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May 1991

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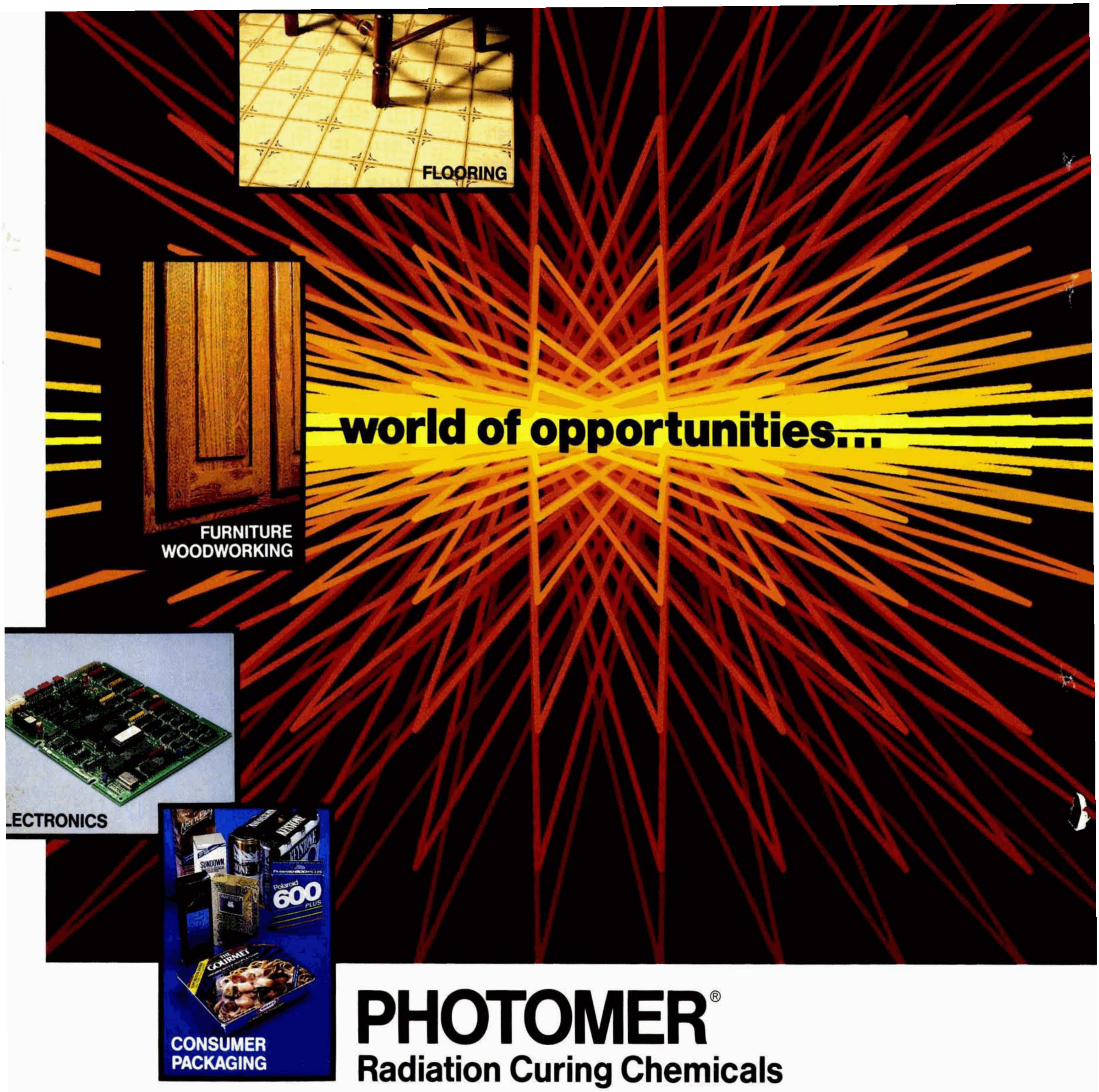
Preservative Evaluation: Designing an Improved Test System



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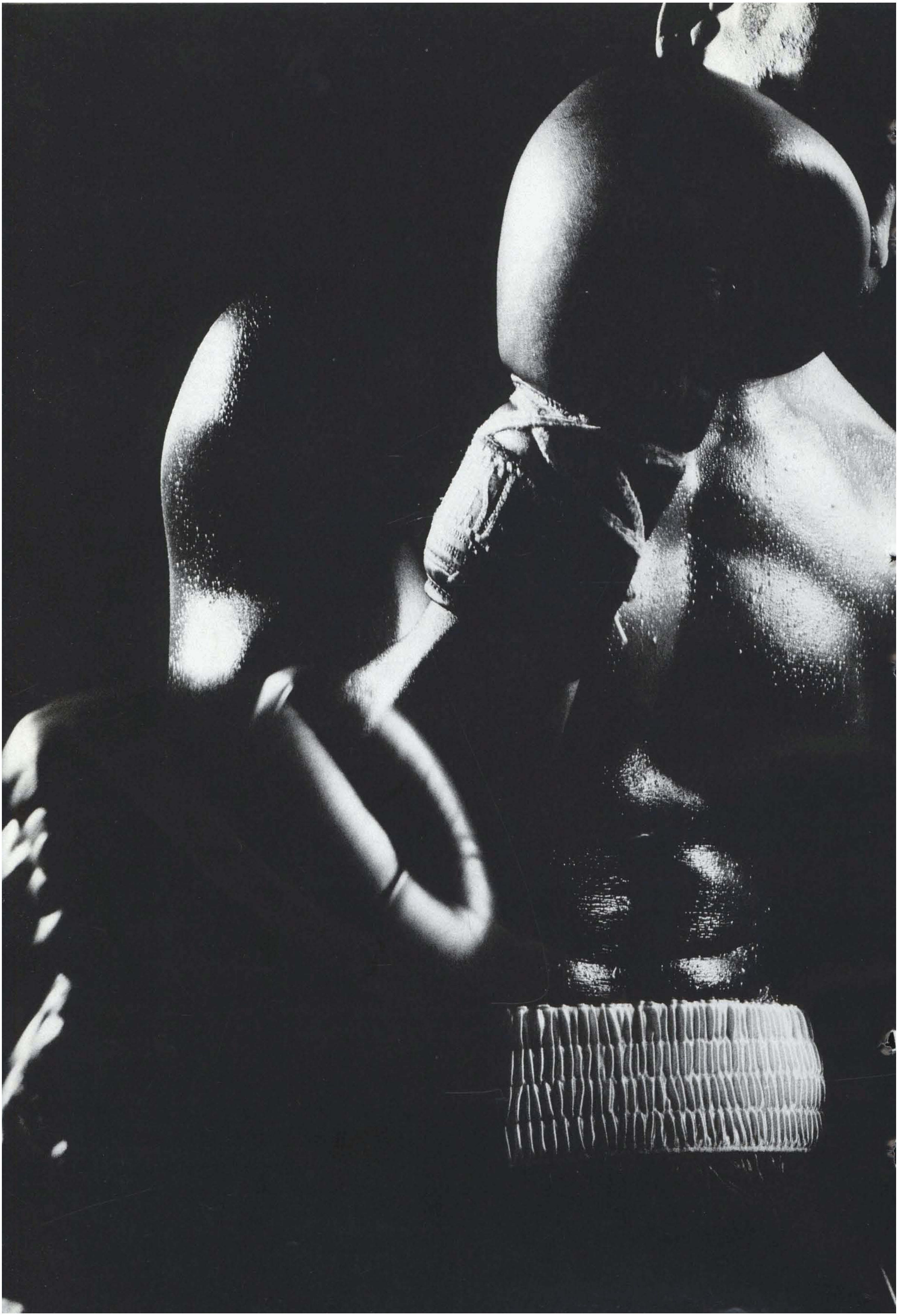

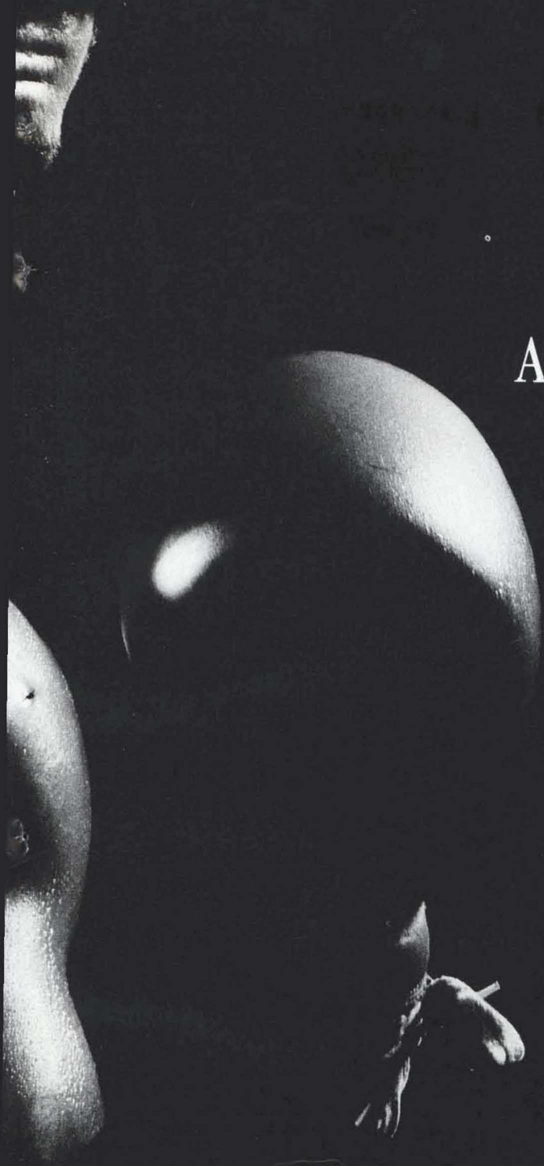

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Comment

A Great Place to Meet—
The Indians Had a Name for It

The Federation Annual Meeting and Paint Industries' Show returns to Canada, November 4-6, when Toronto hosts the 1991 event, and early indications point to a repeat of the highly successful first-time engagement north of the border—in 1983, when the AM&PS was held in Montreal.

Exhibitors are reserving booth space at a rate that presages another "sold out" Paint Show, with over 240 supplier firms already signed up to display their products and services. Meanwhile, programming efforts have yielded a smorgasboard of technical presentations to pique the appetite of both laboratory and production personnel.

And supplementing the attractions in the meeting rooms and on the exhibit floor is the opportunity to savor the charms of an international metropolis, described by *Fortune* magazine as the "world's newest great city."

Toronto derives its name from a Huron Indian word meaning "meeting place," and the natives clearly knew what they were talking about. Strategically located within two hours' flying time to almost two thirds of the North American population, the city is a center for commerce and trade, Canada's top tourist destination, and its number one convention and trade show site. And—not the least of its attractions—it's a clean, safe city.

With exhibit space nearing record proportions, a full complement of meaty programming, and the many attractions offered by a truly cosmopolitan city, the 1991 Annual Meeting and Paint Industries' Show promises to be a memorable one.

So, make your arrangements early and plan to be on hand for the big coatings event of the year—and see why the natives think Toronto's a great place to meet.

Thomas A. Kocis

Thomas A. Kocis
Contributing Editor

Abstracts of Papers in This Issue

PRESERVATIVE EVALUATION: DESIGNING AN IMPROVED TEST SYSTEM—P.K. Cooke et al.

Journal of Coatings Technology, 63, No. 796, 33 (May 1991)

Conventional preservative test methods suffer from fundamental errors in experimental design, notable among them, the use of single, pure cultures of microorganisms grown on laboratory media. Additionally, they fail to consider that acclimated microorganisms can arise from diluted material found in the paint manufacturing process. A technique has been developed, based on the Springle method, which uses acclimated inocula in conjunction with pure cultures of microorganisms commonly found in spoiled paint products. Testing is done such that the effects of preservatives on both diluted and undiluted product can be determined reliably and accurately.

LATENT AMINE CATALYSTS FOR EPOXY-CARBOXY HYBRID POWDER COATINGS. INVESTIGATIONS ON PHASE CHANGE CONTROL OF REACTIVITY—S.P. Pappas, V.D. Kuntz, and B.C. Pappas

Journal of Coatings Technology, 63, No. 796, 39 (May 1991)

Ten crystalline amic acids, derived from four carboxylic acid anhydrides and four diamines, possessing both primary and tertiary amine groups, were synthesized and investigated as latent amine catalysts for bisphenol A epoxy-polyester carboxy (hybrid) powder coatings. On heating, the zwitterionic amic acids underwent thermally induced intramolecular cyclization to imides, which catalyzed the carboxylic acid-epoxide reaction leading to cure of the powder coatings. We reasoned that cyclic imidization might be facilitated by melting of the amic acids, in which case latency could be controlled by the melting point phase change. This premise was investigated by differential scanning calorimetry (DSC), thermogravimetric analysis, and thermal Fourier transform infrared studies on the amic acids together with DSC and storage stability studies on melt-mixed powder coatings. The premise that cure response may be controlled by a melting point phase change appears to be ideally exemplified by two of the amic acids (MPA/DMP and DMPA/DMP). The other acids exhibit poorer storage stability in the powder coatings and/or lower cure response. These deficiencies can be attributed in varying extents to low temperature, solid state imidization of the amic acids, solubilization of the amic acids prior to imidization, and lower catalytic cure response of the corresponding imides.

QUINONE-AMINE POLYMERS, VIII: CURING STUDIES ON JEFFAMINE® D-400-P-BENZOQUINONE POLYMER—V.S. Nithianandam, F. Chertok, and S. Erhan

Journal of Coatings Technology, 63, No. 796, 47 (May 1991)

The failure of poly(amine-quinone) = 3:2 (PAQ = 2.3) coatings to resist salt spray, even though they are nonwettable by water, was attributed to the use of a volatile solvent and very low solid content, which led to surface imperfections that were aided by low crosslinking density. The addition of several polyamines and epoxides to the polymer, in appropriate solvent, before heat curing, demonstrated that adhesion of the coatings was improved by the addition of the amines. The best salt-water resistance, however, was obtained by the addition of a regular epoxy resin, Epon® 828 (Shell Oil Company).

QUINONE-AMINE POLYMERS, VII: SELECTION OF APPROPRIATE SOLVENT COMBINATIONS FOR JEFFAMINE® D-400-P-BENZOQUINONE POLYMERS (PAQ = 2:3)—V.S. Nithianandam, F. Chertok, and S. Erhan

Journal of Coatings Technology, 63, No. 796, 51 (May 1991)

Using calculated cohesive energy densities and two-dimensional solubility maps, several solvent combinations were found that could dissolve polyamine-quinone = 2:3. Since n-butanol:xylene (1:4v/v) could dissolve the polymer up to 85% solids, studies were confined to this mixture using high aromatic commercial products. It was found that super high flash naphtha, with some alcoholic or ketonic cosolvents, could dissolve the polymer; the solution when cured showed good adhesion to metals.

Regulatory UPDATE

MAY 1991

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.

Environmental Protection Agency
March 21, 1991—56 FR 12098
National Pollutant Discharge Elimination System Permit Application Regulations for Storm Water Discharges; Application Deadline for Group Applications
Action: Final rule

On November 16, 1990, the U.S. Environmental Protection Agency (EPA) promulgated regulations specifying application requirements and deadlines for The National Pollutant Discharge Elimination System (NPDES) permits for storm water discharges associated with industrial activity. A new procedure for applying for the permits was established through a group application process. At that time, EPA set March 18, 1991 as the deadline for submitting part I of the group applications.

The deadline has now been extended to September 30, 1991. EPA extended the deadline because a significant amount of the regulated community either were unaware of the impact of the final rule (promulgated in November 1990), or they were unable to determine if the rule was applicable to them. Part II of the group applications must be submitted by May 18, 1992.

