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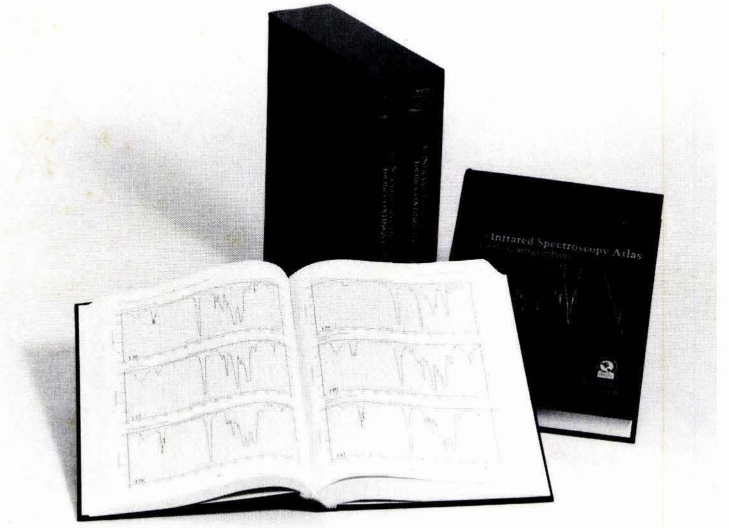

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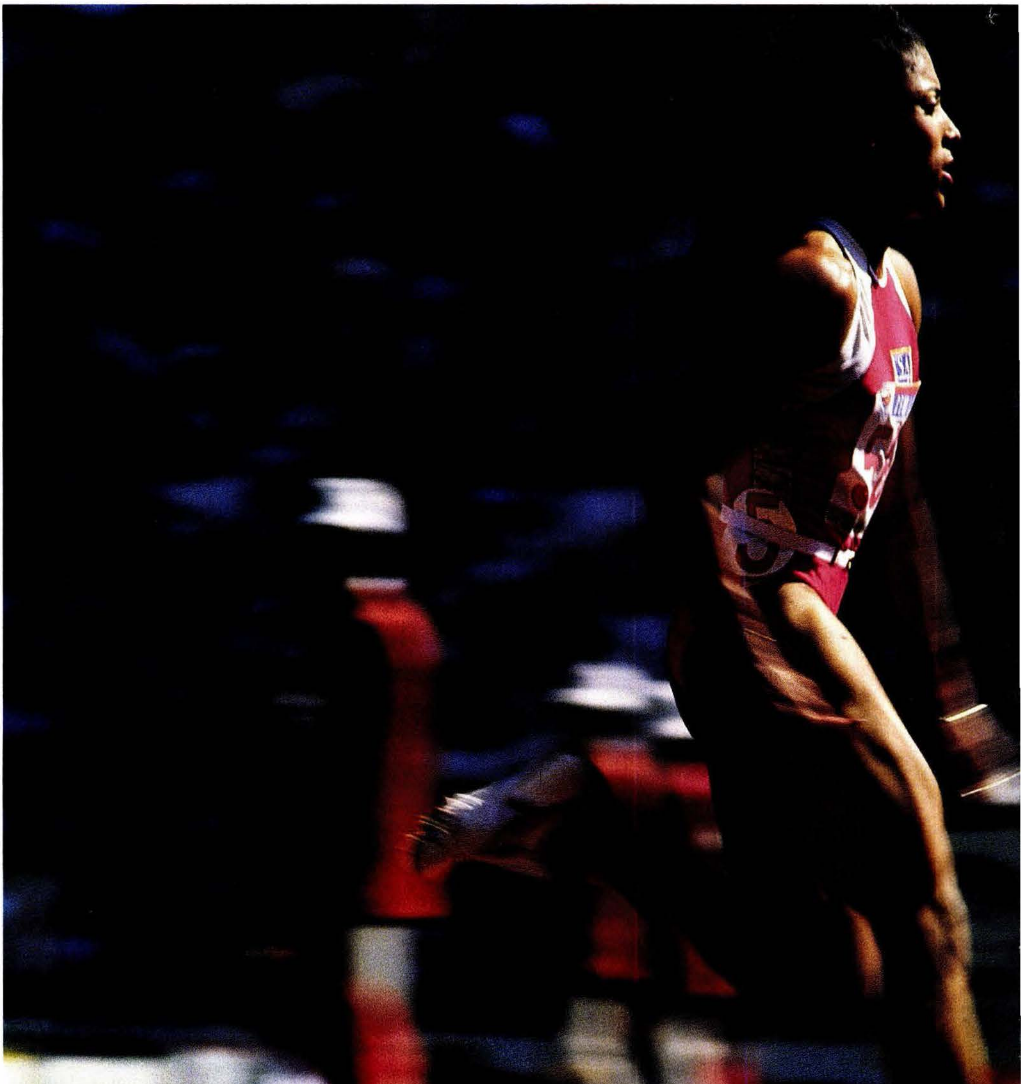

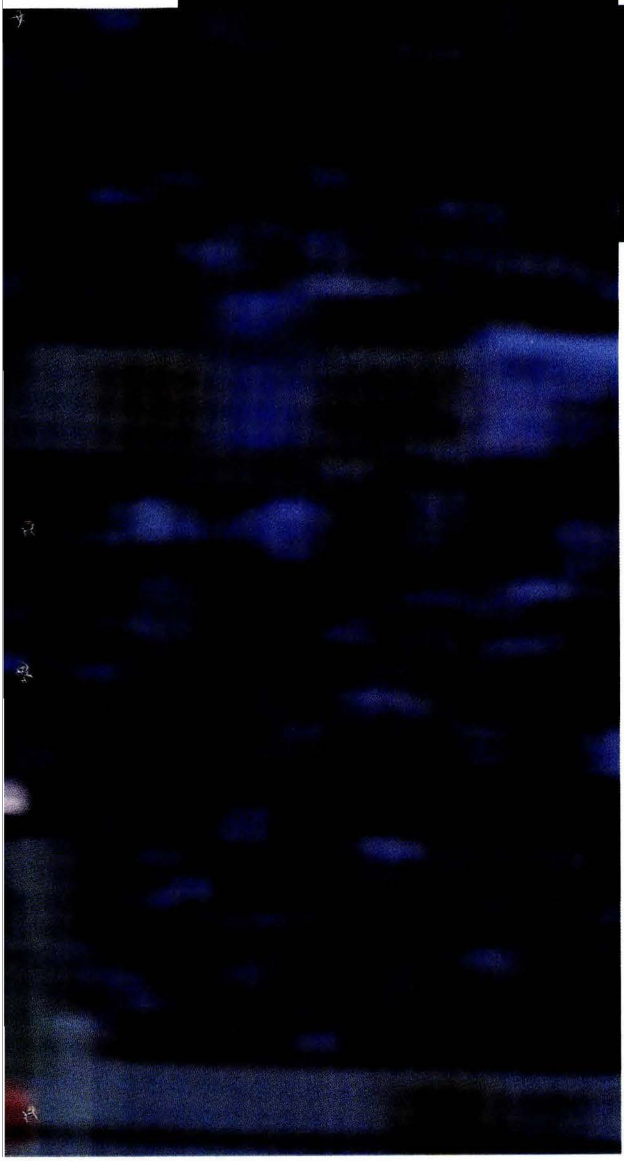

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Comment

A Week in the Windy City

Unusually mild breezes blew across Lake Michigan. On the campaign trail, candidates focused attention on the city and, in the characteristic manner of political candidates, promised solutions to urban woes. Even more important, the Bears restored pride to the city by soundly defeating the Tampa Bay Buccaneers at Soldier Field.

For many Chicagoans, it was a *very good* week.

The spirit of good will was apparent as the city extended its welcome to over 8,400 registrants attending the Federation's 70th Annual Meeting and 57th Paint Industries' Show on October 21-23. These registrants were attracted from all parts of the globe as over 50 countries were represented, in addition to the heavy contingent from North America.

Beginning with the compelling Keynote Address by noted columnist Jack Anderson to the Mattiello Lecture by Dr. John Gardon which closed the technical programming, attendees at the Annual Meeting were treated to a full complement of technical presentations which focused around the theme of "New Directions for a Changing World." For an industry facing many challenges, these presentations provided an excellent opportunity to explore the rapidly changing world of coatings and to possibly extract some new ideas for developing strategies for formulating products, for responding to regulatory and safety demands, and for management of resources. From the lively discussions which followed many presentations, it was evident that attendees were off to a promising start.

The 295 exhibiting companies expressed pleasure with the spacious facilities at McCormick Place North and with the heavy traffic which flowed throughout the hall for the three-day event. The registrants who attended the FSCT's largest Paint Show were impressed with the attractive, informative displays and with the opportunities available to meet with knowledgeable personnel at the booths.

The good feelings which were generated were not solely focused on the events taking place in Chicago. The paint industry once again showed its concern for the "international community" as it donated over $2000 in funds for disaster relief efforts of the Red Cross in its attempts to alleviate the devastation resulting earlier this year from Hurricanes Andrew and Iniki. The generosity of the industry was noted at the Federation's Annual Luncheon as President Bill Holmes was presented with a plaque by the Red Cross in appreciation for these efforts.

All in all, for those attending the Annual Meeting and Paint Industries' Show, you couldn't have asked for a much better week.

Patricia D. Viola

Patricia D. Viola
Editor

Abstracts of Papers in This Issue

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

Low-VOC Waterborne Coatings for Wood Based on Nitrocellulose-Acrylic Latex—H.F. Haag

JCT, 64, No. 814, 19 (Nov. 1992)

Increasing concern over solvent emissions has prompted renewed interest in low-VOC lacquers for wood. Waterborne lacquers based on a solvent-free nitrocellulose-acrylic (NC-A) latex have been formulated at VOC contents of 2.3 lb/gal and less. These coatings have the appearance, polishing, stripping, and repair qualities normally associated with conventional solution lacquers. Formulation guidelines for clear furniture coatings based on NC-A latex have been established through evaluations of plasticizers, coalescing solvents, and additives. Plasticizer solvency, coalescent evaporation rate, and microfoam retention can all affect the clarity and gloss of NC-A latex films. Specific recommendations are presented for clear sealer and topcoat formulations, including the use of flatting agents, sanding aids, and rheology modifiers. Performance properties of coatings based on NC-A latex are compared to those of coatings based on commercial acrylic latexes.

Carbon Filled Paints of Improved Electrical Conductivity—A. Calahorra, D. Aharoni, and H. Dodiuk

JCT, 64, No. 814, 27 (Nov. 1992)

Improved conductive paints were prepared by adding graphite to a conductive paint based on carbon black at its critical volume concentration. Determining volume resistivity and specific volume as a function of the graphite volume concentration and observing films surfaces micrographs revealed a point of incontinuity, at about 12% graphite by volume, additional to the one found at the carbon black critical pigment volume concentration.(CPVC). This point is related to a second CPVC due to the existence to two pigments of totally different character, in terms of particle size and surface, leading to the arrangement of the small graphite particles among the relatively large carbon black particles, in the dry paint film. Volume resistivity, thus achieved, was 0.45 Ω cm compared to 1.6 Ω cm of the carbon black-based conductive paint.

Revêtements Aqueux Pour le Bois à Bas Niveaux de Composés Organiques Volatiles à Base de Latex Nitrocellulose-Acrylique—H.F. Haag

JCT, 64, No. 814, 19 (Nov. 1992)

De plus en plus d'intérêt est manifesté pour la fabrication de laques à bois à bas COV. Des laques aqueuses à base de latex nitrocellulose-acrylique (NC-A) ont été formulées à un COV de moins de 2.3 lb/gal. Ces revêtements possèdent les mêmes caractéristiques d'apparence, de polissage et de décapage que les laques conventionnelles. Des principes généraux de formulation pour des revêtements clairs à base de latex NC-A ont été établis via l'évaluation de plastifiants, agents coalescents et additifs. La solvabilité du plastifiant, le taux d'évaporation de l'agent coalescent, et la rétention de mousse peuvent tous affecter la clarté et le brillant des feuils à base de latex NC-A. Des recommendations spécifiques sont présentées pour la formulation de bouche pores transparents et de couches de surface, incluant i'utilisation d'agents de mattage, d'agents de ponçage et d'agents de rhéologie. Les performances de ces revêtements à base de latex NC-A sont comparées à celles des revêvements à base de latex acryliques commerciaux.

Amélioration de la Conductivité Electrique de Peintures Contenant du Carbone—A. Calahorra, D. Aharoni, and H. Dodiuk

JCT, 64, No. 814, 27 (Nov. 1992)

L'amélioration de la conductivité électrique de peintures a été effectuée par l'addition de graphite à une peinture conductrice contenant du noir de carbone, et ce à la concentration volumétrique critique. La détermination de la résistivité volumétrique et le volume spécifique en fonction de la concentration volumétrique du graphite, et l'observation microscopique de la surface des feuils révèlent un point de non-continuité, à environ 12% de graphite par volume, additionnellement à celui trouvé à la concentration volumétrique pigmentaire critique (CPVC) du noir de carbone. Ce point est relié à un second CVPC dû à l'existence de deux pigments de caractères très différents en terme de grosseur de particule et de surface, menant à la disposition des petites particules de graphite parmi

Recubrimientos Base Agua de Bajo VOC Para Madera Basados en Latex Acrilico-Nitrocelulosa—H.F. Haag

JCT, 64, No. 814, 19 (Nov. 1992)

La mayor preocupación en las emisiones de solventes ha renovado el interes en el desarrollo de lacas para madera con bajo VOC. Se han formulado lacas base agua basados en un latex acrílico (NC-A)-nitrocelulosa libre de solvente con un contenido de VOC de 2.3 lb/gal y menor. Estos recubrimientos tienen la apariencia, pulido, decapado y cualidades de reparación normalmente asociadas a las lacas convencionales en solución. Se han establecido las guías de formulación para recubrimientos transparentes de muebles basados en NC latex-A mediante evaluaciones de plastificantes, solventes coalescentes y aditivos. La solvencia del plastificante, la velocidad de evaporación del coalescente y la retención de microespuma pueden ser factores que afecten la claridad y el brillo de las películas de NC latex-A. Se presentan recomendaciones específicas para formulaciones de recubrimiento final y selladores transparentes, incluyendo el uso de agentes mateantes, ayudas para la lijabilidad y modificadores reológicos. Se comparan las propiedades funcionales de los recubrimientos basados en NC latex-A con los recubrimientos base latex acrílico comercial.

Pinturas Conteniendo Carbon de Conductividad Electrica Mejorada—A. Calahorra, D. Aharoni, and H. Dodiuk

JCT, 64, No. 814, 27 (Nov. 1992)

Se prepararon pinturas con un mejoramiente en la conductividad mediante la adición de grafito a una pintura conductiva basada en negro de humo a su concentración crítica en volumen, determinando la resistividad volumétrica y el volumen específico como una función de la concentración en volumen del grafito y observando microfotografías de la superficie de la pelúcla revelaron un punto de discontinuidad, alrededor del 12% de grafito en volumen, adicionalmente al punto qua sa encontró en el negro de humo a la concentración critica del pigmento en volumen (CPVC). Este punto se relaciona con un segundo CPVC debido a la existencia de dos pigmentos de caracteres totalmente diferentes, en términos del tamaño de

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The Distribution of Driers Between the Alkyd and Aqueous Phase in Alkyd Emulsions and its Relation to Drying Properties—G. Östberg, B. Bergenståhl, and K. Sörenssen

JCT, 64, No. 814, 33 (Nov. 1992)

The influence of pH, emulsifiers, and alkyd properties on the distribution of driers between the alkyd- and water phase in alkyd emulsions has been studied. When the pH in the emulsion is decreased, cobalt and calcium driers are redistributed towards the water phase. However, zirconium was found to remain in the alkyd phase independent of pH. Hydrophilic anionic emulsifiers were found to decrease the amount of cobalt and calcium driers in the alkyd phase. The distribution is not influenced by alkyd properties such as oil length or acid values. The relation between the distribution of driers and drying properties has also been investigated. The results indicate a correlation between the early drying rate and cobalt concentration in the alkyd phase.

Suspension of TiO_2 Pigments in Organic Solvents: Identification of Rutile and Anatase in Suspended State—K.V.S.N. Raju and M. Yaseen

JCT, 64, No. 814, 45 (Nov. 1992)

The basic principle of this approach is based on the physical interaction between pigment particles and solvent molecules. It has been observed that in some pigment-solvent suspensions, the interaction is so strong that the finely divided pigment particles remain suspended for days. The magnitude of the interaction is classified in terms of a certain period of time during which the pigment remains suspended in a solvent. Rutile and anatase forms of the TiO_2 pigment were observed to have different suspension characteristics in a few solvents. This feature may be of benefit to the industry, which sometimes faces the difficulty in identifying them.

les particules relativement larges de noir de carbone, dans le feuil de peinture sec. La résistivité volumique obtenue est de 0.45 Ω cm comparativement à 1.6 Ω cm pour la peinture conductrice à base de noir de carbone.

La Distribution de Siccatifs Entre la Phase Alkyde et Aqueuse dans des Emulsions Alkydes, et Leurs Relations avec les Propriétés de Séchage—G. Östberg, B. Bergenståhl, and K. Sörenssen

JCT, 64, No. 814, 33 (Nov. 1992)

L'influence du pH des émulsifiants et des propriétés des akydes sur la distribution des siccatifs entre la phase alkyde et aqueuse d'émulsions alkydes a été étudiée. Lorsque le pH de l'émulsion décroît, les siccatifs de cobalt et de calcium sont redistribués vers la phase aqueuse. Par contre, un siccatif de zirconium est demeuré dans la phase alkyde indépendemment du pH. Des émulsifiants anioniques hydrophiliques ont permis de décroitre la quantité de siccatifs de cobalt et de calcium dans la phase alkyde. La distribution n'influence pas les propriétés de l'alkyde, telles la longueur de l'huile et l'acidité. La relation entre la distribution des siccatifs et les propriétés de séchage a également été étudiée. Les résultats indiquent une corrélation entre le taux initial de séchage et la concentration du siccatif de cobalt dans la phase alkyde.

Suspension des Pigments TiO_2 dans les Solvants Organiques: Identification du Rutile et Anatase en Etat de Suspension—K.V.S.N. Raju and M. Yaseen

JCT, 64, No. 814, 45 (Nov. 1992)

Le principe de base de cette approche est basé sur l'interaction entre les particules de pigment et les molécules de solvant. Il a été observé que pour quelques suspensions pigment-solvant, l'interaction est si forte que les particules de pigments sont restées suspendues pour plusieurs jours. La grandeur de cette interaction est classée en terme de la période durant laquelle le pigment demeure suspendu dans le solvant. Les formes rutile et anatase du pigment TiO2 ont des caractéristiques de suspension différentes dans quelques solvants. Cette particularité peut être bénéfique à l'industrie, qui quelques fois fait face à des difficultés pour l'identification du type de crystal.

partícula y superficie, lo que lleva al acomodo de las partículas pequeñas de grafito entre las partículas relativamente grandes del negro de humo, en la película de pintura seca. La resistividad volumétrica, alcanzada, fué de 0.45 Ω cm comparada con el 1.6 Ω cm de la pintura conductiva basada solo en negro de humo.

La Distribucion de los Secantes Entre el Alquidal y la Fase Acuosa en Emulsiones Alquidalicas y su Relacion con las Propiedades de Secado—G. Östberg, B. Bergenståhl, and K. Sörenssen

JCT, 64, No. 814, 33 (Nov. 1992)

Se estudió la influencia del pH, los emulsificantes y las propiedades del alquidal en la distribución de los secantes entre la fase acuosa y el alquidal en emulsiones alquidálicas. Cuando el pH de la emulsión disminuye, los secantes de cobalto y calcio se redistribuyen a traves de la fase acuosa. Sin embargo, se encontro que el zirconio remanente en la fase alquidálica de manera independiente al pH. Se encontró que los emulsificantes aniónicos hidrofílicos disminuyen la cantidad de cobalto y calcio dentro de la fase alquidálica. La distribución no se ve afectada por las propiedades del alquidal como son la longitud del aceite y los valores de acidez. También se investigaron la relación entre la distribución de los secantes y las propiedades de secado. Los resultados indicaron una correlación entre una velocidad de secado inicial y la concentración de cobalto en la fase alquidálica.

Suspension de Pigmentos de TiO_2 en Solventes Organicos: Identificacion del Rutilico y Anatasico en el Estado Suspendido—K.V.S.N. Raju and M. Yaseen

JCT, 64, No. 814, 45 (Nov. 1992)

El principio básico de este artículo está basado en la interacción física entre las partículas del pigmento y las moléculas del solvente. Se ha observado que en algunas suspensiones pigmento-solvente, la interacción es tan fuerte gyue las partículas de pigmento finamente divididas permanecen suspendidas durante días. La magnitud de la interacción se clasifica en términos de un cíerto período de tiempo durante el cuál las partículas de pigmento estan suspendidas en el solvente. Se observó que las formas rutilica y anatásica en el pigmento TiO_2 tienen diferentes características de suspensión en duferentes solventes. Este hecho es benefico para la industria, la cuál algunas veces se encuentra con la dificultad de tener que identificarlos.

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Theme Announced for 1993 FSCT Spring Week Seminar, May 18-19, Houston, TX

The Federation of Societies for Coatings Technology has announced that the theme for its 1993 Spring Week seminar will be "The Influence of Substrates and Application Methods/Techniques on Coatings Performance." The event will be held at the South Shore Harbour Resort and Conference Center in Houston, TX, on May 18-19, 1993.

The seminar will include information on both the substrates and application methods which affect the performance of coatings. The first day of the seminar will be devoted to formulation considerations needed for the development of coatings for sheet rock and masonry/concrete, while also focusing on the application methods which are used on a variety of substrates. Day two of the program will focus on the importance of surface preparation and will consider the development of coatings for a variety of forestry products, including solid wood, pressure treated wood, plywood/composites, and hardwood.

Designed to benefit both the coatings chemist and the coatings applicator, the seminar is being developed and conducted by FSCT's Professional Development Committee. The topic was selected from a survey of attendees at the Federation's Annual Meeting and Paint Industries' Show. The attendees will have ample time to question the speakers, both during the Open Forum segments and at a reception scheduled for Tuesday evening.

Additional information on the event will be available in January 1993. To be included on the mailing list, contact Michael G. Bell, Director of Educational Services, FSCT, 492 Norristown Rd., Blue Bell, PA 19422. Phone: (215) 940-0777, FAX: (215) 940-0292.

NPCA Honors Four Industry Statesmen at Annual Meeting

The National Paint and Coatings Association (NPCA), Washington, D.C. honored four men with Industry Statesman Awards during the group's 105th Annual Meeting in Chicago, IL, on October 19-21. The awards are given in appreciation of the recipient's long and devoted service to the paint and coatings industry.

Those individuals honored by the association were:

Herbert A. Champlin, Executive Vice President, of Akzo Coatings, Inc., Louisville, KY. Mr. Champlin joined Reliance Universal, Inc., which is now a part of Akzo, in 1971. Throughout his 30-year career in the coatings industry, he has been involved in industry activities, both locally and nationally. He began his committee involvement at NPCA as a member of the National Membership Steering Committee in 1974. Since then, Mr. Champlin has spent 15 years on the Industrial Coatings Committee (formerly the Chemical Coatings Steering Committee), holding the office of Chairman for two years. He also was Chairman of the Chemical Coatings Industry Committee in 1982, and he has been a member of the Architectural Coatings Committee for the past two years. Mr. Champlin has participated in local association activities, wherever he was located. He has been a member of the Metropolitan New York PCA, President of the Chicago PCA, and is currently a member of the Louisville local association.

Donald B. Kurfees, former President and Chief Executive Officer, of Kurfees Coatings, Inc., Louisville, KY. Only two stints as an Air Force pilot interrupted Mr. Kurfees' 37-year tenure at Kurfees, which ended with his retirement this year. Active in the industry on national and local levels, he received NPCA's highest honor, the George Baugh Heckel Award, in 1983, and served as President of the association in 1989. He has been a member of various NPCA Committees, including Management Information, Trade Sales Steering, Trade Sales, Budget and Finance, Joint Paint Industry Coordinating, and Architectural Coatings. He spent a total of nine years on the Board of Directors and six years on the Executive Committee. On the local level, Mr. Kurfees was President of the Louisville PCA from 1967 to 1968.

James O'Connor, former Corporate Manager/Regulatory Affairs, of Rust-Oleum Corporation, Vernon Hills, IL. During his 33 years in the industry, Mr. O'Connor worked at several chemical companies, returning to Rust-Oleum for the second time in 1967. His involvement in the industry includes working with the Chicago PCA and serving as their President from 1983 to 1984. Over the past few years, he has worked on NPCA's Air Quality, Occupational Health/Product Safety, Spray Paint Manufacturers, and State Affairs Committees. In 1991, Mr. O'Connor served as the first Chairman of the Illinois Paint Council. He was successful in guiding the council through its first year, meeting the challenges of preventing passage of a bill that would have restricted the use of aerosol paint, educating a special state childhood lead poisoning task force, and lobbying against other legislation that would have negatively affected the industry. Mr. O'Connor is a member of the Chicago Society for Coatings Technology.

Ernest Scheller, Jr., Chairman Emeritus, of Silberline Manufacturing Company, Inc., Tamaqua, PA During his almost 40 years in the paint industry, Mr. Scheller has served on the association's Board of Directors for the past two years, and has also been active on numerous NPCA committees. He has been on the Industry Suppliers Committee for 25 years and now holds the office of Chairman. In addition, Mr. Scheller has served on the Chemical Coatings Industry Committee, the Industrial Coatings Suppliers Committees, and remains a member of the Management Information Committee.

Key Issues Were Discussed at Reg-Neg Workshop Held on September 17-18

A regulatory negotiation (reg-neg) workshop was held in Washington, D.C., on September 17-18, to discuss key issues involved in the development of a national regulatory program by the U.S. Environmental Protection Agency (EPA) to control volatile organic compound (VOC) emissions from architectural and industrial maintenance (AIM) coatings.

During the workshop, presentations were given on such key issues as relative reactivity, performance/quality/formulations of coatings, the format for presentation of emissions inventory survey results, the definitions involved in VOC calculation methods, and possible regulatory approaches.

These key issues were scheduled to be addressed again at the first formal negotiating meeting, October 15-16, in Chicago. At the meeting, the final selection of members for the advisory committee charter was adopted, and a "working" protocol—which sets guidelines for how the negotiations will be conducted—was agreed upon. Also, recommendations were proposed on how to incorporate the issue of relative reactivity into the negotiations, and how to address/modify the definitions for VOC calculations. In addition, initial ideas and suggestions for a possible regulatory format were presented, as well as initial results of the industry-wide emissions inventory survey.

The current projected timeframe for the reg-neg process is as follows: Negotiations began in October and will terminate by May 1, 1993 unless the Advisory Committee and EPA decide to extend the deadline. In January 1993, the committee and EPA will evaluate whether reasonable progress is being made toward the May 1 deadline and whether to continue discussions. EPA intends to issue a proposed rule in late summer 1993 and a final rule by January 15, 1994.

Future reg-neg meetings are scheduled for December 7-8, in Denver, CO; and January 6-7, at a site to be announced. For details on the content of these open meetings, contact NPCA, 1500 Rhode Island Ave., N.W., Washington, D.C. 20005-5597.

The Dry Color Manufacturers' Association Files Suit With U.S. Court of Appeals

The Dry Color Manufacturers' Association (DCMA), Alexandria, VA, has filed a suit with the U.S. Court of Appeals for the Fourth Circuit a petition for review of the final rule of the Occupational Safety and Health Administration's (OSHA) new standard for occupational exposure to cadmium. The OSHA standard was issued August 31, and published in the *Federal Register*, September 14, 1992.

DCMA, through its Cadmium Pigments Committee, has had a number of concerns with reference to the standard that had been made known to OSHA during the rule-making process. Among those issues was a request that cadmium pigments be considered in a separate rule-making, because of their chemical differences from other cadmium compounds. OSHA elected to disregard this.

In brief, the lower limit of the standard establishes a single eight-hour time-weighted average permissible exposure limit (TWA PEL) of 5 µm of cadmium per cubic meter of air for all cadmium compounds. Employers are required to comply with this limit primarily by means of engineering and work practice controls.

Also, the new rule established separate engineering control air limits (SECAL) or exclusions for certain industry segments. The SECAL's range up to 50 µm of cadmium per cubic meter of air for calcine, crushing, milling, and blending in pigments manufacture, to 15 for other processes in pigment manufacture, as well as segments of plating process and battery production. Both the PEL and SECAL must be achieved by engineering and work practice controls except "to the extent that the employer can demonstrate that such controls are not feasible," according to the *Federal Register* notice.

The DCMA Cadmium Pigments Committee is currently in the process of reviewing all of the material in the Federal Register notice and final standard in order to prepare its appeal. Shortly, it will also provide advice to users of cadmium pigments of the requirements of the standard.

For more details, contact DCMA, P.O. Box 20839, Alexandria, VA 22320-1839, (703) 684-4044.

Hitox Corp. Opens Technical Center

The Hitox Corporation of America, Corpus Christi, TX, has opened a 5,000 sq. ft. Technical Center at its main plant location in Corpus Christi. The new center was constructed to provide additional laboratory and office space for: process control and quality assurance for pigment manufacturing; technical services and product application studies for pigments; and research and development. In addition, the center includes state-of-the-art color evaluation instrumentation.

KRONOS TiO_2 Plant Is Open for Business

KRONOS, Inc., Houston, TX, has officially opened its chloride process, titanium dioxide (TiO_2) pigment manufacturing facility in Lake Charles, LA. The new plant is equipped with two pigment chlorination lines which have the capacity to produce 90,000 tons of TiO_2 per year, representing a 25% increase in the company's worldwide titanium production.

KRONOS, Inc. has manufacturing facilities in the United States, Canada, Germany, Norway, and Belgium.

New Site Announced for Miles Inc.'s Organic Pigment Operations

Miles Inc., Pittsburgh, PA, has announced that it will transfer its production of organic pigments from the company's Haledon, NJ plant to a new manufacturing facility in Bushy Park, SC. Beginning in November, the Haledon plant will operate at reduced capacity while maintaining production capability until the Bushy Park plant is fully operational. It is expected operations at Haledon will cease by mid-1993.

The Haledon plant currently employs 173 people. In addition to 16 employees who have accepted transfers to Bushy Park, at least 11 others will be reassigned within the company. Remaining salaried and hourly employees will be offered a comprehensive benefits package that includes severance pay, retraining, and company-paid job placement assistance.

Red Spot Paint & Varnish Outlines Expansion Plans

Red Spot Paint & Varnish Company, Evansville, IN, has dedicated a $1 million building addition to its Evansville facility. The two-story, 7,500 square foot expansion houses state-of-the-art quality control facilities and equipment which includes: automated temperature and humidity controlled paint booths; laboratories for color shading, quality assurance, and process engineering; light booths; and additional office space.

In addition, Red Spot recently moved its Ultraviolet Curable Coatings Division into a recently renovated Evansville building. Further expansion plans include a completion of a 22,000 square foot addition to the company's Westland, MI production facility. Ground was broken in July for the $1.1 million project.

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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 7,300 in 26 Constituent Societies in the United States, Canada, Great Britain, and Mexico. The JOURNAL is devoted to the advancement of knowledge in the science and technology of surface coatings, the materials comprising such coatings, and their use and performance.

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

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

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

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Four complete copies should be sent to the Editor, JOURNAL OF COATINGS TECHNOLOGY, 492 Norristown Rd., Blue Bell, PA 19422-2350. The cover letter should address copyright, clearance, and release issues discussed above and should specify paper category: *Original Research, Reviews, Open Forum*, or *Back to Basics*.

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

. . . by Constituent Societies For Annual Meeting Presentation

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

...for Roon Foundation Award Competition

Ten complete copies of the manuscript are required, and should be submitted to the Chairman of the 1992 Roon Awards Committee, Richard Himics, Daniel Products Co., 400 Claremont Ave., Jersey City, NJ 07304. (For complete details, see "Roon Awards" section of the JOURNAL in January 1992 issue.)

