named CEO of W.R. Bonsal Co., Charlotte, NC. Mr. Ferro succeeds **William R. Bonsal, III**, who retired in December 1997. Mr. Bonsal will remain as Chairman of the Board.

David P. Brandenstein has joined the staff of UCB Chemicals Corp./Radcure Business Group, Smyrna, GA, as Sales Manager. Mr. Brandenstein replaces **Richard A. Mackiewicz** who has relocated to UCB's Malaysia operation as Radcure Business Manager—Southeast Asia.

National Starch and Chemical Co., Bridgewater, NJ, has announced the appointment of **Walter F. Schlauch** to Chief Operating Officer. Mr. Schlauch joined the company in 1963. Prior to this position, he was Executive Vice President, Specialty Chemicals and Electronic Materials.

Margot S. Connor has been appointed Northeast Technical Sales Representative by Columbian Chemicals Co., Atlanta, GA. Headquartered in Jamesburg, NJ, Ms. Connor will be responsible for rubber and industrial carbon black sales to various market segments.

The Technical Association of the Pulp and Paper Industry (TAPPI) , Atlanta, GA, has bestowed L.E. "Skip" Scriven, Regents' Professor at the University of Minnesota, as a TAPPI Fellow. Dr. Scriven was recognized for his pioneering research in several areas of fluid mechanics, interfacial, phenomena, coating processes, porous media, and surfactant technologies.

Dr. Scriven joined the Department of Chemical Engineering and Materials Science at the University of Minnesota in 1959. He has held his present title since 1989, and has directed the Coating Process Fundamental Program of the Center for Interfacial Engineering, of which he was a co-founder in 1988.

TAPPI confers this prestigious title on those who have contributed exceptional meritorious service to the association or to the industry.


L.E. Scriven

Consler Filtration Products, Honeoye Falls, NY, has hired **Burke Allen** as Southeast Regional Sales Manager. Mr. Allen will be responsible for developing and managing the company's manufacturer's representatives.

Benjamin A. Rucker has been named Technical Marketing Specialist at Dock Resins Corp., Linden, NJ. Mr. Rucker will be responsible for sales and marketing as well as technical assistance for the company's manufacturers representatives.

John Cochran, Jr. has been appointed Senior Account Manager of Technical Sales for Vianova Resins Inc., Charlotte, NC. Based in Cleveland, OH, Mr. Cochran will be responsible for handling select accounts in the region covering Michigan, western Pennsylvania, southern Indiana, and northern Kentucky.

Computational Systems, Inc., Knoxville, TN, has appointed two Managers as Directors. **Jack Dischner**, former Manager of Strategic Market Development, has been named Director of International Sales, and **John Ostrowski**, has been promoted from Northeast Regional Sales Manager to Director of North American Sales.

Due to the realignment of the industrial market sector at International Specialty Products, Wayne, NJ, two senior managers have received additional responsibilities. **Ron Brandt**, Vice President and General Manager of Performance and Fine Chemicals, has added responsibility for ISP's Performance Chemicals business unit. Reporting to Mr. Brandt will be **Jack Boss**, who has been named to the new position of Senior Business Director of Performance Chemicals.

Geoffrey A. Gaywood, Vice President and Managing Director, European Region, has been given the additional responsibility for ISP's Acetylenics usiness unit.

Reporting to Mr. Gaywod will be **David DeSantis**, who becomes the Business Director of Acetylenics.

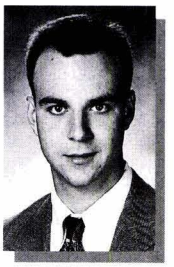
R. Brandt

G.A. Gaywood

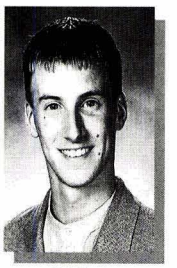
Gary Julian has joined the staff of Ultra Additives, Inc., Paterson, NJ, as Technical Support Manager for the company's Paint, Coatings, and Ink Group. Mr. Julian is a member of the Cleveland Society.

In addition, the company announced the relocation of two Textile Mangers to the Charlotte, NC, area. **James B. Hept**, Textile Account Manager and **Paul M. Fox**, Textile Service Manager will work out of Ultra's Clover, SC facility.

G. Julian



J.B. Hept



P.M. Fox

Judy Visscher has accepted the position of Applications Engineer for Brawn Mixer, Inc., Holland, MI. In her new position, Ms. Visscher will be responsible for internal technical support of the company's international sales agency network.

HunterLab has announced the addition of **Tom Snow** to its sales team. Mr. Snow will represent the company's products and services in New England, Northern New Jersey, and Eastern New York.

Whittaker, Clark & Daniels, Inc., South Plainfield, NJ, has announced the appointment of **Robert M. Cowsert** as National Marketing Manager for Ceramics and Refractories. Mr. Cowsert is responsible for marketing the company's products to the ceramics and refractories industries throughout the United States.