For further information, contact Thomas J. Seaton, Office of Water Enforcement and Permits (EN-336), U.S. EPA, 401 M Street, S.W., Washington, D.C. 20460, (202) 475-9518.

Environmental Protection Agency
March 21, 1991—56 FR 12101
National Pollutant Discharge Elimination System Permit Application Regulations for Storm Water Discharges; Application Deadline
Action: Proposed rule

In an effort to minimize confusion among the regulated community, EPA has proposed to extend until May 18, 1992, the deadline for submitting applications for individual industrial storm water permits. The original deadline was November 18, 1991. The extension will allow industry the necessary time to determine what application requirements affect which facilities. Under another proposal by EPA, any rejected member of a storm water group will be able to submit an individual application up until May 18, 1992.

For further information, contact Thomas J. Seaton, Office of Water Enforcement and Permits (EN-336), U.S. EPA, 401 M Street, S.W., Washington, D.C. 20460.

Environmental Protection Agency
April 4, 1991—56 FR 13827
Technical Support Document for Water Quality—Based Toxics Control: Final Guidance Availability
Action: Notice of availability

The U.S. EPA has released a final guidance document entitled "Technical Support Document for Water Quality—Based Toxics Control."

The document is intended to support the implementation of a March 1984 EPA policy which states that EPA will use "an integrated strategy consisting of both biological and chemical methods to address toxic and nonconventional water pollutants from industrial and municipal sources." The document also supports the implementation of a June 1989 surface water toxics control regulation that established requirements for evaluating and controlling point-source discharges of pollutants which cause or contribute to "an excursion above any state water quality standard."

The comprehensive technical recommendations for water-based toxics control included in the document are designed to assist regulators and the regulated community by providing "scientifically sound and useful procedures."

Copies of the technical support document can be obtained through the National Technical Information Service (NTIS), U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161, (703) 487-4650. Please reference the NTIS NO-PB91-127415.

For further information, contact Jackey Romney, (202) 475-9528, U.S. EPA, 401 M Street, S.W., Washington, D.C. 20460.

Indoor Air Quality—Sen. George Mitchell (D-ME) and Rep. Joseph Kennedy (D-MA) have both introduced legislation to improve the quality of indoor air. Both bills (S-465 and H.R. 1066) contain provisions regarding lead exposure.

While no action has been scheduled in the Senate, House Health and the Environment Subcommittee Chairman, Rep. Henry Waxman (D-CA), has scheduled a hearing specifically on lead exposure for April 25.

Environmental Crimes—Rep. Charles Schumer (D-NY) is planning to introduce legislation that would make it a criminal offense to simply cause the risk of an environmental accident or to endanger life.

Reportedly, the new bill will be similar to legislation Rep. Schumer introduced last year (H.R. 3641). That bill imposed fines of up to $500,000 for individuals and up to $2 million for corporations who "knowingly create a risk of death by polluting." Persons could also be charged with a misdemeanor for negligent endangerment, and repeat offenders could face up to 30 years in prison.

Resource Conservation and Recovery Act (RCRA)—The Senate Environment and Public Works Committee Staff have released a draft of a comprehensive Resource Conservation and Recovery Act (RCRA) proposal. Written by staff of the Environmental Protection Subcommittee Chairman, Max Baucus (D-MT), the proposal is expected to be formally introduced within the next two weeks.

The proposal is a five-title bill that includes general amendments, waste reduction, recycling, waste and secondary materials management, and underground storage tanks.

Under the recycling title, a national goal is established by reducing municipal solid waste by 10% by the year 2000 with 25% of this waste stream to be recycled by 1995 and 50% by 2000. The Administrator of the U.S. EPA, in conjunction with the Commerce Secretary, would be directed to set forth either a product requirement for minimum recycled content, or standards establishing the amount of recycled materials that would be used in recyclable products on a commodity-specific basis.

The draft proposal also authorizes states to prohibit solid waste imports. States would also be permitted to impose and collect fees for imported wastes, if "such fees are applicable throughout the state and do not discriminate against any particular disposal or incineration site or point of municipal solid waste generation"; such fees do not apply to any municipal solid waste and any recyclable materials that have been separated from municipal solid waste that is being transported to a recycling facility.

Reportedly, the pollution prevention title includes "targeted planning provisions" that are similar to last year's legislation which set out industry reporting requirements.

Lead—On April 17, 1991, The Senate Toxic Substances, Environmental Oversight, Research and Development Subcommittee, will mark up S. 391, The Lead Exposure Reduction Act of 1991.

The legislation is an amendment to the Toxic Substances and Control Act (TSCA), and it would limit all paint and coatings products to no more than 0.06% lead by dry weight. The EPA could raise the proposed statutory threshold if "the higher level promotes the protection of human health and the environment, or if no comparable substitute is available at the time the regulations are promulgated." Further provisions include a labeling requirement for all lead-containing products indicating the presence and percentage of lead, and a research program to identify and develop more cost-effective lead-based paint abatement methods and strategies. The legislation also imposes strict penalties for companies or individuals found in violation—$25,000 fines for each day of violation and up to a year in federal prison.

Clean Water—Senators Baucus (D-MT) and Chafee (R-RI) have released a tentative schedule for action on the reauthorization of the Clean Water Act. The comprehensive bill was to be introduced on April 11, but at press time, there was no confirmation of introduction.

Reportedly, the bill will contain provisions for water conservation, effluent guidelines, water quality standards, nonpoint source pollution, storm water, combined sewer overflow, costal pollution, contaminated sediments, research, monitoring, and enforcement. Hearings are expected to begin in the Environmental Protection Subcommittee on April 23, and run through the end of May.

The debate on clean water in both Houses of Congress is expected to be long and arduous, primarily because some members will attempt to incorporate RCRA provisions into the legislation.

Product Liability Reform—Sen. Robert W. Kasten, Jr. (R-WI) has introduced S. 640, The Product Liability Fairness Act. The bill is identical to the legislation Kasten introduced last year (S.1400).

S. 640 provides uniform liability standards; maintains full recovery for economic losses—imposing noneconomic damages proportionate to a defendant's individual fault; establishes a defense where a plaintiff was intoxicated or under the influence of drugs; and provides an expedited settlement procedure. The bill also abolishes joint and several liabilities for new economic damages, and places no caps on damage awards.

States Proposed Legislation and Regulations

Alabama

Air Quality—A Department of Environmental Management proposal incorporates Federal New Source Performance Standards (NSPS) and National Emission Standards for Hazardous Air Pollutants (NESHAP) into the Department of Environmental Management's air rules and regulations.

For more information, contact Tommy E. Bryan, Hearing Officer, Office of General Counsel, Department of Environmental Management, 1751 Cong. W.L. Dickinson Drive, Montgomery, AL 36130.

Alaska

Toxic Substances—H. 49 (Ulmer) amends the definition of slow-leaching TBT-based marine antifouling paint.

Arkansas

Toxic Substances—H. 1359 (Mitchell) provides that the state Board of Health has the power to properly control chemical exposures that may result in adverse health effects to the public.

Arizona

Hazardous Waste—H. 2401 (Palmer) reduces hazardous-products tax from 8.5% to 4% and deletes some products from the list.

Air Quality—H. 2490 (Mundell) authorizes the Environmental Quality Department to analyze air samples to determine the source of pollution.

Household Hazardous Waste—S. 1191 (English/Blanchard) provides that before 1992 every county, city, and town with a population of more than 25,000 would have to provide collection programs for household hazardous waste.

California

Air Quality—A. 157 (Roybal-Allard) authorizes an air pollution control officer to require specified information from a supplier of volatile organic compounds or chemical substances, and requires the supplier to disclose that information.

Packaging—A. 1609 (Cortese) enacts the Heavy Metal Packaging Waste Act of 1991 to prohibit the use, on and after January 1, 1997, of package or packaging, in any bottling or manufacturing process, for any product sold at retail or wholesale in California if it is composed of any intentionally introduced lead, mercury, cadmium, or hexavalent chromium.

Hazardous Waste—S. 428 (Ayala) requires any business, after July 1, 1992, which sells or delivers any liquid hazardous material to any person to accept back from that person the empty container used to transfer that hazardous material, if the container has a capacity of five gallons or more.

Toxic Substances—A. 1519 (Lee) enacts the Toxics Reporting and Use Reduction Act of 1991. Makes a statement of legislative intent, would define terms, and would require the Environmental Affairs Agency, in cooperation with each state and local agency which collects hazardous materials data, to establish systems and procedures for collecting, storing, and distributing hazardous materials data to the public and among state and local agencies.

A. 1565 (Lee) imposes an excise tax upon all retailers in an amount equal to $0.50 per gallon of paint from the sale of all paint sold at retail in this state. Requires that the monies from the excise tax be deposited in the Lead Based Paint Fund, which the bill would create.

S. 240 (Torres) requires the state Department of Health Services to establish and maintain an occupational lead poisoning prevention program. It authorizes the Department to adopt implementing regulations, and requires a fee to be assessed on those employers involved in industries which present a potential source of occupational lead poisoning.

Household Hazardous Waste—A. 2092 (Sher) extends to July 1, 1992 the date when the source reduction and recycling element is required to be prepared and adopted in the case of a city element, and January 1, 1992, in the case of a county element. Extends to January 1, 1992 the date when the city and the county household hazardous waste element is required to be prepared. Requires each city and county to prepare and submit to the California Integrated Waste Management Board written reports on the status of elements.

A. 2178 (Brulte) would require a retailer, as of July 1, 1992, to accept unused latex paint and would exempt a retailer, collection location, or intermediate collection location which receives or transports used latex paint from specified requirements concerning the receipt, storage, and transportation of hazardous waste, if certain conditions are met. Makes a statement of legislative intent concerning the disposal of latex paint, and defines terms.

A Department of Health Services proposal establishes and revises technical, administrative, and financial operating requirements for Temporary Household Hazardous Waste Collection Facilities (THHWCFs) pursuant to a permit by rule. For more information, contact Sue Stack, Regulations Coordinator, (916) 324-9933 or Hossein Nassiri, (916) 327-4493, Department of Health Services, Toxic Substances Control Program, 714/744 P Street, P.O. Box 942732, Sacramento, CA 94234-7320.

Colorado

Criminal Law—H. 1057 (Prinster) creates the crime of abusing toxic vapors and provides a penalty therefor. Defines "toxic vapors" and lists the substances which are toxic vapors.

Connecticut

Toxic Substances—H. 7216 (Committee on Environment) provides for a voluntary return program for certain products containing mercury in order to reduce the presence of this hazardous material in the waste system.

Hazardous Waste—H. 6022 (Smith) promotes a better environment through a coordinated approach to toxics use reduction.

Florida

Aerosols—H. 1827 (Garcia) prohibits certain possession, sale, and display of aerosol spray paint cans and broad-tipped markers; requires signature of purchaser.

Packaging—H. 2117 (Friedman) creates the Packaging Reduction and Recycling Act; requires environmentally acceptable packaging; provides for packaging standards.

Georgia

Right-To-Know—H. 217 (Brown) relates to the Public Employees Hazardous Chemical Protection and Right-to-Know Act of 1988; deletes provisions requiring the promulgation and review of the Georgia Hazardous Chemical List.

Hawaii

Hazardous Waste—H. 740 (Yoshimura/Chang) establishes a hazardous waste recycling and treatment facility.

Illinois

Toxic Substances—H. 463 (Trotter) imposes a fee of 15 cents per pound on emissions of certain toxic chemicals into the air, with the revenue to be used to support programs relating to air pollution, hazardous waste management, and monitoring of health effects.

H. 814 (Deering) provides that a household product, that is required to bear a warning label because it is likely to be harmful if ingested may not be sold after January 1, 1992 unless it is naturally bitter or contains a bittering agent designed to discourage its ingestion by children.

Household Hazardous Waste—H. 1509 (Currie) enacts the Household Hazardous Waste Act. Requires each county (and Chicago) to adopt such a collection plan, authorizes Energy and Natural Resources Department to provide support, grants, loans, etc., and imposes a 33 1/3% surcharge on state Solid Waste disposal fee to be used for these programs.

Hazardous Waste—H. 1510 (Currie) bans disposal of waste oil, organic solvents, gas, liquid paint, and certain pesticides at a sanitary landfill or city waste incinerator, beginning in 1996.

Aerosols—H. 2196 (Madigan) creates an Act to prohibit the sale of spray paint.

Iowa

Environmental Issues—H. 683 (Committee on Ways and Means) relates to the establishment of a Toxics Pollution Prevention Program. Provides for the imposition of toxics pollution prevention and air contaminant source fees.

Maine

Packaging—S. 165 (Kany) requires the Maine Waste Management Agency to develop a policy and implementation schedule designed to decrease the volume and toxicity of packaging of consumer goods. It also requires the Maine Waste Management Agency to research and develop a product labeling system for recyclable or reusable consumer goods.

Minnesota

Air Quality—H. 160 (Munger) appropriates funds to the Pollution Control Agency to establish a statewide monitoring system for toxic air pollutants and an inventory of emission sources or probable sources of listed toxic air pollutants and, by January 1, 1993, a list of toxic air pollutants.

H. 1401 (Munger) same as S. 841—Adopts legislative policy of reducing toxic pollutant releases by 70% by the year 2000, based on 1989 release reports. Requires submission of notice of toxic pollution prevention plan completion within 30 days of completing a plan.

S. 840 (Morse) appropriates funds to the Pollution Control Agency to establish a statewide monitoring system for toxic air pollutants and an inventory of emission sources or probable sources of listed toxic air pollutants and, by January 1, 1993, a list of toxic air pollutants.

S. 841 (Morse) adopts legislative policy of reducing toxic pollutant releases by 70% by the year 2000, based on 1989 release reports. Requires submission of notice of toxic pollution prevention plan completion within 30 days of completing a plan.

Hazardous Waste—H. 890 (Rukavina) same as S. 778—Sets supplementary recycling goals and limits heavy metals in packaging.

S. 778 (Marty) sets July 31, 1996, county recycling goal. Requires cities and towns of 5,000 or more to require all residents and businesses to recycle by July 1, 1992. Bars toxic metals in any packaging material, die, paint, or fungicide after July 1, 1994.

Packaging—S. 731 (Lessard) regulates packaging volume and use of toxic materials in packaging.

Transportation—H. 660 (Peterson) requires the Commissioner on Public Safety to adopt rules implementing a statewide hazardous materials incident response plan, including provisions for coordinating duties among regional hazardous materials response teams and strategic chemical assessment teams.

Taxation—H. 1327 (Clark) imposes a tax of five cents per gallon on each container of paint sold by a wholesaler to a retailer, requires wholesalers to apply for paint tax identification numbers and tax permits, imposes recordkeeping requirements and requires tax stamps on paint containers, and allocates proceeds to a lead abatement fund for appropriation for lead abatement programs administered by the Housing Finance Agency and Department of Health.

Missouri

Hazardous Waste—H. 655 (McCarthy) creates an Office of Hazardous Waste Reduction within the Department of Natural Resources to assist generators in preventing and reducing hazardous waste, requires promulgation of guidelines for waste reduction plans within 18 months of enactment, requires generators to submit waste reduction plans within two years for large generators and three years for small generators of promulgation of guidelines.

S. 422 (Goode) reduces hazardous waste generation, use of toxic substances and release of toxic substances, establishes an Office of Hazardous Waste Reduction in the Department of Natural Resources to assist generators of hazardous waste in preventing and reducing the amounts, toxicity, and adverse public health and environmental effects of waste produced.

Montana

Household Hazardous Waste—H. 858 (Gilbert) relates to the Statewide Household Hazardous Waste Public Education Program.

New Hampshire

Household Hazardous Waste—H. 776 (A. Merrill) establishes a household hazardous waste management program and advisory committee and a consumer education program on household hazardous wastes.

S. 186 (Hollingworth/Cohen) establishes the Rockingham County Household Hazardous Waste Cleanup Day. Requires the Rockingham County commissioners to convene a meeting of municipal officials to prepare a plan for the cleanup day, and provides funding for the cleanup day.