MANUSCRIPT PREPARATION

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

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

Original Research Papers: The main technical content of the JOURNAL OF COATINGS TECHNOLOGY will continue to be original research papers. Editors support the trend in scientific writing to a direct, less formal style that permits limited use of personal pronouns to avoid 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. Reviews that consist mainly of computer searches with little attempt to integrate or critically evaluate are not solicited.

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

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

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

Manuscripts should be typed with double spacing on one side of $8^1/_2$ x 11 inch (22 x 28 cm) paper, with at least one-inch (2.5 cm) margins on all four sides. All paragraphs should be indented five spaces, and all pages should be numbered at the top center, or upper right corner.

Title

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

Authors' Biographies and Photographs

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

Abstracts

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

Text

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

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

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

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

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

Metric System

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

Tables, Graphs, and Drawings

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

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

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

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

Photographs

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

Color prints and slides are unacceptable.

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

Nomenclature

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

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

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

Equations

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

Summary

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

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References

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

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

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

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

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

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

OTHER INFORMATION

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

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Regulatory UPDATE

NOVEMBER 1992

This digest of current regulatory activity pertinent to the coatings industry is published to inform readers of actions which could affect them and their firms, and is designed to provide sufficient data to enable those interested to seek additional information. Material is supplied by National Paint and Coatings Association, Washington, D.C. and edited by members of the FSCT Environmental Affairs Committee.

Lead—In the House, H.R. 5730, a combination of legislation drafted by Rep. Henry Waxman (D-CA), and Rep. Al Swift (D-WA), died October 6 after objections to consideration on the House floor. The bill would have called for an across-the-board industrial coatings limit of 0.06% by dry weight for lead, enforceable two years after enactment of the law. Among several amendments adopted earlier by the House Energy and Commerce Committee was a provision to allow a 1.9% by dry weight limit for lead used in industrial electrodeposition primer coatings (EDP), and one that raises the allowable *incidental* presence of lead in industrial paint to .12% by dry weight. The U.S. Environmental Protection Agency (EPA) would have, after five years, re-evaluated the health and environmental effects of the lead content levels in those products to determine if further regulatory action would be needed.

The bill also provided for a five-year period to allow substitutes to be readily available for mirror backing coatings, lead frit (automotive and architectural), automotive agricultural coatings, marine refinish coatings, and industrial special purpose coatings by government specifications. Artists' paints would have been exempt from the legislation.

While H.R. 5730 did not pass, the following provisions, taken from the bill, were added to the Housing bill (H.R. 5334) that did pass at the end of September. The "non-controversial" provisions included the establishment of a two-year grant program to reduce lead paint hazards in housing; disclosures of lead paint hazards in real estate and leasing transactions; and training and certification standards for workers who remove lead.

Because the House failed to act, the Senate bill, S. 391, which had been waiting for floor action since October 1991, also died.

During the last year, there has been a tremendous amount of debate on the all-encompassing provisions of the lead issue at the federal, state, and local levels and in the media. It may be incorrect to state that these bills are dead, when in fact, they are merely asleep for the time being. We can expect certain actions early next Congress.

The Resource Conservation and Recovery Act—Congress made a valiant effort to rewrite the nation's primary solid and hazardous waste law, but even after scaling back the language to a shadow of their former selves, H.R. 3865 and S. 976 remained too controversial to pursue on either floor.

After being significantly amended in the House Energy and Commerce Committee and the Senate Environment and Public Works Committee, respectively, efforts to reauthorize the Resource Conservation and Recovery Act (RCRA) centered around various recycling programs.

The Senate bill, approved by the committee late in May, would have set varying recycling targets for paper, plastic, and glass, but gave the industries broad discretion to meet those goals. On July 2, the House Committee approved H.R. 3865, which would have required states to set up solid waste management plans and force industry to recycle 40% of paper, glass, and steel by 1995.

When it became clear that action on the solid waste bills would not be forthcoming, the Senate moved separately on one of the more contentious issues of the bill—shipments of waste across state borders. S. 2877, which would have given states limited powers to block out-of-state trash, passed the full Senate on July 23. The bill would have given Indiana, Ohio, Pennsylvania, and Virginia—states that receive the most out-of-state garbage—additional authority to curb garbage imports. The House never even debated the issue, so that bill also died at the end of the session. (Sponsors of the bill accused House members of favoring "politics over policy" and vowed to bring the issue up again early next year.)

Product Liability—Efforts to pass a national uniform product liability law failed for the 12th year in a row and if Gov. Clinton wins the election, prospects for passage over the next four years are practically nil.

The latest attempt to pass product liability legislation came to a halt on September 10 after supporters in the Senate were unable to generate enough votes to cut off a certain filibuster.

The bill, S. 640, would have set national standards for determining compensation for victims of faulty products and would have provided incentives to settle lawsuits quickly. There would have been no cap on punitive damage awards. The issue will undoubtedly resurface again next year, but any significant action would be surprising.

Worker Safety—Despite a veto threat by President Bush, both Houses of Congress attempted to move legisla-

The Regulatory Update is made available as a service to FSCT members, to assist them in making independent inquiries about matters of particular interest to them. Although all reasonable steps have been taken to ensure the reliability of the Regulatory Update, the FSCT cannot guarantee its completeness or accuracy.

tion that would strengthen federal worker-safety laws under the 1970 Occupational Safety and Health Act.

Both bills, S. 1622 and H.R. 3160, were passed at the committee level but failed to make it to the floor. The bills would have required employers to prepare safety plans and to form labor-management committees that would make recommendations on health and safety issues. The bills also would have allowed criminal prosecution of employers in cases in which an employer's actions led to serious injury of a worker. Under current law, an employer can only be prosecuted if the worker dies as a result of the actions.

The Bush Administration opposed the legislation because it said the bills would result in higher costs, excessive regulations, and increased litigation. The issue is sure to generate significant action during the 103rd Congress.

Indoor Air Quality—While interest in Indoor Air Quality legislation was at a high point during the first session of the 102nd Congress, the issue lost momentum despite efforts to re-draft a bill.

During the summer of 1991, the House Subcommittee on Environment approved a full committee action, H.R. 1066, sponsored by Rep. Joseph P. Kennedy, II. But the House Science, Space, and Technology Subcommittee, which had sequential referral, sent the bill back because "it was burdensome and costly."

The bill would have mandated specific Occupational Safety and Health Administration (OSHA) standards on air contaminants and ventilation and required labelling of products that emit hazardous gases. It also would have mandated the creation of an OSHA Office of Indoor Air Quality to coordinate all indoor air activities and to act as liaison to public interest groups, labor and businesses to compile information on controlling and reducing contaminants. The bill remained in the Environment Subcommittee for the better part of a year, when a re-draft was attempted.

The new draft, which was never actually introduced, was a joint effort between Rep. Kennedy and Rep. Robert Andrews (D-NJ). The new version would have required OSHA to inspect a workplace if an employer failed to reduce air contaminants after a certain percentage of employees filed complaints. The Department of Labor would have established the number of complaints needed to trigger the standard. Employees would also have been able to file civil suits against employers who failed to decrease indoor air contaminants within 180 days of receiving an OSHA citation.

Efforts to revitalize the issue, either as a free standing measure, or as part of the OSHA reform package, will undoubtedly be on the agenda for the next Congress.

Water Quality—Efforts to revitalize interest in reauthorizing the Clean Water Act did not come to pass during this last session, but will likely see significant action next year. Rep. Robert Roe (D-NJ), Chairman of the House Public Works and Transportation Committee, has been reviewing staff recommendations on provisions for a bill that could include reauthorizing certain water resource projects and possible pollutant trading measures.

The Senate Environment and Public Works Committee introduced a comprehensive reauthorization bill, S. 1081, in May 1991, but no further action was taken.

Meanwhile, just before Congress adjourned, the House passed legislation (H.R. 6004) that would extend by two years the deadline for obtaining permits for storm water discharges associated with municipal and industrial activities.

The measure was introduced as a result of industry reaction to an EPA final rule regarding general storm water permits that set an October 1, 1992 deadline for filing notices of intent to be covered under the permit. The bill would have extended the deadline until October 1, 1994, but the Senate did not concur with the House in time for the bill to become law.

Department of Transportation
Research and Special Programs Administration
October 1, 1992—57 FR 45446
Editorial and Technical Revisions to HM-181
Action: Final rule

On December 21, 1990, the Research and Special Programs Administration (RSPA) published a final rule (Docket HM-181) which revised the Hazardous Materials Regulations (HMR) with respect to hazard communication, classification, and packaging requirements based on the UN Recommendations. A document containing responses to petitions for reconsideration and containing editorial and substantive revisions to the final rule was published on December 20, 1991.

RSPA has now issued final corrections and editorial errors and makes minor regulatory changes to the revised rule (title 49 of the Code of Federal Regulations (CFR) parts 100-199) published in December 1991. The final corrections are intended to promote accuracy and consistency to the CFR, and does not assess any new requirements on those subject to the HMR.

For further information, contact John Gale or Beth Romo, Office of Hazardous Materials Standards, RSPA, (202) 366-4488, or Charles Hochman, Office of Hazardous Materials Technology, RSPA, (202) 366-4545.

Department of Transportation
Research and Special Programs Administration
October 1, 1992—57 FR 45424
Federal Preemption of State and Local Requirements Under the Hazardous Materials Transportation Act
Action: Notice

The Hazardous Materials Transportation Uniform Safety Act (HMTUSA) significantly amended the Hazardous Materials Transportation Act (HMTA) upon its passage in 1990. Particularly affected were requirements for federal preemption of state and local governments.

To assist the public understanding of the judicial and administrative precedents concerning preemption under the HMTA, the Research and Special Programs Administration (RSPA) has published a subject-matter index and table summarizing RSPA inconsistency rulings, non-preemption determinations, and a waiver of preemption determination, and all court decisions which discuss HMTA preemption issues.

For further information, contact Edward H. Bonekemper, III, Assistant Chief Council for Hazardous Materials Safety, Office of the Chief Counsel RSPA, Department of Transportation, Washington, D.C. 20590, (202) 366-4400.

Environmental Protection Agency
September 25, 1992—57 FR 44438
Final NPDES General Permits for Storm Water Discharges Associated with Industrial Activity
Action: Notice

The U.S. EPA's Regional Administrators have issued final NPDES permits for storm water discharges associated with industrial activity in Massachusetts, Puerto Rico, District of Columbia, Guam, and American Samoa, and from federal facilities in Delaware. EPA has targeted these states and territories for general permits because it has determined that they lack the resources to administer their own NPDES programs.

The general permits, effective September 25, 1992, establish a Notice of Intent (NOI) requirement, requirements for the development and implementation of storm water pollution prevention plans, and monitoring requirements for certain classes of facilities. According to EPA, one of the most important requirements of the general permit is the preparation and development of site specific storm water pollution prevention plans. The plans would include preventative maintenance of storm water controls and other facility equipment, as well as procedures for spill prevention and emergency response.

In order to be authorized to discharge under the general permits, appropriate discharges should have filed an NOI by October 1, 1992. The address is: Storm Water Notice of Intent, P.O. Box 1215, Newington, VA 22122. For further information on the storm water general permit or for individual permit applications, contact the NPDES Storm Water Hotline at (703) 821-4823.

Environmental Protection Agency
September 16, 1992—57 FR 42832
Standards Applicable to Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities; Financial Responsibility for Third-Party Liability, Closure, and Post-Closure
Action: Final Rule

On July 1, 1991, the U.S. EPA proposed to amend its financial assurance requirements under Subtitle C of the Resource Conservation and Recovery Act (RCRA). The affected regulations related to third-party liability coverage, specifically the claims reporting provision and the provisions for obtaining a letter of credit.

The Agency has promulgated those proposals which expand the use of the non-parent corporate guarantee to owners and operators of hazardous waste facilities for demonstrating financial responsibility for closure and post-closure care. The effective date for the final rule is September 16, 1992.

For further information, contact the RCRA Hotline at (800) 424-9346, or Ed Coe, Office of Solid Waste, U.S. EPA, Washington, D.C. 20460, (202) 260-6259.

Department of Transportation
Research and Special Programs Administration
September 14, 1992—57 FR 42466
Tank Cars and Cargo Tank Motor Vehicles: Attendance Requirements
Action: Notice of proposed rulemaking

The Hazardous Materials Regulations (HMR) requires that rail tank car unloading operations must be performed by "a reliable person who has been properly instructed in unloading hazardous materials and attended by the unloader until unloading is completed." The regulations also require that a cargo tank motor vehicle be attended at all times by "a qualified person (usually the driver)" while it is being loaded or unloaded. While these "personal" attendance requirements were implemented for safety purposes, they can also be very time consuming.

In an effort to recognize recent technological innovations and to improve safety during the loading and unloading process, the Research and Special Programs Administration (RSPA) is proposing to amend the HMR to allow the use of signalling systems (sensors, alarms, electronic surveillance equipment) to satisfy the attendance requirements.

RSPA is also proposing to revise the tank car unloading requirements to remove obsolete provisions, and to allow tank cars containing hazardous materials to remain standing with unloading connections attached when no product is being transferred.

Comments must be received by December 14, 1992 and should be addressed to the Dockets Unit (DHM-30), Research and Special Programs Administration, U.S. Department of Transportation, Washington, D.C. 20590. Comments should be submitted in quintuplicate and should identify the docket and notice number (Docket No. HM-212; Notice No. 92-9). For further information, contact Diane La Valle or Jennifer Karim, Office of Hazardous Materials Standards, RSPA at (202) 366-4488.

Department of Labor
Occupational Safety and Health Administration
September 14, 1992—57 FR 42102
Occupational Exposure to Cadmium
Action: Final rule

The Department of Labor has determined that employees exposed to current allowable levels of cadmium face significant risk of developing kidney dysfunction and cancer. Based on that determination, the Occupational Safety and Health Administration (OSHA) has promulgated a new standard for occupational exposure to cadmium, applicable to general industry, agriculture, and maritime.

The new standard, effective December 14, 1992, establishes a single eight-hour time weighted average permissible exposure limit (TWAPEL) of 5 micrograms of cadmium per cubic meter of air for all cadmium compounds, including dust and fumes. Employers are required to comply with this limit primarily by means of engineering and work practice controls.

For further information, contact James F. Foster, Director, Office of Information and Consumer Affairs, OSHA, U.S. Department of Labor, Room N-3647, 200 Constitution Avenue, N.W., Washington, D.C. 20210, (202) 523-8151.

States Proposed Legislation and Regulations

California

Labeling—CA A. 2942 (Archie-Hudson) requires a manufacturer, distributor, or seller of plastic or metal four-gallon to six-gallon, straight sided, slightly tapered, open head, industrial containers, as defined by the American Society for Testing and Materials, intended for use, sale, distribution, or any other purpose within California, irrespective of point of origin, to place warning labels in English and Spanish on those containers prior to release into the stream of commerce. A key amendment to the bill provides for federal preemption when the Congress enacts similar legislation. The bill, which is intended to prevent small children from drowning in the containers, was signed by the Governor on September 27.

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Maryland

Emergency Response Plans (Proposed Revisions)—The Department of the Environment has proposed revisions to the regulations affecting the state's Hazardous Substance Response Plan which includes standards for responding to and cleaning up releases of hazardous substances into the environment and cost recovery actions against responsible parties. For information, contact the department at (301) 631-3343.

Michigan

Toxics-in-Packaging—MI S. 1109 (Ehlers) prohibits a manufacturer or distributor from selling or offering for sale or for promotional purposes any package or packaging component or any product in a package to which lead, cadmium, mercury, or hexavalent chromium has been intentionally added during manufacture or distribution; establishes maximum allowable concentration levels for those toxics that are incidentally present in packaging materials. The bill was introduced on September 15 and referred to the Senate Committee on Natural Resources and Environmental Affairs.

Environmental Marketing—MI S. 1110 (Ehlers) provides standards for use of the terms recyclable, recycled, and degradable. The bill was introduced on September 15 and referred to the Senate Committee on Natural Resources and Environmental Affairs.

Minnesota

Occupational Safety; Employee Right-to-Know (Proposed Rules)—The Department of Labor and Industry has proposed to amend the state's Employee Right-to-Know standard to make the standard conform to certain changes in the regulation's underlying statute and federal OSHA standards relating to occupational exposure to bloodborne pathogens. For further information, contact the Minnesota Department of Labor and Industry, Occupational Safety and Health Division at (612) 296-2116.

New Jersey

Lead—NJ S. 1135 (Bassano) requires certification of lead inspectors and lead abatement workers by the Department of Health. The bill was amended and released from the Senate Committee on Health and Human Services on October 1.

NJ A. 1855 (R. Smith) prohibits sale or use of lead-containing solder or flux in certain plumbing works; requires warning labels on lead-containing solder or flux sold in-state. The bill is in the Assembly Committee on Energy and Hazardous Waste.

NJ A. 1732 (Hartmann) establishes certification program for lead abatement workers and inspectors. The bill was introduced on September 14, and referred to the Assembly Committee on Energy and Hazardous Waste.

Ohio

Environmental Marketing—OH S. 377 (Fingerhut) requires persons who make environmental marketing claims relating to a consumer good or its package or container to maintain and provide upon request documentation supporting the claims. The bill is in the Senate Committee on Energy, Natural Resources and Environment.

Lead—OH H. 879 (Miller) requires the abatement of hazardous levels of lead in buildings used for human habitation; requires health care professionals to report the results of lead poisoning tests performed on Ohio residents to the Director of Health; prohibits the application of lead-containing materials on buildings; requires the Public Health Council to establish mandatory lead poisoning screening guidelines; establishes a lead abatement certification and licensure program within the Department of Health. The bill was introduced on September 29.

OH H. 888 (Campbell) requires lead abatement in residential structures; creates a tax credit for such abatement; provides for licensure or certification of persons performing lead abatement; and creates the Child Lead Poisoning Prevention Advisory Committee. The bill, introduced on October 6, has yet to be referred to a committee.

Pennsylvania

Air Quality (Notice of Public Hearing)—The Department of Environmental Resources (DER) will hold a public hearing on the proposed revision to the State Implementation Plan (SIP) which includes Section 507 of the Clean Air Act requiring the state to provide assistance to small businesses in complying with air pollution control requirements. Among other things, the program includes compliance audit and permit application assistance and confidentiality assurance. For information on the outcome of the October 15 hearing in Harrisburg, PA, or on a comment period following the hearing, or copies of the proposed SIP, contact Dean Van Orden at (717) 787-1663.

Air Quality (Proposed Rule)—As mandated under the Clean Air Act, the Environmental Quality Board (EQB) has proposed through its State Implementation Program (SIP) a revision that employers with 100 or more employees in the severe nonattainment area implement a program to reduce work related vehicle trips and miles traveled by employees. The SIP revision requires employers to increase average passenger occupancy per vehicle in commuting trips between home and the workplace during peak travel periods by at least 25% above the average vehicle occupancy. For more information, contact Gary Triplett at (717) 787-7060.

Texas

Air Quality (Proposed Amendments)—The Texas Air Control Board (TACB) has proposed amendments to the State Implementation Plan (SIP) concerning emissions banking, which provides increased availability of emissions offsets required for the permitting of new or expanding industry in ozone nonattainment areas. Four new definitions are added (including emissions banking, reduction credit, and stationary source) and two modified definitions are proposed (including the potential to emit, which more closely matches the federal definition). For further information, contact the TACB at (512) 908-1451.

Washington

Air Quality (Proposed Rules)—The Department of Ecology has proposed amendments to the state's air regulations to incorporate changes in the state and the federal clean air laws mandated by the Federal Clean Air Act Amendments of 1990. Included among the proposed changes are those relating to emissions of hazardous air pollutants and the state's upcoming operating permit program. For further information, contact the department at (206) 459-6256.

Low-VOC Waterborne Coatings for Wood Based on Nitrocellulose-Acrylic Latex

Harold F. Haag
Aqualon*

Increasing concern over solvent emissions has prompted renewed interest in low-VOC lacquers for wood. Waterborne lacquers based on a solvent-free nitrocellulose-acrylic (NC-A) latex have been formulated at VOC contents of 2.3 lb/gal and less. These coatings have the appearance, polishing, stripping, and repair qualities normally associated with conventional solution lacquers. Formulation guidelines for clear furniture coatings based on NC-A latex have been established through evaluations of plasticizers, coalescing solvents, and additives. Plasticizer solvency, coalescent evaporation rate, and microfoam retention can all affect the clarity and gloss of NC-A latex films. Specific recommendations are presented for clear sealer and topcoat formulations, including the use of flatting agents, sanding aids, and rheology modifiers. Performance properties of coatings based on NC-A latex are compared to those of coatings based on commercial acrylic latexes.

INTRODUCTION

Nitrocellulose has been the resin of choice for clear wood coatings, especially furniture lacquers, in this country for over 60 years[1] because of its attractive appearance, ease of application, fast dry, exceptional hardness, and repairability. In the furniture industry, the word *lacquer* is still synonymous with nitrocellulose coatings. Increasing concern over solvent emissions has prompted renewed interest in low-VOC lacquers for wood.

Nitrocellulose lacquer emulsions were reported as early as 1929[2] and soon found commercial use for coating porous substrates such as paper, fabric, and leather.[3-5] Multicolor lacquers, which are dispersions of lacquer enamel droplets in water, have been used as architectural coatings and product finishes since the 1950s.[6,7] Nitrocellulose coatings emulsions are easily prepared, but have had the shortcomings of relatively high VOC content and only fair stability. New technology for manufacturing stable, small particle size lacquer emulsions with lower VOC for wood furniture coatings has been recently described.[8]

Another form of waterborne nitrocellulose technology available for formulating coatings for wood is nitrocellulose-acrylic (NC-A) latex. An NC-A latex is prepared by dispersing nitrocellulose and acrylic monomer in water and then polymerizing the acrylic monomer by free radical polymerization.[9] The resulting product is a dispersion in water of particles containing nitrocellulose and acrylic polymer.

A commercially available NC-A latex product is designated CTG D-857. Typical properties of CTG D-857 NC-A latex are listed in *Table* 1. This product contains no solvent. Plasticizer, coalescing solvent, or other resins must be added to this NC-A latex to achieve film formation.

Clear coatings for wood furniture have been developed based on CTG D-857 NC-A latex. Coalescing solvents, plasticizers, and defoamers were evaluated to develop initial topcoat formulations. Some of the films prepared did not display the high degree of clarity which is normally characteristic of nitrocellulose coatings. Clarity is of utmost importance in clear wood furniture coatings. These coatings are typically applied at low solids in multiple coats to allow for artistic embellishments which contribute to the final illusion of depth. Any undesired lack of clarity detracts from the esthetics of the finished piece. Plasticizer, coalescent, and defoamer selections were all found to affect film clarity.

Thickeners were evaluated for the formulation of a sag-resistant sealer and topcoat, and sanding aids were evaluated to formulate a sanding sealer.

Presented at the 19th Annual Waterborne, Higher-Solids, and Powder Coatings Symposium, on February 26-28, 1992, in New Orleans, LA.

*A Hercules Incorporated Unit, Research Center, 500 Hercules Rd., Wilmington, DE 19808-1599.

Table 1—CTG D-857 Nitrocellulose-Acrylic Latex

Typical Properties

Appearance	Milky white liquid
Average particle size, microns	<0.2
Brookfield viscosity, mPa·s	50
pH	4.8-5.5
Density, lb/gal (25°C)	9.54
Specific gravity (25/25°C)	1.14
Flash point, °C	>93
°F	>200
Glass transition temperature, °C	47
Mechanical stability, Waring blender, 5 min	Pass
Heat stability, 60°C (140°F), 10 days	Pass
Freeze-thaw stability	Keep from freezing
Composition, wt %:	
Solids	53-54
Water	46-47
Solvent	0

Two NC-A latex topcoats were compared to two commercial acrylic latexes in an evaluation based on a testing regimen typical for wood furniture coatings.

EXPERIMENTAL

Materials

All materials used in formulating were commercial products. The tradenames and suppliers for these materials are listed in the *Appendix*. Deionized water was used throughout the work. Five-ply 5/16-in. birch- or maple-veneer plywood was used as the wood substrate.

Coatings Preparation

Coatings were prepared using the following procedure:

(1) Charge CTG D-857 NC-A latex to container.

(2) Add water.

(3) Stir at a speed sufficient to maintain a good vortex.

(4) Premix coalescent and plasticizer and add slowly to the latex while mixing.

(5) Adjust mixing speed to maintain vortex as viscosity increases.

(6) Add defoamer, flow-control agent, or thickener, preferably diluted with water.

(7) Mix 5-10 min.

(8) Filter through 80-200 mesh screen or cloth and let stand overnight before application.

It is important to add water to dilute the NC-A latex *before* adding plasticizer or coalescent. Plasticizers and coalescents quickly swell the NC-A latex particles, and some coagulation of the latex will result if it has not been diluted.

The pH of the NC-A latex system must be maintained at 7 or lower. The NC-A latex is unstable at basic pH and will quickly coagulate. Modifying materials having pH higher than 7, such as some pigment and wax dispersions and alkali-swellable emulsions, should be neutralized before adding to the NC-A latex.

Flatting pigments were added using a *reverse addition* procedure; that is, the pigments were dispersed in water, and the formulated NC-A latex vehicle was then added **to** the pigment dispersion. This mixing scheme is the reverse of the traditional let-down sequence of adding pigment dispersion to vehicle, hence the term reverse addition.

Coatings Application

Coatings were applied, unless otherwise noted, by conventional siphon-fed air-atomized spray. Drying conditions were 23 ±2°C (73 ±4°F) and 50 ±5% relative humidity. Coatings were dried for 24 hr before testing unless otherwise specified. Coatings were aged two weeks before conducting cold-check resistance testing.

Coatings Testing

Viscosities were measured by Brookfield viscometer or Ford cup as indicated. A rating scale of zero (no performance or complete failure) to 10 (perfect performance or no effect) was used for most of the subjective evaluations. The following ASTM test methods were used as guides: D 1211-87 (cold check), D 2091-88 (print resistance), D 3359-90 (cross-hatch adhesion), D 4366-87 (König pendulum hardness), and D 869-85 (pigment settling).

RESULTS AND DISCUSSION

Initial Film Forming Compositions

Two plasticizers, tributoxyethyl phosphate (TBEP) and butyl benzyl phthalate (BBP), and a coalescing solvent, butoxyethyl acetate (EB acetate), were used to determine the minimum amounts of plasticizer and coalescent required to achieve film formation of the NC-A latex (*Table* 2). Higher amounts of both plasticizer and coalescent were required for the formation of crack-free films by spray application than by casting with a draw-down blade. This was probably due to evaporation of coalescent from the atomized liquid during spray application. The results indicate that at 11 parts of TBEP or BBP per 100 parts NC-A latex, 20 parts of EB acetate are necessary to get clear, crack-free films by spray application on wood. The VOC content at these levels of plasticizer and coalescent is 275-280 g/L (2.3 lb/gal).

Defoamer Selection

Macrofoam Control: The initial compositions produced excessive amounts of foam during their preparation

Table 2—Initial NC-A Latex Film Forming Compositions

Plasticizer and Coalescent, Parts per 100 Parts NC-A Latex by Weight			Film Quality		VOC Content (Calculated)	
TBEP	BBP	EB Acetate	Glass, Cast	Wood, Sprayed	g/L	lb/gal
12	—	10	Good	Cracked	160	1.3
10	—	15	Good	Cracked	225	1.9
—	10	15	Good	Cracked	230	1.9
10	—	20	Good	Cracked	280	2.3
—	10	20	Good	Cracked	285	2.4
11	—	20	Good	Good	275	2.3
—	11	20	Good	Good	280	2.3

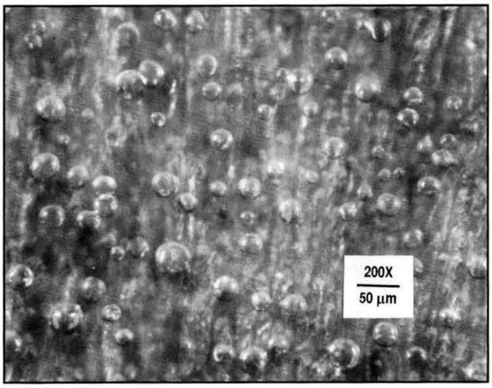

Figure 1—Photomicrograph of microbubbles in dry NC-A latex film on stained birch-veneer plywood

and spray application. A series of defoamers was evaluated by adding one drop of defoamer (25-35 mg) to 30 grams of the NC-A latex in a 4-oz bottle, capping the bottle, shaking it vigorously, and then evaluating the amount and persistence of the resulting foam (*Table* 3). Defoamer G, a silicone which was the best of four very effective defoamers, was selected for further formulation work.

MICROFOAM CONTROL: A slight haze in spray-applied NC-A latex films was traced to the presence of microbubbles in the dried films. Typical microbubbles are pictured in *Figure* 1. Although the Defoamer G effectively controlled macrofoam, it was not effective in controlling the microfoam[10] which caused the haze in dried films.

Defoamer M, although not very effective on macrofoam, was found to significantly improve film clarity by reducing the retention of microfoam. This defoamer is a polysiloxane-polyether copolymer marketed as a *deaerator*. Defoamer M also had a positive effect on the gloss of a formulation based on TBEP and EB acetate as seen in *Table* 4.

Initial Gloss Topcoats

Based on these results, the two formulations listed in *Table* 5 were prepared as starting-point topcoats. Although the initial film formation experiments indicated that 11 parts plasticizer and 20 parts EB acetate per 100 parts by weight NC-A latex were sufficient to obtain good coalescence of spray-applied films, these topcoat formulations include 12.5 parts plasticizer per 100 parts NC-A latex to help ensure good coalescence under variable application conditions of temperature and humidity. Increased plasticizer was chosen over increased coalescent in order not to exceed a VOC content of 275 g/L (2.3 lb/gal), which is the limit for clear topcoats scheduled to take effect July 1, 1994, in the South Coast Air Quality Management District of California under Rule 1136.

Although the two formulations performed comparably in most regards, Formulation 2, which used BBP as the plasticizer, had a slight haze that was not attributable to

Table 3—Defoamer Evaluation

Defoamer	Chemical Type	Foam Level
None	—	High
A	Proprietary	High
B	Polymeric	Low
C	Modified polysiloxane	High
D	Alcohol/silicone	High
E	Alcohol/siloxane	Medium
F	Proprietary	High
G	Silicone	Low
H	Silicone	Low
I	Silicone/silica	Medium
J	Silicone/silica	Medium
K	Organic/silica	Low
L	Organic	High
M	Siloxane-polyether	High

Low = Very little foam lasting no longer than 2 min.
Medium = Moderate foam lasting up to 17 min.
High = Much foam lasting longer than 17 min.

Table 4—Effect of Deaerator Concentration on Gloss

100/25/12.5/20 NC-A Latex/Water/TBEP/EB Acetate; Three Coats on Birch-Veneer Plywood

	60° Gloss	
Defoamer M, wt%	Range	Average
None	59-62	60
0.5	70-75	73
1.0	76-77	77
1.5	78	78

Table 5—Initial NC-A Latex Topcoat Formulations (Compositions as Parts by Weight)

	Formulation 1	Formulation 2
CTG D-857 NC-Acrylic latex	100.0	100.0
Water	25.0	25.0
Tributoxyethyl phosphate	12.5	—
Butyl benzyl phthalate	—	12.5
EB acetate	20.0	20.0
Polysiloxane additive		
10% aqueous	1.0	1.0
Defoamer M		
50% aqueous	2.4	2.4
Total	160.9	160.9
Solids, weight %	42	42
Viscosity		
No. 4 Ford cup, sec	15	17
Brookfield, mPa·s	55	91
Density, g/L	1080	1080
lb/gal	9.0	9.0
Minimum filming temperature, °C	6	8
VOC content, calculated		
g/L	275	265
lb/gal	2.3	2.2
Print Resistance,[a] 4 psi		
2 hr air dry	4	4
24 hr air dry	10	10
Cold-check resistance,		
Cycles passed	20+	12

(a) 1-10 rating scale, 10 = no effect.