John R. Favilla has accepted the position as Director of Technical Marketing—General Industry, for BetzDearborn Metals Process Group, Horsham, PA. Mr. Favilla will be responsible for technology development and marketing for the phosphate programs throughout North America.

In other news, **Duane W. Fudge** has been promoted to Director of Technical Marketing—Coil Group. Mr. Fudge is charged with identifying growth opportunities for the coil industry in North America.

Raabe Corp, Menomonee Falls, WI, has added two new employees to its color match operations. **Cesar A. Morales** is the new manager of color technology while **Kevin James** has been promoted to OEM market specialist.

Philip J. Tarullo has been elected President of the Chemical Fabrics and Film Association (CFFA). Mr. Tarullo is President of LSI in Louisville, KY, and Vice President of Product Specialties Inc., New Albany, IN. He replaces **James L. Tremoulis**.

In other news, **Thomas J. Carstens, Jr.**, President/Chief Executive Officer of Athol Corp., Butner, NC, has been voted Second Vice President of CFFA.

John K. Givens, Chairman of Sandusky Limited, Sandusky, OH, was named First Vice President.

G. Kazemi

Gissoo Kazemi has been named to the position of Marketing Manager within the Rubber Chemicals and Pigments Division of Degussa Corp., Ridgefield Park, NJ. Ms. Kazemi will be responsible for market development of the company's line of carbon blacks, silicas, and silanes to the mechanical rubber goods market.

Donna Preklas has joined Dar-Tech, Inc., Cleveland, OH, as a Sales Representative. Based in Cincinnati, OH, Ms. Preklas will be responsible for the Southern Ohio region.

Lonza, Fair Lawn, NJ, has appointed **Mark Schomp** to Director, Marketing and Sales. Mr. Schomp will focus on the management of the marketing and sales and related personnel of the Specialty Alumina products group for North America.

New Products

Raw Materials

Low VOC Colorants

A line of Tint-Ayd® Colorants designed for very low to zero VOC waterborne coatings is available from Elementis Specialties, Colorants and Additives Business. Included in the line are "NV" solvent-free colorants, "CW" compliant water dispersions, and "AP" dry powdered colorants. Additional products in the line are W-30, W-22, and W-28. W-30 is a pigment dispersant for water systems. W-22 and W-28 can be used as independent vehicles or as additives, and are compatible with most water-reducible alkyds, acrylics, polyesters, and epoxies, as well as latex emulsions intended for gloss, semi-gloss and flat finishes.

Circle No. 30 on Reader Service Card

Wetting Agent

Tego Chemie Service has developed a low-foaming, highly-active substrate wetting agent for waterborne systems. Tego® Wet 265 is a modified trisiloxane that reduces the surface tension and improves adhesion properties in waterborne coatings for metal, wood, plastic, and other substrates. In addition, it may also be used in primers or fillers.

Circle No. 31 on Reader Service Card

Acrylic Emulsion

A chemical-resistant waterborne acrylic emulsion for wood, plastic, and concrete surfaces is now available from SC Johnson Polymer. SCX-1970™ is a self-crosslinking, one-component, non-formaldehyde system. The polymer requires no mixing and is suited for wood product coatings used in schools, offices, and homes. It may also allow applications as a coating for hardboard, plastic, and concrete.

Circle No. 32 on Reader Service Card

Anti-Corrosion Pigment

Grace Davison has introduced Shieldex® C 303, a high-performance, non-toxic, corrosion-inhibiting pigment for coil coatings and related primers. This pigment line replaces strontium chromate in polyester, epoxy, and polyurethane primers used in coil coatings, aluminum extrusion coatings, aerospace coatings, and general metal finishing. Based on patented calcium ion-exchanged silica chemistry, the pigment has reportedly shown exceptional performance in extensive accelerated and natural exposure testing.

Circle No. 33 on Reader Service Card

Ink Resin

Loos & Dilworth, Inc. is offering the Hercules 2043 resin. The resin is an aqueous solution of a cationic, water-soluble polyamide/epichlorohydrin polymer that reportedly reacts with paper cellulose and self-crosslinks on drying to impart bleedfastness, or resistance to water, detergents, and alcohol. When applied to tissue and toweling as an ink vehicle, the resin reportedly dries almost instantly and develops a level of cure in about two days at room temperature.

Circle No. 34 on Reader Service Card

Black Aqueous Acrylics

Two high pigmentation water-based black acrylic dispersions, BS 15440 and BS 16653, are available from CDI Dispersions. Both products are designed to provide high covering power in water-based ink and coating applications where this property is required.