New Jersey

Right-To-Know—A. 4654 (Catania) requires containers of hazardous substances sold to schools to be labeled in compliance with Right-to-Know.

New Mexico

Packaging—H. 481 (Picraux) authorizes the State Environmental Improvement Division to promulgate regulations to require packaging to be reuseable, recyclable or made of recyclable materials to reduce the amount of solid waste in landfills. Provides that fees may be charged to packagers who do not meet standards.

Air Quality—H. 565 (King) allows for the creation of local air quality authorities. Specifies powers and duties of State Environmental Improvement Division.

New York

SARA—A. 3845 (Hinchey) enacts the multi-media toxic chemical release inventory act. Requires reporting on facilities where toxic chemicals are stored.

Household Hazardous Waste—A. 6542 (Tokasz) requires solid waste management facilities to provide a plan for household hazardous waste disposal when applying for permits.

A. 7001 (McGee) establishes a household hazardous waste disposal program within the Department of Environmental Conservation, defines the term "household hazardous waste." Such a program will provide a means for the elimination, removal, abatement, treatment, and disposal of hazardous materials used or possessed by individual households in this state. It provides that a municipality may establish a household hazardous waste program.

S. 4357 (Marino) same as A. 7001.

North Dakota

Household Hazardous Waste—H.C.R. 3062 (R. Berg) studies the feasibility of establishing a collection and disposal program for agricultural pesticides, hazardous household chemicals, and their containers.

Oregon

Packaging/Labeling—H. 3187 (Committee on Human Resources) requires disclosure of proper disposal of toxic household products by business advertising or selling toxic household products.

S. 1010 (Springer) requires Department of Environmental Quality and State Department of Agriculture to develop programs to require labeling and distribution of consumer information about hazardous household products, pesticides, and commercial fertilizers. Imposes civil penalties for failure to label or provide information.

S. 1108 (Smith) prohibits sale of toxic packages or packaging components. Requires manufacturer or distributor to provide certificate of compliance to purchaser.

Occupational Safety and Health—S. 874 (Otto/Kirkpatrick) allows Director of Department of Insurance and Finance to promulgate rules to establish hazardous painting certificate programs.

Pennsylvania

Household Hazardous Waste—H. 953 (D. Wright) provides for labeling of, and information about, household hazardous materials, confers powers and duties upon the Department of Environmental Resources, and establishes the Household Hazardous Materials Fund.

South Dakota

Fire Protection—H. 1348 (Frederick) allows the dispensing of flammable and combustible liquids from aboveground storage tanks for retail sales.

Texas

Toxic Substances—H.C.R. 109 (Jackson) expresses support for the elimination of heavy metals from household paints.

Vermont

Hazardous Waste—S. 156 (Committee on Natural Resources and Energy) revised the system by which certain industries find ways to reduce their use of toxic substances and their generation of hazardous materials.

Resumenes de Artículos en este Número

EVALUACION DE CONSERVADORES: DISEÑANDO UN SISTEMA MEJORADO DE PRUEB—P.K. *Cooke et al.*

Journal of Coatings Technology, 63, No. 796, 33 (May 1991)

Los métodos de prueba convencionales para preservativos su fren de errores fundamentales en el diseño experimental destacando entre ellos, el uso de sólo cultivos puros de microorganismos que se desarrollan en el ambiente del laboratorio. Adicionalmente, fallan al considerar que los microorganismos aclimatados pueden desarrollarse de material diluido encontrado en el proceso de fabricación de pintura. Una técnica ha sido desarrollada, basada en el método springle, el cuál ultiliza aclimatación por medio de inoculación en conjunción con cultivos puros de microorganismos comunmente encontrados en pinturas que por este efecto han fallado. La prueba es determinante, tal que los efectos de preservativos en productos diluidos y no diluidos, pueden ser determinados exacta y confiablemente.

CATALIZADOR LATENTE AMINA PARA RECUBRIMIENTOS EN POLVO HIBRIDOS EPOXI CARBOXI. INVESTIGACIONES SOBRE EL CONTROL DE REACTIVIDAD EN EL CAMBIO DE FASE—S.P. Pappas, V.D. Kuntz, and B.C. Pappas

Journal of Coatings Technology, 63, No. 796, 39 (May 1991)

Diez ácidos aminicos cristalinos, derivados de cuatro ácidos carboxilicos anhídridos y cuatro diaminas, posesionando gru pos amina primarios y terciarios, fueron sintetizados e investi gados como catalizadores latentes amina para bisfenol A epoxi-poliester carboxi (híbrido) en recubrimientos en polvo. En calentamiento, los ácidos aminicos sufren, debido al calor, cicli zación intramolecular inducida a imidas, las cuáles catalizan la reacción ácido carboxilico epoxi mejorando el curado de los recubrimientos en polvo. Se piensa que la imidización ciclica pudiese facilitarse por la fusión de ácidos aminicos, en cuyo caso, lareacción en potencia, podría controlarse por el punto de fusión en el cambio de fase. Esta premisa fue investigada por calorimetría de barrido diferencial, análisis termogravimetrico y estudios termicos por infrarrojo empleando transformadas de Fourier en los ácidos amínicos junto con DSC y estudios de esta bilidad en almacenamiento de los recubrimientos en polvo—mezcla-fusión. La premisa que sostiene que el curado, puede ser controlado por el punto de fusión en el cambio de fase, se puede ejemplificar perfectamente por dos de los ácidos aminicos (MPA/DMP y DMPA/DMP). Los otros ácidos muestran poca establidilidad al almacenaje en los recubrimientos en polvo y/o baja respuesta al curado. Esas deficiencias pueden ser atribuidas por variacio nes en la distribución a baja temperatura, imidización de, estado sólido de los ácidos amínicos, solubilización de los ácidos aminícos previa a la imidización y baja catalización en la cura en respuesta a las imidas correspondientes.

QUINONE-AMINE POLYMERS, VIII: ESTUDIOS DE CURADO EN EL POLIMERO JEFFAMINE® D-400-P-BENZO-QUINONA—V.S. Nithianandam, F. Chertok, and S. Erhan

Journal of Coatings Technology, 63, No. 796, 47 (May 1991)

La falla de los recubrimientos a base de poli (amina-quinona) resistentes al ambiente salino, aún cuando sean impermeables, fue atribuida al uso de solventes volátiles y de bajo contenido de sólidos, los cuales conducen a imperfecciones de superficie que fueron ocasionadas por baja densidad de entrecruzamiento. La adición de diferentes poliaminas y epoxis al polimero, en el solvente apropiado, antes del curado por calor, demonstraron que la adhesión del recubrimiento fue mejorada por la adición de las aminas. La mejor resistencia al ambiente salino, sin embargo, fue obtenida por la adición de una resina epoxi regular, Epon® 828, (Shell Oil Company).

QUINONE-AMINE POLYMERS, VII: SELECCION DE LA COMBINACION APROPIADA DE SOLVENTES PARA POLIMEROS JEFFAMINE® D-400-P-BENZOQUINONA (PAQ=2:3)—V.S. Nithianandam, F. Chertok, and S. Erhan

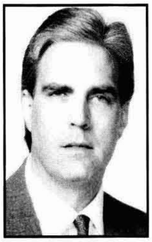
Journal of Coatings Technology, 63, No. 796, 51 (May 1991)

Usando densidades de energía cohesiva calculadas y mapas bidimensionales de solubilidad fue encontrado que, diferentes combinaciones de solventes pueden disolver poliminaquinona=2:3 desde n-butanol-xileno (1:4 v/v) se puede disolver el polímero con más de 85% de sólidos, los estudios fueron confinados a esta mezcla usando productos comerciales con altos aromáticos, se encontró que super alta "flash" nafta, con algo de cosolventes alcohólicos o cetónicos pueden disolver el polimero; la solución cuando cura, muestra buena adhesión a los metales.

Spanish translation of abstracts was provided by Mexico Society Member, Ing. Gustavo Sanchez, Technical Chief, Instituto Mexicano de Técnicos en Pinturas y Tintas, Mexico

Michael G. Bell Joins Federation Staff As Director of Educational Services

Robert F. Ziegler, Executive Vice President of the Federation of Societies for Coatings Technology (FSCT), Blue Bell, PA, recently announced the addition of Michael G. Bell to the Federation staff as Director of Educational Services.



Michael G. Bell

In his new role, Mr. Bell will be responsible for working with the following FSCT committees to develop new educational programs for both the Federation membership and the coatings industry: Educational, Manufacturing, Corrosion, Technical Advisory, and Professional Development. In addition, he will also supervise the preparation of audio-visual presentations, monitor FSCT's scholarship program, organize seminars and short courses, including FSCT's annual Spring Week, and coordinate the Federation's Annual Meeting technical program.

Mr. Bell comes to the Federation from the Society of Manufacturing Engineers (SME) in Dearborn, MI, where he most recently served as Manager of Professional Interests. With SME since 1980, he was also involved with membership development and managed several of SME's associations and groups, including the Association for Finishing Processes of SME.

A 1976 graduate of Hillsdale College in Hillsdale, MI, with a Degree in Economics and Business Administration, Mr. Bell recently served as President of the Hillsdale College Metro Detroit Alumni Association. He also was on the Industrial Advisory Board for Eastern Michigan University's Coatings Department from 1984 to 1987. His outside interests include photography and he has earned several awards for his work.

Mr. Bell is married and has one daughter.

Corrosion Committee Announces Availability Of Survey on Accelerated Test Methods

The Corrosion Committee of the Federation has published a report entitled, "Survey of Accelerated Test Methods for Anti-Corrosive Coatings Performance." This survey, conducted by the Steel Structures Painting Council, appeared in a condensed form in the August issue of the JCT [Vol. 62, No. 787, 57 (1990)]. Copies of the complete survey are available from the Federation for $20. Contact Ms. Meryl Cohen, FSCT, 492 Norristown Rd., Blue Bell, PA 19422.

Federation of Societies for Coatings Technology

1991 Annual Meeting and Paint Industries' Show

Housing Information/Application
Advance Registration Form

Metro Toronto Convention Centre
Monday, Tuesday, Wednesday • November 4 - 5 - 6
Toronto, Ontario, Canada

TO MEMBERS AND FRIENDS OF THE FEDERATION EVERYWHERE:

It is with great pleasure and pride that I invite you to the Federation's 69th Annual Meeting and 56th Paint Industries' Show, in my home city, Toronto.

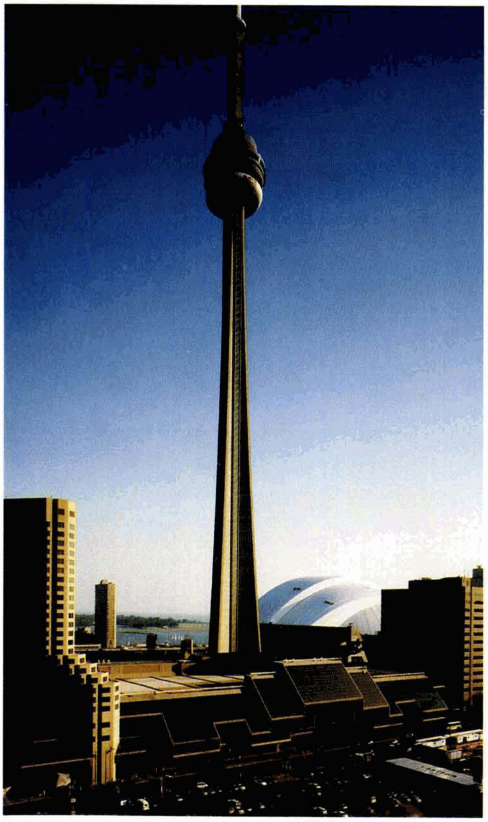
It has been eight years since these twin events have been held in Canada—in Montreal, in 1983—and the first time in Toronto. The theme of the Annual Meeting reflects the truly international nature of the convention, "The International Coatings Environment: Today's Opportunity, Tomorrow's Challenge." Over 60 technical presentations will be offered by many of the leading professionals in the coatings industry. Topics will emphasize the international perspective and will focus on such areas as quality improvement, cutting edge technology, and environmentally and performance engineered products.

The internationally acclaimed Paint Industries' Show will be held concurrently with the technical presentations and will feature the latest in products and services of over 230 exhibiting supplier companies.

Both of these events, housed in the magnificent Metro Toronto Convention Centre, will offer opportunities to learn of the advances being made in today's industry and to generate ideas for future progress.

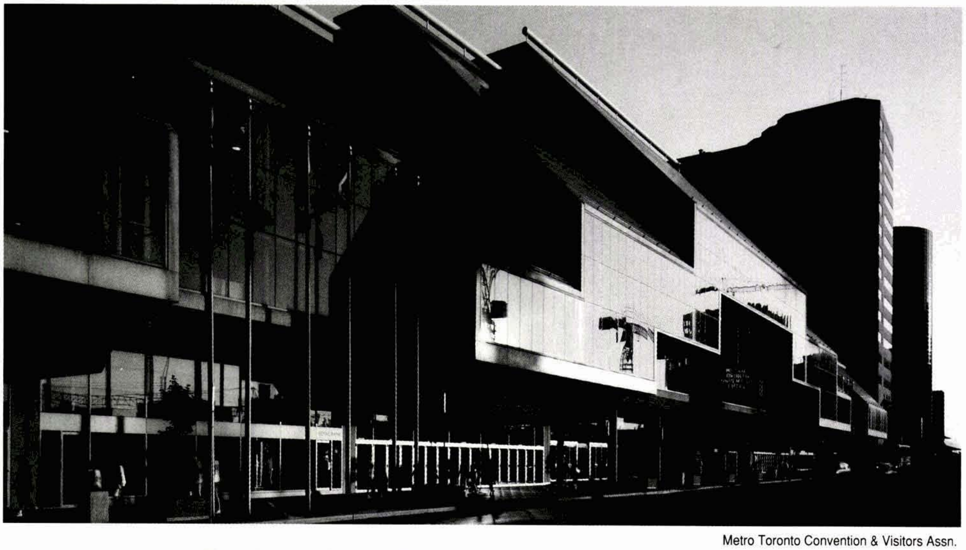
Please join us in Toronto, and experience the joy that is Canada!

Kurt F. Weitz
President, FSCT



Metro Toronto Convention & Visitors Assn.

Metro Toronto Convention Centre is conveniently located next to the CN Tower, the SkyDome, L'Hotel, and Lake Ontario



Metro Toronto Convention & Visitors Assn.

Metro Toronto Convention Centre—Canada's largest convention facility

Guess which surfactant line reflects everything you want in your water-based inks and coatings. Surfȳnol® surfactants.

What do you want from your surfactant? Coverage over difficult to wet surfaces? Rapid wetting and color development? Defoaming? Low water sensitivity and viscosity? All of the above?

Then all you really want is one of our Surfȳnol surfactants. Surfȳnol is the most broad-based surfactant line for high performance water-based inks and coatings. Each of the more than two dozen Surfȳnol surfactants is *multi-functional*, so you're never forced to choose one desired property at the expense of another.

Somewhere in the Surfȳnol line you'll find a surfactant that provides precisely the combination of benefits you're looking for, including superb dynamic wetting, excellent coverage on contaminated surfaces, stable pigment dispersions, reduced risk of water sensitivity problems—and, of course, foam control.

Just as importantly, Air Products can offer you the technical expertise to make our quality surfactants work for you. Take the guesswork out. Use a Surfȳnol surfactant. For a free sample, call (800) 345-3148 or (215) 481-6799. In Europe, call 31-30-511828. Or for more information, send in this coupon to Air Products and Chemicals, Inc., Chemicals Customer Service, 7201 Hamilton Boulevard, Allentown, PA 18195-1501.