Table 6—Plasticizer Evaluation
(12.5 Parts Plasticizer by Weight per 100/25/20 Parts NC-A Latex/Water/EB Acetate)

Plasticizer	Print Resistance[a]	Hardness % Glass[b]	Haze	Cracking
Tributoxyethyl phosphate	7	17	None	None
Tricresyl phosphate	9	26	None	None
Dibutyl phthalate	8	29	None	None
Butyl benzyl phthalate	9	25	V slight	None
Di-2-ethylhexyl phthalate	9	35	V slight	None
Di-2-ethylhexyl terephthalate[c]	9	25	Heavy	Heavy
Diisononyl phthalate[c]	10	34	Moderate	None
Diisodecyl phthalate[c]	10	21	Moderate	Slight
Dibutoxyethoxyethyl adipate	8	17	None	None
Di-2-ethylhexyl adipate[c]	8	20	V slight	None
Diisodecyl adipate[c]	10	22	Moderate	Moderate
Di-2-ethylhexyl sebacate[c]	10	19	Moderate	Heavy
Tetraethylene glycol di-2-ethylhexoate	7	19	None	None
Triethyl citrate	6	15	None	None
Epoxidized soybean oil[c]	10	21	V slight	None

(a) 4 psi applied after 21 hr air dry, 1-10 rating scale, 10 = no effect.
(b) Measured after 21 hr air dry.
(c) Slight separation in liquid phase.

Table 7—Coalescent Evaluation
(20 Parts Coalescent by Weight per 100/25/12.5 Parts NC-A Latex/Water/TBEP)

Coalescent	Evap. Rate[a]	DFT, Mils	Dry Time, Min[b]	Film Quality
2-Methoxypropyl acetate	34	1.9	16	Cracked
C-6 acetate	17	2.2	18	Microbubbles
C-7 acetate	8	2.4	18	Microbubbles
Ethyl 3-ethoxy propionate	12	2.0	17	Microbubbles
2-Butoxyethyl acetate	3	2.1	21	Few microbubbles
C-8 acetate	3	2.1	25	Few microbubbles
2-Ethylhexyl acetate	3	2.3	26	Few microbubbles
C-9 acetate	1	2.0	24	Clear
C-10 acetate	0.6	3.4	34	Clear
Dibasic esters	0.8	2.6	56	Clear
C-11 ketone	0.2	2.5	31	Clear
2,2,4-Trimethyl-1,3-pentanediol monoisobutyrate	0.2	2.5	16	Microbubbles
C-13 acetate	0.1	2.8	31	Clear

(a) Relative to n-butyl acetate = 100.
(b) Gardner circular dry time, time to no tear.

microbubbles and also passed only 12 cycles of cold-check testing.

Evaluation of Plasticizers and Coalescents

Additional plasticizers and coalescing solvents were evaluated for their contributions to film formation, hardness development, and clarity. These evaluations identified specific plasticizers and coalescents which are highly effective for the formation of good, clear films and also identified the characteristics that make these materials effective in NC-A latex coatings.

PLASTICIZERS: Plasticizers were evaluated by substituting each on an equal weight basis for TBEP in Formulation 1 while omitting the polysiloxane flow additive and defoamer. The results are listed in *Table* 6. Films were evaluated for print resistance, König pendulum hardness, clarity, and integrity.

The plasticizers giving clear films are all known as solvating plasticizers for nitrocellulose.[11] The others, which all produced various degrees of haze, are known nonsolvents for nitrocellulose. Increasing alkyl chain length in esters leads to lower solvency for NC; for example, dibutyl phthalate is a solvent, but di-2-ethylhexyl phthalate is not. Most of the plasticizers giving hazy films also showed a tendency to separate from the emulsion on standing.

König pendulum hardness did not correlate well with resistance to imprinting in this or other evaluations. The lack of correlation is no doubt due to the pendulum test result depending more on the damping properties of films than on their resistance to indentation.[12]

COALESCENTS: Coalescing solvents were evaluated by substituting each on an equal weight basis for EB acetate in Formulation 1 and again leaving out the flow additive and defoamer. The coalescing solvents were selected based on their low water solubility. Solvents with appreciable water solubility tend to destabilize the NC-A latex when used in significant amounts.[13]

The coalescing solvents were evaluated for their effects on dry time and film quality. The results are listed in

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Table 8—Effect of Coalescent Evaporation Rate on Gloss
(Evaluated in Formulation 1)

Coalescent	Evap. Rate[a]	60° Gloss
C-6 acetate	17	40
C-7 acetate	8	60
2-Butoxyethyl acetate	3	61
C-8 acetate	3	67
C-9 acetate	1	66
C-10 acetate	0.6	65

(a) Relative to n-butyl acetate = 100.

Table 9—Flatting Pigment Settling

Flatting Pigment	Surface Treatment	Average Particle Size, microns	Settling	Re-Dispersibility
A	Fluoride	4	V hard	V poor
B	Wax	4.5	Moderate	Good
C	None	2.5	Moderate	Poor
D	None	6	Hard	V poor
E	None	4	Slight	V good
F	None	5	Moderate	Good
G	Wax	3	Hard	V poor
H	Wax	3	Hard	V poor

Table 7. Dry times generally followed the relative evaporation rates of the solvents. Some of the deviations from this trend can be attributed to film thickness variations.

The fastest evaporating solvent, 2-methoxypropyl acetate, produced a cracked film. The remaining solvents all produced crack-free films, but many of these films displayed haze. The haze was traced to the presence of microbubbles in the dried films. Except for 2,2,4-trimethyl-1,3-pentanediol monoisobutyrate, all of the solvents with evaporation rates of one or lower (relative to n-butyl acetate = 100) produced films which were clear and free of haze. All of the films found to contain microbubbles also exhibited haze. Although the slower evaporating solvents produced better films, they also generally gave longer drying times.

The effects of a selected group of coalescents on gloss are presented in *Table* 8. Slower-evaporating coalescents provided improved gloss in addition to improved clarity. In general, higher gloss and improved clarity, as might be expected, went hand-in-hand throughout this work.

Flatted Topcoat

Eight silica flatting pigments were evaluated in Formulation 1 at 3% silica by weight on coating solids (1.7-1.8% PVC). Each flatting pigment was predispersed in water before adding Formulation 1, as described previously in the Coatings Preparation section. Although all of the silica pigments readily dispersed to a Hegman 7 or finer, settling properties over a period of one month varied considerably as seen in *Table* 9. Settling did not correlate with particle size or the presence or absence of a surface treatment.

Table 10—Flatting Pigment Efficiency and Appearance

Flatting Pigment	Addition Rate, %	Dry Film Thickness, mils	Gloss, 60°	Smoothness[a]	Clarity[a]
B	1.3	3.1	40	5	5
C	1.7	3.2	38	7	6
E	1.8	3.4	34	6	8
F	2.5	3.3	41	8	7
G	1.9	3.7	34	7	10
H	1.7	3.4	35	5	9

(a) 1-10 rating scale, 10 = no effect.

Table 11—Sag-Resistant Topcoats and Sanding Sealer (Based on Formulation 1; Compositions as Parts by Weight)

	High-Solids Topcoat 1A	Low-Solids Topcoat 1B	Low-Solids Sealer 1S
CTG D-857 NC-Acrylic latex	62.0	36.9	35.5
Water	15.5	44.9	41.6
Tributoxyethyl phosphate	7.8	4.6	4.5
EB acetate	12.4	11.6	14.5
Polysiloxane additive			
10% aqueous	0.6	0.4	—
Defoamer M			
50% aqueous	1.5	0.9	0.9
HEUR associative thickener	0.2	0.7	0.5
Polyolefin dispersion	—	—	2.5
Total	100.0	100.0	100.0
Solids, weight %	41	25	25
Viscosity			
No. 4 Ford cup, sec	33	31	30
Brookfield, mPa·s			
0.6 rpm	3,000	1,750	730
60 rpm	83	75	285
VOC content, calculated			
g/L	265	360	405
lb/gal	2.2	3.0	3.4

Table 12—Lower-VOC NC-A Latex Topcoat Formulation 3 (Compared to Formulation 1; Compositions as Parts by Weight)

	Formulation 1	Formulation 3
CTG D-857 NC-Acrylic latex	100.0	100.0
Water	25.0	25.0
Tributoxyethyl phosphate	12.5	9.0
EB acetate	20.0	—
Dibasic esters	—	15.0
Polysiloxane additive		
10% aqueous	1.0	1.0
Defoamer M		
50% aqueous	2.4	2.4
Total	160.9	152.4
Solids, wt %	42	41
Viscosity		
No. 4 Ford cup, sec	15	13
Brookfield, mPa·s	55	20
Density, g/L	1080	1100
lb/gal	9.0	9.2
Minimum filming temperature, °C	6	<0
VOC content, calculated		
g/L	270	235
lb/gal	2.3	2.0
Print Resistance,[a] 4 psi		
4 hr air dry	8	8
24 hr air dry	10	10
Cold-check resistance,		
Cycles passed	20+	20+
König hardness, % of glass		
1 day	18	20
3 day	18	28
1 week	18	31
Gloss, 60°	61	66

(a) 1-10 rating scale, 10 = no effect.

Table 13—NC-Acrylic Latex and Commercial Acrylic Latex Comparison

	NC-Acrylic Latex Formulations		Formulated Commercial Acrylics	
	1	3	A	B
Solids, wt %	42	41	35	31
VOC, calculated				
g/L	275	240	230	240
lb/gal	2.3	2.0	1.9	2.0
pH	6.8	6.8	8.9	7.7
Dry time,[a] minutes	13	16	19	12
Gloss, 60°				
initial	61	66	83	70
rubbed	81	82	84	80
Print resistance,[b]				
4 psi at 4 hr	8	8	5	9
Hardness development, König, % glass				
4 hr	7	4	8	6
1 day	18	20	21	24
1 week	18	31	38	33
Cross-hatch adhesion	4B	4B	4B	4B
Cold-check resistance,				
cycles passed	20+	20+	20+	20+
Rubbability	Good	Excellent	Poor	Good
Clarity	Excellent	Excellent	Poor	Good
Strippability, MEK, 10 min	Excellent	Excellent	Poor	Good
Repairability	V good	V good	Good	Good
Resistance spot tests[b]				
Water, 1 hr	10	10	10	10
100° ethanol, 1 hr				
initial	7	7	3	3
recovered	8	8	4	5
Ammonia, 10 min				
initial	10	10	6	10
recovered	10	10	7	10

(a) Gardner circular dry time, time to no tear.
(b) 1-10 rating scale, 10 = no effect.

To evaluate flatting efficiency, the level of each silica was adjusted to provide 60° gloss values of 35-40. Flatting pigments A and D, which had settled very hard after only one week, were excluded from the efficiency study. Each formulation was applied in three coats to birch-veneer plywood to a total dry film thickness of 3.4 ±0.3 mils. Each coat was baked 45 min at 120°F (49°C). The flatted coatings were also rated subjectively for smoothness and clarity with the results presented in *Table* 10.

Flatting pigment B was the most efficient flatting silica but adversely affected clarity. Flatting pigment G had very good efficiency with the least effect on clarity. Flatting pigment E, which had excellent anti-settling and was very easily redispersed, was considered the best overall flatting agent for NC-A latex.

Sag-Resistant Formulations

Conventional solvent-borne lacquers display near-Newtonian rheology and are applied at low viscosities, usually less than 50 mPa·s. The evaporation of solvent from the atomized liquid coating between the spray gun and the substrate and after deposition causes a rapid rise in viscosity which controls sag on vertical surfaces. Sag cannot be controlled by such a mechanism in waterborne coatings because water does not evaporate quickly enough under the typical temperature and humidity conditions at which coatings are applied. Waterborne NC-A latex coatings thus require the addition of a thickener to control sag.

A hydrophobically modified ethoxylated urethane (HEUR) associative thickener was the most efficient of thickeners found to be compatible with NC-A latex. A vinylpyrrolidone copolymer was less efficient and failed heat stability testing. Modified cellulosic thickeners tend to be incompatible with the NC-A latex.

High-solids and low-solids sag-resistant topcoats are presented in *Table* 11 along with a low-solids, sag-resistant sanding sealer which will be discussed. All three compositions are based on Formulation 1, in that they contain 12.5 parts TBEP per 100 parts NC-A latex. It should be noted that the low-solids formulations contain higher proportions of coalescing solvent relative to the NC-A latex than high-solids formulations. It was found that dilution with more than 25 parts water per 100 parts NC-A latex should be done with an approximately 80:20 blend of water:coalescent in order to maintain coalescence.

Sanding Sealer Formulation

Furniture sealers are typically formulated with materials to improve cutting and prevent clogging of the sandpaper. Zinc stearate is commonly used as a lubricant in solvent-borne sanding sealers; however, zinc stearate in various forms was not compatible with the NC-A latex. A polyolefin blend was found to be an effective sanding aid when used in the amount specified in the sanding sealer formulation in *Table* 11. This formulation had good sanding with stearated paper after one-hour air dry and provided good adhesion to NC-A topcoats.

Lower-VOC Topcoat with Improved Hardness

A gloss topcoat based on NC-A latex was developed using dibasic esters (DBE) as the coalescent. The use of the slower evaporating DBE allowed reduction in both the amount of coalescent and in the amount of TBEP plasticizer necessary to achieve good coalescence. The composition and properties of this topcoat, Formulation 3, are presented in *Table* 12.

The reduction in coalescent resulted in lower VOC content. The reduction in plasticizer resulted in higher ultimate film hardness. In addition to the increased hardness, Formulation 3 gave higher gloss and an improvement in clarity over Formulation 1.

Comparison of NC-A Latex and Acrylic Latex Topcoats

The NC-A latex Formulations 1 and 3 were tested along with two commercial acrylic latexes which had been formulated into wood coatings as recommended by their respective suppliers. The results of this comparison are listed in *Table* 13.

The NC-A latex coatings displayed better clarity and had better resistance to alcohol than the coatings based on commercial acrylics. The NC-A latex coatings were also more easily stripped and, when repaired, had better meld-in and reflow than the acrylics, which exhibited haze on recoating with lacquer.

The NC-A latex coatings had very good print resistance—comparable to the better of the two acrylics—even though their measured hardness was somewhat lower. As applied, the NC-A latex formulations had lower gloss than the commercial acrylic latexes, but gloss after polishing was comparable for all four coatings.

One of the acrylics had poor resistance to household ammonia. Because of their basic pH, both acrylics induced color shift in the nongrain-raising (NGR) acid dye stain used. The NC-A latex coatings did not affect the stain color.

CONCLUSIONS

Nitrocellulose-acrylic latex coatings for wood can be formulated at VOC contents of 2.3 lb/gal and lower. Proper selection of plasticizer and coalescent will provide optimal film formation and hardness development.

Clarity of applied NC-A coatings is affected by the choice of plasticizer and coalescing solvent and by the presence of microfoam. Microfoam retention can be minimized by the use of slower evaporating coalescents and by the use of an effective deaerator.

Silica flatting agents can be incorporated to adjust topcoat gloss. Sag-resistant low- and high-solids topcoats and a sanding sealer have been formulated using associative thickeners.

NC-A latex coatings displayed better clarity, better resistance to alcohol, and better strippability and repairability than coatings based on commercial acrylic latexes. The print resistance of the NC-A latex coatings was comparable to that of the better acrylic coating. The NC-A formulations had lower applied gloss than the acrylic coatings but had equivalent gloss after rubbing and polishing. The acrylic coatings affected the color of the NGR stain used, whereas the NC-A latex coatings did not.

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APPENDIX

Materials and Suppliers

Material	Product	Supplier
2-Butoxyethyl acetate	Ektasolve® EB acetate	Eastman Chemicals
Butyl benzyl phthalate	Santicizer® 160	Monsanto
C-6 acetate	Exxate® 600	Exxon Chemicals
C-7 acetate	Exxate 700	Exxon Chemicals
C-8 acetate	Exxate 800	Exxon Chemicals
C-9 acetate	Exxate 900	Exxon Chemicals
C-10 acetate	Exxate 1000	Exxon Chemicals
C-11 acetate	Exxate 1100	Exxon Chemicals
C-13 acetate	Exxate 1300	Exxon Chemicals
C-11 ketone	C-11 ketones	Eastman Chemicals
Defoamer A	Colloid 581B	Colloids, Inc.
Defoamer B	Dehydran® D-1208	Henkel
Defoamer C	Dehydran D-1293	Henkel
Defoamer D	Dehydran D-1513	Henkel
Defoamer E	Dehydran D-1620	Henkel
Defoamer F	Foamaster JMY	Henkel
Defoamer G	AF 9021	GE Silicones
Defoamer H	Nalco® 2300	DayGlo Color Corporation
Defoamer I	Patcote® 519	Patco Specialty Chemicals
Defoamer J	Patcote 577	Patco Specialty Chemicals
Defoamer K	Patcote 841M	Patco Specialty Chemicals
Defoamer L	Patcote 847	Patco Specialty Chemicals
Defoamer M	Tego® Foamex 805	Tego Chemie Service USA
Dibasic esters	Dibasic esters	Du Pont Company
Dibutoxyethoxyethyl adipate	Plasthall® DBEEA	C.P. Hall Company
Dibutyl phthalate	Kodaflex® DBP	Eastman Chemicals
Di-2-ethylhexyl adipate	Kodaflex DOA	Eastman Chemicals
Di-2-ethylhexyl phthalate	Kodaflex DOP	Eastman Chemicals
Di-2-ethylhexyl sebacate	Plasthall DOS	C.P. Hall Company
Di-2-ethylhexyl terephthalate	Kodaflex DOTP	Eastman Chemicals

APPENDIX (cont'd)

Materials and Suppliers

Material	Product	Supplier
Diisodecyl adipate	Plasthall DIDA	C.P. Hall Company
Diisodecyl phthalate	Jayflex® DIDP	Exxon Chemicals
Diisononyl phthalate	Jayflex DINP	Exxon Chemicals
Epoxidized soybean oil	Flexol® EPO	Union Carbide Corporation
Ethyl 3-ethoxypropionate	Ektapro® EEP	Eastman Chemicals
2-Ethylhexyl acetate	2-Ethylhexyl acetate	Eastman Chemicals
2-Methoxypropyl acetate	Arcosolv® PM acetate	Arco Chemical Company
NGR stain, mahogany	No. 37 Brown Red	Star Finishing Products
Nitrocellulose-acrylic latex	CTG D-857	Aqualon
Polyolefin dispersion	Slip-Ayd® SL 630	Daniel Products Company
Polysiloxane additive	Dow Corning® 57	Dow Corning Corporation
Silica flatting pigment A	Syloid® 83	Davison Chemical Corporation
Silica flatting pigment B	Syloid 169	Davison Chemical Corporation
Silica flatting pigment C	Syloid 234	Davison Chemical Corporation
Silica flatting pigment D	Syloid 74x6500	Davison Chemical Corporation
Silica flatting pigment E	TS 100	Degussa
Silica flatting pigment F	TK 900	Degussa
Silica flatting pigment G	OK 412	Degussa
Silica flatting pigment H	OK 500	Degussa
Tetraethylene glycol di-2-ethylhexoate	Flexol 4GO	Union Carbide Corporation
HEUR associative thickener	Acrysol® RM-825	Rohm and Haas Company
Vinyl pyrrolidone thickener	Collacral® VL	BASF Corporation
Tributoxyethyl phosphate	KP-140®	FMC Corporation
Tricresyl phosphate	Kronitex® TCP	FMC Corporation
Triethyl citrate	Morflex® Citroflex 2	Morflex, Inc.
2,2,4-Trimethyl-1,3-pentanediol monoisobutyrate	Texanol® solvent	Eastman Chemicals

Carbon Filled Paints Of Improved Electrical Conductivity

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Improved conductive paints were prepared by adding graphite to a conductive paint based on carbon black at its critical volume concentration. Determining volume resistivity and specific volume as a function of the graphite volume concentration and observing film surfaces micrographs revealed a point of incontinuity, at about 12% graphite by volume, additional to the one found at the carbon black critical pigment volume concentration (CPVC). This point is related to a second CPVC due to the existence of two pigments of totally different character, in terms of particle size and surface, leading to the arrangement of the small graphite particles among the relatively large carbon black particles, in the dry paint film. Volume resistivity, thus achieved, was 0.45 Ω cm compared to 1.6 Ω cm of the carbon black based conductive paint.

INTRODUCTION

Conductive paints are regularly used in the production of RFI barriers for electronic devices, antistatic coatings, radar absorbing materials, space heating, and in various other electrical applications.[1-3]

Understanding the parameters that govern their electrical and mechanical behavior and controlling them are very important goals that provide the coating formulator with a powerful tool, enabling the preparation of conductive coatings according to the electrical designer's specification.

In a recently published work,[4] the mechanism of electrical conductivity of carbon black filled organic coatings was discussed and it was found that:

(1) The highest conductivity or the lowest resistivity of a paint film is achieved at the critical pigment volume concentration (CPVC) of the conductive filler of the formulation, a point at which the coating was shown to have also its lowest specific volume. This result is of a very high significance, since, as it is well known, a discontinuity of the mechanical, optical chemical, and environmental properties of the coating is found at the CPVC.[5-8] This leads to the frequent use of the CPVC, in terms of the reduced pigment volume concentration (PVC) (lambda) defined as the ratio of PVC to CPVC, as the most important parameter for coatings formulation.

(2) Up to the CPVC, (lambda < 1), the volume resistivity of the film, as a function of the PVC of the carbon black filler, follows theory as described by equation (1), that is, resistivity is proportional to the cubic root of the volume concentration of the conductive pigment which is proportional to the mean interparticle distance.[9]

$$\log \rho = \left(\frac{1}{PVC}\right)^{\frac{1}{3}} \tag{1}$$

where ρ is the volume resistivity of the coating (Ω cm).

(3) Beyond the CPVC (lambda > 1), the coating gradually loses its electrical and mechanical properties due to air voids created in the coating's film and a pronounced increase in the electrical resistivity is observed.

To enlarge the available resistivity range, the use of carbon black/graphite combinations was investigated in the present work. The advantage of a conductive carbon black evolves from the low density and large dimensions of its particles, relative to regular grades, resulting in low electrical resistivity at low weight loading. In the meantime, graphite stands out as a highly conductive material with low surface area, enabling relatively high loading without affecting the rheological properties of the coat to the material's structure, in which electrical charge sharing at the aromatic rings plane, as well as in the perpendicular π orbitals leads to a volume conductivity in the

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*Industrial Zone Acco, POB 5238, Acco 24121, Israel. corrected 3 Jun.93/AP

... POB 2238, Acco. 24121, Israel

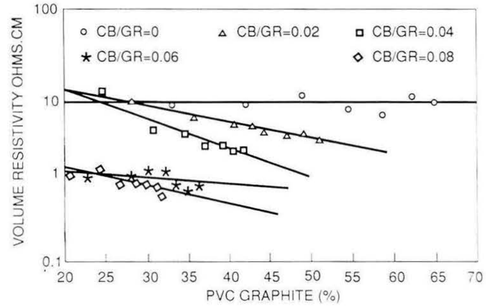

Figure 1—Volume resistivity as a function of graphite PVC for compositions in which small amounts of carbon black were added to a graphite base (graphite PVC = 65%)

order of 10^5 1/ohms cm at this plane compared to about 100 1/ohms cm in the perpendicular direction. Beyond that, conductivity of a specific grade depends on graphitation process parameters, especially the temperature, leading to the existence of a wide variety of graphite grades.[10] The objective of the present work, therefore, was to determine the optimal carbon black/graphite combination, in terms of conductivity, in a conductive paint and to suggest an explanation of the improvement in conductivity achieved over the carbon black loaded paint.

EXPERIMENTAL

Materials

The binder used in the present study was Tamalkyd 4-252-M55 (Tambour Paints Ltd., Acco, Israel), a soybean modified medium oil length, 55% solids in mineral spirits. It was used along with the appropriate auxiliary materials, such as driers and an antiskinning agent and diluted to application consistency with measured quantities of xylene.

The conductive carbon black used was, as previously mentioned,[4] Ketjenblack EC DJ-600 (Akzo Chemie, The Netherlands) with a real density of 0.345 g/cc based on a dibutyl-phthalate absorption of 510 mL/100 g and apparent density of 125 g/cc. Its mean particle size is 30-50 nm.

The graphite filler used was Flake Graphite No. 8539 (Superior Graphite, USA), a colloidal graphite. Its carbon content is 98-99%, the typical particle size is 5 μm and its density is 2.26 gr/cc. Volumetric oil absorption was determined according to ASTM D 281-84 and was found to be 1.80 mL oil to mL graphite.

Mylar® sheets (Du Pont, USA) served as substrates for the paint films.

PREPARATION AND APPLICATION METHODS

Paint formulations with various combinations of carbon black and graphite were prepared by mixing two concentrated bases and alkyd binder in the appropriate amounts. The first base included 31.25% carbon black, by volume, which is identical to the CPVC of the formulation as found in previous work,[4] and the second base included 65% graphite by volume. The bases were prepared by dispersing the pigments to a Hegman value higher than seven, with a parallel disk impeller driven by a high-speed stirrer using glass beads 2-3 mm in diameter as the dispersing media.

The pigment to binder weight ratios of the concentrated bases were 0.15 and 4.0 and the nonvolatile contents were 14% and 30% by weight, respectively.

The paints were applied to solvent cleaned Mylar substrates and dried as described in detail previously.[4] Films of different thicknesses were prepared by repeatedly coating fully dried films to the desired thickness.

CHARACTERIZATION OF PAINT FILMS

The conductive films, prepared as described, were characterized by: (1) measuring their surface resistivities and thickness and computing the volume resistivity, accordingly; (2) determining the specific volume of each film; and (3) scanning electron micrography.

The details of these procedures are described in literature.[4]

RESULTS AND DISCUSSION

Methodology

To investigate the effect of the carbon black and graphite combinations on the electrical properties of the paint films, two approaches were studied. In the first, increasing amounts of carbon black were added to the graphite base, while in the second, increasing amounts of graphite were added to the carbon black base. In both cases, PVC ladders were created. However, since a system of two pigments of different weight and volume properties is dealt with, the partial and total PVCs were computed according to the following equations, derived from the basic definition of the PVC:

$$\mathrm{PVC} = \frac{\left(\frac{P_{cb}}{B}\right) + k\left(\frac{P_{gr}}{B}\right)}{\left(\frac{P_{cb}}{B}\right) + l\left(\frac{P_{gr}}{B}\right) + 1} \qquad (2)$$

where:

P_{cb}, P_{gr}, B = the weight fractions of carbon black and graphite and the binder, respectively, in the dry film

k = the ratio of carbon black and graphite densities and is equal to 0.153

l = the ratio of carbon black and the binder's densities and is equal to 0.33.

$$\mathrm{PVC}_{GR} = \frac{\left(\frac{P_{gr}}{B}\right)}{\left(\frac{P_{gr}}{B}\right) + m\left(\frac{P_{cb}}{B}\right) + n} \qquad (3)$$

where:

m = 1/k and is equal to 6.54

n = the ratio of graphite and carbon black densities and is equal to 2.15.

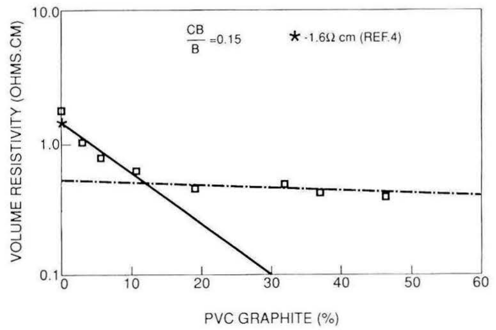

Figure 2—Volume resistivity as a function of graphite PVC for formulations in which graphite was added to the carbon black base (carbon black PVC = 31.25%)

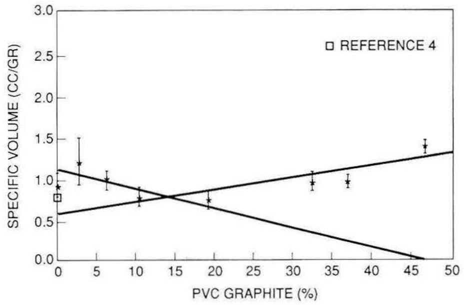

Figure 3—Specific volume as a function of graphite PVC of formulations in which graphite was added to the carbon black base (carbon black PVC = 31.25%)

ELECTRICAL RESISTIVITY OF GRAPHITE-BASED COMPOSITION

Addition of Carbon Black to Graphite Base: Formulations prepared by the addition of carbon black to the graphite base were described in terms of carbon black to graphite, graphite to binder and carbon black to binder weight ratio, PVC of graphite and the total PVC of both carbon black and graphite.

Figure 1 depicts the volume resistivity of various formulation terms of different ratio of carbon black/graphite as a function of the PVC of graphite. It can be seen that without carbon black (carbon black/graphite = 0), the graphite-based film resistivity is insensitive, over a wide range, to the graphite concentration and is limited to a constant value of about 8 ohms cm, which is a value much higher than the resistivity obtained with the carbon black base, that is, 1.6 ohms cm.[4]

This indicates that at PVC as low as 26% the graphite base conductivity is already at its highest value, as the constant resistivity values show. However, referring to the graphite CPVC computed, following Hegedus and Eng,[11] from the graphite OA data, it is found that the graphite OA CPVC is 0.35. This value is in accordance with the value found by Frame and Tedford[12] for a similar alkyd-graphite system. They also concluded that no distinct critical volume fraction exists for this system and related this to the high conductivity of graphite and its lamellar character, which lead to conduction mainly through the graphite particles rather than across resin gaps at relatively low concentration without correlation to the OA CPVC of the mixture. This leads to the conclusion that carbon black is much more electrically efficient than graphite, despite the latter's much lower bulk resistivity, a fact that can be related to the carbon black's relatively high surface area (1250 sq m/gr) and low density.[13]

The addition of small amounts of carbon black, up to carbon black/graphite ratio of 0.04, linearly decreases the resistivity, with graphite PVC, down to 2.2 ohms cm at an increasing rate, implicating an interaction between the two pigments. As the role of the carbon black in constructing the conductive network becomes more dominant, as the carbon black/graphite ratio increased to 0.06 and 0.08, the resulting resistivity is further lowered and values down to 0.9 and 0.65 ohms cm could be measured. However, the rate of the decrease with graphite PVC is much more moderate, implying a close proximity to the CPVC.

Addition of Graphite to the Carbon Black Base: The discussion in the previous paragraph leads to the conclusion that higher proportion of carbon black in the formulation will bring about lower resistivities than those already achieved. However, since the carbon black's CPVC (with the materials used in this study) is 31.25% or carbon black/binder = 0.15, it was found advantageous to add graphite to the carbon black base.

Volume resistivities and specific volume of formulations prepared by adding graphite to the carbon black base are described in *Table* 1 along with their main characteristics, that is, graphite/binder, graphite/carbon black weight ratio, and the graphite and the total PVCs.

Figures 2 and 3 graphically describe the volume resistivity and the specific volume of these formulations.