Circle No. 35 on Reader Service Card

Alkoxylated Monomers

Henkel Corp. has launched three low skin irritation alkoxylated monomers that can be used as direct substitutes for existing acrylates. The RCC™ 13-361 is a low draize, high performance monomer. RCC™ 13-362 is a low draize diluent for use as a flexibilizer. Both RCC™ monomers are suggested for paper/paperboard, plastics and wood overprint varnishes and inks. The third, Photomer® 4171, is a low draize, high performance, fast curing monomer that exhibits crosslink density and chemical/abrasion resistance properties

Circle No. 36 on Reader Service Card

Adhesion Promoters

A new range of proprietary metal organic adhesion promoters for SB and 2K systems have been developed by Chartwell International, Inc. The new products, C-505.2, E-505.2, and F-505.2, are mercapto functional for 2K epoxy and sulfur cured rubbers. E-515.2 is amino functional for 2K epoxy and 2K urethane. D-531.1 is a C-14 hydrocarbon which functions as a pigment dispersant for phthalo blue/green, carbon black, and various inorganic pigments in all SB/2K systems.

Circle No. 37 on Reader Service Card

Software

Factor Design

Version 5 of Design-Ease® software for Windows™ is being offered by Stat-Ease, Inc. This software has been designed to help engineers, scientists, and industrial researchers to find critical factors affecting products and processes. The design of experiments generates two-level factorial designs with rotating 3D plots and interactive 2D graphics. Free technical and statistical support, along with an illustrated tutorial are added features of the software.

Circle No. 38 on Reader Service Card

Options for ICC™ Family

New options are available in the Industrial Control Computer™ (ICC™) family, offered by Nematron Corp. These additional configurations, for the ICC-5000, -6000, and -7000 series, consist of 24 VDC CE-marked versions that allow the units to be used in applications that demand this power input voltage, and a Class 1, Div. 2 hazardous location rating. Both of the new options are supported by ICC models featuring 100-200 MHz Pentium processors.

Circle No. 39 on Reader Service Card

Waterproofing CD-Rom

A new CD-Rom entitled, "Design of Water-Repellent Surface Treatment — Sensible Use of Protectosil®," is available from Degussa AG. The CD-Rom explains the principle of waterproofing building-material surfaces with an impregnating agent. Further, it explains how to identify typical damage to facades or concrete as a building material, and comments on the mechanisms causing such damage.

Circle No. 40 on Reader Service Card

X-Ray for Coating Testing

Fischer Technology, Inc., Windsor, CT, has developed the Fischerscope XDL, a new Windows™-based X-ray system. The system is designed for material testing and measuring coating thickness and composition on single coatings, binary alloy coatings, ternary alloy coatings, double coatings, double coatings with one alloy layer, and triple coatings. Material analysis can be done on alloys containing up to four different elements.

Circle No. 41 on Reader Service Card

Books/ Publications

Labware Catalog

The new 208-page 1998 Nalgene® Labware Catalog is now being offered by Nalge Nunc International. The catalog offers more than 4,500 Nalgene products. Indexes, compatibility charts, specification and ordering guides, and graphic icons are located in the catalog to help readers find appropriate products for their application needs.

Circle No. 42 on Reader Service Card

Pollution Brochure

Environmental Resources Management has published *Pollution Prevention*. This new six-page, four-color brochure covers seven steps necessary for a successful pollution prevention program. Also covered in a diagram are the four basic pollution prevention choices — source reduction, recycling, material and energy recovery, and treatment.

Circle No. 43 on Reader Service Card

Misc. Miscellaneous

Metal Cleaner

The BetzDearborn Metals Process Group has developed the BetzDearborn Kleen™ 134 alkaline cleaner, which removes a wide variety of soils on aluminum, galvanized steel, and fiberglass substrates. The cleaner is reportedly caustic free and produces a water break free surface

Circle No. 44 on Reader Service Card

Corrosion Inhibitor

Two new anti-corrosion products have been introduced by Denovus. SafeSeal Steel Protectant and SafeSeal Premium Steel Protectant are reportedly designed to meet the requirements of injection molding applications, ensure complete coverage, provide excellent short- and long-term protection, ensure environmental and worker safety, and remove easy with minimal waste. The protectants are grass-green in color.

Circle No. 45 on Reader Service Card

Protective Wear

New garments designed for electrostatic contamination control in food or paint rooms, throughout the electronics and pharmaceutical industries, and in any environment where a buildup of static electricity may cause manufacturing defects, are now available from Lakeland Industries, Inc. StaticSorb® Coveralls are constructed with a densely woven reusable barrier fabric comprised of a blend of multifilament polyester yarn and carbon fiber material. The garments are offered with double lap felled seams, zipper and/or snap closures, and come in a range of sizes

Circle No. 46 on Reader Service Card

Protective Sleeves

NSW Corp. is offering PP and PVDF perforated plastic tubes for use as protective outer sleeves and supports in electrocoating. The tubes reportedly offer exceptional strength, high heat deflection temperature, and excellent chemical resistance. Standard tubes are available in lengths up to 12 ft. with diameters ranging from 0.750" to 9".