Air Products and Chemicals, Inc.,
Chemicals Customer Service,
7201 Hamilton Boulevard,
Allentown, PA 18195-1501.
Yes, I'd like more information on Surfȳnol surfactants.
Please send to:

Name ____________________

Company ____________________

Address ____________________

City __________ State ______ Zip ______

Telephone ____________________

Desired Application ____________________

____________________ JCT

More than chemicals. Chemistry.

AIR PRODUCTS

FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY
1991 ANNUAL MEETING AND PAINT INDUSTRIES' SHOW
METRO TORONTO CONVENTION CENTRE
MONDAY, TUESDAY, AND WEDNESDAY, NOVEMBER 4, 5, 6, 1991

The combined Annual Meeting and Paint Industries' Show is a major educational activity of the Federation. This international coatings manufacturing industry event consists of three days of technical program sessions and exhibits, running concurrently. Registration is required for admission.

"INTERNATIONAL COATINGS ENVIRONMENT: TODAY'S OPPORTUNITY, TOMORROW'S CHALLENGE"

The theme of the 1991 Annual Meeting underscores that today's coatings environment requires pro-active marketing and technology strategies. An opportunity today will be a challenge tomorrow if not addressed in a timely and effective manner. To address this theme, programming will emphasize the international perspective and will focus on such topics as quality improvement, cutting edge technology, and environmentally and performance engineered products. Also on the program will be the Mattiello Memorial Lecture, Roon Award Papers, Society Papers, and Seminars. Speakers will come from throughout the world of coatings science and manufacture.

INTERNATIONAL PAINT SHOW WILL FEATURE THE PRODUCTS/SERVICES OF MORE THAN 230 EXHIBITORS

The Paint Industries' Show — the largest and best international exhibit of its kind in the world — will feature attractive exhibitor displays devoted to a wide variety of raw materials, production equipment, containers, laboratory apparatus, testing devices, and services furnished to the coatings manufacturing industry.

The purpose of the Show is to provide attendees with an opportunity to learn of the latest developments in these products and services. Key personnel from the top technical and sales staffs of exhibitors will be on hand. More than 230 exhibitors from the U.S., Canada, and Europe will utilize over 82,000 net square feet of exhibit space at the Show.

Exhibit hours will be:

10:00-5:30	Monday, Nov. 4
8:00-5:30	Tuesday, Nov. 5
8:00-Noon	Wednesday, Nov. 6

AMERICAN AIRLINES AND AIR CANADA OFFER SPECIAL FARES TO TORONTO

American Airlines and Air Canada, in cooperation with the FSCT, are offering special discounted fares which afford passengers a 25-40% minimum savings off their round trip, undiscounted day coach fares for travel to the FSCT Annual Meeting and Paint Industries' Show on the airlines' domestic systems.

To take advantage of these discounts, you must:

(1) Travel between October 28-November 12, 1991;

(2) Purchase tickets at least seven days in advance;

(3) Phone 1-800-433-1790 (for American Airlines) or 1-800-361-7585 (for Air Canada) for reservations. Immediately reference the FSCT file number: **Star File #S-0201CN** (for American Airlines) or **File #917086** (for Air Canada). The special fares are available only through these numbers.

Discounts are good for both direct and connecting flights to Toronto. If you use a travel agent, have your reservations placed through the toll-free number to obtain the same fare advantages. Both American Airlines and Air Canada have a variety of other promotional fares, some of which may represent even greater savings. When you phone for reservations, ask for the best discount applicable to your itinerary.

FEDERATION BOARD OF DIRECTORS TO MEET ON SUNDAY AT SHERATON

The Board of Directors of the Federation will meet on Sunday, November 3, at 9:00 a.m. in the Sheraton Centre Hotel.

FEDERATION ANNUAL LUNCHEON WILL BE HELD ON WEDNESDAY

The annual Federation Luncheon will be held on Wednesday, November 6, at the Metro Toronto Convention Centre.

PARTICIPATING HOTELS

SHERATON CENTRE (Co-headquarters)

Toronto's largest convention hotel located downtown opposite City Hall. The two-acre property contains four restaurants and two lounges as well as indoor/ outdoor pool. Non-smoking rooms and facilities for the disabled available. 416-361-1000

ROYAL YORK (Co-headquarters)

Large convention hotel connected to the city's underground shopping network. Six dining spots and non-smoking rooms available. Gym/health club on premises. 416-368-2511

WESTIN HARBOUR CASTLE

Nestled on the shores of Lake Ontario, the hotel offers a resort setting. Three restaurants and two lounges are on the premises. Non-smoking rooms and rooms for handicapped available. 416-869-1600

MARRIOTT EATON CENTRE

Newest hotel in Toronto, next to Eaton Centre, offers two restaurants, two lounges, and complete health club with indoor pool. 416-597-9200

HILTON INTERNATIONAL

Downtown hotel connected to miles of underground shopping malls and restaurants. Indoor pool and health club plus two restaurants and two lounges. 416-869-3187

HOLIDAY INN DOWNTOWN CITY HALL

Adjacent to City Hall, this downtown hotel has three dining spots. Non-smoking floors and full fitness facility on premises. 416-977-0707

BOND PLACE

Situated in the heart of downtown. Non-smoking floors available. Wheelchair access and ample parking. Features cafe and lounge. 416-362-6061

KING EDWARD

Located in heart of the financial district, this historic landmark hotel features world-class elegance. Contains health spa, two restaurants and piano bar. 416-863-9700

L'HOTEL

Connected to Convention Center. Features health club with pool, three restaurants, and a lounge. 416-597-1400

SPOUSES TOUR TO INCLUDE SIGHTS OF THE CITY AND THE ROYAL ONTARIO MUSEUM

Spouses activities will begin on Monday with an afternoon social in the Metro Toronto Convention Centre. On Tuesday, following a continental breakfast, registered spouses will take a guided tour of the city in a deluxe air-conditioned motorcoach. Included will be such famous landmarks as the prize-winning City Hall, Osgoode Hall, the spectacular Eaton Centre, quaint old St. Lawrence Market, Harbourfront and Queen's Quay, the SkyDome, the gracious University of Toronto Campus, and Casa Loma, Canada's only castle.

An elegant three-course luncheon will be served at famous Ed's Warehouse. After lunch, the tour will continue to the magnificent Royal Ontario Museum. The Museum offers visitors a unique combination of earth and life sciences, fine art and archaeology. The internationally acclaimed collections include Egyptian mummies, Chinese artifacts, and Ming Tomb and even twelve complete dinosaur skeletons. Following the tour of the museum the spouses may either shop in the chic boutiques of Hazelton Lanes or return by motorcoach to the hotel.

Wednesday morning will be a free morning for spouses to continue their exploration of Toronto on their own. The Federation luncheon will be held in the Convention Centre at noon. Tickets will be available at the registration area.

Metro Toronto Convention & Visitors Assn.

Casa Loma, a 98-room "dream castle"— one of the many attractions to be enjoyed in cosmopolitan Toronto

HOTEL ROOM AND SUITE RATES*

Map Key	Hotel	Singles	Doubles/Twins	Suites 1 BR	Suites 2 BR
1	Sheraton Centre	$140	$155	$300-412	$360-700
	Towers	152	183		
2	Royal York	140	155	425-875	565-1,425
3	Westin Harbour Castle	140	160	250	375
4	Marriott Eaton Centre	139	149		
5	Hilton International	140	155	324	446-900
6	Holiday Inn Downtown City Hall	99	109	175	400
7	Bond Place	89	89		
8	King Edward	165	165	360-485	525-650
9	L'Hotel	145	160	295-400	375-490

*The rates are quoted in Canadian funds. At the present time the U.S. dollar is worth $1.13 Canadian. (To determine the rates in U.S. dollars multiply by .87). The rates are subject to Provincial and Goods and Services Tax and other applicable taxes.

SHUTTLE BUS SERVICE

Shuttle bus service will be provided between the cooperating hotels and the Metro Toronto Convention Centre beginning Sunday, November 3

APPLICATION FOR HOTEL ACCOMMODATIONS

Mail to:	**FSCT Housing Bureau** **P.O. Box 126** **207 Queen's Quay West** **Toronto, Ont., M5J 1A7** **Canada** **Fax: 416-367-9088**
By 10/4/91	

Please indicate below the type of accommodations desired and choice of hotels. (Refer to hotel map and rates on opposite page). All reservations will be processed by the FSCT Housing Bureau. Hotel assignments will be made in accordance with prevailing availability. You will receive an acknowledgment from the Housing Bureau. This is not the hotel confirmation. That will come directly to you from the hotel to which you have been assigned. Prior to October 4, all changes must be made, in writing, through the Housing Bureau. After October 4, all modifications should be made directly with the hotel.

A one-nights' deposit MUST accompany each housing request. Checks or credit cards may be used. Checks **must** be made out to FSCT Housing Bureau.

TYPE OF ACCOMMODATION	NUMBER	RATE	CHOICE OF HOTEL
Single (1 person, 1 bed)	______	______	(1) ______
Twin (2 people, 2 beds)	______	______	(2) ______
Double (2 people, 1 bed)	______	______	(3) ______
Suite (parlor and 1 bedroom)	______	______	(4) ______
Suite (parlor and 2 bedrooms)	______	______	

NAMES OF ROOM OCCUPANTS AND DATES OF ARRIVAL/DEPARTURE

Type of Room	Name	Dates Arrive	Depart

Please Type Additional Reservations on a Separate Sheet and Attach to This Form

SEND CONFIRMATION FOR ALL RESERVATIONS TO:

Name ______________________ Telephone ______________

Company ______________________ FAX ______________

Address ______________________

City, State, Zip ______________________

Country ______________________

Name of Credit Card ______________ Signature ______________

Credit Card Number ______________ Exp. Date ______________

Note: Requests for accommodations at either the Sheraton Centre or the Royal York will be limited to 10 rooms per company. A parlor counts as one room.

HOW TO MAKE YOUR ARRANGEMENTS

1. To place AIRLINE reservations, call the toll free numbers for American Airlines and Air Canada.

2. To make HOTEL reservations, mail or fax the housing application to the FSCT Housing Bureau. Housing cut-off date is October 4.

3. REGISTER IN ADVANCE for the Annual Meeting and Paint Industries' Show by filling out the form and mailing it as instructed with your registration payment.

4. To register your SPOUSE or GUEST, fill out the spouse portion of the advance registration form.

5. Mark NOVEMBER 4-6 on your calendar. Don't forget—you get a discount if you register by October 4.

HOTEL RESERVATION INSTRUCTIONS

(1) Reservations must be made by October 4, 1991. Reservations may be mailed or faxed. Phone calls will NOT be accepted.

(2) Acknowledgments will be mailed. Please allow 30 days for receipt of acknowledgment. Hotel confirmations will follow the Housing Bureau acknowledgment.

(3) A one-night's deposit **must** accompany each housing request. Requests will not be processed without deposit or credit card. Acceptable payments include: personal check, bank draft, and certified check. Checks should be made payable to FSCT Housing Bureau. Credit cards may be used.

(4) Keep a photocopy of your housing request.

(5) Prior to October 4, all changes must be made through the Housing Bureau. Changes should be made in letter form. Phone calls will be not accepted. After October 4, all changes should be made directly with hotel.

NON-EXHIBITOR REGISTRATION

Advance register to attend the 1991 Annual Meeting and Paint Industries' Show by filling out the form included in this brochure.

The registration options are listed below. Advance registration forms must be received by October 4.

Register in Advance and SAVE!

Full Time	Advance	On-Site
Member	$65	$75
Non-member	$80	$95
Spouse	$50	$60

Advance Registration

If you register in advance you may pick up your badge in the Convention Centre during the following hours:

Saturday, Nov. 2 .... 1:00 pm - 5:00 pm
Sunday, Nov. 3 .... 8:00 am - 7:00 pm
Monday-Tuesday, Nov. 4-5..... 7:30 am - 5:30 pm
Wednesday, Nov. 6 .... 7:30 am - 12:00 noon

On-Site Registration

Register at Convention Centre.

Sunday, Nov. 3 .... 8:00 am - 7:00 pm
Monday-Tuesday, Nov. 4-5 ..... 7:30 am - 5:30 pm
Wednesday, Nov. 6 .... 7:30 am - 12:00 noon

Cancellation and Refund Policy

All cancellations must be submitted in writing to the FSCT Headquarters Office. Cancellations received by October 4 will be subject to a $10 handling charge. *No refunds will be issued after that date.*

COST OF TRANSPORTATION

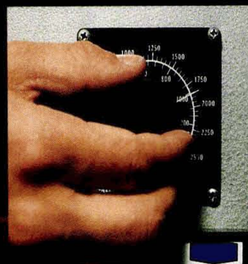
(from Pearson International Airport)

Airport Express Bus (every 20 minutes to downtown hotels) $10.00

Limousine .... $32-$34.00

Taxi $29.00

(Quoted in Canadian dollars, plus 7% Goods and Services Tax.)



TRAVEL FROM THE U.S. TO CANADA

When you arrive at Lester B. Pearson International Airport, you are required to go through Customs & Immigration before collecting your baggage. (You will receive a Customs Declaration form onboard your inbound flight.)

Citizens and legal residents of the United States do not need visas to enter Canada. However, all American citizens must show proof of citizenship. Documents such as a birth certificate, passport, or "green card" are acceptable. You should also carry photo I.D. due to tightened security on all airlines. Naturalized citizens need naturalization certificates or other proof of citizenship. NOTE: A VALID DRIVER'S LICENSE IS NOT SUFFICIENT IDENTIFICATION.

Following immigration, proceed to the baggage claim area to collect your bags. Baggage carts (complimentary) and skycaps are on hand for luggage transfer. Due to tightened security no one other than inbound passengers and ground crew are allowed in the baggage claim area. You are then required to go through customs control.

Citizens of countries other than the United States should check with the Canadian Embassy or nearest Consulate before departure.

RETURN TO U.S. FROM CANADA

We suggest you allow a minimum of 2 to 2 1/2 hours before flight departures to check in to the airport. Upon arrival at Pearson International Airport, you are required to go through U.S. Customs and security with your bags.

DUTY FREE ALLOWANCES— U.S. VISITORS

For every 30 days, returning U.S. citizens are allowed to bring back duty free, $400 worth of personal or household merchandise, provided they have been out of the U.S. for 48 hours. This amount can include one carton of cigarettes, 100 cigars (no Cuban), one pound of smoking tobacco and 32 ounces of liquor. Goods bought in Canada but manufactured in the U.S. are duty free and not included in the basic exemption; however, a receipt of purchase may be required.

TAX REBATES

Provincial Sales Tax of 8% and Federal Goods and Services Tax of 7% are levied on goods and services purchased for use of consumption within Ontario. In general, visitors may apply for a refund of these taxes once they have accumulated $100 worth of receipts for non-disposable merchandise to be used outside Ontario. Sales Tax refund forms can be obtained on arrival in Toronto at the Transport Canada Information Desk or Canada Customs Office.

Metropolitan Toronto Convention & Visitors Assn.

Downtown Toronto and Harbourfront—Toronto's harbourfront features year-round recreational facilities, and is close to the SkyDome stadium and the CN Tower


DOWN
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1991 PAINT INDUSTRIES' SHOW

Current List of Exhibitors

ACS-Datacolor
Aceto Corp.
Advanced Coating Technologies
Advanced Software Designs
Air Products & Chemicals, Inc.
Akzo Chemicals Inc.
Alcoa Industrial Chemicals
Allied Signal, Inc.
American Cyanamid Co.
Amoco Chemical Co.
Anachemia Solvents Ltd.
ANGUS Chemical Co.
Anker Labelers USA, Inc.
Aqualon Co.
Arco Chemical Co.
Aries Software Corp.
Ashland Chemical Co., IC&S
Atlas Electric Devices Co.
Automated Filling Specialists Corp.