A pronounced discontinuity is observed when graphite concentration reaches the value of about 12% by volume. Up to this point, the volume resistivity decreases linearly, on the logarithmic scale, from 1.6 to about 0.45 ohms cm. From this point on, volume resistivity remains virtually constant around 0.45 ohms cm. It seems that adding

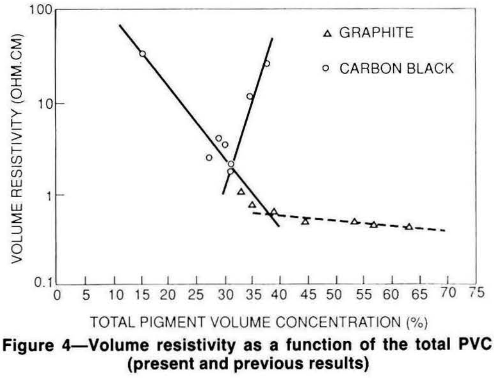

Figure 4—Volume resistivity as a function of the total PVC (present and previous results)

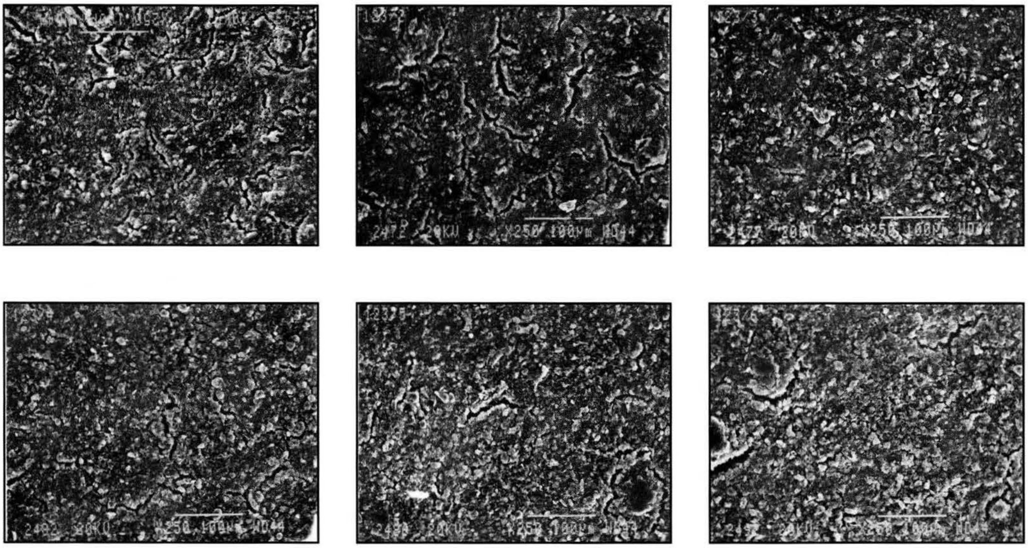

Figure 5—SEM micrographs of the surface of carbon black and graphite filled conductive paint films with different graphite PVC values, at × 250 magnification

about 12% by volume of graphite to the carbon black base already in its CPVC, reveals a second critical concentration.

As graphite PVC is increased beyond this point, no further decrease in the resistivity is observed, indicating the fact that the arrangement of the two kinds of particles reached an optimum and the only limiting factor for additional decrease of the resistivity is the thin binder film that envelops each particle and serves as the potential barrier.

This is a very interesting phenomenon which can be explained by the different particle size and shape of graphite and carbon black. Attempts to analytically compute packing factors and interparticle distance, in order to suggest a mechanism, are inherently inaccurate since it is based (as in the case of the LEE algorithm[15]) on an idealized packing of spherical particles, a model largely deviating from the current case of hollow irregularly shaped carbon black particles, lamellar graphite particles, and a very large particle size ratio. Therefore, the second CPVC is qualitatively interpreted in terms of particle geometry and size, as follows:

Table 1—Characteristics Following Addition of Graphite to Carbon Black

Graphite Volume Concentration [%]	Graphite to Binder Weight Ratio	Graphite to Carbon Black Weight Ratio	Volume Resistivity (Ω·cm)	Specific Volume [cc/gr]	Total Pigment Volume Concentration (PVC) [%]
0	0	0	1.89	0.97	31.2
2.8	0.09	0.6	1.08	1.22	33.2
5.6	0.18	1.2	0.80	1.00	35.1
10.6	0.37	2.4	0.65	0.80	38.5
19.1	0.74	4.8	0.49	0.82	44.4
19.7	0.77	5.0	0.36	—	45.2
32.1	1.48	9.6	0.49	0.98	53.3
37.1	1.85	12.0	0.46	0.95	56.7
46.3	2.70	18.0	0.43	1.35	63.0

The mean particle size of the graphite used in this work is 5 μm. These particles are dense and lamellar with an aspect ratio of about 10.[12,14] While the carbon black used has hollow shell particles with a typical mean diameter of 0.03 to 0.05 μm, that is, two orders of magnitude smaller than the graphite particles. Since the electrical resistivity of a composite system of this kind is related to the interparticle distance, it can be assumed that the relatively large lamellar graphite particles bridge or connect many carbon black particles over the interparticle gaps which narrows as the graphite PVC increases, thus increasing the probability of electron transfer leading to a lower volume resistivity.

The independent determination of the specific volume of these formulations further assists this conclusion since, as can be seen in *Figure* 3, the specific volume decrease turns into an increase, as a function of graphite PVC, at 12-13% by volume of graphite, which is exactly the same value where the resistivity change of slope occurs.

The 12% graphite CPVC is observed only when the carbon black concentration equals its CPVC. Otherwise, the dependence of the volume resistivity of the graphite/carbon black mixture on graphite PVC is similar to that of the carbon black/graphite mixtures described in *Figure* 1.

This observation directly proves the existence of a second CPVC, this time, of the bipigment system as the two turning points appear at the same graphite PVC. An analogy between the monopigmented and the bipigmented system is shown to exist, that is, a discontinuity in the line describing volume resistivity as a function of a conducting pigment indicates the existence of CPVC in terms of optimal particles packing.

Figure 4 combines volume resistivity values as a function of the total PVC of the carbon black, as found previously,[4] and the values found for the formulations, prepared in this work, in which graphite was added to the base containing carbon black at its CPVC.

The most interesting fact depicted by this figure is that the added graphite causes resistivity to continue dropping on the same line and with the same slope (on a log scale) as was found for the carbon black formulation before the carbon black CPVC, up to the new CPVC at about 40% total pigment volume. This fact further assists the percolation theory, namely, that the only significant parameter determining electrical resistivity/conductivity in composite material systems is the mean interparticle distance.

PAINT FILM MORPHOLOGY

Micrographic examination of a series of film surfaces enables interpretation of its morphology in relation to its composition and other properties.[4,9]

Figure 5 shows SEM micrographs of paint films having carbon black at its CPVC to which various amounts of graphite were added. It can be seen that as graphite is added, the number and density of the microcracks at the film surface slightly increases (*Figure* 5b) and then diminishes to a minimum (*Figure* 5c) at 10.6% graphite by volume, which is very close to the new CPVC previously described (about 12%). As the graphite PVC is further increased, the number, width, and density of the cracks are slightly larger but there is no significant difference among these films (*Figures* 5d-5f). This picture closely resembles the behavior of the volume resistivity and of the specific volume as shown in *Figures* 2 and 3, contributing to the definition of the observed discontinuity as CPVC by the classical meaning. Furthermore, a distinct film reinforcing effect by the graphite filler is clearly observable as it is evident that crack's density decreases and their width narrows.

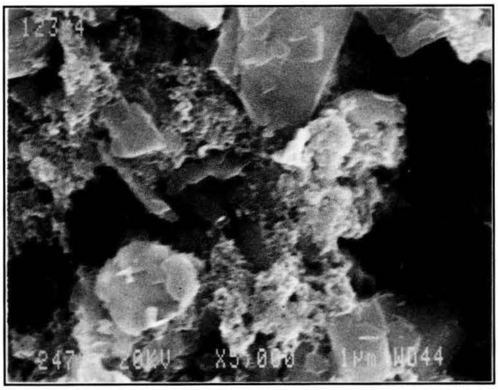

Figure 6—SEM micrographs of the surface of carbon black and graphite filled conductive paint at 19.1% by volume (near the CPVC), at × 5000 magnification

Another topic evident from these micrographs is the existence of two distinct phases. The first consists of the relatively large low binder consuming graphite particles embedded in the apparent continuous phase made of binder-coated carbon black particles. This visual picture further assists the assumption that graphite particles fill up the relatively large spaces among the high surface area hollow carbon black particles up to the point of second optimal arrangement of particles where both resistivity and specific volume have their minimum values.

SUMMARY

Conductivity of a carbon black-filled paint was improved by the addition of graphite. Both dry paint film properties evaluated, namely, the volume resistivity and the specific volume as well as micrographic studies showed a distinct discontinuity when presented as a function of the graphite PVC at about 12% by volume which, obviously, is a second CPVC. This is explained by bridging up of spaces among the relatively small carbon black particles, already at the critical volume concentration, with lamellar particles up to a second critical volume concentration when the interparticle distance is minimal, thus enabling significant reduction of resistivities, that is, to 0.45 from the 1.61 ohms cm found previously for the carbon black-based composition.

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Distribution of Driers between the Alkyd And Aqueous Phase in Alkyd Emulsions And Its Relation to Drying Properties

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The influence of pH, emulsifiers, and alkyd properties on the distribution of driers between the alkyd and water phase in alkyd emulsions has been studied. When the pH in the emulsion is decreased, cobalt and calcium driers are redistributed towards the water phase. However, zirconium was found to remain in the alkyd phase independent of pH. Hydrophilic anionic emulsifiers were found to decrease the amount of cobalt and calcium driers in the alkyd phase. The distribution is not influenced by alkyd properties such as oil length or acid values. The relation between the distribution of driers and drying properties has also been investigated. The results indicate a correlation between the early drying rate and cobalt concentration in the alkyd phase.

INTRODUCTION

Growing environmental awareness has led to an increased interest in waterborne alkyd paints, especially to protect workers from organic solvents. However, in some applications where waterborne paints such as thermoplastic dispersions do not give the desired properties of the paint film, organic solvent-borne alkyd paints are still used. Alkyd emulsions, where the alkyd oil is dispersed in water, offer an interesting alternative for these applications. The major drawbacks of these paints lie in their drying properties and colloidal instability.

The reason for the slower chemical drying (polymerization) of alkyd emulsion paints compared to organic solvent-borne alkyd paints is not fully understood. Different mechanisms have been proposed in the literature, for example, inactivation of the driers by formation of complexes with components in the water phase. In water-soluble alkyd paints, the slower drying is believed to depend on the complex formation between cobalt and amine-type neutralizing agents. Cobalt (III) hexamine complexes seem to be irreversibly reduced to cobalt (II) hexamine complex.[1] This influences the drying properties, since the catalytic activity of cobalt is dependent on the ability of cobalt to change repeatedly between Co^{2+} and Co^{3+}.[2,3] Water complexes of cobalt are known to reduce the catalytic activity of cobalt.[4,5] Cobalt can also form a complex with the polyoxyethylene component of nonionic emulsifiers[6] and thereby be hydrolyzed or precipitated as a metal hydroxide.[1,7] Finally, the slower drying can be due to lower oxygen uptake by the alkyd due to the lower solubility of oxygen in water compared to organic solvents,[8] and low efficiency of the auxiliary drier in water.[9]

The drier in the alkyd emulsion can be located either in the water, in the alkyd phase, or at the surface of the alkyd droplets together with the emulsifier. In this work, we have investigated the influence of emulsifier, pH, and alkyd properties such as oil length and acid value on the distribution of driers between the alkyd and water phase. The effect of the distribution on drying properties has also been studied. Conventional driers dissolved in white spirit have been used. These are common in waterborne alkyds, although other emulsifiable types exist.[9]

One reason for the slower drying of alkyd emulsions compared to organic solvent-borne alkyds could be a redistribution of the drier towards the water phase. A slower drying rate is expected with the drier in the water phase due to inactivation of the drier by formation of complexes with water-soluble components. This would also result in an uneven distribution of the drier in the

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alkyd phase after evaporation of the water. When an alkyd emulsion is applied on a porous substrate, for example, wood, it can be assumed that the water penetrates deeper into the wood compared to the alkyd which has a relatively high molecular weight. If the drier is located in the water phase, it is likely that, due to its low molecular weight, it too will penetrate deeper into the wood. The drier then would not be located where it should be in order to increase the drying rate.

EXPERIMENTAL

Model systems consisting of alkyd, water, emulsifier, and driers were used in the experiments.

Alkyds

One commercial and a few model alkyds were used. The model alkyds were made with constant acid values and varying oil lengths and vice versa. All alkyds were based on tall oil fatty acid and manufactured by Bergvik Kemi AB. Data on the alkyds are listed in *Table* 1.

Emulsifiers

The emulsifiers used were of non- and anionic character (see *Table* 2). All emulsifiers were of technical grade except sodium dodecyl sulfate (SDS), a quality grade, which was used for synthesis.

Driers

Five types of driers were used. Three contained solely cobalt salts for surface drying and two were for through drying. The cobalt driers used as sole driers were cobalt 2-ethylhexanoate, cobalt hexanoate, and cobalt oleate. The first one, Manosec Cobalt®, was a commercial drier dissolved in white spirit. The other two were synthesized as follows:

Cobalt hexanoate was precipitated by adding a neutralized water solution of hexanoic acid (Roth) to a solution of cobalt bromide (BMD). The solution with the precipitate was stored at 5°C over night, filtered, and dried in a vacuum freeze-drying unit. The precipitate was washed with ethyl ether. The cobalt hexanoate is highly water soluble, and therefore could not be washed in water. The most probable impurities are sodium hexanoate and sodium bromide. Analysis of the salt with atomic adsorption gave a relative proportion of Co:Na:Br of 2:1:4.

The cobalt oleate was precipitated by adding an aqueous solution of cobalt bromide to an aqueous solution of sodium oleate. The precipitate was extracted with hexane. The solution was washed with water and evaporated to a Co content of 5% (w/w).

The drier for through drying was a commercial product, Cozirc 69 (Manchem Ltd., England). It consists of the reaction products of cobalt and zirconium with 2-ethylhexanoic acid. The ratio of metal to acid, Co:Zr:acid is 1:1:2. This is a higher ratio of metal to acid than in cobalt 2-ethylhexanoate. The drier was used together with calcium 2-ethylhexanoate, Manosec Calcium®, which is claimed to improve the performance of the through drier. Both driers were dissolved in white spirit.

Cobalt octanoate, for the Differential Thermal Analysis (DTA) measurements, was synthesized by adding a cobalt bromide solution to a water solution of sodium octanoate. The precipitate was washed with distilled water and dried in a vacuum freeze-drying unit.

The concentration of alkyd in water was 50% (w/w). The cobalt concentration was 0.2% (w/w) of the alkyd in the experiments where the distribution of driers between the phases was determined. When cobalt, zirconium, and calcium were used, the content of the metals was 0.2, 0.3, and 0.2% (w/w) of the alkyd, respectively. The concentration of emulsifier was 1% (w/w) of the alkyd.

In the drying and hardness experiments, the concentration of the alkyd and driers was the same as in the distribution measurements. The concentration of emulsifier was 5 and 10% (w/w) of the alkyd.

METHODS

Equilibrium Experiments

The distribution of the drier between the alkyd and the water phase was measured after four days of equilibration for most of the samples. Some samples were measured after two hours since they reached equilibrium rapidly. During the equilibration the samples were gently stirred. The phases were separated by centrifugation at 190,000 g for 6-100 hr. The metal concentration in the phases was determined with atomic absorption and atomic emission spectroscopy. Metal analysis was performed by Mikro Kemi AB, Uppsala, Sweden.

The spontaneous pH in the system with cobalt 2-ethylhexanoate was 5.4 and with Cozirc and calcium 2-ethylhexanoate was 6.7. The pH was regulated by addition of NaOH or HCl before the first mixing. The necessary amount of base or acid was determined from titrations (using a Metrohm automatic titroprocessor). Five percent of a nonionic emulsifier was added to the system alkyd, water and drier before titration to prevent clogging of the electrode. The final pH was measured in the aqueous phase after centrifugation. The equilibration time to low pH was slow (three days), while for higher pH it was more rapid (about six hours). The drier was always dissolved in the alkyd phase before the equilibration. The emulsifiers were dissolved in the aqueous phase. The water content of the alkyd phase was checked with Karl Fisher titration after centrifugation and was found to be less than 0.5% with one exception of 1.3% at pH 7.8. These low values do not change the results of the distribution of the drier.

The melting enthalpy of cobalt octanoate necessary for the calculated distribution was determined by DTA (Mettler, Switzerland). The liquid crystalline precipitate, recovered from separating SDS emulsions, was characterized by x-ray diffraction (low angle slit collimated camera) and with polarized light microscopy.

Drying Experiments

The emulsions were prepared by high pressure homogenization at 1000 bar and 60°C. The equipment used was

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Manosec Cobalt and Manosec Calcium are registered tradenames of Manchem, Ltd., England.

Table 1—Alkyd Properties. (All Alkyds Manufactured by Bergvik Kemi AB.)

Alkyd	Dibasic Acid	Polyol	Oil Length (as % Triglyceride)	Acid Value (mg KOH/g Alkyd)	Viscosity (mPa·s) 100% Alkyd at 20°C	Molecular Weight (g/mole)	Hydroxyl Value mg KOH/g Alkyd
S-84 (commercial)	Isophthalic acid	Pentaerythritol	84	9-13	3000-5000	1400	32-36
M-72/10	Isophthalic acid	Trimethylol propane	72	11	1200	1241	36
M-78/10	Isophthalic acid	Trimethylol propane	78	10	750	1080	34
M-84/10	Isophthalic acid	Trimethylol propane	84	12	330	918	34
M-84/5.5.............	Isophthalic acid	Pentaerythritol	84	5.5	1600	1730	34
M-84/6.8.............	Isophthalic acid	Pentaerythritol	84	6.8	1500	1679	34
M-84/10.4............	Isophthalic acid	Pentaerythritol	84	10.4	1500	1552	34
M-84/14	Isophthalic acid	Pentaerythritol	84	14	1400	1451	33
M-84/17	Isophthalic acid	Pentaerythritol	84	17	1000	1399	30

Table 2—Emulsifiers

Emulsifier	Type	Supplier
Nonylphenol (12) (oxyethylene glycol) monoether...... NPE_{12}	nonionic	Berol Nobel AB
Nonylphenol (20) (oxyethylene glycol) monoether...... NPE_{20}	nonionic	Berol Nobel AB
Nonylphenol (50) (oxyethylene glycol) monoether...... NPE_{50}	nonionic	Berol Nobel AB
Ethoxylated (13) linseed oil based product LA13	nonionic	Berol Nobel AB
Sodium dodecylsulfate...... SDS	anionic	Riedel-de-Haën AG
Sodium lauryl/myristyl ether (3) sulfate...... C_{12}/C_{14}-S	anionic	AKZO Chemie
Sodium dioctylsulfosuccinate .... Aerosol OT®	anionic	American Cyanamid Company

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Aerosol OT is a registered tradename of American Cyanamid Company, Wayne, NJ.

Table 3—Droplet Size (Volume Mean Diameter) for Alkyd Emulsions Used in the Drying and Hardness Tests. 50% Alkyd in Water

	Droplet size (μm) with different driers					
					Co/Zr/Ca[b]	
Emulsifier	None	Cohex.[a]	Co-2-ethylhex.[a]	Co-oleate[a]	pH 6	pH 7.5
NPE_{12}........	4.3	—	4.6	—	—	—
NPE_{20}........	4.4	5.0	4.4	4.9	0.32	0.30
LA 13........	7.3	9.8	8.7	7.6	3.13	0.31
SDS	0.5	0.4	0.4	0.4	0.32	0.31
C_{12}/C_{14}-S	0.5	0.5	0.5	0.5	—	—
Aerosol OT ...	0.7	—	0.5	—	—	—

(a) 5% Emulsifier/alkyd.
(b) 10% Emulsifier/alkyd.

Table 4—pKa for Some Organic Acids from the Literature[10]

n-Hexanoic acid	4.84
Iso-hexanoic acid..................................	4.82
n-Octanoic acid	4.89
2-Ethylpentanoic acid	4.71
n-Nonanoic acid..................................	4.95

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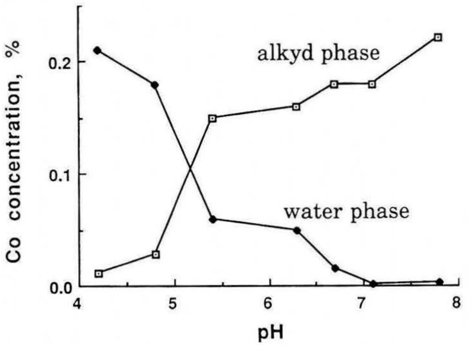

Figure 1—Cobalt concentration in the alkyd and water phase with cobalt 2-ethylhexanoate at different pH. The model systems contain 50% (w/w) alkyd S-84 in water, 0.2% (w/w) Co/alkyd, and no emulsifier

a Microfluidizer TM-110 (Microfluidics, Boston, USA). The driers were added to the oil phase and the emulsifier to the aqueous phase before the homogenization. The quality of the homogenization process was controlled by a droplet size determination with a light diffraction instrument (Mastersizer, Malvern Instruments, England). The instrument uses the Mie scattering theory, which utilizes the refractive index of the dispersed phase and its absorption. The relative refractive index $\frac{n_{alkyd}}{n_{water}}$ was 1.12 and the absorption value was estimated to be 0.1. Lower absorption values do not change the resulting droplet size distribution. The results are recorded as a volume distribution (see *Table* 3). The emulsions were used at the spontaneous pH obtained. The drying time was measured in a BK drying recorder (Sheen Instruments, England). The recorder consists of needles that travel on a painted test strip. The recorder defines four stages in the drying process.

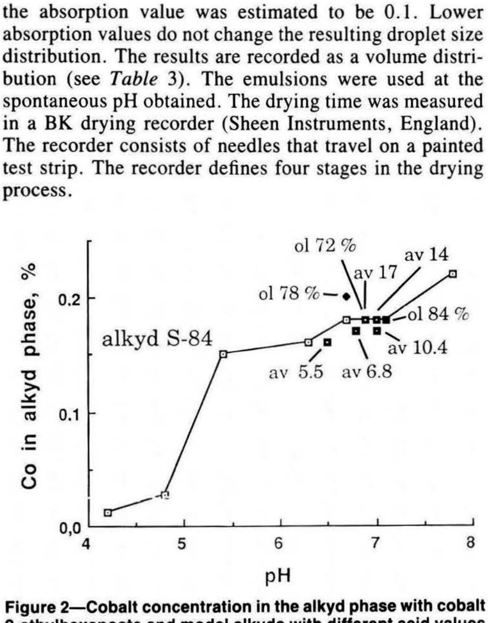

Figure 2—Cobalt concentration in the alkyd phase with cobalt 2-ethylhexanoate and model alkyds with different acid values (av) and oil lengths (ol) (dots). The continuous line is alkyd S-84. The model system contains 50% (w/w) alkyd in water, 0.2% (w/w) Co/alkyd, and no emulsifier

SETTING TIME: Changes due to solvent evaporation. The stage is reached when the needle produces a deep continuous furrow in the film.

TOUCH DRY: The stage is reached when the furrow in the film in stage one starts to be irregular due to drying of the surface.

THROUGH DRY: The stage is reached when a thin weakly continuous furrow with a slightly zigzag pattern is obtained.

HARD: When no needle mark can be seen, the film is defined to be hard according to the test.

Hardness was measured in a pendulum damping test (König). The tests were performed on glass at 23°C and 50% relative humidity. Different thicknesses of the films were used.

RESULTS

Influence of pH and Alkyd Properties

Figure 1 shows the cobalt concentration in the alkyd and the water phase with the drier cobalt 2-ethylhexanoate at different pH, when no emulsifier is added. As seen in *Figure* 1, the distribution of the drier between the phases is strongly influenced by the pH. At high pH, the drier is located in the alkyd phase. When the pH is decreased, a redistribution towards the water phase is observed. Below pH = 5, most of the drier is located in the water phase. The total recovery of cobalt in the two phases together varied from 91 to 106% of added cobalt.

The measured effect of alkyd properties on the distribution at around pH 7 is shown in *Figure* 2. The continuous line is the same curve as in *Figure* 1, the cobalt concentration in the alkyd phase with alkyd S-84. The dots are model alkyds with different oil lengths at a constant acid value and vice versa (see *Table* 1). The distribution is shown to be independent of these alkyd properties in the range studied. The recovery of the added cobalt with the model alkyds was 87 to 105%.

Cobalt 2-ethyl hexanoate is a drier that particularly accelerates the drying of the surface of the alkyd film due to the action of cobalt. Driers for through drying are usually also included in paints. These driers act by other mechanisms. The distribution of a drier based on a reaction product of cobalt, zirconium, and 2-ethylhexanoic acid for through drying has also been investigated. This drier is often used together with an auxiliary drier, calcium 2-ethylhexanoate, which is claimed to improve the performance. The metal content in the alkyd phase for the Co/Zr and the Ca driers (Cozirc 69 and calcium 2-ethylhexanoate) used together at different pH is shown in *Figure* 3.

The distribution of cobalt is rather similar to that obtained with cobalt 2-ethylhexanoate as the sole drier except that the preferential distribution towards the aqueous phase continues to a higher pH. The calcium drier requires an even higher pH to be transferred into the alkyd phase. The zirconium remains in the alkyd phase over the whole pH range investigated. The recovery of added Co,

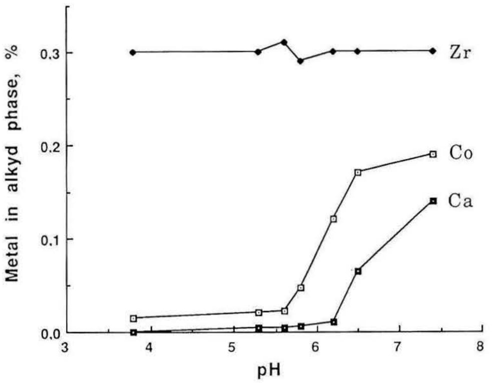

Figure 3—The metal concentration in the alkyd phase with the driers Cozirc 69 and calcium 2-ethylhexanoate for through drying at different pH. The model system contains 50% (w/w) alkyd S-84 in water, 0.2% Co, 0.3% Zr, and 0.2% Ca (w/w) on alkyd, and no emulsifier

Zr, and Ca in these experiments was 90-108%, 97-104%, and 103-113%, respectively.

Influence of Emulsifier and Acid Part of the Drier

The influence of the acid part of the plain cobalt drier on the distribution between the phases is shown in *Figure* 4. The experiments were performed at the spontaneous pH obtained. With cobalt hexanoate, which is the most hydrophilic drier, almost equal parts of the drier are located in the water and in the alkyd phases. With the most hydrophobic drier, cobalt oleate, most of the drier is found in the alkyd phase, as is expected.

Figure 5 shows the change of the distribution of these driers when nonionic and anionic emulsifiers are introduced into the system. Nonionic emulsifiers do not affect the distribution in most cases. The hydrophilic anionic emulsifiers, SDS, and an ethoxylated fatty acid sulfate (C_{12}/C_{14}-5), contribute to a reduced concentration of the drier in the alkyd phase for all three driers. In these systems only 62-84% of the total amount of added cobalt was found in the water and alkyd phases together. Instead the samples contained a third phase with a very high concentration of cobalt, which probably is the cobalt salt of the emulsifier. This third phase for the two systems, SDS/ cobalt 2-ethylhexanoate and SDS/ cobalt hexanoate, was identified as a liquid crystalline phase. With the more hydrophobic anionic emulsifier, sodium dioctylsulfosuccinate (Aerosol OT), no decrease of cobalt in the alkyd phase could be measured.

Some of the emulsifiers were also added to the systems with the Co/Zr and Ca drier and the distribution was determined (*Figure* 6). The distribution was measured at the natural pH obtained, at a lower pH, about 6, and at a higher pH, about 7.5. Neither the nonionic nor the anionic emulsifiers influenced the distribution of cobalt or zirconium (see *Figure* 6a and b). Over pH 6.5, both the anionic and the nonionic emulsifiers contribute to a lower concentration of calcium in the alkyd phase. Only 45% of the total added amount of calcium was found in both phases together when SDS was present. In these samples, a precipitate was found which probably was the calcium salt of SDS. We noticed that the calcium concentration in the alkyd was lowered about 0.06% units when SDS was present. This corresponds approximately to the added amount of SDS if we assume that two SDS ions are associated with each Ca ion. The precipitation of SDS with calcium explains why SDS does not lower the cobalt content in the alkyd phase, as it did with driers composed of only cobalt. With the nonionic emulsifiers the rest of the calcium was found in the aqueous phases.

Drying Properties in Relation to Distribution of the Drier

Drying tests were performed, both with cobalt as sole driers for surface drying and with the drier combination for through drying, to investigate if there is a correlation between drying time and the distribution of the drier between the phases. Stages two, "touch dry," and three, "through dry," on the BK drying recorder were selected for evaluation since many of the emulsions did not reach the fourth stage, "hard," during the 24 hr period. The emulsions were prepared in a high pressure homogenizer and used at the pH obtained.

Figure 7a shows the time to touch dry as a function of the cobalt content in the alkyd phase determined in the distribution study. The concentration of emulsifier was higher in the emulsions, 5%, compared to 1% in the distribution study, in order to obtain emulsions of good quality that could be applied on the test panels. That could mean that the cobalt concentration in the alkyd phase is even lower than shown in the diagram for the emulsions with the anionic emulsifiers, due to the formation of the third phase. The points in the diagram represent the three driers containing solely plain cobalt, cobalt hexanoate, cobalt 2-ethylhexanoate, and cobalt oleate, with the different emulsifiers. The samples with 0.2% cobalt in the alkyd phase are cobalt 2-ethylhexanoate and cobalt oleate in white spirit, and the others are emulsions. All systems have a total amount of 0.2% Co/alkyd. Emulsions which contain 0.12% Co or more in the alkyd phase have equal drying times, which are of the same order of magnitude as the drying times for the organic solvent-

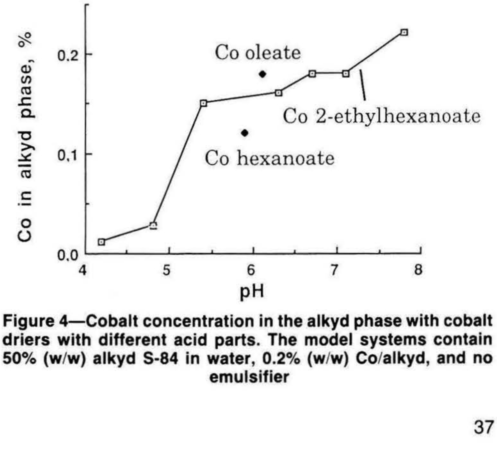

Figure 4—Cobalt concentration in the alkyd phase with cobalt driers with different acid parts. The model systems contain 50% (w/w) alkyd S-84 in water, 0.2% (w/w) Co/alkyd, and no emulsifier

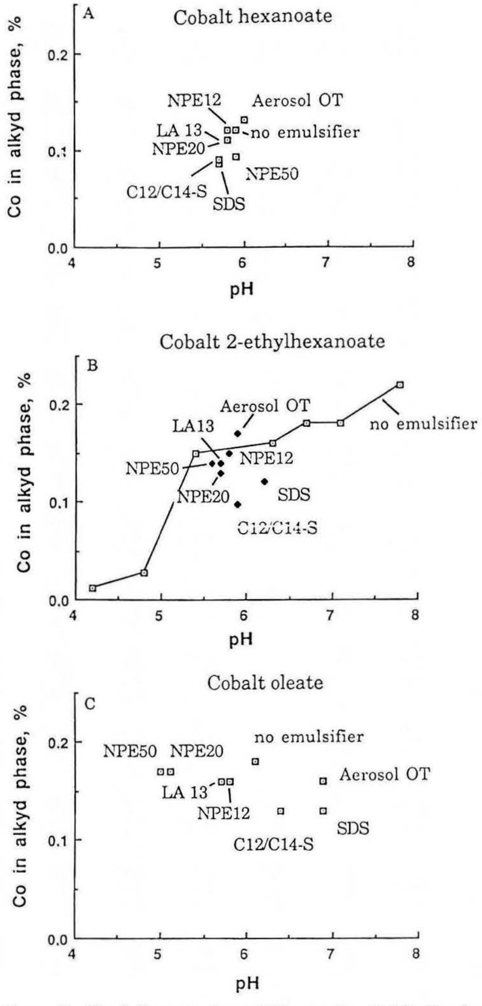

Figure 5—The influence of emulsifier on the distribution between phases of: a—cobalt hexanoate, b—cobalt 2-ethylhexanoate, and c—cobalt oleate. The model systems contain 50% (w/w) alkyd S-84 in water, 0.2% (w/w) Co/alkyd, and 1% (w/w) emulsifier/alkyd

borne alkyds. Below 0.12% Co in the alkyd phase the drying time is increased. These results indicate that the distribution could be important for the early stage of drying. For the stage through dry no clear correlation to the cobalt concentration in the alkyd phase could be seen (see *Figure* 7b). The values are widely spread but all the emulsions have longer drying times than the solvent-borne alkyds. Measurement of hardness on these systems with driers only for "surface dry" gave, in most cases, an initial increase of the hardness during the first three and six hours. The hardness was then decreased and after that it increased again. It is therefore not certain if the values before one day are reliable. However, after three and especially after six hours drying, a correlation between hardness and the cobalt content in the alkyd phase could be noticed (see *Figures* 8a and b). After one day no correlation could be seen (see *Figure* 8c). Further measurements after 7, 14, and 60 days (*Figure* 8d) gave the same results. The hardness tests of thicker films, 100 and 120 μm, gave the same results as with 90 μm.