Circle No. 47 on Reader Service Card

Calendar of Events

Federation Meetings

For information on FSCT meetings, contact Federation of Societies for Coatings Technology, 492 Norristown Rd., Blue Bell, PA 19422 (610) 940-0777, FAX: (610) 940-0292. Web site: http://www.coatingstech.org

1998

(April 25-26)—FSCT Spring Board of Directors Meeting. April 25—Executive Committee Meeting; April 26—Board Meeting. Renaissance Cleveland Hotel, Cleveland, OH.

(May 14-15)—FSCT Incoming Society Officers Meeting. May 14—FSCT Headquarters Visit; May 15—Meeting, Park Ridge Hotel and Conference Center, King of Prussia, PA.

(June 17-18)—"Switching from Solvent-Based to Water-Based." Seminar sponsored by the FSCT Professional Development Committee. Hyatt Regency O'Hare, Chicago, IL.

(June 19)—"Technical Writing." Workshop sponsored by the FSCT Professional Development Committee. Hyatt Regency O'Hare, Chicago, IL.

(July 23-24)—Pan-American Coatings Expo. World Trade Center, Mexico City, Mexico.

(September)—"Experimental Design and Analysis Workshop." Seminar sponsored by the FSCT Professional Development Committee. Dates and location to be announced.

(Oct. 11-13)—International Coatings Technology Conference. Ernest N. Morial Convention Center, New Orleans, LA.

(Oct. 14-16)—ICE '98—FSCT Annual Meeting and International Coatings Expo and Technology Conference. Ernest N. Morial Convention Center, New Orleans, LA.

(Nov. 4-5)—"Practical Rheology." Seminar sponsored by the FSCT Professional Development Committee. Orlando Airport Marriott, Orlando, FL.

(Nov. 5-6)—"Extender Pigments." Seminar sponsored by the FSCT Professional Development Committee. Orlando Airport Marriott, Orlando, FL.

1999

(Oct. 20-22)—ICE '99—FSCT Annual Meeting and International Coatings Expo and Technology Conference. Dallas Convention Center, Dallas, TX.

Special Society Meetings

1998

(April 21)—"Innovative Coatings: Practical Solutions for Global Demands." 23rd Annual FOCUS Conference sponsored by the Detroit Society. Michigan State University Management Education Center, Troy, MI. (Rosemary Brady, Akzo Nobel Coatings Inc., P.O. Box 7062, Troy, MI 48007-7062).

(April 22)—"Manufacturing Symposium." Co-sponsored by the Cleveland Society and the Pittsburgh Society. (James Currie, Jamestown Paint Co., 108 Main St., P.O. Box 157, Jamestown, PA 16134; 412-932-3101).

(April 23-24)—"Waterborne Coatings: Sink or Swim II." 41st Annual Technical Symposium. Co-sponsored by the Cleveland Society and the Pittsburgh Society. (Vicki Fisher, Jamestown Paint Co., 108 Main St., P.O. Box 157, Jamestown, PA 16134; 412-932-3101).

(May 1-2)—"Maximizing Performance Properties and Minimizing Production Problems of Waterborne Coatings." 51st Annual Technical Symposium. Sponsored by the Pacific Northwest Society. Doubletree Inn at the Quay, Vancouver, WA. (Debra Severson, Miller Paint Co., 12730 NE Whitaker Way, Portland, OR 97230; 503-255-0190).

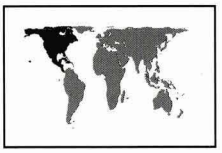
(May 11-14)—Eastern Training Conference II and Show. Sponsored by the Philadelphia Society. Valley Forge Convention Center, King of Prussia, PA. (Wayne Kraus, Hercules Incorporated, Research Center, 500 Hercules Rd., Wilmington, DE 19808; (302) 995-3435).

(June 5-6)—Joint Meeting of the St. Louis and Kansas City Societies. Lake of the Ozarks, MO. (Randy Ehmer, 500 Railroad Ave., N. Kansas City, MO 64116; (816) 842-3014).

1999

(Feb. 16-18)—24th Biennial Western Coatings Societies' Symposium and Show. Sponsored by the Golden Gate, Los Angeles, Pacific Northwest, and Rocky Mountain Societies. John Ascuaga's Nugget, Sparks, NV.

Other Organizations



1998—North America

(Apr. 18-19)—"Water Problems in Building Exterior Walls: Evaluation, Prevention, and Repair." Symposium sponsored by the American Society for Testing and Materials (ASTM) Committee E-6. Atlanta Hilton and Towers, Atlanta, GA. (ASTM, 100 Barr Harbor Dr., West Conshohocken, PA 19428-2959).

(Apr. 18-23)—"Vacuum Coating Manufacturing and Technology Issues." 41st Technical Conference. Sponsored by the Society of Vacuum Coaters. The Westin Hotel, Copley Place, Boston, MA. (Society of Vacuum Coaters, 440 Live Oak Loop, Albuquerque, NM 87122).