B&P Environmental Resources
BASF Corp.
Blackmer Pump Div., Dover Resources Co.
Bohlin Reologi, Inc.
Brookfield Engineering Labs., Inc.
Brookhaven Instruments Corp.
Buckman Laboratories, Inc.
Buhler, Inc.
Bulk Lift International, Inc.
Burgess Pigment Co.
Byk-Chemie USA
Byk-Gardner, Inc.

C B Mills, Inc.
CPI Purchasing Magazine
Cabot Corp., Cab-O-Sil & Special Blacks Div.
Calgon Corp., Div. of Merck & Co., Inc.
Canada Colors & Chemicals Ltd.
The Carborundum Co.
Cardolite Corp.
Cargill, Inc.
Carroll Scientific, Inc.
Caschem, Inc.
Catalyst Resources, Inc.
Chemical & Engineering News
Chemical Marketing Reporter
Chemical Week
Coatings Magazine
Color Corp. of America
Colores Hispania, S.A.
Colorgen, Inc.
Consolidated Research, Inc.
Coulter Electronics, Inc.
Cray Valley Products International
Crosfield Chemicals, Inc.
Custom Recovery Services, Inc.
Cyprus Industrial Minerals Co.

D/L Laboratories
DSA Consulting, Inc.
DSET Laboratories, Inc.
Daniel Products Co.
Day-Glo Color Corp.
DeFelsko Corp.
Degussa Corp.
University of Detroit
Dominion Colour Corp.
Dow Chemical USA
Dow Corning Corp.
Draiswerke, Inc.
Drew Chemical Corp.
Dry Branch Kaolin Co.
Du Pont Co.

E.C.C. America
Eagle Picher Minerals, Inc.
Eagle Zinc Co.
Eastern Michigan University
Eastman Chemical Products, Inc.
Eiger Machinery, Inc.
Elders Resources Chemicals Inc.
Elektro-Physik USA, Inc.
Elmar Industries, Inc.
Engelhard Corp., Spec. Min. & Colors Group
Epworth Manufacturing Co., Inc.
Etna Products Inc., Specialty Chemical Div.
Exxon Chemical Co.

FMC Corp., Food & Phamaceutical Div.
FMJ International
Fawcett Co., Inc.
FCF-Bowers, Inc.
Federation of Societies for Coatings Technology
Freeman Polymers Div./Cook Composites & Polymers
H.B. Fuller Co.

Paul N. Gardner Co., Inc.
B.F. Goodrich Co., Spec. Polym. & Chem. Div.
Goodyear Chemical Division
Guer-Tin Brothers Polymers

Halox Pigments, Div. of Hammond Lead Products
Harcros Pigments, Inc.
Henkel Corp., Process Chemicals
Hitox Corp. of America
Hockmeyer Equipment Corp.
Hoechst Celanese Corp.
Hoechst Celanese Corp. Waxes & Lubricants Group
Horiba Instruments, Inc.
Hüls America, Inc.
Hungarian Aluminium Corp.
Hunterlab

ICI Americas, Inc.
ICI Resins U.S.
Ideal Mfg. & Sales Corp.

S.C. Johnson Wax

K-T Feldspar Corp.
Kenrich Petrochemicals, Inc.
King Industries, Inc.
Kronos, Inc.

Labsphere
Laporte Absorbents, Inc.
Leeds & Northrup, A Unit of General Signal
Liquid Controls Corp.
The Lubrizol Corp., Coatings Technologies

3M, Industrial Chemicals Div.
MTS Colormetrie (France), Klieve
Macbeth Div., Kollmorgen Corp.
Malvern Minerals Co.
McWhorter, Inc.
The Mearl Corp.
Michelman, Inc.
Micro Powders, Inc.
Micromeritics Instrument Corp.
Mid-States Eng. & Mfg. Co.
Miller Manufacturing Co., Inc.
Millipore, Inc.
Milton Roy Co.
MiniFibers, Inc.
Minolta Corp.
Mississippi Lime Co.
University of Missouri-Rolla
Mixmor
Modern Paint & Coatings
Monsanto Co.
Morton International
Moulders Supply Ltd.
Mountain Minerals Co., Ltd.

NYCO
Nacan Products Ltd.
Netzsch Incorporated
Neupak, Inc.
New Way Packaging Machinery, Inc.
Nicolet Instrument Corp.
Nippon Shokubai America, Inc.

Obron Atlantic Corp.
Ortech International
Otsuka Electronics (U.S.A.) Inc.

PPG Industries, Silica Prods.
P Q Corporation
PRA Laboratories
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Construction Contracting Stabilizes in January

The decline of construction contracting in January was virtually unchanged from December 1990, according to the Dodge Index, compiled by the F.W. Dodge Division of McGraw-Hill, New York, NY.

The experts at Dodge believe the decline of construction contracting may be bottoming out, as evidenced by January's seasonally adjusted index of 132. The Dodge index for December 1990 was 133. The Index uses 1982 as its 100 base.

Even with the construction industry showing signs of steadying, officials at Dodge have cautioned that construction is not about to stage a strong rebound.

January's showing drew much of its support from public works projects as highway/bridge construction advanced 17% above its December 1990 value, and the smaller sewer/waste treatment category surged 23%. Total "nonbuilding" construction (public works and utilities) was up a seasonally adjusted 13%.

Nonresidential building contract value eased 1% in January. The opening month's contracting showed a familiar pattern of continued weakness in commercial/industrial construction which was offset by a gain in institutional building.

Residential building value tumbled another 7% in January, as starts of both single family homes and apartments/condos sagged side by side. It was the fourth consecutive month that Dodge reported a rate of total housing starts of less than one million units.

On an unadjusted basis, January's total construction contract value of $14 billion was 23% below the January 1990 amount. Most regions reported declines of between 20-30%, with one exception, the South Central, where January 1991 contracting was down 9%.

The Dodge Index measures the value of all newly started construction.

Society of Plastics Industry Releases Plastics Resins Data

The prodction of plastics resins totaled 4.35 billion pounds in December 1990, up 12.9% over the same month in 1989, according to a study by The Society of the Plastics Industry, Inc., Washington, D.C. The report was compiled by the Committee on Resins Statistics.

The December 1990 production figures are down 2.8% from the previous months' total. However, the production of plastics resins for 1990 totaled more than 53 billion pounds, up 7% over the same period in 1989.

Sales and captive (internal) use of plastics resins in December 1990 were approximately 3.95 billion pounds, a decrease of 0.4% from the same month in 1989. Also, December 1990 sales were down nearly 9% from November 1990. Sales and captive use year-to-date are 6.3% ahead of 1989.

The December 1990 figures are based on final data on selected major plastics materials.

For more information on production of plastics resins, write The Society of the Plastics Industry, Inc., 1275 K St., N.W., Suite 400, Washington, D.C. 20005.

SSPC Sponsors National Painter Competition

The Steel Structures Painting Council (SSPC), Pittsburgh, PA, held its First National Painter Competition during its national conference in Nashville, TN, on December 3, 1990.

The National Painter Competition is designed to emphasize the importance of craftsmanship to the protective coatings industry and to demonstrate good practice in the application of coatings.

Seven crews of three men each participated in this initial competition. Each three-man crew applied a topcoat to a preprimed steel panel with angles and pipe sections welded to it. The judges observed and rated the work of each team using a standard score sheet.

The participants were judged on their safety practices, such as: use of proper protective equipment and review of material safety data sheets, on their quality control checks, including measurement of ambient conditions and wet and dry film thicknesses; on set-up of equipment, and on mixing and thinning the coating according to manufacturer's instructions; and on application of stripe and finish coats. Each team consisted of a foreman, a craftsman, and an apprentice. All work had to be completed in one hour.

A team of painters from Service Painting Company, a unit of Brock Enterprises, Beaumont, TX, won the competition. Other teams in the competition were: Cannon/Sline, Philadelphia, PA, the second place finisher; Jeffco Painting and Coating, Martinez, CA, the third place winner; D.L. Smith, Pittsburgh, PA; Fish Engineering, Houston, TX; High Steel Structures, Lancaster, PA; and Irvin H. Whitehouse and Sons, Louisville, KY.

The next National Painter Competition will be held in conjunction with SSPC's National Conference and Exhibition, at the Long Beach Convention Center, Long Beach, CA, on November 10-15.

White—The Color of Choice Among U.S. Car Buyers

The color white was the U.S. automobile color of choice in 1990, according to the Du Pont Company's Automotive Products Division, Troy, MI.

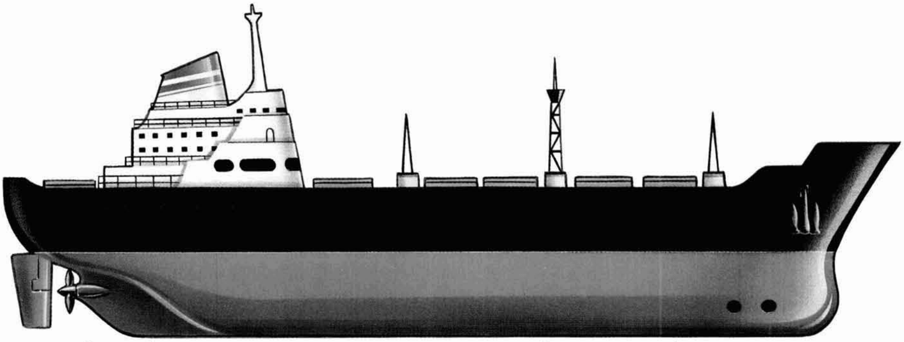
An average of 21.6% of each vehicle category was dominated by the color white. The other top five colors overall, in order, include, red, light blue, black, and silver.

In the light truck/van segment, which accounted for approximately 40% of all vehicles sold in 1990, white increased its leading share of 5% over 1989. Medium/dark blue was the second most popular choice in this category, followed by medium/dark red, black, and red.

For the third consecutive year, white was the car buyer's top choice for full/intermediate cars, which made up 36% of 1990 new car sales. Medium red was second, followed by medium gray, light blue, and silver.

In the sports and compact car category, red accounted for nearly 22% of the segment. White finished a close second, with light blue, black, and medium/dark gray finishing out the top five. Sales of the sport and compact cars accounted for 18% of the total vehicle market last year.

Luxury cars buyers, representing 6% of new vehicles sold in 1990, choose white as the most popular color. Light brown was second in consumer preference, followed by silver, medium red, and dark blue.



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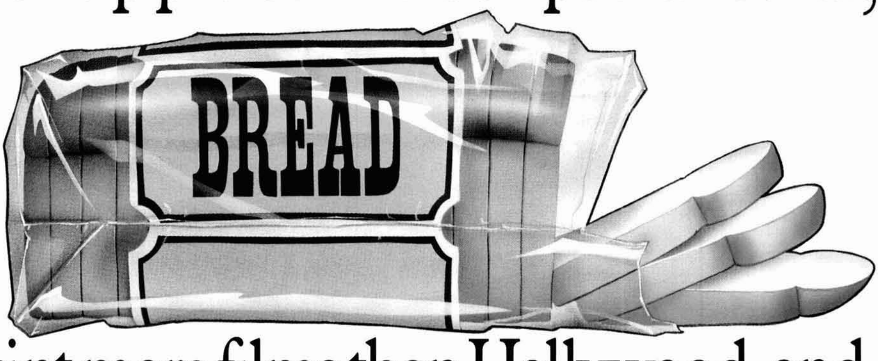

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Rauch Study Reports 1990 Paint Industry Production and Shipments

The U.S. paint industry registered estimated sales of $11.715 billion in 1990 and shipped 1.030 billion gallons of paints and allied products according to an industry study compiled by Rauch Associates, Inc., Bridgewater, NJ. Estimated 1990 results and projections to 1995 are presented in the new *Rauch Guide to the U.S. Paint Industry.*

The guide offers data on world paint production and paint shipments in Canada, Europe, and the leading world producers. Also, the publication describes the current use and consumption of raw materials. Marketing data on end uses and major suppliers are also included. The activities of 450 leading U.S. paint companies are described in this 224-page book.

The *Rauch Guide* indicates that the shipment of 1.03 billion gallons of paints and allied products represents a decrease of 3.6% from revised 1989 government data. Last year's downturn ends the upward trend that began in 1983, following the industry's 15-year low set in 1982. Estimated final 1990 paint shipments will increase only 3.5% in value, however, they will decrease 3.6% in units.

OEM finishes had the greatest unit decrease at 7.0%, architectural coatings decreased 4.0%, and special purpose coatings had a modest gain in unit production at 3.8%, according to the report.

The study states that near term growth is estimated at only 1.2% a year, reaching 1.092 billion gallons in 1995. Also, sales will increase to 15.6 billion, a 5.9% rate of change—less than the 10-year average. Analysis of market demand factors and technology transfer aspects for product finishes provide different growth rates by segment. The Rauch study predicts the volume of architectural coatings will increase at the rate of 1.2% a year versus 1.6% for the past 10 years. Special purpose coatings will have the highest increase at 3.9% a year, and product finishes, due to a changing mix to high solids coatings and other nonsolvent-based coatings, will decrease at the rate of 0.5%.

The study indicates that by category, architectural coatings continue to account for over 50% of industry shipments, OEM finishes with over 33% of unit shipments, and special purpose coatings with 16% of total shipments.

For more details on the *Rauch Guide to the U.S. Paint Industry*, write Rauch Associates, Inc., P.O. Box 6802, Bridgewater, NJ 08807.

RPM Enters into Agreement to Purchase Rust-Oleum Intl.

RPM, Inc., has contracted to purchase from Rust-Oleum International, a division of Rust-Oleum Corporation, the Rust-Oleum European business subsidiaries, Rust-Oleum Nederland BV and Rust-Oleum France SA. The contract calls for a long-term license agreement covering the use of Rust-Oleum names and trademarks in the European marketplace.

The closing of the agreement is expected to take place by July 1, after various required governmental filings are completed, and is subject to customary closing conditions.

State of New Jersey Forms Advocacy Council To Represent Paint and Coatings Companies

The state of New Jersey's paint and coatings industry has formed the New Jersey Paint Council. The advocacy organization will represent paint and coatings and allied products companies in the legislative, regulatory, communications, and education arenas.

The Council was developed by the National Paint and Coatings Association (NPCA), the New York Metropolitan Paint and Coatings Association (MNYPCA), and the Chemical Industry Council of New Jersey (CIC/NJ).

Peter Tepperman, Chief Executive Officer of Seagrave Coatings Corporation, has been elected to be the first Chairman of the New Jersey Paint Council. The group has held several organizational and legislative meetings and plans to host specialized environmental regulatory seminars for members.

Membership in the New Jersey Paint Council is open to all members of the NPCA, MNYPCA, and the Philadelphia Paint and Coatings Assocation.

The first public outreach program of the Council will be the donation of paint to refurbish the Morven mansion, once the New Jersey governor's mansion. The materials will be supplied by MNYPCA.

For further information about the New Jersey Paint Council, contact David Lloyd, Director, State Affairs Div., NPCA, 1500 Rhode Island Ave., N.W., Washington, D.C. 20005-5597.

Powder Coating Sales for 1990 Post a Nine Percent Gain

Statistics gathered by The Powder Coating Institute (PCI), Alexandria, VA, indicate that fourth quarter and year-end 1990 sales of general decorative formulated powder coatings remained above sales figures for the same time periods in 1989.

According to the data gathered by PCI, powder sales were up 3.4% for the fourth quarter of 1990 versus the same 1989 period. Year-end 1990 powder coating sales posted a 9% gain over the record 1989 sales level.

Further projections indicate the estimated total 1990 North American market for thin-film thermoset powder coatings was 116 million pounds, another record volume. This contrasts with a total market of 23 million pounds eight years ago.

The statistics show that sales of application equipment in the fourth quarter were weak, with the number of manual electrostatic spray guns off 11.3% for the year. The numbers of automatic spray guns and automatic installations were off by 1.1% and 2.1%, respectively, at year end.

In 1990, the dollar value of equipment was up by 5% over 1989. The industry estimate of total dollar sales of powder coating application and recovery equipment for 1990 approached $53 million.