With the Co/Zr and Ca drier for through dry, drying tests were performed at different pH to obtain different distributions of the driers between the phases. The time to touch dry and through dry as a function of cobalt content in the alkyd phase, determined in the distribution study, are shown in *Figure* 9. Three different emulsifiers, LA13, NPE_{20}, and SDS, were used separately in the emulsions at pH 6 and pH 7.5. The results show that SDS strongly reduces the drying rate while the other two emulsifiers only gave a minor reduction in the drying performance. Because of the high concentration of emulsifier, 10%/alkyd, it is clear that all the added calcium will precipitate with SDS, leaving an excess of SDS which can reduce the concentration of cobalt in the alkyd phase as in *Figure* 5b. However, due to this high concentration of SDS, the real concentrations of cobalt in the alkyd phases are actually much lower compared to the predictions and could be essentially equal at the two pH levels. It is surprising that with LA13 and NPE_{20} a better or equal drying is obtained at pH 6, when at pH 6, only half of the cobalt is located in the alkyd phase. *Figure* 9 shows the results at 76 μm film thickness (wet). Equivalent results were obtained at 100 and 150 μm thicknesses. Investigation of the optimal pH for drying in the system with NPE_{20} shows that pH 6 to 6.5 gave a better time to through dry than pH 7.5 (at 76 and 100 μm thicknesses), and about equal time to touch dry (see *Figure* 10). It is quite obvious that the pH dependence of the performance of the Co/Zr and Ca drier cannot be explained from the distribution of Co and Ca between the phases. The results with emulsifiers however suggest that the slow surface drying with SDS may be due to a transfer of the cobalt to a separate liquid crystalline precipitate.

DISCUSSION

The drier can be situated in different places in an alkyd emulsion as shown in *Figure* 11. The influence of some parameters on the distribution of the drier between the alkyd and water phases has been investigated. We expect that poorer drying properties of the alkyd emulsion will be obtained when the drier is in the water phase.

It is clear from the results presented in *Figures* 1 and 3 that the distribution of cobalt and calcium driers between the phases is very sensitive to pH. An important issue then is how the distribution depends on properties of the drier. To understand this we have developed a simple model of the distribution. The model is based on the equilibrium reactions:

$$Co^{2+}_{(aq)} + 2R^{-}_{(aq)} \rightleftharpoons CoR_{2(aq)} \rightleftharpoons CoR_{2(alkyd)} \quad R = \text{2-ethylhexanoic acid}$$
$$H^{+} + R^{-} \rightleftharpoons HR$$

when the pH is lowered the acid-base reaction is shifted to the right while the cobalt reaction is shifted to the left.

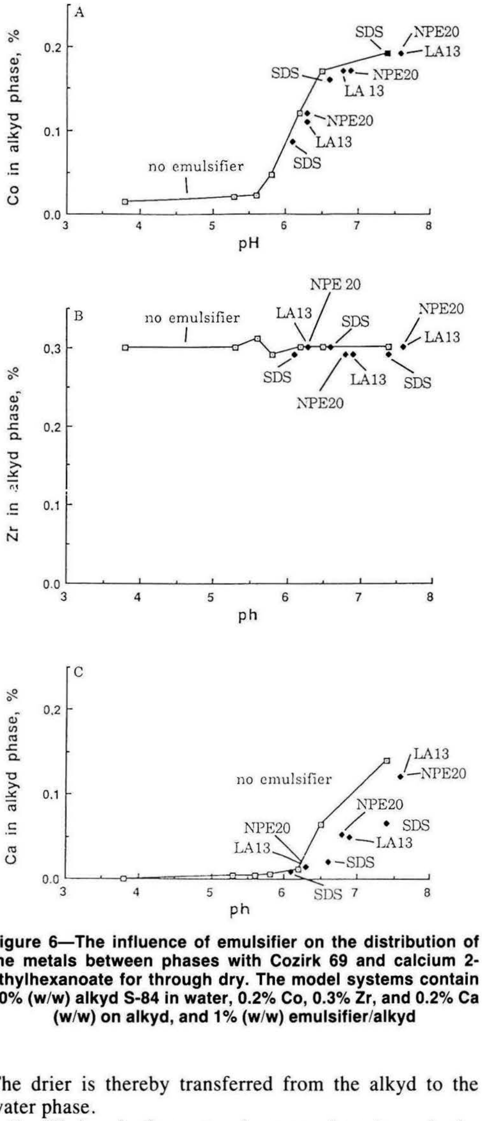

Figure 6—The influence of emulsifier on the distribution of the metals between phases with Cozirk 69 and calcium 2-ethylhexanoate for through dry. The model systems contain 50% (w/w) alkyd S-84 in water, 0.2% Co, 0.3% Zr, and 0.2% Ca (w/w) on alkyd, and 1% (w/w) emulsifier/alkyd

The drier is thereby transferred from the alkyd to the water phase.

Equilibrium in the system is assumed as shown in the following,

$$\{CoR_2\}_{alkyd} = \{CoR_2\}_{aq} = \frac{1}{K_s} \cdot \{Co^{2+}\} \cdot \{R^-\}^2$$

A pure melt is considered as the reference state for the $\{CoR_2\}$ activity. The reference state is in equilibrium with an aqueous solution described by a solubility constant K_s. Ideal solution is assumed in the alkyd phase, and the $\{CoR_2\}$ activity can then be described by its molar fraction in the alkyd phase. The reduced activity lowers the concentration of Co in the aqueous phase. The system could then be described by the following six equations.

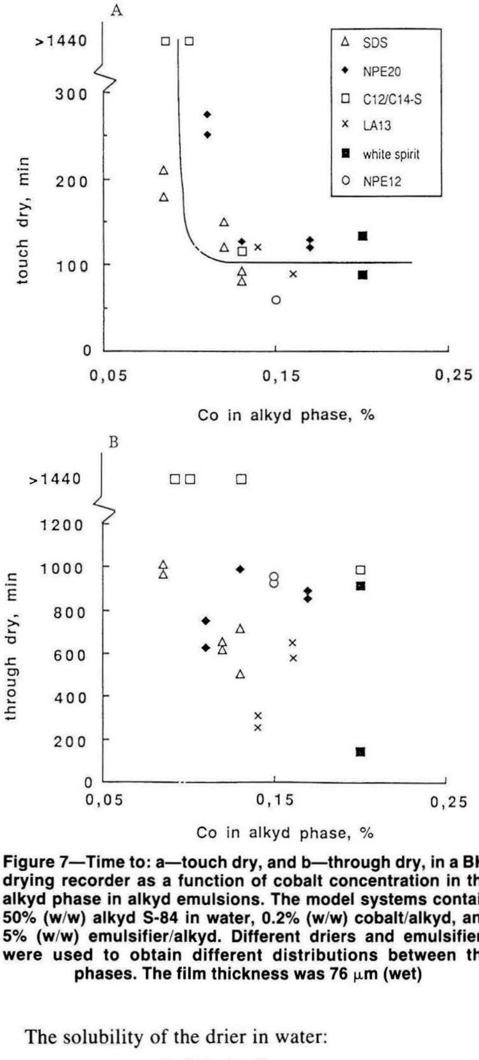

Figure 7—Time to: a—touch dry, and b—through dry, in a BK-drying recorder as a function of cobalt concentration in the alkyd phase in alkyd emulsions. The model systems contain 50% (w/w) alkyd S-84 in water, 0.2% (w/w) cobalt/alkyd, and 5% (w/w) emulsifier/alkyd. Different driers and emulsifiers were used to obtain different distributions between the phases. The film thickness was 76 μm (wet)

The solubility of the drier in water:

$$\frac{\{Co^{2+}\}_{aq}\{R^-\}^2_{aq}}{\{CoR_2\}_{alkyd}} = K_s \qquad (1)$$

The dissociation of the acid in water:

$$\frac{\{H^+\}\{R^-\}}{\{HR\}} = K_a \qquad (2)$$

The activity (but not the concentration) of the drier is equal in both the oil and aqueous phase:

$$X_{CoR_2}\text{ in alkyd} = \frac{[CoR_2]_{alkyd}}{[alkyd] + [CoR_2]_{alkyd}} = \{CoR_2\}_{alkyd} = \{CoR_2\}_{aq} \qquad (3)$$

The mass balance for cobalt:

$$[Co]_{init.} = [Co^{2+}]_{aq} + [CoR_2]_{alkyd} + [CoR_2]_{aq} \qquad (4)$$

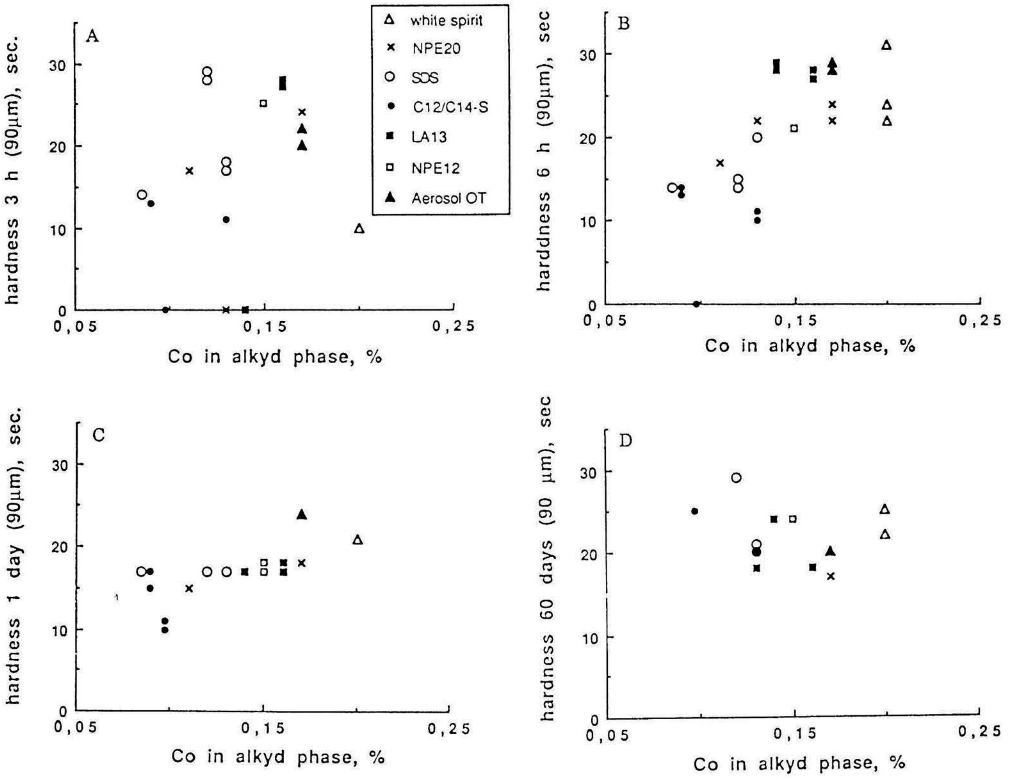

Figure 8—Hardness in König seconds after different times, as a function of cobalt concentration in the alkyd phase. The model systems contain 50% (w/w) alkyd S-84 in water, 0.2% (w/w) cobalt/alkyd, and 5% (w/w) emulsifier/alkyd. Different driers and emulsifiers were used to obtain different distributions between the phases. The film thickness was 90 µm (wet)

However, the solubility of the undissociated complex in water is very low and can in the mass balance be assumed to be zero. The mass balance then reduces to: $[Co]_{init} = [Co^{2+}]_{aq} + [CoR_2]_{alkyd}$.

The mass balance of the acid:

$$2[Co^{2+}]_{aq} = [HR] + [R^-] \qquad (5)$$

The distribution of the drier between alkyd and water:

$$\frac{[CoR_2]_{alkyd}}{[Co^{2+}]_{aq}} = K \qquad (6)$$

After reducing and combining equations (1)-(6), the following expression is obtained:

$$K(1 + K)^2 = \frac{4[alkyd] \cdot [Co]^2_{init.}}{K_s \cdot \left(1 + \frac{[H^+]}{K_a}\right)^2} \qquad (7)$$

by substituting

$$a = 4 \cdot [Co]^2_{init.} \frac{[alkyd]}{K_s \left(1 + \frac{[H^+]}{K_a}\right)^2} \qquad (8)$$

we obtain:

$$a = K(K+1)^2 \qquad (9)$$

the equations were solved for K (negative and imaginary solutions were rejected):

$$K = \left[\frac{-2}{3} + \frac{1}{9\left(\frac{1}{27}+\frac{a}{2}+\left(\frac{-1}{729}+\left(\frac{1}{27}+\frac{a}{2}\right)^{2)1/2)1/3}\right.\right.} + \left(\frac{1}{27}+\frac{a}{2}+\left(\frac{-1}{729}+\left(\frac{1}{27}+\frac{a}{2}\right)^{2)1/2)1/3}\right.\right.\right] \qquad (10)$$

where:

$\{CoR_2\}_{alkyd}$ = activity of cobalt 2-ethylhexanoate in the alkyd phase

$\{CoR_2\}_{aq}$ = activity of cobalt 2-ethylhexanoate in the aqueous phase

$\{Co^{2+}\}_{aq}$ = activity of cobalt ion in the aqueous phase

$\{R^-\}_{aq}$ = activity of 2-ethylhexanoate in the aqueous phase

$[Co^{2+}]_{aq}$ = concentration of cobalt in the aqueous phase

$[R^-]_{aq}$ = concentration of 2-ethylhexanoate in the aqueous phase
$[CoR_2]$ = concentration of cobalt 2-ethylhexanoate
$[H^+]$ = concentration of hydrogen ions
$[HR]$ = concentration of 2-ethylhexanoic acid
$[alkyd]$ = the molar concentration of the alkyd oil
$[Co]_{init.}$ = initial concentration of cobalt in the alkyd phase
K_s = solubility product for cobalt 2-ethylhexanoate
K_a = dissociation constant for 2-ethylhexanoic acid
K = distribution constant for cobalt between alkyd and water phase
$X_{CoR_2 \text{ in alkyd}}$ = mole fraction of cobalt 2-ethylhexanoate in alkyd

The dissociation constant (K_a) for 2-ethylhexanoic acid and the solubility constant (K_s) for cobalt 2-ethylhexanoate are not known. pK_a has been estimated to be five, based on dissociation constants for other similar organic acids found in the literature[10] (see *Table* 4).

The pK_s for the drier was estimated to be 5.93. This pK_s value describes the process of the transfer from a pure melt to aqueous solution. The pK_s value for saturated cobalt soaps is known from the literature. These salts are all solids in equilibrium with a solute. To estimate pK_s for cobalt 2-ethylhexanoate in liquid form (corresponding to the dissolved state in the alkyd), it was assumed that the free energy of dissolution, ΔG_s, is a sum of different contributions:

For a solid salt:

$$\Delta G_s = \Delta G_{melt} + \Delta G_{hydrophobic\ interaction} + \Delta G_{hydration} \qquad (11)$$

where:

$$\Delta G_{melt} = \Delta H_{melt} \left(1 - \frac{T}{T_m}\right)$$

T = experimental temperature
T_m = melting temperature

For a melt:

$$\Delta G_{s_{melt}} = \Delta G_{hydrophobic\ interaction} + \Delta G_{hydration} \qquad (12)$$

Equations (11) and (12) are combined assuming that the hydrophobic interaction and hydration interaction only depends on the length of the hydrocarbon chain and on the counter ion, but is independent of the branching of the molecule:

$$\Delta G_{s_{melt(in\ alkyd)}} = \Delta G_s - \Delta H_{melt} \left(1 - \frac{T}{T_m}\right) \qquad (13)$$

$\Delta G_{s_{melt(in\ alkyd)}}$ can be recalculated to K_s for the reaction:

$$CoR_{2alkyd} \leftrightharpoons Co^{2+}_{(aq)} + 2R^-_{(aq)}$$

pK_s for unbranched cobalt octanoate was obtained by extrapolation of measurements of pK_s for unbranched cobalt soaps with chain length from C_{10} to C_{18}.[11] The value was reduced with the part of pK_s that comes from ΔG_{melt} (calculated from the melting point and the enthalpy of melting). The enthalpy of melting for cobalt octanoate was determined to 44 J/g by DTA measurements and the melting point was 130°C.

The distribution of Co 2-ethyl hexanoate calculated according to the model is shown in *Figure* 12 (continuous line). The measured values are also included in *Figure* 12 (dots). It should be noticed that the calculated distribution is not adjusted to the measured distribution. The model shows the shift of the distribution toward the alkyd phase starting at a lower pH than do the measured values. This deviation may arise from failure of the model to consider the formation of micelles of 2-ethylhexanoate ions, or else from the limited solubility of 2-ethylhexanoic acid in the water phase. The model describes the cobalt approach to a plateau concentration in the alkyd phase well. The values measured in the alkyd phase at the highest pH are higher than the model predicts. A possible explanation is that cobalt exchanges its original acid for other acids in the alkyd. The new cobalt compounds may then have different solubility properties than the original drier. However, measurements of the distribution in this pH range with model alkyds with different acid values and oil lengths showed no influence of these properties. From our model it is clear that an increased hydrophobicity of the counter ion to the metal should favor a distribution towards the alkyd. This is also clear when 2-ethylhexanoate is compared with oleate in *Figures* 4 and 5. The more

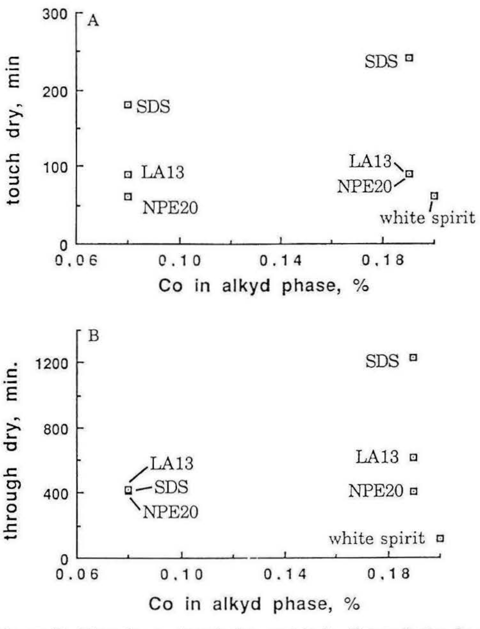

Figure 9—Time to: a—touch dry, and to b—through dry, in a BK-drying recorder as a function of cobalt content in the alkyd phase. The model systems contain 50% (w/w) alkyd S-84 in water, 0.2% Co, 0.3% Zr, and 0.2% Ca (w/w) on alkyd, and 10% (w/w) emulsifier/alkyd. Different pH were used to obtain different distributions of the driers. The film thickness was 76 μm (wet)

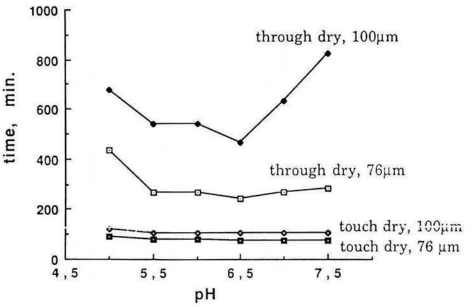

Figure 10—Optimal pH for drying of the model system 50% (w/w) alkyd S-84 in water, 10% (w/w) NPE_{20}, and 0.2% Co, 0.3% Zr, and 0.2% Ca (w/w) of alkyd

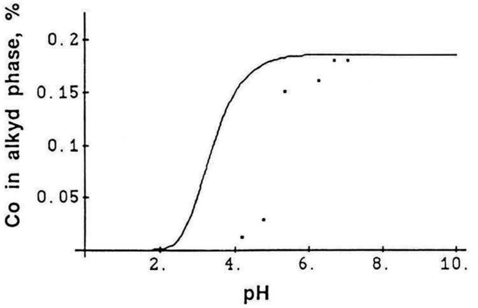

Figure 12—Calculated cobalt concentration in the alkyd phase with cobalt 2-ethylhexanoate at different pH according to the mathematical model (continuous line). The measured values are included in the diagram (dots)

hydrophilic counter ion hexanoate should give a lower plateau level of the alkyd concentration which is also observed.

However, the distribution of the Co/Zr drier in the combination with Ca is not as simply understood. The ratio of Co, Zr, and acid is 1:1:2, but the structure of the complex is not clear. From the distribution we can conclude that the cobalt and the zirconium are separated and that the cobalt is transferred to the aqueous phase. However, it is not understood why the cobalt is not associating with the counter ions following the calcium. Probably the presence of calcium in the aqueous phase and the remaining zirconium causes a shortage of 2-ethylhexanoate ions, and forces the distribution of cobalt towards the aqueous phase.

The pH is often adjusted to about 7 in alkyd emulsion paints which means that most of the drier is initially located in the alkyd phase. When the paint is stored, the pH decreases due to the hydrolysis of the alkyd. This can result in a redistribution of the drier towards the aqueous phase during storage of the paint if pH becomes low enough. This could be a contributing factor to the well known fact that the drying properties of alkyd emulsion paints deteriorate with age.

Nonionic emulsifiers do not, in most cases, influence the distribution of cobalt and zirconium driers between the phases. In some systems they increase the distribution towards the aqueous phase but only to a slight extent; they increase the distribution of calcium towards the water phase. Hydrophilic anionic emulsifiers result in a decreased concentration of cobalt in the alkyd phase with the plain cobalt driers. In these systems, a third phase with high cobalt concentration was found which probably is the cobalt salts of the emulsifiers. This phase has, in some systems, been shown to be a liquid crystalline phase. Liquid crystalline phases have been identified with similar sulfonated surfactants and Mg and Ca ions.[12,13] The formation of this phase will, in this case, draw the drier out from the alkyd phase. Liquid crystalline phases are known to be located around emulsion droplets. A positive effect of these phases is that they are effective in stabilizing emulsions.[14] However, the existence of these phases is dependent on the concentration of the different components in the system. In this study, only 1% emulsifier/alkyd was used, which is low compared to the concentration usually used in alkyd emulsion paints. The effect of changing the hydrophobic part of the drier (e.g., from 2-ethylhexanoate to SDS) on the drying properties over and above affecting the distribution, is not fully understood.

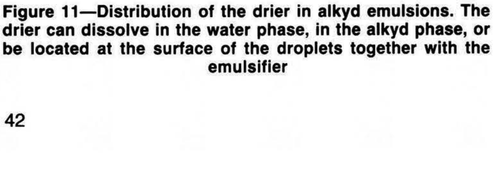

Figure 11—Distribution of the drier in alkyd emulsions. The drier can dissolve in the water phase, in the alkyd phase, or be located at the surface of the droplets together with the emulsifier

The influence of the distribution of the driers between the phases on the drying properties cannot be completely determined from this study. Several important questions still remain open. With cobalt as the sole drier, a longer time to touch dry was obtained when the concentration of cobalt was less than 0.12% in the alkyd phase in an emulsion containing 0.2% cobalt/alkyd and 50% alkyd in water. This is in agreement with the concentration of cobalt needed in organic solvent-borne systems to obtain good drying properties. Under 0.12% cobalt, the drying time is increased.[17] No clear correlation to through dry was obtained. This may be explained by the fact that cobalt alone mostly contributes to drying of the surface. These results indicate that the distribution can be important for the early drying rate.

No correlation between the drying rate and the cobalt concentration in the alkyd phase could be seen with the Co/Zr and Ca drier for through drying. This can partly depend on the fact that the pH had to be changed to obtain different distributions and that addition of auxiliary driers also gives an increasing effect of the cobalt. The distribution of calcium probably does not influence the drying properties directly since its main mechanism is to react with low molecular weight acids that otherwise could react with zirconium. A contributing factor to the lack of correlation may be that the zirconium in these emulsions is located in the alkyd phase since its distribution was independent of both pH and addition of emulsifier. However, when SDS was added, the drying rate was slower. This suggests that SDS transfers cobalt to a separate liquid crystalline phase.

It should be pointed out that all drying experiments were performed on glass. The effect on a porous substrate, for example, wood, could be different. It is possible that the drier in the water phase may penetrate deeper into the wood than the alkyd. This may be one reason for a slower drying rate.

SUMMARY

Due to environmental considerations, there is increased interest in waterborne alkyd paints. In some applications, where other types of waterborne paints do not give the desired properties to the paint film, organic solvent-borne alkyds are still used. Alkyd emulsion paint, where the alkyd oil is dispersed in water, is an interesting alternative in these applications, if the problems of slower drying properties compared to organic solvent-borne alkyds, and colloidal stability can be solved.

In this work, we have investigated the influence of pH, emulsifiers, and alkyd properties on the distribution of driers between the alkyd and aqueous phase in alkyd emulsions. It was thought that the distribution could be important for the drying properties.

The distribution of cobalt and calcium is dependent on the pH in the emulsion. At high pH, the metals are located towards the alkyd phase. When pH is decreased, the driers are redistributed toward the aqueous phase. The distribution of a commercial drier cobalt 2-ethylhexanoate has partly been correlated to its solubility product and the dissociation constant of the corresponding acid. Zirconium, in a Co/Zr and Ca drier for through dry, is situated in the alkyd phase independent of pH.

Nonionic emulsifiers do not, in most cases, influence the distribution of cobalt and zirconium between phases, but they do increase the distribution of calcium towards the water phase. Hydrophilic anionic emulsifiers decrease the concentration of cobalt and calcium in the alkyd phase. A third cobalt phase was found in these systems, which in some cases has been identified as a liquid crystalline phase. If a calcium drier is added to the emulsion, the calcium salt of the anionic emulsifier is precipitated.

The distribution of cobalt as the sole drier is not influenced by alkyd properties such as oil length and acid values.

Drying tests indicate that the distribution of cobalt as the sole drier can influence the early stage of drying. However, with a drier for through drying based on Co/Zr and Ca, no correlation between drying properties and the distribution of cobalt and calcium could be measured. A probable reason is that different pH levels have to be used to obtain the different distributions of cobalt in these emulsions, and pH influences the drying properties by itself. The zirconium was found to be located to the alkyd phase.

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The authors wish to thank the Swedish Work Environmental Fund and the following industries: Jotun A/S, Perstorp AB, Wilhelm Becker AB, Berol Nobel AB, Nordsjö Nobel AB, and Veitsiluoto Oy for financing this work. We also want to thank Bergvik Kemi AB for supplying all alkyds used, Tommy Sebring for helpful assistance in the laboratory, and M. Huldén, our Paint Specialist at the Institute, and the Research Director, Bengt Kronberg, for comments on the manuscript.

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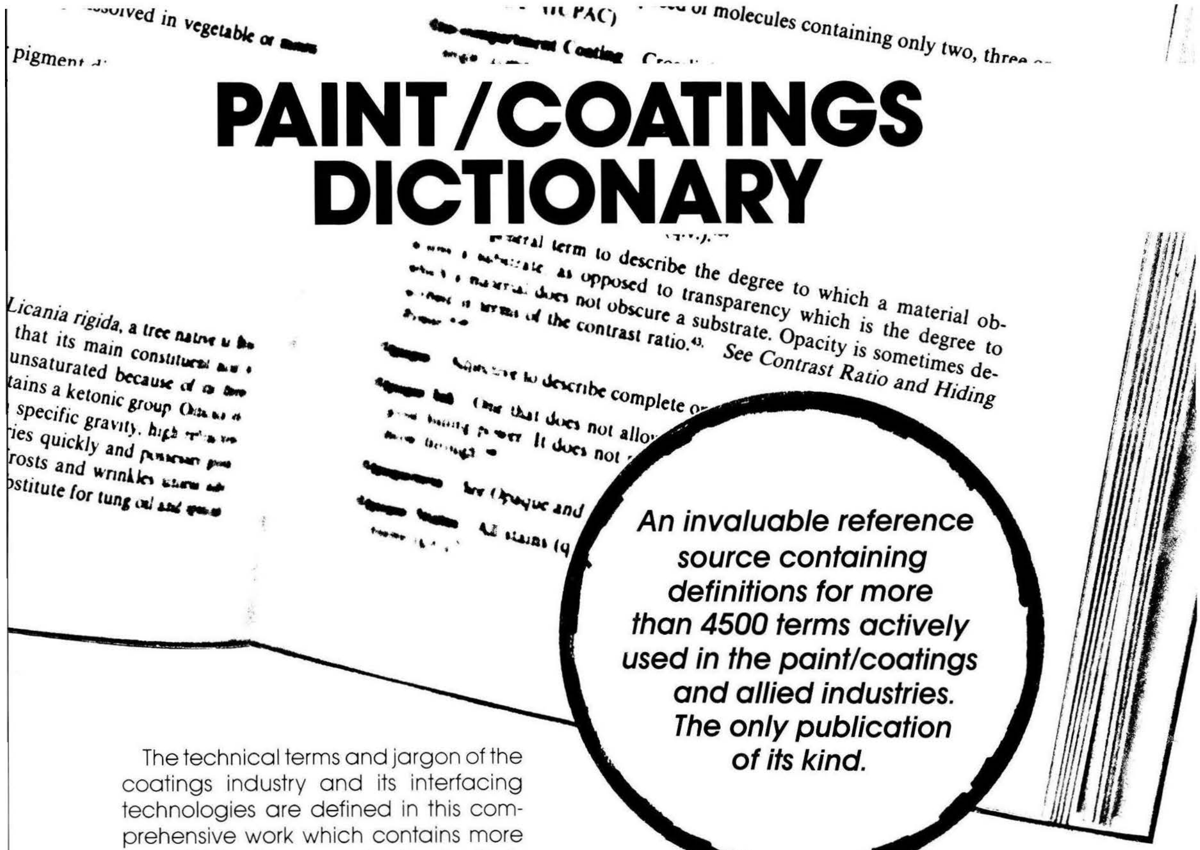
PAINT/COATINGS DICTIONARY



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OPEN FORUM

Suspension of TiO_2 Pigments In Organic Solvents: Identification Of Rutile and Anatase in Suspended State

K.V.S.N. Raju and M. Yaseen
Indian Institute of Chemical Technology*

The basic principle of this approach is based on physical interaction between pigment particles and solvent molecules. It is observed that in some pigment-solvent suspensions, the interaction is so strong that the finely divided pigment particles remain suspended for days. The magnitude of interaction is classified in terms of a certain period of time during which the pigment remains suspended in a solvent. Rutile and anatase forms of TiO_2 pigment are observed to have different suspension characteristics in a few solvents. This feature may be of benefit to the industry, which sometimes faces difficulty in identifying them.

Introduction

Titanium dioxide pigments form about 52% of pigments used in paint and allied industries.[1] Though TiO_2 exists in three forms, that is, brooklite, anatase, and rutile, the latter two are used extensively in paint formulations. Rutile and anatase are tetragonal and anisotropic and are identical in properties such as whiteness, brightness, and chemical composition. They do differ in some physical properties such as crystallinity, chemical structure, refractive index, specific gravity, etc. Some of the properties of the two pigments are specific to be used as standards in quality control and for identification. Usually, the techniques used for making the distinction between rutile and anatase forms of TiO_2 pigments are expensive, and may not be available to the common users. Rutile and anatase forms of TiO_2 pigment were observed to have different suspension characteristics in a few organic solvents because of the difference in their physical interaction. This feature of suspension of rutile and anatase in such solvents could be used to distinguish between the two.