(Apr. 19-22)—RadTech '98 North America Conference. Sponsored by RadTech International North America. Hyatt Regency, Chicago, IL. (RadTech International North America, 60 Revere Dr., Ste. 500, Northbrook, IL 60062).

(Apr. 20-22)—ASTM Committee B-8 on Metallic and Inorganic Coatings. Sponsored by the American Society for Testing and Materials. West Conshohocken, PA. (ASTM, 100 Barr Harbor Dr., West Conshohocken, PA 19428.

(Apr. 20-22)—"Industrial Ink Technology." Sponsored by The Center for Professional Advancement. Sheraton Boca Raton Hotel, Boca Raton, FL. (The Center for Professional Advancement, Box 1052, East Brunswick, NJ 08816-1052).

(Apr. 20-24)—"Applied Rheology for Industrial Chemists." Short course sponsored by Kent State University. Kent, OH. (Carl J. Knauss, Director, Professional Development Institute, P.O. Box 1792, Kent, OH 44240).

(Apr. 20-24)—"Introduction to Paint Formulation." Short course sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (UMR Coatings Institute, 1870 Miner Circle, Rolla, MO 65409).

(April 21)—"Innovative Coatings: Practical Solutions for Global Demands." 23rd Annual FOCUS Conference sponsored by the Detroit Society. Michigan State University Management Education Center, Troy, MI. (Rosemary Brady, Akzo Nobel Coatings Inc., P.O. Box 7062, Troy, MI 48007-7062).

(Apr. 21-24)—"Coverings." Exhibition organized by TSI, Inc. Orange County Convention Center, Orlando, FL. (TSI, Inc., 900 E. Indiantown Rd., Ste. 207, Jupiter, FL 33477).

(Apr. 22)—"Manufacturing Symposium." Co-sponsored by the Cleveland Society for Coatings Technology and the Pittsburgh Society for Coatings Technology. (James Currie, Jamestown Paint Co., 108 Main St., P.O. Box 157, Jamestown, PA 16134; 412-932-3101).

(Apr. 23-24)—"Waterborne Coatings: Sink or Swim II." 41st Annual Technical Symposium. Co-sponsored by the Cleveland Society for Coatings Technology and the Pittsburgh Society for Coatings Technology. (Vicki Fisher, Jamestown Paint Co., 108 Main St., P.O. Box 157, Jamestown, PA 16134; 412-932-3101).

(Apr. 27-29)—"Making Life Easier for the Epoxy Formulator—Technical Solutions." Conference sponsored The Society of the Plas-

tics Industry Inc.'s Epoxy Resin Formulators Division. The Ritz-Carlton Kempinski, Montreal, Canada. (Tina Kierzek, SPI Epoxy Resin Formulators Div., Ste. 600K, 1801 K St., N.W., Washington, D.C. 20006-1301).

(Apr. 28-29)—44th Annual Technical Meeting of the Institute of Environmental Sciences and Technology. Phoenix Civic Plaza, Phoenix, AZ. (Institute of Environmental Sciences and Technology, 940 East Northwest Hwy., Mount Prospect, IL 60056-3422).

(Apr. 28-29)—Hazardous Materials Training Seminar. Sponsored by the National Paint and Coatings Association (NPCA). Baltimore,). (Dorothy Brawner, NPCA, 1500 Rhode Island Ave., Washington, D.C. 20005-5597).

(May 1-2)—51st Annual Technical Symposium. Sponsored by the Pacific Northwest Society for Coatings Technology. Doubletree Inn at the Quay, Vancouver, WA. (Debra Severson, Miller Paint Co., 12730 NE Whitaker Way, Portland, OR 97230; 503-255-0190).

(May 4-6)—"Adhesion and Coatings Adhesion: Theory , Applications, and Durability." Conference sponsored by The Institute of Materials Science. Orlando, FL. (Angelos V. Patsis, The Institute of Materials Science, State University of New York, New Paltz, NY 12561).

(May 4-8)—"Spray Systems Technology." Sponsored by Carnegie Mellon University. Pittsburgh, PA. (Norman Chigier, Dept. of Mechanical Engineering, Carnegie Mellon University, Pittsburgh, PA 15213-3890).

(May 4-8)—"Adhesion Principles and Practice for Coatings and Polymer Scientists." Short course sponsored by Kent State University. Kent, OH. (Carl J. Knauss, Director, Professional Development Institute, P.O. Box 1792, Kent, OH 44240).

(May 5-6)—"Effects of Surface Finish on Corrosion Testing." Symposium sponsored by the American Society for Testing and Materials (ASTM). Atlanta Hilton, Atlanta, GA. (Bob Held, ASTM, 100 Barr Harbor Dr., West Conshohocken, PA 19428-2959).