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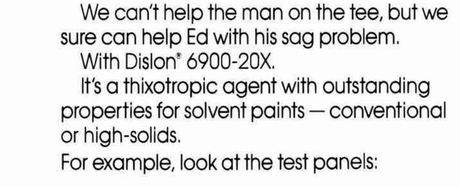

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Preservative Evaluation: Designing an Improved Test System

P.K. Cooke, U.R. Gandhi, E.S. Lashen, and E.L. Leasure
Rohm and Haas Company*

Conventional preservative test methods suffer from fundamental errors in experimental design, notable among them, the use of single, pure cultures of microorganisms grown on laboratory media. Additionally, they fail to consider that acclimated microorganisms can arise from diluted material found in the paint manufacturing process. A technique has been developed, based on the Springle method, which uses acclimated inocula in conjunction with pure cultures of microorganisms commonly found in spoiled paint products. Testing is done such that the effects of preservatives on both diluted and undiluted product can be determined reliably and accurately.

INTRODUCTION

Paint and latex preservatives are tested for effectiveness using variations of a three-step procedure: inoculation with microorganisms, incubation, and analysis to detect the presence of surviving microorganisms. It is here that the similarity ends. The type and number of microorganisms, the time length and temperature of incubation, the intervals at which the samples are analyzed, the method of analysis, and the number of times the test is applied ("cycles") vary greatly from one test to another. In addition, conventional test methods are often based upon assumptions that do not correlate well with actual conditions. Their design addresses "in-can" conditions; the manufacturing conditions that often underlie in-can spoilage are not taken into account.

The selection of a microorganism and how it is generated for use is a key component of preservative evaluations. The ASTM paint preservative test (ASTM D 2574-86)[1] uses a single organism, *Pseudomonas aeruginosa,* a troublesome, difficult-to-control organism commonly found in spoiled paints. An assumption is frequently made that if a given treatment is effective against this organism, it will be effective against other microbes as well.[2] Many biocide manufacturers and users also use a single organism, in order to simplify lab procedures, or may use a combination of *Pseudomonas aeruginosa* and another bacterium, *Enterobacter aerogenes.* Other, more elaborate test methods use these two bacteria in combination with other bacteria and fungi.[3,4]

Although the microorganisms may vary from one procedure to the next, they are typically grown in pure culture on microbiological media (or "lab media").[1,3,4] Pure cultures grown on lab media are used because they permit standardization of the inoculum, increase the reproducibility of the test, and are convenient. However, microorganisms grown on lab media are seldom representative of problem organisms encountered in the field, and their use can produce misleading test results.

As an example, it has been observed that latex emulsions that appeared to be adequately preserved when tested against laboratory cultures became contaminated in the field. However, when a naturally contaminated product was used as the inoculum, the test results were markedly different.* Microbes that have developed in this manner are termed "acclimated," as they have adapted to use the emulsion as a growth medium. These contaminated products are usually not pure cultures, but contain several different species.

The observed difference in test results from using laboratory cultures versus acclimated microorganisms is readily explained. When a culture is grown on lab media, the microorganisms are in an environment with an abundance of preferred nutrients, at a controlled and optimal pH, and

Based on a presentation given by Ms. Cooke at the 66th Annual Meeting of the Federation of Societies for Coatings Technology, in Chicago, IL, on October 19, 1988.
*Research Laboratories, 727 Norristown Rd., Spring House, PA 19477.

*This observation has been seen repeatedly and is supported by many years of preservative testing at Rohm and Haas Company. Additional details can be obtained by contacting the authors of this paper.

under favorable osmotic pressure. Once these microorganisms are transferred from such an optimal environment into a paint product or latex, the pH is likely to be different, and available nutrients are in low concentration and may be of a chemical composition not easily utilized. The stress that results from such a contrasting environment is often sufficient to kill the inoculum in the untreated control sample, making it appear that the product is not susceptible to microbial contamination. Alternatively, if a portion of the inoculum survives, the kill rate observed in preservative-treated samples may be largely attributable to stress, not biocidal efficacy.

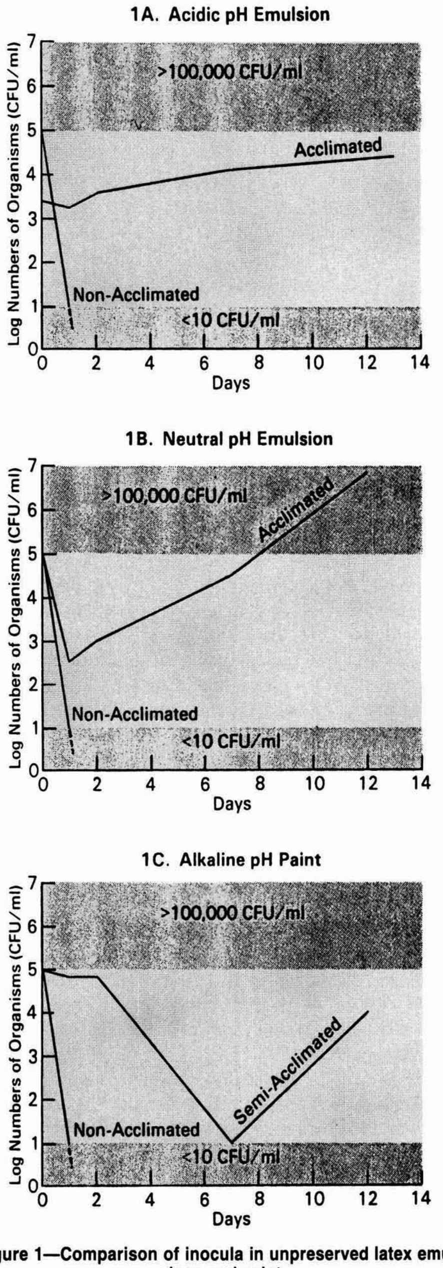


Figure 1—Comparison of inocula in unpreserved latex emulsions and paint

Paint preservative tests, in particular, often suffer from the inability of the test organisms to survive in unpreserved paint. The susceptibility of a given paint to microbial contamination is due to the interaction of a number of factors. Certain paint components such as pigments, binders, and thickeners (especially cellulosic ones) are themselves susceptible to growth and, therefore, contain preservatives, while solvents and mineral oil will not support growth unless traces of water are present. Once added to the paint, ingredients that can act as nutrients will contribute to susceptibility, while other components such as certain solvents and traces of preservatives carried over from other ingredients may act as inhibitors of microbial growth. The pH of the paint will affect susceptibility, paints of near neutrality being at greater risk of contamination, all other factors being equal. Thus, the susceptibility of a given paint is due to a combination of factors, and a finished paint may not permit survival of the nonacclimated microbes typically used in laboratory testing. However, when an acclimated inoculum is used, such paints may quickly become contaminated. This observation is seen in the following series of experiments, designed to study the ability of acclimated and nonacclimated inocula to survive and grow in unpreserved products.

TESTING WITH ACCLIMATED VERSUS NONACCLIMATED INOCULA

Duplicate samples of latex emulsions and a latex paint prepared without preservatives were inoculated with a spoiled product of the same, or similar, composition (the acclimated inocula) or with a mixture of *Pseudomonas aeruginosa* and *Enterobacter aerogenes* grown in pure culture on lab media (the nonacclimated inocula), then incubated at 25°C. Samples were analyzed at one day, two days, seven days, and 12 days by means of an agar streak plate technique to determine the number of surviving microorganisms. The agar plates were incubated at 30°C for seven days. The detection limit was 1 log or 10 Colony Forming Units (CFU) per mL of sample, unless noted.

When an acid pH latex emulsion (pH range of 3.5-5.0) was inoculated with 100,000 CFU per mL of nonacclimated inocula, no survivors were detected within one day. However, when inoculated with less than 10,000 CFU per mL of the acclimated inocula, those microorganisms survived and began growing, as seen in *Figure* 1A.

Similar results were obtained for a neutral pH latex emulsion (pH 6.5); a heavy, nonacclimated inoculum died off within one day. When treated with nearly 100,000 CFU per mL of acclimated inoculum, however, the number of survivors dropped off sharply at one day, then began to grow rapidly (*Figure* 1B).

An acrylic latex paint (pH 9.2) was tested using a contaminated emulsion (emulsion pH range 9.0-9.7) (similar to the one used to prepare the paint) as the inoculum. Since the inoculum was acclimated to one component of the paint, and not the paint itself, it was termed a "semi-acclimated" inoculum.

PHYLLIS K. COOKE holds the Associates Degree in Biological Science from Montgomery County Community College. She joined Rohm and Haas Company in 1968 and is currently researching the susceptibility of emulsions to microbial contamination and the effectiveness of preservatives at protecting them. Ms. Cooke is a member of the Society for Industrial Microbiology.

USHA R. GANDHI earned the B.S. Degree in Microbiology from the University of Bombay. She joined Rohm and Haas Company in 1983 and is currently responsible for the development and support of research into the microbiological activity of preservatives and mildewcides. Ms. Gandhi is a member of the Society for Industrial Microbiology.

EDWARD S. LASHEN received the B.S. Degree in Biology from City University of New York (Brooklyn College). He earned the M.S. Degree in Animal Physiology, Biochemistry, and the Ph.D. Degree in Microbiology from Rutgers University. In 1964, Dr. Lashen joined Rohm and Hass Company, initially studying the biodegradation of surfactants by microorganisms. He has also researched the antimicrobial activity of the isothiazolone class of chemical compounds. Dr. Lashen is currently Section Manager, Biocides Research Department, at Rohm and Haas.

EDWARD L. LEASURE earned the B.S. Degree in Chemistry from West Virginia Wesleyan College and the Ph.D. Degree in Physical Chemistry from Purdue University. Dr. Leasure is currently working on the MBA Degree at The Wharton School, University of Pennsylvania. Since joining Rohm and Haas in 1975, he has held positions of increasing responsibility in coatings research, including: Project Chemist, Project Leader, and Section Manager. Dr. Leasure is currently Marketing Manager, Interior Binders for Architectural Coatings, at Rohm and Haas.

In this system, the nonacclimated cultures also showed die off at one day. The semi-acclimated cultures died off slowly until no survivors were detected at seven days, but then began to grow rapidly (*Figure* 1C). This effect, or "regrowth," can occur because analysis is done using a very small sample (in this study, 0.1 mL) that may not contain microbes, although they may be present elsewhere in the paint where they can adapt to their new environment and grow.

These results demonstrate the importance of using acclimated or semi-acclimated inoculum in paint preservative testing. In addition, because of the possibility of regrowth, tests of short duration should be avoided as they can lead to the false conclusion that a paint or emulsion sample is adequately protected. This is even more critical when the inoculum is not fully acclimated, since microbes may require a longer time to overcome the shock of being transferred into a different environment.

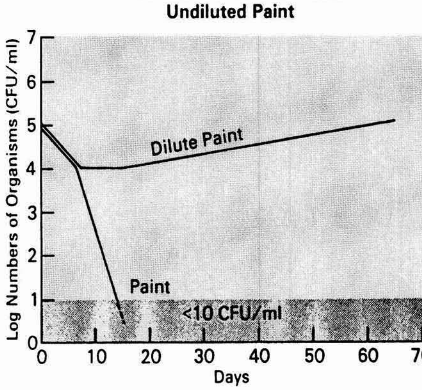
ADAPTATION AND THE USE OF DILUTED TEST SAMPLES

The studies noted previously show that heavy inocula of *Pseudomonas aeruginosa*, a difficult-to-control organism, are rapidly killed in the emulsions and paint tested. These results make it seem unlikely that acclimated organisms would arise and multiply in field conditions like a paint manufacturing plant. Yet, practical experience shows that this does occur.

In paint plants, skins of old material build up; water overlays can occur in storage tanks; condensation takes place in storage, mixing, or completion tanks; and rinse water from one production run may be used as dilution water for the next batch. Microorganisms that survive in such diluted product, or an accumulation of old product, can slowly adapt to increasing concentrations of the product. Eventually, they become able to survive, or even grow, in undiluted paint and, in addition, may build up a tolerance to the biocide being used. This "adaptation sequence" may take weeks or months to occur and can present a serious problem for the manufacturer.

As an example, when an acrylic paint of pH 9.2 was inoculated with microorganisms from pure cultures, the organisms died off within 14 days. However, when the

2A. Growth/Survival of Microorganisms from Pure Culture in Diluted and Undiluted Paint



2B. Growth/Survival of Acclimated Microorganisms in Undiluted Paint

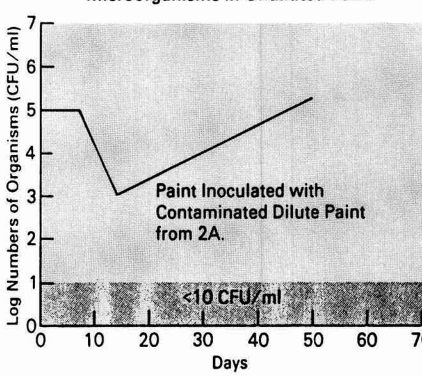


Figure 2—Microbial acclimation resulting from paint dilution

same paint at 50% strength was inoculated, a decrease at seven days, no change in 14 days, and subsequent growth after two weeks was observed. After a high level of contamination was reached, a portion of it was inoculated into fresh paint. Analysis of this sample showed a drop at 14 days, and then vigorous growth after two weeks (*Figure* 2).

These results demonstrate that, over a period of time, acclimated microorganisms can develop in diluted product. Therefore, the best test organisms for a given product are those that have adapted to use it as a growth medium. However, a sample of spoiled product is not always available. In this case, the development of adapted microorganisms can be simulated.

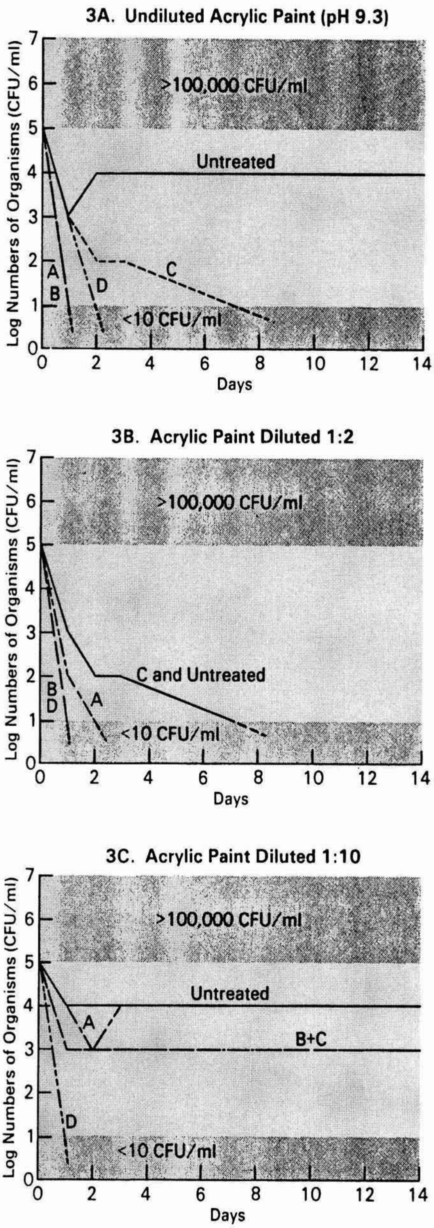


Figure 3—Effect of preservative treatments on microbial survival in acrylic paint. Treatment code A—Nuosept 95; treatment code B—Dowicil 75; treatment code C—Proxel CRL; and treatment code D—Kathon LX 1.5%

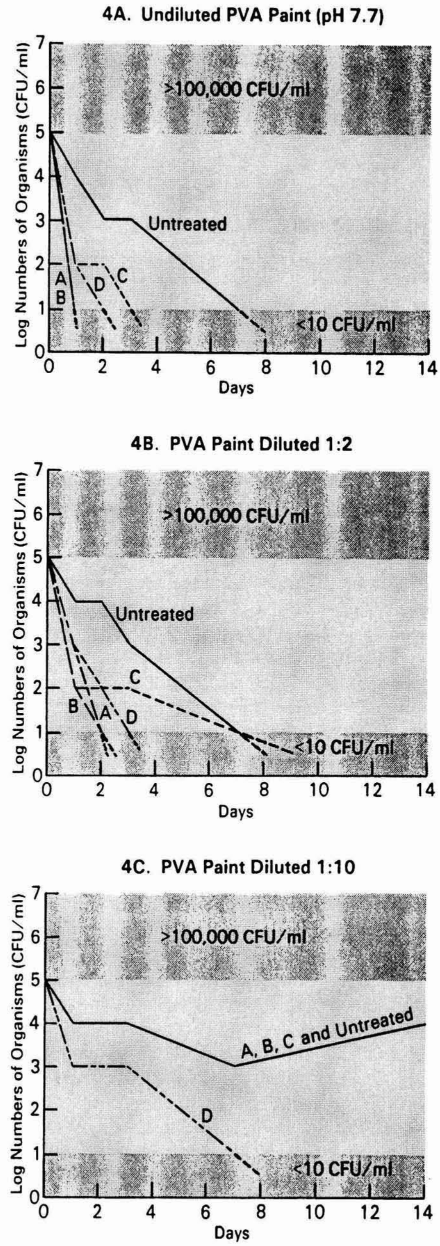


Figure 4—Effect of preservative treatments on microbial survival in PVA paint. Treatment code A—Nuosept 95; treatment code B—Dowicil 75; treatment code C—Proxel CRL; and treatment code D—Kathon LX 1.5%

MODELING ADAPTED MICROORGANISMS—THE MODIFIED SPRINGLE METHOD

In the Springle method[5] a portion of a paint sample is untreated, while other portions are treated with the biocide(s) of interest. These samples are subsequently diluted 1:2 and 1:10 in water. All the samples, diluted and undiluted, are then inoculated with a heavy load of *Pseudomonas aeruginosa* cells grown on laboratory media. Survival of the inoculum is monitored over a period of three weeks. Any samples free of contamination after three weeks are reinoculated and the cycle is repeated.