On the basis of their interaction with organic liquids, the Toronto Society for Paint Technology[2] classified TiO_2 pigments into alcohol and ether groups. Romo's[3] calculations based on the theories of Hamaker and Overbeck-Verwey led to the conclusion that the stability of TiO_2 suspensions in 1-butanol and in 1-butylamine was due to electrostatic attraction. In our earlier study,[4] the synergistic effect observed in the case of dissolution of resin in mixtures of solvents[5] was not found to be applicable to the suspension of TiO_2 pigments in blends of solvents. Schröder[6] reported that in nonaqueous systems, the acid-base properties of pigments play an important part in the form of interfacial charges and donor-acceptor interactions. Because of the low dielectric constants of many organic solvents, electron exchange processes are more important than dissociative, that is, ionic processes. Janardhan et al.[7,8] studied the adsorption of resins on the surface of various types of pigments by using gel permeation chromatography and concluded that the amount of alkyd adsorbed on TiO_2 (anatase) depends on the dielectric constant of the solvent and also on the solvent-resin interaction.

Sörensen[9] suggested that to have a favorably stabilized dispersion of the pigment in the resin solution, the choice of solvents should be determined by considering the acid-base class of resins and pigments so that interaction between resin and solvent is greater than that between pigment and solvents. The adsorption of resin on the pigment surface is influenced by factors like chemical groups, steric interaction, pigment modification, and the nature of organic solvents. To enhance the dispersibility into binders, the commercial TiO_2 pigments are surface treated with hydrous oxides of Al, Si, P, Zn, Zr, etc.[10,11] The treatment reduces the photocatalytic effect of TiO_2 in paints and also improves the dispersion stability of solvent-borne and waterborne formulations.[12] Losoi[13,14] studied the surfaces of alumina, silica-, and alumina-silica coated TiO_2 pigments with zeta potential, x-ray photoelectron spectroscopy, and secondary ion mass spectroscopy measurements, and found that the uppermost layers of the coatings were dominated by alumina and silica.

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In a recent study of pigment-solvent interaction and characterization of pigment surface, a distinct difference was observed in the suspension of rutile and anatase in certain solvents.[15] The observations suggest a simple method which could be used for differentiating between rutile and anatase.

Materials

Anatase of 3.84 specific gravity and more than 99% pure (Travancore Titanium Products Limited, India), untreated rutile of 4.12 specific gravity and almost 100% pure (Woodall Duckham Chemicals Limited, U.K.), and treated TiO_2 pigments of RCL 575 (Glidden-Durkee Division, SCM Corporation) and TR 92 (PPG Industries, Inc.) were used.

It was found earlier that the difference in the sizes of finely ground pigment particles does not influence the suspension characteristics of the pigment in a solvent.[16] The factor responsible for keeping the pigment in a suspended state in a particular solvent (regardless of its viscosity) is the magnitude of interaction between the two. For the sake of convenience, pigments passing through 300 mesh were used. The heating of the pigment at 140°C for a certain period of time facilitates the displacement of entrapped gases and moisture from the voids of the pigment. Thus, the pigments passing through 300 mesh, dried at 140°C, and stored in a desiccator were used whenever required.

Sixty-two organic solvents having Hildebrand (solubility) parameters[17] ranging from 14.40 to 33.34 $(\mathrm{MP_a})^{1/2}$, that is, 7.04 to 16.30 $(\mathrm{cal/cc})^{1/2}$, were selected for suspending the pigments.

Procedure

A total of 0.25 g of a TiO_2 pigment was placed in a 50 mL conical flask and dried at 140°C for 8 hr, and then 25 mL of a solvent was added immediately after it was removed from the oven. The pigment was suspended individually in 62 liquids following the identical procedure and the flasks were shaken for 16 hr. The suspended pigment in a solvent was transferred to a 25 mL stoppered measuring cylinder, and its suspension was observed at intervals of five minutes, 30 minutes, one, two, six, eight and 24 hours, and every day for a period of seven days.[16,17]

Classification of Suspension

The suspension of the pigment in a solvent was broadly classified in the following classes by considering the periods during which a certain amount of pigment remained suspended:

Table 1—Total and Three-Component Cohesion Parameters, $\delta/(\mathrm{MPa})^{1/2}$, of Organic Liquids and Classification of Their Interaction with TiO_2 Pigments[18,19]

Solvent	Solubility Parameter δt	Classification of Suspension: Rutile	Classification of Suspension: Anatase
1	2	3	4
Diethyl amine	16.28	II	I
Iso-butyl butyrate	16.45	III	I
MIBK	17.00	III	III
n-Butyl acetate	17.31	I	II
1-Butyl chloride	17.41	III	I
m-Xylene	18.00	II	II
Toluene	18.23	I	II
MEK	19.00	I	II
Cyclohexanone	20.21	II	II
1-Hexanol	20.50	IV	III
1,4-Dioxane	20.50	IV	I
Diacetone alcohol	20.80	IV	IV
Butyl cellosolve	20.80	IV	II
Amyl alcohol	21.70	IV	III
Pyridine	21.70	IV	III
Acetophenone	21.81	IV	I
t-Butyl alcohol	22.09	IV	III
Cyclohexanol	22.40	IV	IV
Iso-octyl alcohol	22.71	IV	IV
Iso-butyl alcohol	22.71	IV	I
n-Butanol	23.09	IV	IV
Iso-propanol	23.50	IV	I
Ethyl cellosolve	24.30	II	II
n-Propanol	24.51	II	I
Allyl alcohol	24.51	II	II
Methyl cellosolve	24.67	II	III
Propionic acid	25.51	IV	II
Benzyl alcohol	26.43	IV	III
1,3-Butane diol	28.92	IV	IV
Methanol	29.60	IV	IV
Ethanol amine	31.50	III	III
Ethylene glycol	33.34	IV	IV

Class I — The pigment settled down within 30 min, leaving a clear supernatant liquid.

Class II — A percentage of pigment particles remained suspended up to 8 hr.

Class III — The major part of the pigment remained suspended up to 24 hr.

Class IV — The pigment remained suspended for a period of more than 24 hr.

The classified suspension of the pigments for 32 out of 62 solvents is reported in *Table* 1.

Discussion

The data in *Table* 1 indicate an indirect measure of the level of interaction between pigment particles and solvent molecules in terms of the suspension of pigment particles in a solvent. Rutile was found to have good interaction with 29 of the solvents, 18 of which remained suspended for more than 24 hr. On the other hand, anatase was found to exhibit interaction with 24 solvents. Since organic solvents contain hydroxyl, carboxylic, or amine groups, the pigment surface may have acquired charge distribution in them and developed a strong physical interaction, which in turn, kept the pigment particles in a suspended state for a certain period of time.

Careful observation of the data in *Table* 1 indicates that in 2,4-dioxane, acetophenone, iso-butyl alcohol, and iso-propanol, rutile pigment particles remained in a suspended state for more than 24 hr, as well as in iso-butyl butyrate and n-butyl chloride for up to 24 hr. However, anatase pigment particles settled down in these solvents within 5-30 min. This feature of suspension of rutile and anatase TiO_2 pigments in the previously mentioned six solvents could be used for identification. Acetophenone alone can be used for the purpose of identifyng the two types of TiO_2 pigments.

The suspension of two treated rutile pigments in the six solvents was also determined. Their suspension behavior was found to be identical to that observed in the case of untreated rutile pigment. However, the surface treatment of pigment enhanced the suspension duration. In general, the treatment of the pigment surface improved its dispersibility in a solvent or in resin solution. Usually, anatase pigments are not treated, so the distinction between rutile (treated/untreated) and anatase is likely to remain the same as observed in this study. The applicability of this method has been tested solely in the identification of rutile and anatase and has not been used for studying the comparative effectiveness of surface treatment.

Conclusion

This suspension characteristic of the two types of pigments can be used as a tool in making the distinction between rutile and anatase, and it provides an inexpensive, simple method for identifying the two types of pigments.

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CHICAGO .... SEPT.

"Paint Industry Economics"

The Host Committee Chairmen for the 1992 Paint Industries' Show were introduced by Host Committee Chairman Theodore J. Fuhs, of Tru-Test Manufacturing Company: FSCT Exhibit—Victor M. Willis, of Ace Hardware Corporation; Hospitality Suite—Thomas P. Yates, of United Coatings, Inc.; Information Services—Natu C. Patel, of Ace Hardware Corporation; Program Operations—Karl E. Schmidt, of Premier Coatings; Registration Area—William W. Fotis, of The Valspar Corporation; and Spouses' Program—Cynthia Fuhs.

The meeting's technical presentation was given by Ian C. James, of E.I. du Pont de Nemours & Company. Mr. James' topic was "ECONOMICS AND THE PAINT INDUSTRY."

The speaker reviewed the various economic indicators and what effect they have on the economy. Mr. James said, regardless of who wins the Presidential election, the Gross Domestic Product will experience slow growth for the remainder of 1992 and throughout 1993.

After 1993, he stated that the economy could change, depending on what programs Congress and the President have agreed on. However, none of the programs probably would have an immediate effect.

Continuing, Mr. James explained that the coatings industry largely will be affected by the employment rate. He predicted that this rate will not increase until well into 1993.

Other influences will depend on housing starts, which have been relatively flat during 1992 until just recently (August produced an increase of 10.4% in housing starts). The speaker stated that if the sudden surge in housing were to continue at this rate, it could have a major effect on the paint business in both the trade paint and industrial finishes markets. Mr. James said the stronger segments of the economy in 1993 will include: residential construction, auto sales, and exports. Weaker areas will be nonresidential construction, defense related production, and employment.

In conclusion, the speaker said paint production should show an above average growth in sales during 1993.

CLIFFORD O. SCHWAHN,
Publicity

CHICAGO TECHNICAL SPEAKER—Ian James discusses "Economics and the Paint Industry" during the Society's September meeting

LOS ANGELES .... SEPT.

"Water-Based Resins"

The Society Officers for the 1992-93 year were installed as follows: President—Sandra L. Dickinson, of Synergistic Performance Corporation; Vice President—V.C. "Bud" Jenkins, Consultant; Secretary—John C. Kulnane, of Ameritone Paint Corporation; and Treasurer—Philip C. Bremenstuhl, of Ashland Chemical, Inc.

Robert Backlin, of Hüls America, Inc., presented the President's Gavel to Ms. Dickinson.

Ms. Dickinson presented the Society's Past-President's Award to James D. Hall, of Sinclair Paint Company.

The Society Committee Chairmen for the coming year were introduced to the membership: Educational Committee—Joseph C. Reilly, of Rohm and Haas Company; Environmental Affairs Committee—Dave Muggee, of E.T. Horn Company; Manufacturing Committee—Francisco Stitt, of Sinclair Paint Company; Membership Committee—Mr. Bremenstuhl; and Technical Committee—Mr. Jenkins.

Frank Peters, of Dunn-Edwards Corporation, instructor for the Society sponsored "Paint Technology" course, reported that 15 people were graduated during 1991-92.

The Outstanding Student Award was presented to Raymond Elustondo, of Benjamin Moore & Company.

Mr. Muggee announced that the new Proposition 65 list has been published under Title 26—Toxics, by the California Department of Health Services (DHS).

He reported that the California Air Resources Board has added nickel and inorganic compounds to the air toxics list. No safe threshold level has been established.

Also, Mr. Muggee said that the California Environmental Protection Agency "Permit-by-Rule," dealing with the fixed waste treatment units notification deadline, has been extended to January 1, 1993. He stated that modifying legislation is expected by the end of 1992.

In conclusion, Mr. Muggee explained that California DHS has issued an alert for hexavalent chrome exposure limits.

It was announced that Bob Hildebrand will serve as Chairman of the Hazardous Waste Subcommittee.

Ward T. Brown, of Rohm and Haas Company, delivered the meeting's technical presentation. His topic was "WATER-

BALTIMORE OFFICERS—Elected to serve as Society officers for 1992-93 are (from left): Treasurer—Albert Holder; President—James M. Smith; Secretary—Helene J. Ranfone; Vice President—John S. Kurnas; and Society Representative—Joseph D. Giusto

Constituent Society Meetings and Secretaries

BALTIMORE (Third Thursday—Martins West, Baltimore, MD). Helene J. Ranfone, Duron, Inc.,10406 Tucker St., Beltsville, MD 20705.

BIRMINGHAM (First Thursday—Strathallan Hotel, Birmingham, England). D.C. Morris, PPG Industries (UK) Ltd., P.O. Box 359, Birmingham, B16 0AD, England.

CDIC (Second Monday—Location alternates between Columbus, Cincinnati, Dayton, and Indianapolis). Jeffery I. Buchman, Akzo Coatings, Inc, P.O. Box 147, Columbus, OH 43216-0147 .

CHICAGO (First Monday—Sharko's Restaurant, Villa Park, IL). Natu C. Patel, Ace Hardware Corp., Paint Div., 21901 S. Central Ave., Matteson, IL 60443.

CLEVELAND (Third Tuesday—Brown Derby, Independence, OH in Nov., Mar., and Apr.; Cleveland Hilton, Cleveland, OH, in Feb.; Landerhaven, Mayfield Heights, OH, in May). Constance F. Williams, The Glidden Co., 801 Canterbury Rd., Westlake, OH 44145.

DALLAS (Thursday following second Wednesday—Holiday Inn Crowne Plaza, Dallas, TX). Benny Puckett, Kelly-Moore Paint Co., Inc., 301 W. Hurst Blvd., Hurst, TX 76053.

DETROIT (Second Tuesday—meeting sites vary). Jane Allen, Reichhold Chemicals, Inc., 814 Commerce Dr., Oakbrook, IL 60521.

GOLDEN GATE (Monday before third Wednesday—alternates between Francesco's in Oakland, CA, and Holiday Inn in S. San Franscisco). Richard Cooper, Synergistic Performance Corp., 5801 Christie Ave., #590, Emeryville, CA 94608.

HOUSTON (Second Wednesday—Hobby Airport Hilton, Houston, TX). Tom Fitzgerald, Monarch Paint Co., P.O. Box 55604, Houston, TX 77255.

KANSAS CITY (Second Thursday—Cascone's Restaurant, Kansas City, MO). Lawrence J. Murphy, Tnemec Co. Inc., 123 W. 23rd Ave., N. Kansas City, MO 64116.

LOS ANGELES (Second Wednesday—Steven's Steakhouse, Commerce, CA). John C. Kulnane, Ameritone Paint Corp., 18414 S. Santa Fe Ave., P.O. Box 190, Long Beach, CA 90801.

LOUISVILLE (Third Wednesday—Executive West Motor Hotel, Louisville, KY). William Leightner, C.L. McGuire & Co., 8134 Newlagrange Rd., Louisville, KY40222.

MEXICO (Every fifteen days—Gabriel Mancera, Mexico City, Mexico). Sergio Rojas, Pinturas International, S.A. De C.V., Ganaderos 234, Col. Granjas Esmeralda, 09810 Mexico, D.F., Mexico.

MONTREAL (First Wednesday—Le Bifthèque Steakhouse, Ville St. Laurent, Quebec). Esther Rouleau McCarthy, Stochem Inc., 1455 32nd Ave., Lachine, Que. H8T 3J1, Canada.

NEW ENGLAND (Third Thursday—Sheraton Lexington Hotel, Lexington, MA, and other locations in Massachusetts and Rhode Island). Charles Shearer, ICI Resins US, 730 Main St., Wilmington, MA 01887.

NEW YORK (Second Tuesday—Landmark II, East Rutherford, NJ). George M. Amrich Jr., Benjamin Moore & Co., 134 Lister Ave., Newark, NJ 07105.

NORTHWESTERN (Jax Cafe, Minneapolis, MN). Michael Grivna, Hirshfield's Paint Mfg., Inc., 4450 Lyndale Ave., N., Minneapolis, MN 55412.

PACIFIC NORTHWEST (Portland Section—Third Tuesday; Puget Sound Section—Third Wednesday; Vancouver Section— Third Thursday). John Westendorf, Lipscomb Chemical Northwest, 2627 NW Nicolai, Portland, OR 97210.

PHILADELPHIA (Second Thursday—Williamson's Restaurant, GSB Bldg., Bala Cynwyd, PA). Robert D. Thomas, M.A. Bruder & Sons, Inc., 52nd & Grays Ave., Philadelphia, PA 19143.

PIEDMONT (Third Wednesday—Ramada Inn Airport, Greensboro, NC). Dale Baker, Kohl Marketing, Inc., 3859 Battleground Ave., Ste. 203, Greensboro, NC 27410.

PITTSBURGH (Second Monday—Montemurro's Restaurant, Sharpsburg, PA). Mark A. Harley Jr., PPG Industries, Inc., 4325 Rosanna Dr., P.O. Box 9, Allison Park, PA 15101.

ROCKY MOUNTAIN (Monday following first Wednesday—Zangs Brewery, Denver, CO). Christine LesCamela, Kwal-Howells Inc., 3900 Joliet St., Denver, CO 80239.

ST. LOUIS (Third Tuesday—Salad Bowl Cafeteria, St. Louis, MO). Chuck Reitter, American Paint Journal Co., 2911 Washington Ave., St. Louis, MO 63103.

SOUTHERN (Gulf Coast Section—third Thursday; Central Florida Section—third Thursday after first Monday; Atlanta Section—third Thursday; Memphis Section—bimonthly on second Tuesday; and Miami Section—Tuesday prior to Central Florida Section). Jeff Shubert, Shubert Paints, Inc., 2157 Mountain Industrial Blvd., Tucker, GA 30084.

TORONTO (Second Monday—Cambridge Motor Hotel, Toronto). Bob C. Ng, Hoechst Canada Inc., 100 Tempo Ave., Willowdale, Ont. M2H 2N8, Canada.

WESTERN NEW YORK (Third Tuesday—meeting sites vary). Marko Markoff, 182 Farmingdale Rd., Cheektowaga, NY 14225.

Based Resins for the Wood Finishing Industry."

The speaker discussed how latex resins work and how they are used in wood coatings. He also compared and contrasted latex resins with solventborne coatings, and provided the direction latex coatings are taking in the wood finishing industry.

Dr. Brown stated that the use of waterborne coatings, which comprise less than 5% of the market, will continue to grow because they offer a remedy to the environmental issue.

According to the speaker, early on, waterborne coatings had serious disadvantages when compared to solventborne coatings, including poor early print, grain raising, poor surface definition, staining, and poor surface repairability. In addition, the solvent used in water-based resins negatively affects the wood surface, while the solvent in solventborne coatings does not affect the wood surface.

Recently, developments have been made specifically for the wood coating market. Dr. Brown said that these include core-shell latices which have hardness, but are easily coalesced. Also, he stated that swellable latices were developed to give appearance properties with better solvent resistance. These allow for improved systems that can be tailored for specific wood applications.

The speaker discussed grain raising and color matching. According to Dr. Brown, these properties are related to the carrier in which the resin is borne. He explained that water interacts with wood, causing grain raising and tannin staining. These stains are much more soluble in water than the solvents used in solventborne coatings.

Q. In latex film formation, what happens to the water-soluble but nonvolatile materials in the coating?

A. They stay in the coating. Where they are depends on the coating. Often they accumulate between the latex particles. This hurts stain resistance. Resins are designed to minimize this.

Q. If you use a coalescent that attacks the polymer phase and a coalescent that attacks the water phase, can you improve film formation?

A. Yes, that is a good strategy. You will want to use water soluble cosolvents and water insoluble cosolvents. All water soluble cosolvents affect film formation. You don't want all water insoluble cosolvents because they tend to dry to slowly.

John C. Kulnane, *Secretary*

MONTREAL .... SEPT.

"Coatings for Aeronautics"

Michel Plante, of Bombadier Inc./Canadair, presented a technical talk on "Coatings for Aeronautics."

The application procedures required for each type of coating used and the surface preparation required for each substrate was explained. The special problems which arise due to size and space constraints also were addressed.

Mr. Plante talked about the importance of properly preparing the substrate. He said that the continuing education of employees is required to stress proper work procedures.

The speaker discussed the importance of planning work schedules to minimize the time periods of toxic fume generation. He stated that fumes from aluminum treatment (anodize, etc.) chromate primers and two-component urethane coatings (isocyanates) are a constant concern.

Mr. Plante said that an airplane typically takes three to four days to paint. The coating system, following metal preparation, usually consists of an ambient cure two-component epoxy primer, a topcoat, and a two-component urethane. Large exterior parts are electrostatically finished. The interior parts of an airplane are manually sprayed. Recently, the spraying system was converted to a high volume, low pressure (HVLP) system.

The speaker said that quality testing of all incoming paint shipments takes approximately two weeks. He stated that applied dry film thickness also is critical, and must pass quality standards. The total metal preparation, including epoxy primer and topcoats, equals about 3.5 mil dry.

Q. Are powder coatings being used to coat airplanes?

A. No, but they are being looked at as a possibility. The direction is more towards high-solids and waterborne coatings technology (low VOC coatings).

Q. How is the paint system qualified for use?

A. The customer often specifies the type of paint to be used. If not, the color will determine the choice (e.g., if a blue is approved by Boeing and the same shade is requested by the customer).

Q. What is the cost of painting an airplane?

A. The paint can cost up to $180.00 per gallon. Labor cost is approximately $32,000.00.

JASON G. HART

NORTHWESTERN .... SEPT.

1991 Mattiello Lecture

The 1991 Joseph J. Mattiello Memorial Lecture video, "STRUCTURE/PROPERTY RELATIONSHIPS OF THERMOSET COATINGS," by Loren W. Hill, of Monsanto Company, was presented to the membership. Dr. Hill is a member of the New England Society.

A brief biography of Joseph Mattiello and history of the lecture was presented by Dr. Hill. He said that he chose his subject matter for three reasons: to stimulate activity in an area that largely has been overlooked by coatings chemists; to demonstrate that crosslink density (XLD) can be easily calculated for stoichiometric systems; and to give examples of applications of dynamic mechanical analysis (DMA) which can be used to understand cure mechanisms.

Dr. Hill explained several mechanical property concepts which have been underutilized by coatings chemists, including: stress concentration in a crack, brittle-ductile transition, viscoelasticity, and tertiary structure.

XLD was calculated using DMA, and compared to solvent induced swelling experiments. The results were similar, and it was concluded that they validated the ideal network law. Also, it demonstrated that DMA can be used as a routine method to determine XLD.

In closing, Dr. Hill said that DMA can be used for better understanding cure mechanisms, optimizing reactant structures, selecting coreactants, and following weathering.

MICHAEL GRIVNA, *Secretary*

PHILADELPHIA .... SEPT.

"Aqueous Systems"

The Board of Directors for 1992-93 was announced as follows: President—William J. Fabiny, of SermaGard Coatings; Vice President—J. Brian O'Connor, of McWhorter Inc.; Secretary—Robert D. Thomas, of M.A. Bruder & Sons, Inc.; Treasurer—Barrett C. Fisher, of Van Horn, Metz & Company, Inc.; Assistant Treasurer—Howard J. Salmon, of Clement "Coverall" Company; Society Representative—Wayne A. Kraus, of Aqualon Company; Senior Member-at-Large—Tom G. Brown, of Consultants Consortium; Junior Member-at-Large—Patricia M. Peterson, of M.A. Bruder & Sons, Inc.; Senior Past-President—Lawrence J. Kelly, of Eastech Chemical, Inc.; Junior Past-President—Peter C. Kuzma, of V.I.P. Products Corporation; Educational Committee Chairman—Richard D. Granata, of Lehigh University; Membership Committee Chairman—A. Marshall Jones, of Van Horn, Metz & Company, Inc.; and Technical Committee Chairman—Julio J. Aviles, of KRONOS, Inc.

A Past-President's Pin was presented to Mr. Kuzma, who was thanked for his efforts on behalf of the Society while serving as an officer.

The meeting's technical presentation was delivered by Society member Richard G. Brown, of Aqualon Company. His topic was "RHEOLOGICAL MODIFIERS FOR AQUEOUS COATINGS."

A broad overview of the types of materials used to modify the flow properties of aqueous systems was presented. Emphasis was placed on the application of the materials in waterborne coatings, particularly latex paints.

Mr. Brown discussed the sources and differences of modifiers, as well as the various properties which each type imparts to the completed formulation.

The primary target of interest was the cellulosic type thickeners, and the contribution of the cellulosics when two or more thickeners are used together.

Mr. Brown addressed the mechanisms of the different types of thickeners. Problem areas and deficiencies of modifiers also were explained.

ROBERT D. THOMAS, *Secretary*

TORONTO EXECUTIVE COMMITTEE—Members of the Society Executive Committee for 1992-93 include (from left) front row: Secretary—Bob C. Ng; President—Vik Rana; Membership Committee Chairman—Natalie Janowsky; Past-President—Gerry Parsons; Jackson W. Chan; Michael Laing; and Manufacturing Committee Chairman—John W. Porter. Second row: Treasurer—David P. Jack; Educational Committee Chairman—Walter Fibiger; and John MacLean. Third row: Society Representative—Art Hagopian; R.H. Stevenson; Robert D. McComb; and Michael Molnar

Future Society Meetings

Baltimore

(Feb. 12)—Joint Meeting with BPCA.

(Mar. 18)—Technical Committee.

(Apr. 15)—Educational Committee. Nominations.

(May 20)—Manufacturing Committee. Elections.

Birmingham

(Dec. 3)—"Radiation Curing: Saints or Sinners?"—Michael Philips, UCB (Chem.) Ltd.

(Jan. 7)—Kenneth Cooke Memorial Lecture—"That Was 1992"—Moira McMillan, Paintmakers Association of Great Britain Ltd.

(Feb. 4)—"Squeezing Out the Solvent"—J. Bridle, of Cray Valley Products Ltd.

(Mar. 4)—"Rheology and Its Implications for the Coatings Industry"—M. Power, Carri-Med Ltd.

(Apr. 1)—"Recent Advances on the Issue of Chrome VI Replacement in Metal Pretreatment Processes"—J. Roberts, Henkel Metal Chemicals Ltd.

(May 6)—64th Annual General Meeting.

CDIC

(Dec. 14)—"Experimental High Solids Alkyds: Synthesis and Formulation for Industrial Coatings"—Clive Coady, of Amoco Chemical Co.

(Jan. 11)—"Fluorochemical Additives for Paint and Coatings"—Mike Killan, 3M.

(Feb. 8)—"ISO 9000"—David Dunn, Boehringer Mannheim.

(Mar. 8)—"Water-Based Polyurethanes"—Paul J. Hoffman, Miles, Inc.

(Apr. 12)—"Waterborne Resins"—Richard Johnson, Cargill, Inc.

(May 10)—Speaker to be announced, King Industries.

Chicago

(Jan. 4)—"Measurement of Color and Appearance"—Speaker to be announced, X-Rite, Inc.

(Feb. 1)—"New Development in VOC Compliant Coatings for Consumer Paints"—Richard Johnson, Cargill, Inc.

(Mar. 1)—"Expert Systems in the Chemical Industry and Their Ability to Improve Productivity for Sales, Production, and Lab Functions"—Harold Small, MTL Computer Systems, Inc.

(Apr. 5)—"Solvent Selection for Waterborne Industrial Coatings"—Ronald K. Litton, Eastman Chemical.

(Mar. 7)—Annual Awards Banquet.

Cleveland

(Jan. 26)—Joint Meeting with CPCA.

(Feb. 16)—Environmental Committee Symposium.

(Mar. 16)—"Formulating Color Without Heavy Metal Pigments"—Jim Delaney, CIBA-GEIGY.

(Apr. 20)—"Carbon Black Microdispersion—Effect on Jetness and Undertone in Coatings"—Jerry Rogers, Columbian Chemicals.

(May 18)—To be announced—Richard Ressmeyer, Intermuseum Conservatory.

Golden Gate

(Jan. 18)—"Natural and Accelerated Weathering Techniques"—Speaker to be announced, Atlas Electric Devices Co.

(Mar. 15)—"Silicones in the Coatings Industry: The Influence of Chemical Structure Upon Properties"—Edward Orr, Byk-Chemie.

(Apr. 19)—"The Foam Story"—Jay W. Adams, Tego Chemie.

(May 17)—"Statistical Design in High Solids Polyurethane Coatings"—Sherri L. Bassner, Air Products and Chemicals, Inc.

(June 14)—Manufacturing Committee Seminar.

Montreal

(Jan. 13)—"Coatings for Wood"—Dominic Janssens, Canadian Wood Council.

(Feb. 3)—Annual Symposium. "Waterborne Coatings/Low VOC."

(Mar. 3)—"Techniques for the Analysis and Identification of Coatings for Legal Purposes"—Speaker from the Royal Canadian Mounted Police, Forensic Labs.

(Apr. 7)—Technical Committee Presentation—Daniel Letourneau, Chateau Paints.

(May 5)— Past-Presidents' Night. Manufacturing Committee Presentation—Gerard Paradis, BASF Canada.

New England

(Jan. 21)—"Economic Update"—Art Werz, Eastman Chemical.

(Feb. 18)—"Dealing with Pollution Prevention Regulations in the Coatings Industry"—Robert B. Pojasek, GEI Consultants, Inc.

(Mar. 18)—"Meeting the Challenge of the Nineties with VOC Compliant Silicones"—Lee Hertz, Wacker Silicones.

(May 25-26)—Tech Expo '93.

New York

(Jan. 12)—"Opaque Polymers"—Elmer Williams, Rohm and Haas Co.

(Feb.)—Joint Legislative Update Meeting with MNYPCA.

(Mar.)—Mini Workshop. Waste Minimization, Plant Safety, Purchasing, Anatomy of a Paint, etc.

(Apr. 13)—"Modern Trends in Organic Pigment Technology"—Hugh M. Smith, of Sun Chemical.

(May 11)—PaVaC Meeting. To be announced—Frank Jones, Eastern Michigan University.

Northwestern

(Dec. 8)—"Alternatives to Dioctyl Phthalate"—Harold Haag, Aqualon Co. "Private Edens: The Best Gardens in Minnesota"—Diane Emerson, Minnesota Horticultural Society.

Philadelphia

(Dec. 10)—"Corrosion Improvement Factors for Direct-to-Metal and Primer Coatings"—Edward Orr, Byk Chemie.

(Jan. 20)—Joint Meeting with PPCA.

(Feb. 11)—"Adhesion to Weathered Chalky Surfaces"—Krishan Sehgal, Union Carbide.

(Apr. 16)—Awards Night Dinner Dance.

(Mar. 11)—"Filtering Those Difficult High Solids Paints"—Pete Scovic, Ronnigen Petter.

(May 13)—Manufacturing Committee Presentation. "ISO 9000"—Speaker to be announced.

Pittsburgh

(Jan. 11)—"Plant Hygiene, Challenge for the 90s"—William Machemer, Troy Chemical.

(Feb. 8)—"How Environmental Issues Impact the Coatings Industry"—Hugh M. Smith, Sun Chemical.

(Mar. 8)—"Theory and Application of Defoamers"—Alfred A. Lamy, Ultra Additives.

(Apr. 12)—Environmental Symposium.

Toronto

(Jan. 11)—"Solvent Selection for Waterborne Coatings"—Ron Litton, Eastman Chemicals.

(Feb. 8)—"The Future of Ontario's Economy"—Hon. Ed Philip, Minister of Industry.

(Mar. 8)—Annual Symposium.

Elections

CDIC

Active

Gill, Mark R.—PPG Industries, Inc., Delaware, OH.
Kronenberger, Thomas P.—General Polymers, Cincinnati, OH.
Norby, David B.—Ashland Chemical Co., Dublin, OH.
White, Matthew A.—Boehringer-Mannheim, Indianapolis, IN.

CHICAGO

Active

Ahmed, Maqsood S.—The Sherwin-Williams Co., Chicago, IL.
Albee, Carl A.—Halox Pigments, Hammond, IN.
Groce, Virginia C.—USG Corp., Libertyville, IL.
Heisner, Neil—Halox Pigments, Hammond.
Hite, Frederick P.—Standard T Chemical, Chicago Heights, IL.
Kuhnen, Rob H.—Tioxide America Inc., Lisle, IL.
McGill, George T.—INX International Ink Co., Elk Grove Village, IL.
Sapp, Mary Ann—Halox Pigments, Hammond.
Tortorello, Anthony J.—DSM Desotech Inc., Elgin, IL.
Waldmiller, Paul A. Jr.—Halox Pigments, Hammond.