(May 6-8)—ASTM Committee G-1 on Corrosion of Metals. Sponsored by the American Society for Testing and Materials (ASTM). Atlanta Hilton, Atlanta, GA. (Bob Held, ASTM, 100 Barr Harbor Dr., West Conshohocken, PA 19428-2959).

(May 11-14)—Eastern Training Conference II and Show. Sponsored by the Philadelphia Society. Valley Forge Convention Center, King of Prussia, PA. (Wayne Kraus, Hercules Incorporated, Research Center, 500 Hercules Rd., Wilmington, DE 19808; (302) 995-3435).

(May 11-14)—"Introduction to Powder Coatings Technology." Short course sponsored by The University of Southern Mississippi. Hattiesburg, MS. (Shelby F. Thames or Debbie Ballard, The University of Southern Mississippi, Box 10037, Hattiesburg, MS 39406-0037).

(May 11-15)—"Interpretation of IR and Raman Spectroscopy." Short course sponsored by The Fisk Infrared Institute. Vanderbilt University, Nashville, Tennessee. (Clara Craver, The Fisk Infrared Institute, 1000 17th Ave., N., Nashville, TN 37208).

(May 11-15)—"Dispersion of Pigments and Resins in Fluid Media." Short course sponsored by Kent State University. Kent, OH. (Carl J. Knauss, Director, Professional Development Institute, P.O. Box 1792, Kent, OH 44240).

(May 13-15)—"Spray Finishing Technology Workshop." Sponsored by Bowling Green State University and ITW DeVilbiss. Toledo, OH. (Richard A. Kruppa, Bowling Green State University, Bowling Green, OH 43403).

(May 17-20)—1998 Fluid Controls Institute Annual Meeting. The Cloister, Sea Island, GA. (Fluid Controls Institute, Inc., 1300 Summer Ave., Cleveland, OH 44115-2851).

(May 18-21)—"Coatings Science for Coatings Technicians." Short course sponsored by The University of Southern Mississippi. Hattiesburg, MS. (Shelby F. Thames or Debbie Ballard, The University of Southern Mississippi, Box 10037, Hattiesburg, MS 39406-0037).

(May 18-22)—"Physical Testing of Paints and Coatings." Short course sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (UMR Coatings Institute, 236 Schrenk Hall, 1870 Miner Circle, Rolla, MO 65409).

(May 19-21)—Finishing Technologies '98. Conference and exhibition sponsored by *Coatings Magazine*. International Centre, Toronto, Ontario, Canada. (*Coatings Magazine*, 406 North Service Rd. East, Ste. One, Oakville, Ontario, Canada L6H 5R2).

(June 1-3)—"Colorimetry and Color Measurement." Short course sponsored by Rochester Institute of Technology's Munsell Color Science Laboratory. Rochester, NY. (Colleen M. Desimone, RIT Munsell Color Science Laboratory, 54 Lomb Memorial Dr., Rochester, NY 14623-5604).

(June 1-5)—"Advances in Emulsion Polymerization and Latex Technology." Short course sponsored by Lehigh University. Emulsion Polymers Institute, Bethlehem, PA. (Mohamed S. El-Aasser, Emulsion Polymers Institute, Lehigh University, 111 Research Dr., Bethlehem, PA 18015).

(June 1-12)—"Intensive Coatings Science Course." Sponsored by North Dakota State University (NDSU). Fargo, ND. (Debbie Shasky, Program Coordinator, 54 Dunbar Hall, NDSU, Fargo, ND 58105).

(June 4)—"Instrumental Color Matching." Short course sponsored by Rochester Institute of Technology's Munsell Color Science Laboratory. Rochester, NY. (Colleen M. Desimone, RIT Munsell Color Science Laboratory, 54 Lomb Memorial Dr., Rochester, NY 14623-5604).

(June 5-6)—Joint Meeting of the St. Louis and Kansas City Societies. Lake of the Ozarks, MO. (Randy Ehmer, 500 Railroad Ave., N. Kansas City, MO 64116; (816) 842-3014).

(June 7-10)—ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications. Sponsored by the American Society for Testing and Materials (ASTM), Omni Inner Harbor, Baltimore, MD. (Scott Orthey, ASTM, 100 Barr Harbor Dr., West Conshohocken, PA 19428).

(June 7-10)—ASTM Committee G03 on Weathering and Durability. Sponsored by the American Society for Testing and Materials (ASTM), Omni Inner Harbor, Baltimore, MD. (Scott Orthey, ASTM, 100 Barr Harbor Dr., West Conshohocken, PA 19428).

(June 8-12)—"Introduction to Paint Formulation." Short course sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (UMR Coatings Institute, 1870 Miner Circle, Rolla, MO 65409).

(June 8-12)—"Foundations of Color Management Systems." Short course sponsored by Rochester Institute of Technology's Munsell Color Science Laboratory. Rochester, NY. (Colleen M. Desimone, RIT Munsell Color Science Laboratory, 54 Lomb Memorial Dr., Rochester, NY 14623-5604).