Although the undiluted, untreated paint may quickly kill the inoculum, the Springle method will show whether microorganisms are likely to survive in diluted paint as may occur under normal manufacturing conditions, survival being the necessary first step in the adaptation sequence. The Springle method can also be used to show the effectiveness of a given biocide in protecting diluted product. In this test, the undiluted paint would represent paint in the can, the 1:2 dilution could be taken as representative of dilution by condensation, and the 1:10 dilution would simulate rinse water.

The major limitation of the Springle method is its reliance on a single test species grown on laboratory medium. Therefore, to further improve the reliability of test results, the procedure was modified to use semi-acclimated inocula, that is, paints of similar composition in which several species of microorganisms had grown. In addition, about two dozen bacteria and fungi from pure culture, most of which had been isolated from naturally contaminated paints and emulsions, were also added. The pure cultures included *Pseudomonas aeruginosa, Pseudomonas fluorescens,* the filamentous fungus *Aspergillus niger,* and one yeast. These species were added in order to ensure that a broad range of spoilage organisms was present.

This modified Springle method was used to compare the activity of commonly used paint preservatives in an acrylic paint and a polyvinyl acetate (PVA) paint. Each was treated with the biocides described in *Table* 1, diluted 1:2 and 1:10, inoculated with the semi-acclimated/pure culture microorganisms, and then analyzed at intervals of one, two, three, seven, and 14 days. The number of survivors was rated on a scale of 0 to 4+, with a 0 rating equal to fewer than 10 CFU or 1 log, and a 4+ equal to greater than 100,000 CFU or 5 logs.

Results for the acrylic paint are shown in *Figures* 3A-3C. In the undiluted, untreated paint (the control), a decrease in numbers was observed at one day, followed by recovery at two days. A large number of microbes was able to survive for two weeks. (The acrylic paint was the same as that used in *Figure* 1C, in which the nonacclimated *Pseudomonas/Enterobacter* inoculum died off within one day.) All biocide treatments, except treatment C, reduced the number of survivors to undetectable levels within two days or less. There was no regrowth detected in any of the treated samples over the 14 day duration of the test.

In the 50% strength paint, treatments B and D reduced the contamination level to less than 10 CFU/mL within one day, treatment A required two days, and treatment C did so within seven days, as did the untreated control. At 10% concentration, a large proportion of the inoculum survived for 14 days in the untreated sample. However, the efficacy of the biocides was clearly differentiated: treatment D killed the inoculum within one day, treatment A gave results essentially similar to the untreated sample, while treatments B and C allowed survival of fewer organisms than the untreated sample.

Table 1—Biocides Tested Using the Modified Springle Method

Designation	Product	Level Tested[a]	Chemical Composition
Treatment A	Nuosept® 95	0.15%	subst. 1-aza-3,7-dioxabicyclo (3.3.0) octanes (50%)
Treatment B	Dowicil® 75	0.18%	subst. 3,5,7-triaza-1-azonia adamantane chloride (67.5%)
Treatment C	Proxel® CLR	0.1%	1,2-benzisothiazolone (30%)
Treatment D	Kathon® LX 1.5	0.165%	methylchloro/methyl isothiazolone (1.5%)

(a) Wt % based on product.
Nuosept is a registered tradename of Nuodex Incorporated.
Dowicil is a registered tradename of The Dow Chemical Company.
Proxel is a registered tradename of ICI.
Kathon is a registered tradename of Rohm and Haas Company.

In the PVA paint (pH 7.5), the inoculum died off in the undiluted, untreated paint at seven days. Of those undiluted paints treated with biocides, treatments A and B killed the inoculum within one day, treatment D required two days, and treatment C required three days (*Figure* 4A). No regrowth was detected in any of the samples over the test period.

Figures 4B and 4C show the effectiveness of preservatives on diluted samples. At 50% concentration, again the inoculum died off within seven days in the untreated control sample. Treatments A and B eradicated the inoculum within two days, treatment D within three days, and treatment C within seven days. At 10% concentration, survival of the inoculum was greatly enhanced versus the undiluted and 50% strength paints. Here, only treatment D was capable of killing the inoculum. In contrast, the untreated control and all other treatments caused some degree of kill up to seven days, followed by regrowth.

SUMMARY

Conventionally-designed paint preservative tests can result in inaccurate or unreliable results because they often fail to contaminate an undiluted, untreated paint or latex sample, leading to the incorrect conclusion that a preservative is not required. In addition, they do not factor in the ability of microorganisms to adapt to changing or new environments, as can occur in accumulations of old or dilute product during paint manufacture.

The Springle method overcomes a major limitation of conventional paint preservative tests because it uses diluted, as well as undiluted, test samples. However, its use of a single microorganism, *Pseudomonas aeruginosa,* may not best represent the type of microbes present in actual paint manufacturing environments.

The modified Springle method, described herein, addresses the fact that dilution creates a more favorable environment, and one that encourages acclimation of microorganisms. Therefore, its use of acclimated microorganisms, derived from spoiled paint products, as well as a representative group of organisms from pure culture, leads to more reliable test results and enables the effectiveness of a number of preservatives to be clearly differentiated.

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* * *

APPENDIX

Acrylic Paint (pH 9.2)

Water	70.3 lb
Natrosol (hydoxyethyl cellulose)	85 lb
Tamol® 731 (25%) dispersant	15 lb
Triton® CF-10	2.5 lb
Nopco® NDW	1.0 lb
Propylene glycol	25 lb

APPENDIX (Continued)

Ti-Pure R-902	250 lb
Talc	203 lb

Grind ingredients at high speed for 20 min then let down with following:

Rhoplex® AC 388 emulsion (acrylic)	459 lb
Nopco NDW	1.0 lb
Texanol® (2,2 ,4 trimethyl 1,3 pentanediol monoisobutyrate)	11.5 lb
Propylene glycol	35 lb
Natrosol (HEC)	17.5 lb
NH_4OH (28%)	2.0 lb

Tamol is a registered tradename of Rohm and Haas Company.
Triton is a registered tradename of Rohm and Haas Company.
Nopco is a registered tradename of Diamond Shamrock Corporation.
Rhoplex is a registered tradename of Rohm and Haas Company.
Texanol is a registered tradename of Eastman Kodak Company.

PVA Paint (pH 7.5)

Grind

Water	40.85 lb
Propylene glycol	40 lb
Colloids 643 (mineral oil + defoamer)	2.0 lb
Tamol 731	10.0 lb
Triton CF-10	2.0 lb
DMAE	2.0 lb
Zopaque RCL-9	250 lb
ASP-170	58 lb

Let down

Polyco 2161 (emulsion)	525 lb
Colloids 643	6.0 lb
Water	30 lb
Propylene glycol	35 lb
Texanol	14.4 lb
Natrosol	86.2 lb

Latent Amine Catalysts for Epoxy-Carboxy Hybrid Powder Coatings. Investigations On Phase Change Control of Reactivity

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North Dakota State University†

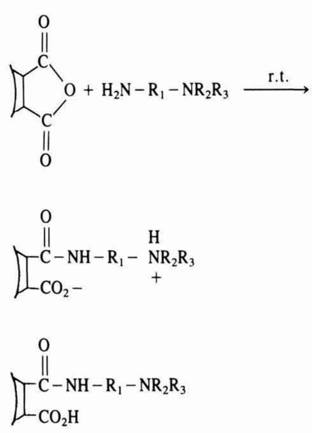
Ten crystalline amic acids, derived from four carboxylic acid anhydrides and four diamines, possessing both primary and tertiary amine groups, were synthesized and investigated as latent amine catalysts for bisphenol A epoxy-polyester carboxy (hybrid) powder coatings. On heating, the zwitterionic amic acids underwent thermally induced intramolecular cyclization to imides, which catalyzed the carboxylic acid-epoxide reaction leading to cure of the powder coatings. We reasoned that cyclic imidization might be facilitated by melting of the amic acids, in which case latency could be controlled by the melting point phase change. This premise was investigated by differential scanning calorimetry (DSC), thermogravimetric analysis, and thermal Fourier transform infrared studies on the amic acids together with DSC and storage stability studies on melt-mixed powder coatings. The premise that cure response may be controlled by a melting point phase change appears to be ideally exemplified by two of the amic acids (MPA/DMP and DMPA/DMP). The other acids exhibit poorer storage stability in the powder coatings and/or lower cure response. These deficiencies can be attributed in varying extents to low temperature, solid state imidization of the amic acids, solubilization of the amic acids prior to imidization, and lower catalytic cure response of the corresponding imides.

INTRODUCTION

Resins and curing agents for thermosetting powder coatings have been described, together with important characteristics of powder relative to liquid coatings.[1] A key issue is achieving an appropriate balance between good flow characteristics and reactivity.

Generally, it is important that crosslinking is delayed until after the powder particles have coalesced and formed a continuous film. Furthermore, it is desirable to effect cure at moderately, rather than highly, elevated temperatures. Consequently, it is of interest to design latent curing agents for powder coatings that remain essentially unreactive during the storage, processing, and film formation stages, yet respond within a relatively narrow temperature range following film formation.

With these objectives in mind, we have synthesized a series of amic acids and investigated their activity as latent catalysts for hybrid powder coatings, consisting of bisphenol A epoxy and carboxylic acid functional polyester resins. The crystalline amic acids were synthesized from four carboxylic acid anhydrides and four diamines, possessing both primary and tertiary amine groups, as illustrated in equation (1), which shows the amic acids in both their neutral and zwitterionic forms.



(1)

Presented at the 68th Annual Meeting of the Federation of Societies for Coatings Technology, in Washington, D.C., on October 30, 1990.
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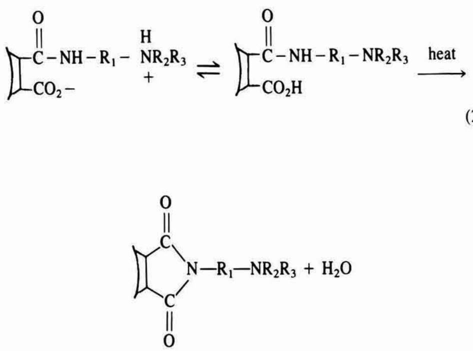
At elevated temperatures, the amic acids were expected to undergo thermally-induced intramolecular cyclization, as shown in equation (2), to the corresponding imides, which were expected to function as active catalysts for the epoxide-carboxylic reaction owing to the presence of available tertiary amine groups. Prior to imidization, catalytic activity of the amic acids was expected to be minimized by their probable existence in the zwitterionic form, resulting in low solubility and inactivation of the tertiary amine by protonation.



(2)

It was considered worthy of investigation to determine whether the cyclic imidization reaction might be facilitated by melting of the amic acids, in which case latency could be controlled, at least in part, by the melting point phase change. This prospect appeared highly desirable, since a narrow temperature range cure response could be anticipated, as well as reasonable, since intramolecular cyclization was expected to be facilitated by the substantial increases in free volume and molecular motions which accompany melting.

Herein, we report the results of our studies, including differential scanning calorimetry (DSC), Fourier transform infrared (FTIR) spectral analysis, and thermogravimetric analysis (TGA) on the amic acids, as well as DSC and storage stability of the powder coatings.

EXPERIMENTAL

General Methods

All solvents were distilled and dried prior to use. Amines were distilled and anhydrides were sublimed or recrystallized before use. Melting points were determined on a Thomas Hoover capillary melting point apparatus. Elemental analysis was done by Desert Analytical. NMR spectra were obtained on a Varian EM-390 (90 MHz) spectrometer in D_2O. Chemical shifts are reported relative to aromatic H, taken as 7.5 ppm. IR spectra on Nujol mulls were obtained on Mattson Fourier transform (FT) and Perkin Elmer 137 infrared spectrophotometers.

DSC and TGA were carried out on DuPont 990 and 2000 Thermal Analyzers, utilizing 910 DSC and 950 TGA modules and the DuPont General Analysis 4.0 Program. Heating rates were 10°C/min in TGA and DSC analysis of the amic acids and 5°C/min in DSC analysis of the powder coatings. Sample sizes ranged from 4 to 6 mg. The N_2 flow rate was ca. 50 mL/min for DSC analysis and less than 10 mL/min for TGA.

Synthesis of Amic Acids

Amic acids were synthesized from four anhydrides and five diamines, possessing both primary and tertiary amine groups. The anhydrides used were: phthalic anhydride (PA), 3-methylphthalic anhydride (MPA), 3,6-dimethylphthalic anhydride (DMPA), and cis-1,2-cyclohexane dicarboxylic acid anhydride (CHA). The amines used were: N,N-dimethylaminoethyl amine (DME), N,N-diethylaminoethyl amine (DEE), N,N-dimethylaminopropyl amine (DMP), N,N-diethylaminopropyl amine (DEP), and N-aminopropyl morpholine. All anhydrides and amines were commercially available, except MPA and DMPA, which were prepared in accordance with references (2) and (3), respectively.

A general synthetic procedure for the amic acids was utilized in which a solution of the amine (4% molar excess) was added drop-wise to the stirred anhydride solution under ambient conditions. Acetonitrile or 1,2-dichloroethane was used as solvent. The amic acid usually precipitated during the amine addition or was precipitated by cooling the reaction mixture in a refrigerator

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overnight. The amic acids were filtered, washed with cold solvent, and dried under vacuum for two days.

Ten crystalline amic acids were obtained by this procedure in yields of greater than 80%, except PA/DME (71%) and DMPA/DME (40%). Attempts to obtain PA/DEE as a solid were unsuccessful.