Associate

Austin, Charles C. Jr.—PPG Industries, Inc., Gurnee, IL.
Decker, David J.—Georgia Marble Co., Conyers, GA.
Goodman, Alan J.—ANGUS Chemical Co., Northbrook, IL.
Henning, Jane S.—PPG Industries, Inc., Gurnee.
Killey, Edward J.—Weber Marking Systems, Arlington Heights, IL.
Lorenzi, Mark E.—Halox Pigments, Hammond, IN.
Lutz, Andrea M.—Texaco Chemical Co., Lisle, IL.
McGrenera, Richard A.—Megan Chemical Group, Elk Grove Village, IL.
Murphy, Thomas E.—EOG Environmental Inc., Westmont, IL.
Murrer, David G.—Rohm and Haas Co., Rosemont, IL.
Nicholas, Karl R.—PPG Industries, Inc., Gurnee.
Osborne, William G.—Cookson Pigments, Woodstock, IL.
Quan, James D.—C.J. Osborn, Arlington Heights.
Reynolds, Tracy A.—Ultra Additives Inc., Paterson, NJ.
Yahi, Rose E.—Ashland Chemical, Inc., Lemont, IL.

CLEVELAND

Active

Fitch, John J.—Avery Dennison Fasson Film Div., Painesville, OH.
Gausman, Joseph H.—Lord Corp., Erie, PA.
Hein, Richard W.—OMG, Inc., Cleveland, OH.
Nickelsen, Glen A.—Master Builders Inc., Berea, OH.
Smith, Paul A.—The Spray-Cure Co., Madison, OH.

Associate

Druffner, Ann M.—ANGUS Chemical Co., Cleveland, OH.

Educator/Student

Shen, Shyan B.—Case Western Reserve University, E. Cleveland, OH.
Sundarapandian, Senthil K.—Akron, OH.

Retired

Sandorf, Victor G.—S. Euclid, OH.

DETROIT

Active

Bieber, Madhu C.—Akzo Coatings Inc., Troy, MI.
Bilko, Jay J.—BASF Corp., Southfield, MI.
Blodick, James R.—United Paint & Chemical Corp., Southfield.
Gott, Barry B.—Toledo Paint & Chemical, Toledo, OH.
Hart, Robert—BASF Corp., Sterling Heights, MI.
Mueller, Thomas P.—BASF Corp., Southfield.
Panek, Kathleen M.—Red Spot Westland Inc., Westland, MI.
Sample, Kirk M.—Akzo Coatings, Inc., Troy.
Weed, Robert D.—United Paint & Chemical, Southfield.

Associate

King, Nobal E.—Aqualon Co., Lisle, IL.
Welka, Jay T.—The R.J. Marshall Co., Southfield, MI.

KANSAS CITY

Active

Flanders, Lynn—Kansas Correctional Industries, Lansing, KS.
Freeman, Hylen K.—Tnemec Co., Inc., Kansas City, MO.
Montgomery, Ennis L.—Davis Paint Co., N. Kansas City, MO.
Ward, Michael E.—Davis Paint Co., N. Kansas City.

LOS ANGELES

Active

Alkhas, Sargon A.—Old Quaker Paint Co., Carson, CA.
Bonnema, Thomas B.—BASF Corp., Anaheim, CA.
Chen, Andrew—Deft Inc., Irvine, CA.
Current, Alan B.—Lilly Industries, Montebello, CA.
DeSilva, Dodwell—Aerojet Ordnance Div., Downey, CA.
Dhaliwal, Pritam—Armor All Products Corp., Aliso Viejo, CA.
Duran, Raymond—Mar-lak Products Co., Hawaiian Gardens, CA.
Ebrahim, Yousry—Akzo Coatings Inc., Orange, CA.
Gamble, Daniel R.—Lilly Industries, Montebello.
Groves, Norman—Akzo Coatings Inc., Orange.
Guerra, John A.—Decratrend Corp., Industry, CA.
Gilmartin, Platt Jay—Ashland Chemical, Inc., Santa Fe Springs, CA.
Holzrichter, Geoffrey R.—Lilly Industries, Montebello.
Khalil, Emil—Guardsman Products, Inc., South Gate, CA.
Long, John H.—Smiland Paint Co., Los Angeles, CA.
Mansueto, Leo C.—The Valspar Corp., Azusa, CA.
Osen, Lambert—Fine Line Paint Corp., Santa Fe Springs.
Schule, Martin—Akzo Coatings, Inc., Orange.
Vanderhoek, Robert F.—Guardsman Products, Inc., South Gate.
Wilkinson, Jonathan—Kelly-Moore Paint Co., San Bernardino, CA.

Associate

Champagne, Judith D.—Texaco Chemical Co., Tustin, CA.
Clover, James D.—SCM Chemicals, Inc., Santa Fe Springs, CA.
Dochety, Paul E.—Eastman Chemical Products, Inc., Santa Fe Springs.
Doherty, Kimberly K.—Environmental Science & Engineering, Inc., Fountain Valley, CA.
Formella, Michael W.—The CP Hall Co., Torrance, CA.
Garcia, Eya D.—AQC Environmental Engineering Inc., Diamond Bar, CA.
Guild, Howard—Dowd & Guild, Inc., San Ramon, CA.
Guntner, Steven W.—Hockmeyer Equipment, Claremont, CA.
Hudnall, J. Scott—PPG Industries, Inc., Mission Viejo, CA.
Hughes, R. Steve—Hitox Corp., Corpus Christi, TX.
Ketchner, Michael S.—Classic Coatings, Prescott, AZ.
McDaniel, Joe—Synergistic Performance Corp., Fullerton, CA.
Melton, Douglas—Morehouse Industries, Fullerton.
Miles, Bruce S.—Norman International, Los Angeles, CA.
Queja, Cora B.—Precision Labs, Orange, CA.
Pasternak, Jim R.—TCR Industries, Inc., La Palma, CA.
Shefa, Virginia L.—Design for Health, San Diego, CA.
Scherrer, R.D.—Soco-Lynch, Los Angeles.
Szadolci, James—Vivion Chemical Co., Inc., Vernon, CA.
Tangen, Danny L.—Synergistic Performance Corp., Fullerton.

Toomey, Robert—Stay & Day, a Division of Dowd & Guild, Inc., Los Angeles.
Witt, Monica E.—SCM Chemicals, Inc., Santa Fe Springs.

NEW YORK

Active

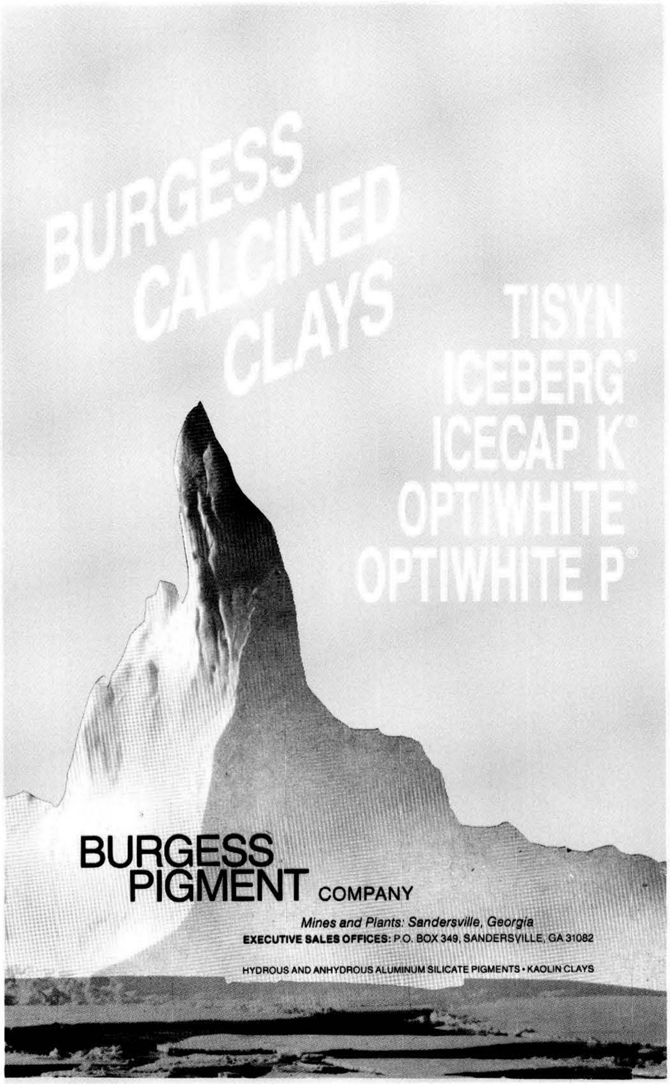
Baird, Edward L.—Verona, NJ.
Grobstein, Cary—Cardinal Color & Chemical Inc., Paterson, NJ.
Mehta, Ashok K.—M. Grumbacher, Inc., Cranbury, NJ.
Papson, Edward T.—Ashland Chemical, Inc., Boonton, NJ.
Raymond, Rita—International Paint Co., Inc., Union, NJ.

Associate

Brown, Charles A.—Jamesburg, NJ.
Calicchio, Michael A.—SCM Americas, Millburn, NJ.
Harradine, Alfred J.—Texaco , Athens, NY.
Kaye, Joseph—Antistatic Industry, Hackensack, NJ.
Michalski, Joseph C.—United Color Tech, Freehold, NJ.
Savage, Timothy M.—Troy Corp., E. Hanover, NJ.
Shawhan, Garrett J.—Enthone-OMI, W. Haven, CT.
Stimpfle, Richard X.—C.P. Hall Co., Glenwood, NJ.

Retired

Friedman, Charles—Westfield, NJ.
Platt, David—Edison, NJ.



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NORTHWESTERN

Active

Hage, Martin L.—Cargill, Inc., Minneapolis, MN.
Rath, Maureen L.—Cargill Resin Products, Minneapolis.
Wolters, Mark A.—Cargill, Inc., Minneapolis.

Associate

Laine, Terry A.—Witco Corp., Apple Valley, MN.
Schwich, James T.—Henkel Corp., Grayslake, IL.

PHILADELPHIA

Active

Connaughton, James T.—Rohm and Haas Co., Spring House, PA.
Leman, Arthur A.—Rohm and Haas Co., Spring House.
McLinden, John—Thoro System Product, Toms River, NJ.
Navarro, Mario—Pyro-Tech Industries, Hatfield, PA.
Thomas, Santosusso M.—Air Products & Chemicals, Allentown, PA.

Associate

Devido, John P.—Aqualon Company, Wilmington, DE.
Ickowicz, Charles—Rhone-Poulenc, Inc., Cranbury, NJ.
McCormick, Chris C.—CIBA-GEIGY Corp., Newport, DE.
Smith, Craig—Hüls America, Inc., Piscataway, NJ.

TORONTO

Active

Gogna, Rikki—Schenectady Chemical Canada Ltd., Scarborough, Ont.
Landsborough, Bill J.—Eagle Dominion Inc., Acton, Ont.
Morton, Theodore J.—John E. Goudey Manufacturing, Toronto, Ont.
Pugi, Andres M.—Dow Chemical, Etobicoke, Ont.
Vu, Long T.—PPG Canada Inc., Toronto.

Associate

Birkbeck, Peter S.—Westroc Industries Ltd., Mississauga, Ont.
Flynn, Anthony M.—Sunchem Div., Sunoco, N. York, Ont.

People

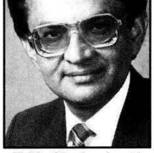
George R. Davis has joined the staff of the Instrument Society of America, Research Triangle Park, NC, as Editorial Director of Journals Publications Services. In this capacity, Mr. Davis will emphasize the new opportunities and challenges created by increased computerization in the manufacturing process.

Sanncor Industries, Inc., Leominster, MA, has announced the promotion of **Jeffrey Blaisdell** to the position of Assistant Director of Research and Development. He brings over 13 years of industrial urethane experience in both research and manufacturing to this position.

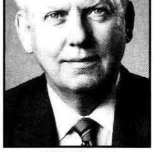
Semi-Bulk Systems, Inc., St. Louis, MO, has promoted **Charles S. Alack** to the position of President and Chief Operating Officer. Mr. Alack will be directly responsible for marketing, manufacturing, and engineering operations in the United States and Canada. Prior to this appointment he served as Executive Vice President.

In addition, the company has also advanced **Leigh A. Rubbright** to the position of Manager/Finance and Administration. Ms. Rubbright will be in charge of internal data management, sales and purchasing documentation, internal business reports, and all office support functions.

Paritosh M. Chakrabarti has been elected Vice President/Science and Technology of PPG Industries, Pittsburgh, PA. He succeeds **Joseph E. Rowe**, Vice President and Chief Scientist, who retired on September 1. In his new position, Dr. Chakrabarti will oversee the company's technical and information systems operations, will establish priorities and resource commitment for operating-group research and development portfolios, and will coordinate and provide functional direction for group R&D and engineering departments. He has been with PPG since 1982.



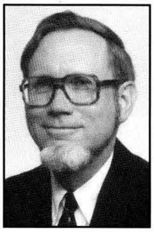
P.M. Chakrabarti



J.E. Rowe

Clifford K. Schoff Receives ASTM's Award of Merit

The American Society for Testing and Materials (ASTM) has awarded **Clifford K. Schoff**, of PPG Industries, Inc., the organization's Award of Merit and named him a 1992 Fellow of ASTM.



The Award of Merit and the accompanying honorary title of Fellow of the Society were established in 1949 by the ASTM Board of Directors to recognize distinguished service by individual members.

Dr. Schoff received the award for outstanding service to ASTM, in particular to Committee D-1. He is also a member of numerous subcommittees and task group; the principal coordinator of a number of ASTM standards; and the author or co-author, coeditor, advisor, and consultant of technical publications.

In 1987 he was a recipient of Committee D-1's W.R. Pearce Award, which recognizes a technical paper of merit related to the science of testing paints and related materials.

Dr. Schoff is a graduate of the University of Idaho and the University of St. Andrews and has B.S., M.S., and Ph.D. degrees in chemistry and polymer chemistry.

Active in the Federation, Dr. Schoff is a member of the Mattiello Memorial Lecture and Roon Awards Committees, and is a member of the Pittsburgh Society for Coatings Technology. He is also a member of the American Chemical Society, the North American Thermal Analysis Society, the Society of Automotive Engineers, and the Society of Rheology.

J.H. Shubrook has been appointed Industrial Maintenance Marketing Manager for the Sherwin-Williams Stores Group, Cleveland, OH. Mr. Shubrook's primary responsibilities will be identifying focus markets, and developing and implementing sales and marketing strategies. He brings extensive engineering and operations experience in heavy industrial maintenance, petrochemical, rail car finishing, and marine coatings to this position.

The position of Director of Marketing and New Product Development for Convenience Products, Fenton, MO, has been accepted by **Dale Hugo**. Prior to joining Convenience, Mr. Hugo had held marketing positions with several leading consumer product companies in the hardware/home center industry.

The promotion of **Barbara L. Paulger** to Manager/Marketing Services for Liquid Carbonic Industries Corporation, Chicago, IL, has been announced. She has been with the company since 1970.

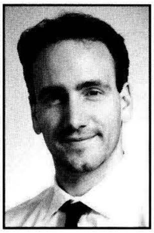
Also, **Bob Lottes** has joined the staff of Liquid Carbonic Industrial/Medical Corporation as National Production Manager.

Henry Berger has accepted the position of Technology Director/Electronic Gases for the BOC Group of Airco Gases, Murray Hill, NJ. He will be based at MCNC's Center for Microelectronics in Research Triangle Park, NC.

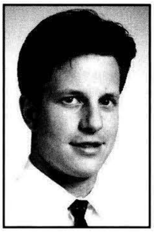
Arco Chemical Company, Newtown Square, PA, has announced that **Marvin O. Schlanger** has been appointed President of Arco Chemical Americas Company, a division of Arco Chemical. Mr. Schlanger will replace **John G. Johnson, Jr.**, who has been Senior Vice President and President of Arco Chemical Americas since 1988. Mr. Johnson has resigned as a Director and will be leaving the company at the end of 1992.

In other company moves, **Walter J. Tusinski** has been named Senior Vice President and Chief Financial Officer, Arco Chemical Co. He has been with the company for 21 years.

Peter C. Harris has become President, Arco Chemical Asia Pacific, Ltd., (ACAP) succeeding **Donald W. Wood** who retired after a 15-year career with the company. Mr. Harris, who previously served as Senior Vice President of ACAP, will continue to work out of regional headquarters in Hong Kong.



W. Chelak



J. Gacek

Buckman Laboratories, Inc., Memphis, TN, has added two new area representatives to their Coatings & Plastics Division.

William Chelak, who will be based in Philadelphia, PA, will cover the northeastern region. Mr. Chelak was previously employed by the Polyurethane Division of ICI. **James Gacek**, located in Chicago, IL, will service the northern region for the company. Prior to joining Buckman, Mr. Gacek marketed a line of fumed silicas and specialty carbon blacks for Degussa.

William R. Toller, Chairman and Chief Executive Officer of Witco Corporation, New York, NY, has announced the realigning of the company's senior management structure and the establishment of an Office of the Chairman. In addition to the Chairman himself, the office would comprise of the company's three other newly established senior positions. Reporting to Mr. Toller will be: **Denis Andreuzzi**—Vice Chairman and Chief Operating Officer/Petroleum; **William E. Mahoney**—Vice Chairman and Chief Operating Officer/Chemicals; and **Michael D. Fullwood**—Executive Vice President and Chief Financial Officer.

In addition, Witco has appointed **C.W. Kimbrell**, Director of Chemical Purchases. Based at company headquarters in New York City, Mr. Kimbrell is a Witco veteran of 27 years.

Also, **Donald Bachrach** has been named Manager of Field Services and Administration in the company's purchasing department. In addition to being responsible for the purchases of fats and oils, all regional purchasing offices will report to Mr. Bachrach. He has been with the company for 37 years.

John M. Gilbert has been promoted to Product Manager/Chemicals, USI Division, Quantum Chemical Corporation, Cincinnati, OH. In this capacity, Mr. Gilbert will be responsible for the day-to-day product management activities of ethyl alcohol, ethyl ether, acetic acid, vinyl acetate monomer, methanol, ethylene glycol, and ethylene oxide. He previously served as a Technical Sales Representative operating out of the company's Chicago sales office.

The Kelco Division of Merck & Company, Inc., San Diego, CA, has announced the promotion of **Norman O. Jangaard** as Vice President of Research & Development. In this position, Dr. Jangaard will oversee the development of new products and technology, technical service, quality assurance, process development, and information and technical services. Prior to this position, Dr. Jangaard was President and Chief Executive Officer of Coors Biotech.

Air Products and Chemicals, Inc., Allentown, PA, has named **Clifford A. Bridges** General Manager of the firm's Industrial Chemicals Division. In this capacity, Mr. Bridges will direct the Air Products' existing methyl and higher amines, polyamines, ammonia, converted products, methanol, and acetic acid businesses. He most recently served as Business Area Manager/Polyvinyl Alcohol.

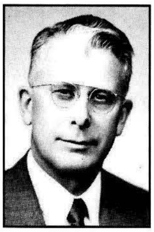
Also, **William J. Cantwell** has been appointed General Manager of the company's Polymer Chemicals Division. Mr. Cantwell will be in charge of overseeing all of Air Products' commercial and technical operations. Since 1979, he has held various sales and marketing positions within the division, most recently as Assistant General Manager.

Obituary

Amos T. Montanye, Federation Past-President (1949-50), Dies at Age 94

Amos T. Montanye, Federation Past-President (1949-50), died September 13. He was 94 years old.

Mr. Montanye was born in Philadelphia, PA, in 1898 and attended Bryn Athyn Academy, Bradley Polytechnic Institute, and the University of Illinois before starting his career in the paint industry with the Morgan Company of Peoria, IL in 1922. He was employed at the Chicago Laboratories of E.I. du Pont de Nemours & Company from 1925 until 1928 when he became associated with the Pratt & Lambert Company, Buffalo, NY.



Mr. Montanye served as Federation Treasurer in 1947 and 1948, President-Elect in 1949, and President 1949-50. He was a member of the Executive Committee in 1942 and served as Chairman of the first Paint Industries' Show in 1946. Mr. Montanye is a Past President and Honorary Member of the Western New York Society and held membership in the Society of Gallows Birds.

He is survived by a son and daughter-in-law, Mr. and Mrs. Frederick W. Montanye.

James A. Downs, Chemist, Spartan Color Corporation, Houston, TX, died August 21. He was 67 years old.

Born in Detroit, MI, Mr. Downs was a chemist for Spartan for 14 years. Prior to that, he was employed by Steelcote Manufacturing Co., St. Louis, MO, and Reliance Universal, in Houston.

A member of the Houston Society, Mr. Downs is survived by his wife, Sandra; a son, James; and two daughters, Jan and Kim.

John P. "Jack" McNally, of McNally & Webber Company, died recently.

Mr. McNally, often referred to as "Gentleman Jack," was a life-long resident of the Cleveland area and attended Case Western Reserve University. He served in World War II, where he received a Bronze Star, among other medals, for his service.

Mr. McNally was a member of the Cleveland Society for Coatings Technology and served as Treasurer of the Cleveland Paint & Coatings Association from 1964-68.

He is survived by a son, Thomas; and three daughters, Margaret R. Gallagher, Mary Bridget Vaughn, and Catherine Szilagyi.

Thomas J. Moulson, of RUCO Polymer Corporation, Hicksville, NY, died August 24.

Dr. Moulson was born in Pawtucket, RI, and received the Ph.D. in Chemistry from Brown University in 1967. He joined RUCO in 1982.

Survivors include his wife, Tina; a son, Matthew; and a daughter, Amanda.

FATIPEC to Hold XXIInd Congress in Budapest, June 5-9, 1994

The Lacquer-Paint Section of the Hungarian Chemists' Association (MKE), a member of FATIPEC, has announced that the XXIInd FATIPEC Congress and Exhibition will be held at the Budapest Convention Centre from June 5-9, 1994.

The Congress will be held in conjunction with World'Coat 94, an international exhibition of raw materials, machines, equipment, instruments, and services of the paint industry, which will also be held at the Budapest Congress Centre.

The theme of the Congress is "Development of the Lacquer and Paint Industry in the Light of Science and Technology." This theme was selected to interest specialists and to give rise to discussion papers by those who have achieved new results either in the paint industry or in the development of scientific bases for the paint industry.

Congress programming will include plenary and section lectures. Plenary lectures will be presented by each FATIPEC member country and by representatives of the invited guest associations [Oil & Colour Chemists' Association (OCCA), Skandinaviska Lackteknikers Forbund (SLF), Federation of Societies for Coatings Technology (FSCT), and Japan Society of Colour Material (JSCM)].

Those interested in submitting papers for the section lectures should submit author's name and title of paper by February 28, 1993. The abstract of the paper is due on June 30, 1992, with the full text of the paper to be submitted by January 31, 1994. Acceptance of submitted papers will be decided by the Scientific Committee.

Lectures may be presented in German, English, or French. Simultaneous translation will be provided in all chambers of the Congress.

Compliance Is Theme of Piedmont Society Symposium and Show

The Piedmont Society for Coatings Technology has scheduled a Mini Technical and Exhibition Show for Wednesday, March 10, at the Holiday Inn-Market Square, High Point, NC.

The topic for the technical sessions is "Compliance, Plain and Simple." The Show is designed to provide a forum for those in the wood, printing ink, plastic, rubber and vinyl sheeting industries. This is an opportunity for companies to display their products to the key formulators, production, and purchasing personnel of some of the national, regional, and local manufacturers in the area.

For additional information, please contact Sara Robinson, HeucoTech Ltd., 10417 Rocking Chair Rd., Matthews, NC, (704) 846-5674.

Short Course on Compliance with Air Quality Regulations Offered by UC Berkeley Extension in New Orleans

Information about the most important consequences of the Clean Air Act and state and local regulations for paints, coatings, and printing facilities will be presented in a three-and-one-half-day course offered this winter. "Getting into Compliance with Air Quality Regulations for Paints, Coatings, and Printing Facilities," will meet January 12-15 in New Orleans, LA, at the University of New Orleans Metropolitan College.

The course is sponsored by Continuing Education in Engineering, University Extension, University of California, Berkeley.

The course is designed to benefit environmental engineers and coordinators, EPA engineers and inspectors, paints and coatings salespersons; and manufacturing, industrial, quality control, and maintenance engineers who are responsible for bringing paints and coatings facilities into compliance with state and local air pollution regulations.

Instructing the course will be Ron Joseph, principal at Ron Joseph & Associates, a coatings consulting firm in Saratoga, CA.

The course will include special sessions on the EPA's progress on permitting rules and CTGs. Participants are encouraged to bring their compliance problems.

Fee is $895; enrollment is limited and advance enrollment is required.

For additional information, contact Alice Boatwright, Continuing Education in Engineering, University Extension, University of California, 2223 Fulton St., Berkeley, CA 94720.

Houston Society for Coatings Technology

50th Anniversary Celebration

University Club in Houston, TX
February 6, 1993

For more information, contact Willy C.P. Busch, Chairman, (713) 453-6806; Julue Duplechian, Co-Chairman (713) 681-4891; or Art McDermott, Co-Chairman (713) 491-3244.

Dallas Society for Coatings Technology to Host 50th Southwestern Paint Convention, Mar. 17-19

Plans are underway for the 50th Southwestern Paint Convention, sponsored by the Dallas and Houston Societies for Coatings Technology, to be held on March 17-19, at the Four Seasons Resort and Club in Las Colinas (Irving), TX. Hosted by the Dallas Society, the event will focus on the theme, "Back to the Future."

Keynote speaker will be Russ Wylie, Director of External Affairs for the Super Conducting Super Collider. His address will be given on Thursday morning, March 18. Dallas Mayor Steve Bartlett will be the banquet speaker for the Award Luncheon on Friday, March 19.

Table top exhibits will be hosted by the many attending distributors and manufacturers. This will be held concurrently and following technical presentations.

Additional activities include a golf outing planned for Wednesday, March 17 at the Tournament Players Course, host of the annual GTE Byron Nelson Classic, and a Supplier's Reception, to be held that evening, with a St. Patrick's Day theme. A dinner dance will be held on Thursday, March 18.

Designed to be informative in a relaxed atmosphere, the convention format is casual, and no suits or ties are required.

For additional details, contact Steve Stephens, Ribeline Sales, Inc., P.O. Box 461673, Garland, TX 75046-1673.

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Western Coatings Societies' 21st Biennial Symposium and Show

Disneyland Hotel & Convention Center
Anaheim, California
March 23 • 24 • 25, 1993

"Visions—Opportunities—Challenges"

For exhibit information, contact William Zimmerman or Robert Garcia at (213) 888-8888, ext. 294

For registration information, contact James Hall at (213) 888-8888, ext. 391.

For general information, contact Don Jordan at (310) 884-5532 or Sandra Dickinson at (714) 441-1141.

MNPCA and New York Society to Sponsor Joint Legislative Update and Exposition

The Metropolitan New York Paint and Coatings Association and the New York Society for Coatings Technology will conduct their annual joint meeting on Thursday, February 4, 1993 at the Landmark II, Route 17 South, East Rutherford, NJ. This meeting will focus on regulatory and legislative matters that affect the coatings industry.

A limited number of spaces will be available for companies interested in exhibiting services connected with regulatory/environmental matters to the paint and coatings industry such as consultants, engineers, software manufacturers, and other related services.

For more information, contact Sidney J. Rubin, Meeting Chairman, Empire State Varnish Co., Inc., 38 Varick St., Brooklyn, NY 11222, or the Metropolitan New York Association/New York Society office, 520 Westfield Ave., Suite 208, Elizabeth, NJ 07208.

St. Louis Society Announces Awards Scholarships

The St. Louis Society for Coatings Technology has announced the recipients of its Harry A. Baumstark Memorial Scholarship Award. Winners are: Sally Byron, Senior Lab Technician, of Carboline Company; Robert A. Harrington, Jr., Senior Lab Technician, of Akzo Resins; and Ellen Murphy, Office Manager and Customer Service Manager, of Walsh and Associates.

The winners of the award will attend one of the following coatings short courses at the University of Missouri-Rolla:

"Basic Composition of Coatings"—March 8-12, "Introduction to Paint Formulation"—March 25-29; and "Introduction to Paint Formulation"—May 17-21.

New Color Matching Seminar Offered by HunterLab; Winter Workshop Schedule Announced

HunterLab, Reston, VA, has introduced a new color matching seminar to its schedule of training programs. Each seminar is designed to train both novice and professional colorists in practical color theory for computer color matching and applications. Participants will learn how to create and maintain a color program in order to maximize production efficiency, as well as explore and determine solutions to individual color matching needs.

Each one and one-half day color matching seminar is $395. The dates and locations are:

January 27-28—Dallas, TX;
April 21-22—Cincinnati, OH; and
June 9-10, Los Angeles, CA.

In addition, HunterLab has scheduled its color theory seminars and workshops to be held in major cities across the U.S. Topics to be covered include color scales, tolerance setting, instrument geometries, and measurement techniques. Tuition is $395.

Seminar dates and locations include:
January 27-28—Dallas, TX;
February 3-4—Philadelphia, PA; and
February 24-25—Atlanta, GA

To register or obtain additional information, contact the Seminar Coordinator, Joan Dorsch, at HunterLab, Inc., 11491 Sunset Hills Rd., Reston, VA 22090.

Solution to October's *"CrossLinks"*

Literature

Membrane Separator

A membrane separator used in the filtration of paint wash water is the focus of a product release. The system was developed to allow a paint manufacturer to take wash water, remove the water for reuse, and ship the fully concentrated paint as product. For more in-depth details on V-SEP (vibratory shear enhanced process) membrane separator, write New Logic International, 1155 Park Ave., Emeryville, CA 94608-3631.

Fungicide/Mildewcide

A product bulletin highlighting a fungicide/mildewcide product for use primarily in alkyd paint and solventborne stains has been released. It may also be used in latex paint applications. For more technical information on Troysan® Polyphase® P-2OT, contact Troy Corp., P.O. Box 366, East Hanover, NJ 07936-0366.

Polyurethane Coating

A high-solids, aromatic, moisture-cure, single-pack polyurethane coating is the focus of a four-page bulletin. The coating is an oil-free urethane designed for interior applications. For additional information on CHEMGLAZE® Z1015 coating, write Lord Corp., Industrial Coatings, 2000 W. Grandview Blvd., P.O. Box 10038, Erie, PA 16514-0038.

Liquid Filters

A brochure highlighting how liquid filters are designed to help solve waste minimization problems has been issued. System design details and cost figures are also included. For a free copy of "A Guide to Minimizing Waste with Clean-in-Place Liquid Filters," write Ronningen-Petter, 9151 Shaver Rd., P.O. Box 188, Portage, MI 49081-0188.

Aqueous Acrylic

A new high pigmentation, low VOC, water-based black acrylic dispersion has been introduced through a product release. The acrylic contains 42% pigment, with 52% total solids content, and low (less than 1% by weight) content of volatile organic components. Samples of BS 15440 are available upon request from CDI Dispersions, 27 Haynes Ave., Newark, NJ 07114.

Thermal Spray System

A thermal spray system designed to maintain the temperature of most coating materials 30 to 40°F above ambient temperature within the triaxial delivery hose has been introduced through a data sheet. The system can be used with a pump, pressure tank, or pressure cup as well as virtually any air atomizing spray gun. More information is available from Binks Manufacturing Co., 9201 W. Belmont Ave., Franklin Park, IL 60521-2887.

Tracer Dyes

A technical bulletin highlights two new tracer dyes used for product identification and lead detection. The oil tracer is a slightly yellow aromatic dye solution which can be applied in inks for product identification or mineral oils/solvents for lead detection. The second is a water soluble colorless powder fluorescing intensely bluish-white and is recommended for aqueous inks, coatings, adhesives, etc. Contact Day-Glow Color Corp., 4515 St. Clair Ave., Cleveland, OH 44103, for technical details on TRY-33 Tracer Yellow and D-282 UV-Blue.