(June 9)—ASTM D01.51 on Powder Coatings. Sponsored by the American Society for Testing and Materials (ASTM). Omni Inner Harbor Hotel, Baltimore, MD. (Jeffrey Hagerlin, O'Brien Powder Products, 9800 Genard Rd., Houston, TX 77041-7624).

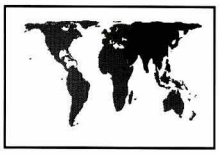
(June 9-11)—1998 Department of Defense-Industry Aerospace Coatings Conference. Renaissance Waverly Hotel, Atlanta, GA. (Omar Deel or Rick Wolterman, Battelle, 505 King Ave., Columbus, OH 43201-2693).

(June 9-11)—Automotive Finishing '98. Conference and Exposition sponsored by the Society of Manufacturing Engineers. Cobo Conference and Exhibition Center, Detroit, MI. (SME, One SME Dr., P.O. Box 930, Dearborn, MI 48121-0930).

(June 10-11)—"Standards for Asbestos Control." Training course sponsored by the American Society for Testing and Materials (ASTM). Dallas, TX. (Kristina Falkenstein, ASTM, 100 Barr Harbor Dr., West Conshohocken, PA 19428).

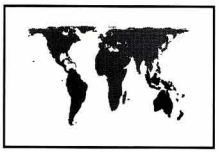
(June 15-18)—"Coatings Science for Coatings Formulators." Short course sponsored by The University of Southern Mississippi. Hattiesburg, MS. (Shelby F. Thames or Debbie Ballard, The University of Southern Mississippi, Box 10037, Hattiesburg, MS 39406-0037).

1998—Asia



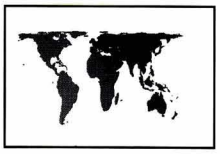
(May 12-14)—Techno Trade '98. Sponsored by Singapore Confederation of Industries, Taiwan Association of Machinery Industry, and Taiwan Industrial Fasteners Institute. World Trade Center, Singapore. (Interfama Brooks Exhibitions Pte. Ltd., Forum Place, Hatfield, Hertfordshire AL1O ORN, United Kingdom).

1998—Australia



(July 29-Aug. 1)—"Coatings for the Future." Second Trans Tasman Surface Coatings Conference. Co-sponsored by Surface Coatings Association, New Zealand, Inc., and Surface Coatings Association, Australia, Inc. The Carlton Hotel, Auckland, New Zealand. (98 Transtas Conference, P.O. Box 5192, Wellesley St., Auckland, New Zealand).

1998—Europe



(Apr. 23)—"What is Paint?" Training course sponsored by the Paint Research Association. Teddington, Middlesex, United Kingdom. (Heena Mehta, PRA, 8 Waldegrave Rd., Teddington, Middlesex TW11 8LD United Kingdom).

(Apr. 27-29)—"Colour Measurement and Colour Control." Training course sponsored by the Paint Research Association. Teddington, Middlesex, United Kingdom. (Heena Mehta, PRA, 8 Waldegrave Rd., Teddington, Middlesex TW11 8LD United Kingdom).

(May 25-27)—11th International Symposium on Polymer Analysis and Characterization (ISPAC-11). Santa Margherita Ligure, Genoa, Italy. (Oscar Chiantore, Dept. of Chemistry IPM, University of Torino, Via Giuria 7-101025 Torino, Italy; Fax: +39 11 670 7855).

(May 25-29)—1998 International Thermal Spray Conference. Sponsored by ASM International. Nice, France. (Congres Scientifiques Services, ITSC '98, 2 rue des Villarmains - BP 124, F-02210 Saint Cloud, France).

(June 22-24)—"SURFEX '98." Sponsored by The Oil & Colour Chemists' Association (OCCA). Harrogate, England. (Christopher Pacey-Day, OCCA, 967 Harrow Rd., Wembley, Middlesex, England HA0 2SF).

(June 28-July 2)—Third Oxford Conference on Spectrometry. Co-sponsored by the Council for Optical Radiation Measurement of the United States and the Ultraviolet Spectrometry Group of the United Kingdom. Royal Holloway College of the University of London, Egham, Surrey, United Kingdom. (Art Springsteen, Third Oxford Conference, c/o Labsphere, Inc., P.O. Box 70, Shaker St., North Sutton, NH 03260).

(Aug. 17-21)—"Advances in Emulsion Polymerization and Latex Technology." Course co-sponsored by Georgia Institute of Technology and Lehigh University. Hotel Flüela, Davos, Switzerland. (F. Joseph Schork, School of Chemical Engineering, Georgia Institute of Technology, Atlanta, GA30332-0100).

Classifieds

Address all classified orders to: Classified Department, JOURNAL OF COATINGS TECHNOLOGY, 492 Norristown Rd., Blue Bell, PA 19422; FAX: (610) 940-0292. For information on closing dates, please call (610) 940-0777.