Silicon Compounds

A comprehensive compilation of silanes and silicones for chemists is presented in a catalog. In addition to a product cross-listing, an empirical formulation index, and a section on silicones and silicon-containing polymers, the publication features other relevant product information and technical articles. Contact Hüls America, Inc., Silicon Compounds Dept., 80 Centennial Ave., P.O. Box 456, Piscataway, NJ 08855-0456, for a free copy of "Silicon Compounds Register and Review."

Vinyl-Acetate Ethylene Emulsion

A new six-page brochure describing a vinyl-acetate ethylene emulsion for building product applications has been printed.The publication includes six tables that provide starting point formulations for caulking and spackling compounds, and acrylic extenders using the emulsion. For a copy of the publication, "Airflex® 532BP Emulsion for Building Products," contact Air Products and Chemicals, Inc., Polymer Chemicals Div., 7201 Hamilton Blvd., Allentown, PA 18195-1501.

Calcium Carbonates

The introduction of two coated natural calcium carbonates has been made through literature. One is an ultrafine ground coated calcium carbonate with a mean particle size of 1.0 μm, and the other is a coated fine ground calcium carbonate with a mean particle size of 3.0 μm. For further details on Supercoat® and Kotamite®, write ECC International, Inc., 5775 Peachtree-Dunwoody Rd., N.E., Ste. 200 G, Atlanta, GA 30342.

Low Volume Injector

A four-page brochure highlighting a low volume injector has been printed. The instrument reportedly combines low volume direct injection with the ability to connect to a purge and trap transfer line. To receive the two-color publication on the low volume injector, contact J&W Scientific, 92 Blue Ravine Rd., Folsom, CA 95630.

Quality

A eight-page, full-color bulletin focusing on a company's quality assurance programs, its use of SPC methods, and its commitment to ISO 9000 standards and Malcolm Baldridge quality criteria has been released. The fully illustrated brochure also discusses the company's "quality in action" approach to problem solving. Write to Betz Laboratories, Inc., 4636 Somerton Rd., Trevose, PA 19053 for a copy of Bulletin C12.

CLASSIFIED ADVERTISING

Technology Transfer and Mexican Marketing Opportunity

Mexican paint and coating company is looking for medium-sized U.S. company interested in transferring state-of-the-art industrial coating technologies and possible distribution relationship in Mexico. Mexican company is modern, well-financed, and offers good entrance into Mexico's expanding paint and coatings market. For more information, please contact: Andrea Migdal, Gray, Cary, Ames & Frye, at: Phone—(619) 699-3590; FAX—(619) 699-1048.

Daylight Lamp

A data sheet on a daylight lamp for color comparison of paints, inks, dyes, photo finishing, fabrics, etc. has been issued. The lamp has a 10" x 10" viewing area that blocks out overhead lights, and, weighing only 25 pounds, is compact and portable. For more information on the ColorView™ daylight lamp, write Paul N. Gardner, Jr., Paul N. Gardner Co., Inc., P.O. Box 10688, Pompano Beach, FL 33061-6688.

Rheometer

A data sheet highlights a rheometer developed for curing analysis and high viscosity measurements for determining elastic properties as well as gel points of a wide variety of materials. Special features include a wider torque range (10 -3 to 50 mNm) and higher speed capability (300 rad/sec). Further details on the Bohlin CS 50 can be obtained by contacting Laura A. Migliore, Bohlin Instruments, Inc., 2540 Rte. 130, Ste. 113, Cranbury, NJ 08512.

Titanium Dioxide

A two-color, six-page technical bulletin with descriptions of a company's line of titanium dioxide pigments has been released. Tables featuring general coatings applications, physical properties, and optical properties are included. For a copy of "Coatings Grades: Titanium Dioxide Pigments," contact KRONOS, Inc., P.O. Box 60087, 3000 N. Sam Houston Pkwy. E., Houston, TX 77205.

Emulsion Polymers

A product sheet introducing a line of high performance emulsion polymers designed to help meet the trend to VOC compliant coatings for concrete has been issued. These products reportedly exhibit high gloss, superior clarity, and waterblush resistance. For more in-depth details on the NACRYLIC™ line of emulsion polymers, write National Starch and Chemical Co., Resins and Specialty Chemicals Div., 10 Finderne Ave., Bridgewater, NJ 08807.

Corrugated Container System

A new recyclable corrugated container system for the transportation and storage of liquid products such as chemicals, food additives, and flowable nonhazardous wastes is the subject of a data sheet. The system is available in 220, 250, 275, and 330 gallon sizes. Contact Georgia-Pacific Corp., Dept. MAX, 133 Peachtree St., N.E., Atlanta, GA 30303, for more information on the FlowMax™ corrugated container system.

FT-IR Microscopes

A line of FT-IR microscopes developed to allow chemists and other scientists to choose the level of sampling flexibility they need for their laboratories has been introduced through literature. The microscope accommodates a large variety of sample types and sizes. For product specifications on the line of IR-Plan® microscopes, contact Michele Siegelin, Spectra-Tech Inc., 652 Glenbrook Rd., P.O. Box 2190-G,. Stamford, CT 06906.

Additive

An additive whose primary use is as a Class II brightener for the electroplating of bright nickel has been introduced through a data sheet. Other applications for the additive include: as a copper metal corrosion inhibitor in activation processes; a steel pickling bath additive designed to protect steel prior to electroplating; and a general corrosion inhibitor designed to protect base metal from acidic attack while removing scale. Write BASF Corp., Performance Chemicals, 119-2 Cherry Hill Rd., Parsippany, NJ 07054 for more in-depth information on Golpanol® BEO additive.

Epoxy Coating

A two-page bulletin detailing a trowelable epoxy coating used to protect concrete, steel, or wood has been published. Data provided in the publication include abrasion resistance, compressive and flexural strength, and service temperatures as well as installation instructions. For a free brochure on PhillyClad 5020AR acid-resistant floor coating and resurfacer, contact Beth Hibbs, ITW Philadelphia Resins, Box 309P, 130 Commerce Dr., Montgomeryville, PA 18936.

Foam Control Agent

A foam control agent for high-gloss latex coatings is the focus of a product release. The agent is a 100% active compound based on a proprietary blend that contains an organically modified silicone copolymer. More information on Foam Control Agent 78 is obtainable from Union Carbide Organo-Silicon Products, Systems and Services, Dept. H2375, 39 Old Ridgebury Rd., Danbury, CT 06817-0001.

Rust-Inhibitive Coating

A VOC-complying, one-coat, rust-inhibitive coating for ceilings and other overhead interior expanses is the subject of a data sheet. The coating is designed for interior applications where corrosion-resistance, light reflectance, and low VOCs are important. Further information on Opti-Bond® Multi-Surface Coating (SWS-3750) can be obtained by writing The Sherwin-Williams Co., c/o HKM Direct, 5501 Cass Ave., Cleveland, OH 44102.

Catalyst Cleaning Service

Technical literature is obtainable on a catalyst cleaning service which reportedly can increase activity levels of deactivated VOC and CO abatement catalysts in chemical, industrial, and commercial processes and power generation applications. The regeneration service uses proprietary chemical cleaning procedures to eliminate non-combusted solids and other contaminants that gradually accumulate on the catalysts surface and prevent reaction with VOC and CO emissions. For further details on CatKleen™ catalyst cleaning service, write Engelhard Corp., Environmental Catalysts Group, 101 Wood Ave., Iselin, NJ 08830-0770.

Books in Print . . .

Liquid Crystalline Polymers, 230 pp. List price: $85.00. ChemTec Publishing, 38 Earswick Dr., Toronto-Scarborough, Ontario M1E 1C6, Canada.

Thin Layer Chromatography—An Introduction. List price: $21.00. Dr. Keith Palmer, EM Science, a Division of EM Industries, Inc., 480 Democrat Rd., P.O. Box 70, Gibbstown, NJ 08027-0070.

The RCRA Land Disposal Restrictions: A Guide to Compliance, 1992 Edition, 310 pp. List price: $70.00. McCoy and Associates, Inc., 13701 W. Jewell Ave., Ste. 202, Lakewood, CO 80228.

Recycling of Plastic Materials, 184 pp. List price: $85.00. ChemTec Publishing, 38 Earswick Dr., Toronto-Scarborough, Ontario M1E 1C6, Canada.

The U.S. Market for Additives for the Paint & Coatings Industry, 259 pp. List price: $2,900. Frost & Sullivan, Inc., Attn: Dept. RE 838 P, 106 Fulton St., New York, NY 10038.

Polymer Latexes: Preparation, Characterization, and Applications, 444 pp. List price: $99.95. American Chemical Society, 1155 Sixteenth St., N.W., Washington, D.C. 20036.

Calorimeter

The introduction of a quench cool differential scanning calorimeter has been made through literature. The instrument is designed to automatically perform controlled heating, controlled cooling, and quench cooling operations over a wide dynamic temperature range, from -150 to 725°C. Technical information on the DSC-60Q calorimeter can be obtained by contacting Shimadzu Scientific Instruments, Inc., 7102 Riverwood Dr., Columbia, MD 21046.

Electron Microscopy

A reprint discussing how cryopreparation stabilizes low melting-point materials, minimizes volume changes, and reveals internal structure by freeze-fracture has been made available. For a free copy of the reprint, "Low-Temperature Scanning Electron Microscopy: Advantages and Applications," by J.A. Sargent of Oxford Instruments, write Carl Zeiss, Inc., Electron Optics Div., One Zeiss Dr., Thornwood, NY 10594.

Polypropylene Bag Filter Housing

Product information has been released on a new polypropylene bag filter housing developed for a broad range of corrosive liquid filtration. The bag is available in two sizes and includes a one-piece polypropylene restrainer basket, as well as a splash shield. Write Greg Amentini, Filter Specialists, Inc., 100 Anchor Rd., Michigan City, IN 46360, for more details on Models No. PPV-11 and PPV-12.

Resin Guide

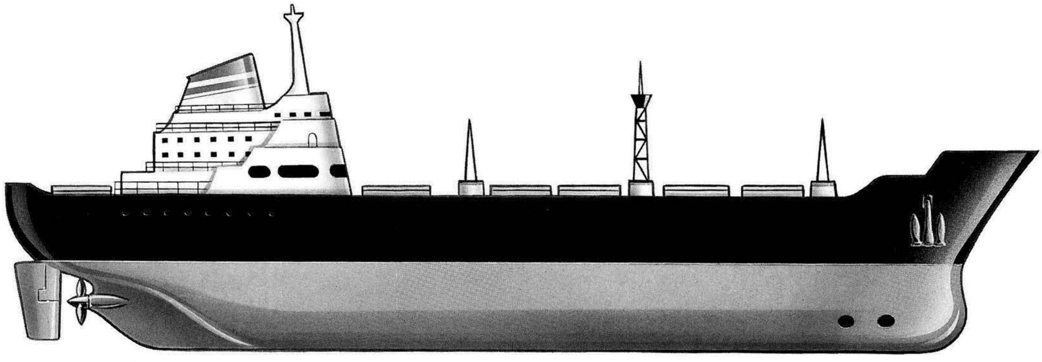
A resin guide containing all standard grades of a company's products has been printed. The publication is tabulated by code number, composition, and suggested uses. For a copy of the "1992-93 Cray Valley Total Resin Guide," contact J. Dix, Technical Information Officer, Cray Valley Ltd., Machen, Nr Newport, Gwent NP1 8YN, United Kingdom.

Rotor Concentrators

Advanced rotor concentrators using hydrophobic zeolite is the focus of a four-page technical paper. The bulletin discusses the use of hydrophobic zeolites with honeycomb rotors, in applications such as spray painting, polyethylene extrusion, semiconductor manufacturing, and plant air quality. For a copy of "Advanced Rotor Concentrators Using Hydrophobic Zeolite," write Munters Zeol, 79 Monroe St., Amesbury, MA 01913.

Blocking Fittings

A line of blocking fittings designed to be mounted in pairs on a cylinder, simultaneously cutting off the supply and exhaust sides of the cylinder has been introduced through a product release. The new fittings are compatible with both horizontal and vertical cylinders, and with all-pneumatic and electro-pneumatic machines. For additional information on the 7800 Series fittings, contact Dennis Fantauzzo, Product Manager/Industrial Div., Legris Inc., 244 Paul Rd., Rochester, NY 14624.



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Coming Events

FEDERATION MEETINGS

For information on FSCT meetings, contact Federation of Societies for Coatings Technology, 492 Norristown Rd., Blue Bell, PA 19422 (215) 940-0777, FAX: (215) 940-0292.

1993

(May 16-19)—Federation "Spring Week." Board of Directors Meeting on the 16th; Incoming Society Officers Meeting on the 17th; Spring Seminar on the 18th and 19th, "The Influence of Substrates and Application Methods/Techniques on Coatings Performance." South Shore Harbour Resort and Conference Center, League City (Houston), TX.

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

1994

(May 12-15)—Federation "Spring Week." Spring Seminar on the 12th and 13th; Incoming Society Officers Meeting on the 14th; Board of Directors Meeting on the 15th. Marriott City Center Hotel, Minneapolis, MN.

(Oct. 12-14)—72nd Annual Meeting and 59th Paint Industries' Show. New Orleans Convention Center, New Orleans, LA.

SPECIAL SOCIETY MEETINGS

1993

(Feb. 4)—New York Society. Joint Legislative Update and Exposition. Landmark II, East Rutherford, NJ. {Sidney J. Rubin, Empire State Varnish Co., Inc., 38 Varick St., Brooklyn, NY 11222; (718) 388-5450}.

(Feb. 6)—Houston Society. 50th Anniversary Celebration. University Club, Houston, TX. {Willy C.P. Busch, 12354 Ledger Ln., Houston, TX 77015; (713) 453-6806}.

(Feb. 24-26)—20th Annual Waterborne, Higher-Solids, and Powder Coatings Symposium. Cosponsored by the Southern Society for Coatings Technology and the University of Southern Mississippi (USM). New Orleans, LA. {Robson F. Storey or Shelby F. Thames, Dept. of Polymer Science, USM, Southern Station Box 10076, Hattiesburg, MS 39406-0076; (601) 266-4868/4080}.

(Mar. 10)—Piedmont Society Symposium and Exhibition. "Plain and Simple: Compliance." Holiday Inn Market Square, High Point, NC. {Robert C. Matejka, Akzo Coatings Inc., 1431 Progress St., P.O. Box 2124, High Point, NC 27261; (919) 841-5111}.

(Mar. 17-19)—Southwestern Paint Convention. "Back to the Future." Dallas and Houston Societies. Four Seasons Resort and Club, Las Colinas (Irving), TX. {Steve Stephens, Ribelin Sales, Inc., P.O. Box 461673, Garland, TX 75046-1673; (214) 272-1594}.

(Mar. 23-25)—Western Coatings Societies' 21st Biennial Symposium and Show. "Visions—Opportunities—Challenges." Golden Gate, Los Angeles, Pacific Northwest, and Rocky Mountain Societies. Disneyland Hotel and Convention Center, Anaheim, CA. {Donald I. Jordan, Cargill, Inc., 2801 Lynwood Rd., Lynwood, CA 90262; (213) 537-9935; or Sandra L. Dickinson, Synergistic Performance Corp., 17821 E. 17th St., Ste. 190, Tustin, CA 92680; (714) 544-8200}.

(Apr. 13)—Pittsburgh Society Symposium. "An Environment Responsible 90s." Airport Marriott, Pittsburgh, PA. {William C. Spangenberg, Hammond Lead Products Inc., 1910 Cochran Rd., Pittsburgh, PA 15220; (412) 344-5811).

(Apr. 21-23)—Southern Society Annual Meeting. "Waterborne Coatings—Riding the Wave to the Future." Opryland Hotel, Nashville, TN. {Mary Finnigan, McCullough & Benton, Inc., 2900 G Carolina Center, Charlotte, NC 28208; (704) 392-2101}.

(Apr. 29-May 1)—Pacific Northwest Society Symposium. Red Lion Hotel, Bellevue, WA. {Richard C. Tomczak, Van Waters & Rogers, Inc., 8201 S. 212th, Kent, WA 98032; (206) 872-5097}.

(May)—Philadelphia Society Seminar. "Waterborne Coatings Formulations." Airport Hilton, Philadelphia, PA. {Peter C. Kuzma, V.I.P. Products Corp., 3805 Frankford Ave., Philadelphia, PA 19124; (215) 535-3025}.

(May 25-26)—New England Society. Tech Expo '93. Sheraton Tara, Danvers, MA. {Joanne Monique, Ashland Chemical, Inc., 400 Main St., Tewksbury, MA 01876; (800) 962-5388}.

(June 4-5)—Joint Meeting of the Kansas City and St. Louis Societies. Holiday Inn, Lake of the Ozarks, MO.

(June 14)—Golden Gate Society. Manufacturing Committee Seminar.

OTHER ORGANIZATIONS

1992

(Nov. 14-19)—SSPC '92. Steel Structures Painting Council National Conference and Exhibition. Kansas City Convention Center,

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South Shore Harbour Resort and Conference Center

League City (Houston), TX

For more information, contact:

Michael Bell, FSCT, Director of Educational Services, 492 Norristown Road, Blue Bell, PA 19422; (215) 940-0777

Kansas City, MO. (SSPC, 4400 Fifth Ave., Pittsburgh, PA 15213).

(Nov. 15-19)—Second North American Research Conference on "Organic Coatings Science and Technology." Sponsored by American Chemical Society Division of Polymeric Materials: Science and Engineering. Marriott's Hilton Head Resort, Hilton Head, SC. (Angelos V. Patsis, Director, Institute of Materials Science, State University of New York, New Paltz, NY 12561).

(Nov. 16-18)—Resins & Pigments '92. Exhibition sponsored by the Paint Research Association. Fiera Milano Congress Centre, Milan, Italy. (Jane Malcolm-Coe, PR & Publicity Manager, FMJ International Publications Ltd., Queensway House, 2 Queensway, Redhill, Surrey, RH1 1QS, England).

(Nov. 16-20)—"Fundamentals of Chromatographic Analysis." Short course sponsored by Kent State University (KSU), Kent, OH. (Carl J. Knauss, Director, Cooperative & Continuing Education-Chemistry, KSU, P.O. Box 5109, Kent, OH 44242-0001).

(Nov. 17-19)—Seventh "Solving Corrosion Problems in Air Pollution Control Equipment" (AIRPOL/92) International Symposium. Sponsored by National Association of Corrosion Engineers (NACE). Orlando, FL. (Jeanette N. Hooper, P.O. Box 218340, Houston, TX 77218-8340).

(Nov. 18-19)—Resins & Pigments '92. Sponsored by *Polymers Paint Colour Journal* and *Paint & Ink International*. Fiera Milano, Hall 20, Milan, Italy. (Jane Malcolm-Coe, PR & Publicity Mgr., FMJ International Publications Ltd., Queensway House, 2 Queensway, Redhill, Surrey, RH1 1QS, United Kingdom).

(Nov. 20-22)—National Decorating Products Show. Sponsored by the National Decorating Products Association (NDPA). McCormick Place North, Chicago, IL. (NDPA, 1050 N. Lindbergh Blvd., St. Louis, MO 63132-2994).

(Dec. 5-7)—"Adhesion Measurement of Films and Coatings." International symposium sponsored by IBM Corporation. Cambridge/Boston, MA. (K.L. Mittal, Organizer, IBM U.S. Technical Education, 500 Columbus Ave., Thornwood, NY 10594).

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(Dec. 6-11)—"Polymer Chemistry: Principles and Practice." Seminar sponsored by The American Chemical Society (ACS), Washington, D.C. Marriott Inn, Blacksburg, VA. (ACS, Dept. of Continuing Education, Meeting Code VPI9203, 1155 Sixteenth St., N.W., Washington, D.C. 20036).

(Dec. 7-9)—SP '92 Polyethylene World Congress. Sponsored by Maack Business Services. Swissôtel Zürich, Zürich, Switzerland. (Maack Business Services, Plastics Technology and Marketing, Moosacherstrasse 14, CH-8804, Au/Zh, Switzerland).

(Dec. 8-10)—Powdex '92. Exhibition sponsored by Cahners Exposition Group. Garden State Convention & Exhibits Center, Somerset (Newark), NJ. (Eileen Oswald, Group Vice President, Reed Exhibition Companies, 1350 E. Touhy Ave., Des Plaines, IL 60017).

(Dec. 8-10)—"Coatings and Corrosion Prevention Technology Update" Seminar. Sponsored by the University of Wisconsin-Milwaukee. New Orleans, LA. (Roger W. Hirons, UW-Milwaukee, Center for Continuing Engineering Education, 929 N. Sixth St., Milwaukee, WI 53203).

1993

(Jan. 12-15)—"Getting into Compliance with Air Quality Regulations for Paints, Coatings, and Printing Facilities." Sponsored by the University of California-Berkeley. University of New Orleans Metropolitan College, New Orleans, LA. (Continuing Education in Engineering, University Extension, University of California, 2223 Fulton St., Berkeley, CA 94720).

(Jan. 19-20)—"Accelerated and Outdoor Durability Testing." Symposium sponsored by ASTM Committee G-3 and Subcommittee D01.27. Ft. Lauderdale, FL. (Warren D. Ketola, 3M Co., Bldg. 553-A, 3M Center, St. Paul, MN 55144, or Douglas Grossman, The Q-Panel Co., 26200 First St., Cleveland, OH 44145).

(Jan. 20-22)—Pretreat '93 Conference. Sponsored by *Products Finishing*. Orlando Marriott, Orlando, FL. (Cindy Goodridge, Gardner Management Services, 6600 Clough Pike, Cincinnati, OH 45244).

(Feb. 4-6)—Surfaces '93. Sponsored by the Western Floor Covering Association (WFCA). Sands Expo & Convention Center, Las Vegas, NV. (Louis Bell, WFCA, 1729 S. Douglass Rd., Ste. A, Anaheim, CA 92806).

(Feb. 21-26)—16th Annual Meeting of The Adhesion Society, Inc. Williamsburg Lodge, Colonial Williamsburg, VA. (Louis H. Sharpe, 28 Red Maple Rd., Hilton Head Island, SC 29928, or F.J. Boerio, Dept. of Materials Science and Engineering {ML 12}, University of Cincinnati, Cincinnati, OH 45221).

(Mar. 16-18)—European Coatings Show '93. Exhibition and Congress. Nuremberg, Germany. (Ina Füllkrug, Vincentz Verlag, Schiffgraben 41-43, D-3000, Hannover 1, Germany).

(Mar. 23-25)—International Symposium on Advanced Infrared Spectroscopy (AIRS). Sponsored by The Spectroscopic Society of Japan. Sanjo Conference Hall, The University of Tokyo, Tokyo, Japan. (Hirokazu Toriumi, AIRS Organizing Committee, Dept. of Chemistry, College of Arts and Sciences, The University of Tokyo, Komaba, Meguro, Tokyo 153, Japan).

(Mar. 27-31)—American Chemical Society (ACS) Spring Seminar on "Raw Materials." Pittsburgh, PA. (ACS, 1627 K St., N.W., Suite 1000, Washington, D.C. 20006).

(Apr. 12-16)—Spring Meeting of the Materials Research Society. San Francisco Marriott Hotel, San Francisco, CA. (Materials Research Society, Meetings Dept., 9800 McKnight Rd., Pittsburgh, PA 15237).

(Apr. 13-15)—Surface Coating '93 Exhibition. Sponsored by Chemical Coaters Association International (CCAI). Grand Center Convention Facility and Amway Grand Hotel, Grand Rapids, MI. (CCAI, P.O. Box 54316, Cincinnati, OH 45254).

(Apr. 18-21)—Inter-Society Colour Council (ISCC) Annual Meeting and Symposium. Doubletree Hotel, Newport, RI. (Romesh Kumar, Program Chairman, 1993 ISCC Annual Meeting, Hoechst Celanese Corp., 500 Washington St., Coventry, RI 02816).

(Apr. 18-23)—"Durability of Coatings" Symposium sponsored by American Chemical Society, Division of Polymeric Materials: Science Engineering, Denver, CO. (Jonathan W. Martin, NIST, Bldg. 226, Rm. B348, Gaithersburg, MD 20879; David Bauer, Ford Motor Co., SRL-E3198, P.O. Box 2053, Dearborn, MI 48121; F. Louis Floyd, Glidden Research Ctr., 16651 Sprague Rd., Strongsville, OH 44136).

(Apr. 20-22)—Surface Treatment '93. "Computer Methods and Experimental Measurements for Surface Treatment Effects." International Conference sponsored by Wessex Institute of Technology. Novotel, Southampton, United Kingdom. (Sue Owen, Conference Secretariat, Wessex Institute of Technology, Ashurst, Southampton, Hants, United Kingdom So4 2AA).

(May 2-6)—RadTech Europe '93. Third Annual RadTech conference. Sponsored by RadTech Europe. Italian vessel T/S Eugenio Costa. (RadTech Europe, Business Office, Pérolles 24, CH-1700 Fribourg, Switzerland).

(May 4-6)—Hazardous Materials and Environmental Management Conference and Exhibition (HazMat West/Spring). Sponsored by Tower Conference Management Company. Long Beach Convention Center, Long Beach, CA. (Tower Conference Management Co., 800 Roosevelt Rd., Bldg. E—Ste. 408, Glen Ellyn, IL 60137-5835).

(May 4-6)—Plasticoat '93 Conference and Exhibition. Sponsored by *Products Finishing*. Drawbridge Estate & Convention Center, Ft. Mitchell, KY (Greater Cincinnati, OH Airport area). (Cindy Goodridge, Gardner Management Services, 6600 Clough Pike, Cincinnati, OH 45244).

(May 4-6)—"Continuous Steel Strip Plating" Symposium. Sponsored by American Electroplaters and Surface Finishers Society (AESF). Ritz-Carlton Dearborn, Dearborn, MI. (AESF, Central Florida Research Park, 12644 Research Pkwy., Orlando, FL 32826-3298).

(June 7-9)—"Engineering Solutions to Industrial Corrosion Problems." Conference cosponsored by the National Association of Corrosion Engineers (NACE) and Norsk Korrosjonsteknisk Forening (NKF). Rica Park Hotel, Sandefjord, Norway. (NKF, Rosenkrantzgate 7, 0159 Oslo, Norway).

(June 22-24)—"Predictive Technology" Symposium. Sponsored by American Defense Preparedness Association. Twin Tower Hotel and Convention Center, Orlando, FL. (Frank A. Gagliardi, U.S. Army Armament Research and Development Center, Bldg. 92, Picatinny Arsenal, NJ 07806-5000).

(June 27-July 2)—ORGABROM '93. 2nd International Symposium. Sponsored by the Dead Sea Bromine Group in cooperation with the Casali Institute of Applied Chemistry, The Hebrew University of Jerusalem. (Secretariat, P.O. Box 50006, Tel Aviv 61500, Israel).

(Sept.)—Conference on "Innovative Responses from an Industry under Siege." Sponsored by the Skandinaviska Lackteknikers Forbund (SLF) Congress. Copenhagen, Denmark, (Michael Symes, President, SLF, Strandboulevarden 38, DK-2100, Copenhagen, Denmark).

(Sept. 5-10)—3rd International Congress on Polymer Photochemistry. Sponsored by Manchester Metropolitan University and University of Milan. Genova, Italy. (Emmezeta SRL, Via C. Farini, 70, I-20159, Milano, Italy).

(Sept. 23)—Detroit Colour Council Meeting. Michigan State Management Education Center, Troy, MI. (James Hall, General Motors Corp., 30009 Van Dyke, Warren, MI 48090).

(Nov. 10-12)—Electroless Nickel '93. Conference sponsored by *Products Finishing*. Orlando Airport Marriott, Orlando, FL. (Cindy Goodridge, Gardner Management Services, 6600 Clough Pike, Cincinnati, OH 45244).

1994

(June 5-9)—XXIInd FATIPEC Congress and Exhibition. Budapest Convention Centre, Budapest, Hungary.

(July 11-15)—MACROAKRON '94 International Symposium. Sponsored by the International Union of Pure and Applied Chemistry. University of Akron, Akron, OH. (Dr. Joseph P. Kennedy, Chairman of the Organizing Committee, or Cathy Manus-Gray, Symposium Coordinator, College of Polymer Science and Polymer Engineering, The University of Akron, Akron, OH 44325-0604).

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION

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I certify that the statements made by me are correct and complete. (signed) Patricia D. Viola, Editor

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'Humbug' from Hillman

Friends Bunnie and Howard Leeds spotted the following, written by Mike Shoup in the Seattle *Times/Post Intelligencer*. It recalls the comments by Perrot (again, I remind you he's not the same guy and not as funny) Phillipps, of "Executive Travel" in our August column.

Mr. Shoup writes, "Below are some examples of fractured English found around the world. But just imagine what we Americans—a people not known for our ability to master foreign languages—are doing to other languages in similar situations." Mr. Shoup found them in an internal corporate bulletin of Air France in New York.

—In a Bucharest hotel lobby: The lift is being fixed for the next day. During that time, we regret that you will be unbearable.

—In a Leipzig elevator: Do not enter the lift backwards, and only when lit up.

—In a Belgrade hotel elevator: To move the cabin, push button for wishing floor. If the cabin should enter more persons, each one should press a number of wishing floor. Driving is then going alphabetically by national order.

—In a Paris hotel elevator: Please leave your values at the front desk.

—In a hotel in Athens: Visitors are expected to complain at the office between the hours of 9 and 11 a.m. daily.

—In a Yugoslavian hotel: The flattening of underwear with pleasure is the job of the chambermaid.

—In a Japanese hotel: You are invited to take advantage of the chambermaid.

—Outside a Hong Kong tailor shop: Ladies may have a fit upstairs.

—Outside a Paris dress shop: Dresses for street walking.

—In a Rhodes tailor shop: Order your summers suit. Because is big rush we will execute customers in strict rotation.

—Similarly, from the *Soviet Weekly*: There will be a Moscow Exhibition of Arts by 15,000 Soviet Republic painters and sculptors. These were executed over the past two years.

—A sign posted in Germany's Black Forest: It is strictly forbidden on our Black Forest camping site that people of different sex, for instance, men and women, live together in one tent unless they are married with each other for that purpose.

—In a Rome laundry: Ladies, leave your clothes here and spend the afternoon having a good time.

—In a Copenhagen airline ticket office: We take your bags and send them in all directions.

—On the door of a Moscow hotel room: If this is your first visit to the USSR, you are welcome to it.

—In a Norwegian cocktail lounge: Ladies are requested not to have children in the bar.

—In an Acapulco hotel: The manager has personally passed all the water served here.

—In a Tokyo shop: Our nylons cost more than common but you find them best in the long run.

—From a Japanese information booklet about using a hotel air conditioner: Cooles and Heates: If you want just condition of warm in your room, please control yourself.

In August, we treated you to some of a compilation of student answers on science tests contributed by Joe Boatwright. Although amusing, I guess it's difficult to laugh when you consider the state of education these days. Oh well, let's believe that some humorist just made them up. Here's more:

- Humans are more intelligent than beasts because the human branes have more convulsions.
- For fainting: Rub the person's chest, or if a lady, rub her arm above the hand.
- For fractures: To see is the limb is broken, wiggle it back and forth.
- For dog bite: Put the dog away for several days. If he has not recovered, then kill it.
- For drowning: Climb on top of the person and move up and down to make artificial perspiration.
- For head colds: Use an agonizer to spray the nose until it drops in your throat.
- Bar magnets have north and south poles, horseshoe magnets have east and west poles.

And from "The Lion":

—Honeymoon: The period between "I do" and "You'd better."

—If you can't be grateful for what you receive, be grateful for what you escape.

—Thanks to automatic teller machines, we no longer have to tell our children that money doesn't grow on trees. They now think it comes out of a wall.

—Vacation is what you take when you can't take what you've been taking any longer.

—Corrective surgery: Back to the suture.

—Herb Hillman
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