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Advertisers' Index

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Humbug from Hillman

Fred Billmeyer stirred up interesting, long ago, memories for me of "colorful" conversations with him and Max Saltzman, when he wrote recently. Appropriately, he enclosed old time "Best of Newscripts" from the 75th anniversary issue of *C&EN News*. Here are a couple of them, in case there are any of you out there who are not ACS members.

Poetry at Dusk—Chicago's Loco Chemical Co. and its chief executive officer, Sir J. Conrad Bleet, have turned up now and then in "Newscripts" on the strength of their cutting-edge thought and activities. On one notable occasion, Sir Conrad was enshrined in a poem, "The Love Song of J. Conrad Bleet." The work . . . opens with the lines:

> Let us go then, you and I,
> When the evening is spread around the sky
> Like a Grignard etherized inside a flask;
> Let us go, through certain half deserted labs.

This impassioned plea, forged in a holocaust of mighty love drove a palpitating maid, one Lily Astolat to pen a "Response to the Love Song of J. Conrad Bleet":

> Tyger! Tyger! burning bright-
> Take me to your lab tonight.
> You have lit my bunsen burner
> Made my day a bit more schoner.
> Aliquot me - Yea, distill me!
> I'm your beaker! C'mon fill me!
> Wee sleekit, cowrin' tim'rous Beastie,
> You've put a panic in my breastie!
>
> (Feb. 28, 1977)

Animal Welfare—Ever since being charged unexpectedly with being antibat, "Newscripts" has taken care to keep readers posted on events in animal welfare. They occur sometimes in odd circumstances: "A legislator in Connecticut has introduced a bill that would ban the throwing of instant rice at weddings, according to the National Wildlife Federation. (She) claims that the rice kills the birds that eat it by absorbing moisture, causing severe bloating. She wants well wishers to throw bird seed instead." (Aug. 26, 1985)

Speaking of the ACS, Bob Athey, in one of his typical collector item epistles, quotes the ACS "Vortex" newsletter of February 1998 with:

—Then there are three kinds of business men–successful, unsuccessful, and those who give lectures telling the second group how the first group did it.

—A customer who had been billed repeatedly for $00.00 finally decided to pay up. He wrote a check in the amount of $00.00. The computerized response was prompt: "Thank you for your payment. We are billing you $00.00 for late payment charges."

—Life and love are like a roller coaster. They have their ups and downs with bumps and jolts, too. (As severely altered by Athey)

AND, of course, there's always Dick Kiefer who gives us:

Resume Writing Tips from the Intelligence Impaired Real (?) resumes printed in the July 21st issue of Fortune

"I demand a salary commiserate with my extensive experience."

"I have lurnt Word Perfect 6.0 computor and spreasheet progroms."

"Reason for leaving last job: maturity leave."

"Wholly responsible for two (2) failed financial institutions."

"It's best for employers that I not work with people."

"Am a perfectionst and rarely if if every forget details."

"I was working for my mom until she decided to move."

"Marital status: single. Unmarried. Unengaged. Uninvolved.

"I have become completely paranoid, trusting completely no one and absolutely nothing."

"My goal is to be a meteorologist. But since I possess no training, I suppose I should try stock brokerage."

"I procrastinate, especially when the job is unpleasant."

"Personal interest; donating blood. Fourteen gallons so far."

"Note: Please don't misconstrue my 14 jobs as 'job-hopping.' I have never quit a job."

"Marital status: often, children: various."

"The company made me a scapegoat, just like my three previous employers."

"Finished eighth in my class of ten."

"References: none. I've left a path of destruction behind me."

And for those who already have jobs, these quotes were taken from job performance evaluations:

"Since my last report, this employee has reached rock bottom and has started to dig."

"His men will follow him anywhere, but only out of morbid curiosity.

"I would not allow this employee to breed."

"This associate is really not so much a has-been but more a definitely won't be."

"Works well under constant supervision and cornered like a rat in a trap."

"He would be out of his depth in a parking lot puddle."

"This young lady has delusions of adequacy."

"He sets low personal standards and consistently fails to meet them."

"This employee is depriving some village of an idiot."

"This employee should go far and the sooner he starts, the better."

Please forgive some personal correspondence: From Anonymous—"The bumper sticker you quoted in the December 1997 issue, "The weather is here. I wish you were beautiful," is a line in the song "The Weather is Here," written by Jimmy Buffet. The patron saint of beach bums deserves the credit . . . H from H apologizes to the bums and certainly to the saint.

To old friend Bob Cardin: Sorry, Bob but all your amusing stuff was either censored or sent to me by other Internet scholars. However, it was great talking with you. Stay in touch.

—Herb Hillman, Humbug's Nest, P.O. Box 135, Whitingham, VT 05361.

HE WAS THRILLED WITH HIS DREAM CAR. BUT THEN THINGS STARTED TO LOOK A LITTLE FISHY.

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