The general procedure is illustrated by the synthesis of PA/DMP, as follows: DMP (0.44 mL, 5.2 mmol) in acetonitrile (5 mL) was added dropwise, at room temperature, under a N_2 purge, to a stirred solution of PA (0.442 g, 5.0 mmol) in acetonitrile (25 mL). A fine white precipitate formed immediately upon addition of the amine. The solution was stirred at room temperature for an additional hour and, subsequently, placed in a refrigerator overnight.

The precipitate was filtered, washed with cold acetonitrile, and dried under vacuum for two days to yield the amic acid (0.785 g, 93% yield): mp 152-154°C; IR (Nujol mull) 1590 (CO_2), 164 (CO-NH), 2260 (amine salt), and 3250 (amide NH) cm^{-1}; NMR (D_2O) 2.2 (2H, CH_2, m), 3.1 (6H, N-Me, s), 3.4-3.6 (4H, CH_2, m), and 7.5 (4H, ArH, m) ppm; Anal. Calcd. for $C_{13}H_{18}N_2O_3$: C, 62.4; and H, 7.2. Found: C, 62.29; and H, 7.23.

When the reaction solvent was 1,2-dichloroethane, PA/DMP was isolated in 53% yield, mp 153-155 °C.

Synthesis of Cyclic Imides

Cyclic imides corresponding to PA/DME and PA/Morph amic acids were synthesized by methods of Moore and Rapala.[4]

PA/DME IMIDE: PA (0.74 g, 5.0 mmol) was reacted with DME (0.81 mL, 5.0 mmol) at 140-160°C for 2 hr, resulting in a clear orange solution. A solid product was obtained on cooling in a refrigerator overnight. Recrystallization from absolute ethanol provided the cyclic imide as fine white crystals, mp 103-105°C (lit.[4] mp 104-105°C); IR (Nujol mull) 1710 and 1790 cm^{-1} (imide). The corresponding PA/DME amic acid had mp 133-134°C.

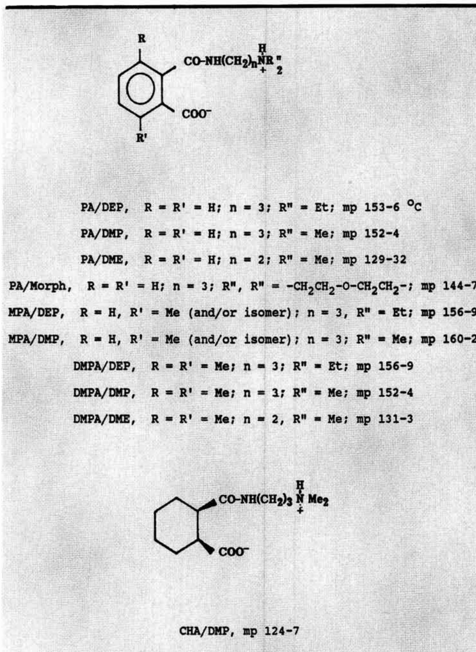
PA/MORPH IMIDE: Phthalimide (0.74 g, 5.0 mmol) was reacted with N-aminopropyl morpholine (0.73 mL, 5 mmol) in absolute ethanol (5 mL) for 2½ hr at 110-120°C, resulting in a viscous clear liquid on cooling. The alcohol was removed by roto-evaporation, followed by the addition of diethyl ether which induced crystallization. After filtration and vacuum drying, the imide was obtained as an off-white solid, mp 101-103°C; IR (Nujol mull) 1710 and 1790 cm^{-1} (imide). The corresponding PA/Morph amic acid had mp 146-147°C.

Thermal Imidization of Amic Acids

The amic acids in Nujol mulls were placed in the thermal IR cell of a Mattson FTIR spectrophotometer and heated in stages. The temperature was raised in 10-15°C increments and held for 15 min at each stage until the characteristic cyclic imide bands appeared.

Powder Coatings Preparation by Melt-Mixing

Powder coatings were prepared in 10 g quantities utilizing a micro-melt mixer, developed in our laboratories.



Scheme 1—Amic acids

The powder coatings consisted of a carboxylic acid functional polyester resin (Uralac P3450, DSM) and a bisphenol A epoxy resin (Araldit GT 7004, CIBA GEIGY Corporation) in a 70:30 wt ratio (1.16:1 carboxy:epoxy equivalent ratio). The amic acid catalysts were added in appropriate amounts to provide 5 and 10 eq% catalyst relative to epoxy equivalents, corresponding to ca. 0.5 and 1 wt% catalyst relative to total resin. For comparison, a commercial imidazole-type catalyst, Hüls B-31, was used at 0.1 wt%, since higher catalyst levels resulted in premature crosslinking. The samples were melt-mixed at ca. 125°C for 1½-2 min. Following melt-mixing, the samples were reground in a Waring coffee grinder to a fine powder.

Details on the micro-melt mixer will be presented at a later date. Similar DSC results were obtained with samples that were prepared in both the micro-melt mixer and a commercial extruder.

Storage Stability of Powder Coatings

Powder coating samples of ca. 1 g, prepared by melt-mixing, were placed in a 40°C oven for one month to evaluate storage stability. Following the storage period, the samples were reanalyzed by DSC to determine changes in the cure exotherm.

RESULTS AND DISCUSSION

Amic Acids—Synthesis and Melting Points

The amic acids, which were synthesized and characterized, together with their melting points in °C, are provided in *Scheme* 1.

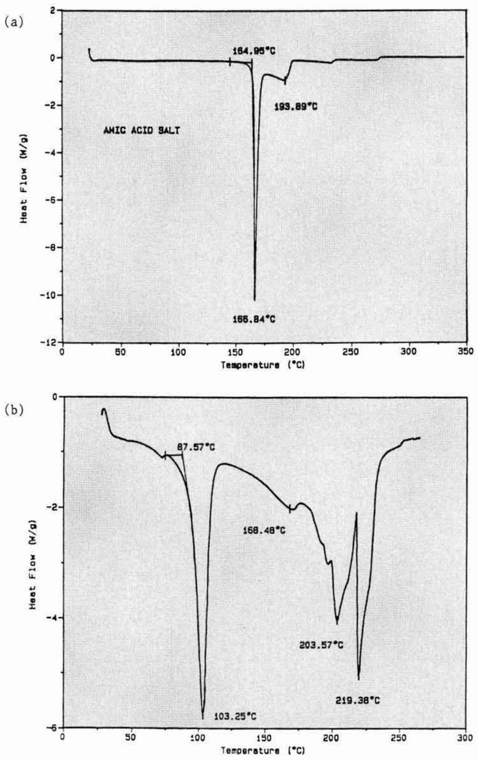


Figure 1—DSC scans of: (a)—MPA/DMP amic acid; and (b)—Hüls B-31 (commercial catalyst)

The indicated zwitterionic structures are consistent with IR spectra, which exhibit characteristic protonated ammonium cation and carboxylate anion absorbances at ca. 2250-2700 and 1550-1650 cm^{-1}, respectively. Reaction of the amines with MPA can occur to give structural isomers, although the indicated isomer resulting from reaction at the less hindered carbonyl anhydride group is expected to be favored.

The amic acids derived from the aromatic anhydrides (PA, MPA, and DMPA) and the propyl amines (DEP and DMP) melt in the 150-160° range. The corresponding morpholine-derived amic acid (PA/Morph) melts at ca. 145°; and the ethyl amine-derived aromatic amic acids (PA/DME and DMPA/DME) melt at substantially lower temperatures, ca. 130°. The corresponding PA/DEE amic acid, which is not investigated herein, could not be induced to crystallize and may well exist as a liquid or low melting solid at room temperature. The aliphatic amic acid (CHA/DMP) melts at ca. 30-35° lower than the corresponding aromatic analogs (PA/DMP, MPA/DMP, and DMPA/DMP).

Amic Acids—Thermal and FTIR Analysis

DSC data on the amic acids, together with their melting points, are provided in *Table* 1. The DSC scans generally show two endotherms in the temperature region of interest. The onset temperature for the first endotherm and temperatures corresponding to the maxima of the first and second endotherms are given in the table. DSC analysis of a commercial imidazole-type catalyst (Hüls B-31) for hybrid powder coatings is also included, since this catalyst was used in comparative studies with powder coatings. DSC scans for MPA/DMP and Hüls B-31, which exhibited four endotherms, are provided in *Figure* 1.

As shown in *Table* 1, the temperature of the first endothermic maximum from DSC corresponds closely to the mp of the amic acids (within ca. 10°). However, the onset temperatures range from ca. 4° (for MPA/DMP) to 40° (for CHA/DMP) below the first endothermic maximum temperatures.

We considered the possibility that the low DSC onset temperatures might be indicative of imidization of the amic acid in the solid state. To test this hypothesis, the cyclic imides of PA/DME and PA/Morph were prepared and found to melt at 103-105° and 101-103°C, respectively, ca. 26° and 43° below the melting point of the corresponding amic acids. Accordingly, the DSC onset temperatures were 104° and 110°C, ca. 23° and 36° below the first endotherm maxima for the corresponding amic acids.

Direct evidence for cyclization of the amic acids in the solid state was obtained from FTIR studies. Utilizing a thermal FTIR cell and step-wise increases in temperature, as described in the Experimental section, the appearance of characteristic imide bands was noted at 102° and 99°C for PA/DME and PA/Morph, respectively. Direct evidence for the onset of imidization of PA/DEP, PA/DMP, and CHA/DMP in the solid state was also obtained from thermal FTIR studies, shown in *Table* 2. Evidence for endothermic, solid state imidization of a polyamic acid has been reported.[5]

The results of TGA of the amic acids, together with their melting points, are provided in *Table* 3. Onset temperatures for weight loss, which were determined using an expanded weight loss scale to improve accuracy and inflection temperatures, when observed, are included.

When inflection temperatures are observed, the onset temperatures are substantially below melting points. In the case of PA/DME, weight loss (7.5%) between the onset (88°) and inflection (113°) temperatures corresponds to one equivalent of water, suggestive that imidization (which involves the elimination of water) is occurring within this temperature range. Beyond the inflection temperature, weight loss is precipitous and rapidly approaches 100%, corresponding to complete volatilization

Table 1—DSC Analysis of Amic Acids

Amic Acid (mp, °C)	DSC Endotherms Onset and Peak Maxima Temp., °C
PA/DEP (153-156)	111, 142, 180
PA/DMP (152-154)	138, 154, 189
PA/DME (129-132)	104, 127, 178
PA/Morph (144-147)	110, 146, 190
MPA/DEP (156-159)	118, 150, 192
MPA/DMP (160-162)	165, 167, 194
DMPA/DEP (156-159)	152, 162, 210
DMPA/DMP (152-154)	144, 152, 167
DMPA/DME (131-133)	125, 138, 196
CHA/DMP (124-127)	86, 124, 208
Hüls B-31	88, 103, 168, 204, 220

of the sample. Except for PA/DME and PA/DEP, which exhibit inflection temperatures 10-15° below and above melting points, respectively, inflection temperatures correspond closely to melting points of the amic acids. In all cases, a precipitous weight loss, corresponding to 100% volatilization of the sample, is observed beyond the inflection temperature.

When inflection temperatures are not observed, the onset temperatures are essentially at or within 10° of the melting point, except for CHA/DMP, for which the onset temperature is ca. 25° below the melting point. In all cases, the weight loss rapidly approaches complete volatilization of the sample, as shown for MPA/DMP in *Figure* 2.

The observed onsets of weight loss below the melting point are attributed to corresponding onsets of imidization in the solid state, in accordance with the DSC and IR studies. Precipitous weight losses are attributed to volatilization of the imide, since the corresponding amic acids are not expected to volatilize so readily. The available results indicate that the onset of imidization is occurring below the melting point for all amic acids derived from PA and CHA, as well as for DMPA/DME, and at or within 10° above the mp for the remaining amic acids (MPA/DEP, MPA/DMP, DMPA/DEP, and DMPA/DMP).

Powder Coatings—DSC Cure Analysis

DSC analysis of melt-mixed, epoxy-carboxy (hybrid) powder coatings is provided in *Table* 4. Two levels of each amic acid were used, ca. 0.5 and 1.0 wt% of total resins, corresponding to 5 and 10 eq% of epoxy equivalents (i.e., equivalents of amic acid/100 equivalents of epoxide groups). A commercial catalyst, Hüls B-31, was used at ca. 0.1 wt% of resins, since higher levels were known to cause premature reaction.[6] (Note that this tendency was confirmed in our storage stability tests: one month at 40°C, as shown in *Table* 5.)

Table 4 provides onset, maximum, and end temperatures, as well as enthalpies of the cure exotherms, which were observed for each sample, following the glass transition temperature (T_g) (ca. 61 ± 4°C). The average enthalpy values and their range from three runs for each sample are provided. A DSC scan of the high level DMPA/DMP powder coatings is shown in *Figure* 3A.

In the phthalic anhydride series, enthalpies fall within the range of ca. 68 to 77 kJ/eq epoxide groups, except for the low level PA/DME samples (45 kJ). Enthalpies of the aliphatic CHA/DMP and Hüls B-31 samples are at the high and low end of this range, respectively. Enthalpies of the MPA and DMPA samples also fall in this range except for the high level MPA/DMP, DMPA/DMP, and DMPA/DME samples, which exhibit enthalpies of 90 to 93 kJ.

It is noteworthy that the two powder coatings in which the amic acids are derived from DME, PA/DME, and DMPA/DME, exhibit the largest differences in enthalpies between the high and low level samples, ca. 23 and 26 kJ, respectively. The only other powder coatings which exhibit similar behavior also contain amic acids with dimethylamine groups, MPA/DMP and DMPA/DMP, for which the enthalpy differences are 16 and 18 kJ respectively. Furthermore, the powder coatings, which exhibit the highest enthalpies, ca. 90 to 93 kJ, are the high level MPA/DMP, DMPA/DMP, and DMPA/DME samples, all of which are dimethylamine analogs.

Aside from the aliphatic CHA/DMP amic acid, PA/DME and DMPA/DME exhibit the lowest melting points, as well as relatively low onset DSC endotherm and TGA weight loss temperatures, indicative of relatively low temperature imidization. Thus, the large differences in enthalpy at the two catalyst levels may reflect pre-reaction or volatilization during melt-mixing, which is expected to have a greater negative impact on the low level

Table 2—Onset Imidization Temperatures of PA- and CHA-Amic Acids

Amic Acid (mp, °C)	T_{onset} (°C) Imidization[a]
PA/DEP (153-156)	127
PA/DMP (152-154)	107
PA/DME (129-132)	102
PA/Morph (144-147)	99
CHA/DMP (124-127)	102

(a) Onset temperature for appearance of characteristic imide bands from thermal FTIR studies.

Table 3—TGA of Amic Acids

Amic Acid (mp, °C)	T_{onset}[a] (°C)	T_{infl}[b] (°C)
PA/DEP (153-156)	125	162
PA/DMP (152-154)	88	156
PA/DME (129-132)	88	113[c]
PA/Morph (144-147)	108	150
MPA/DEP (156-159)	153	—
MPA/DMP (160-162)	171	—
DMPA/DEP (156-159)	158	—
DMPA/DMP (152-154)	157	—
DMPA/DME (131-133)	67	130
CHA/DMP (124-127)	99	—

(a) Onset temperature of weight loss.
(b) Inflection temperature.
(c) Weight loss corresponds to one equivalent of water.

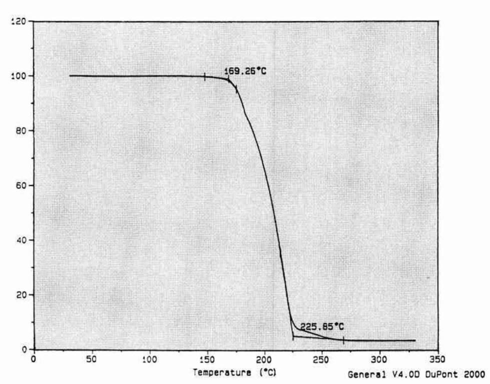


Figure 2—TGA scan of MPA/DMP amic acid

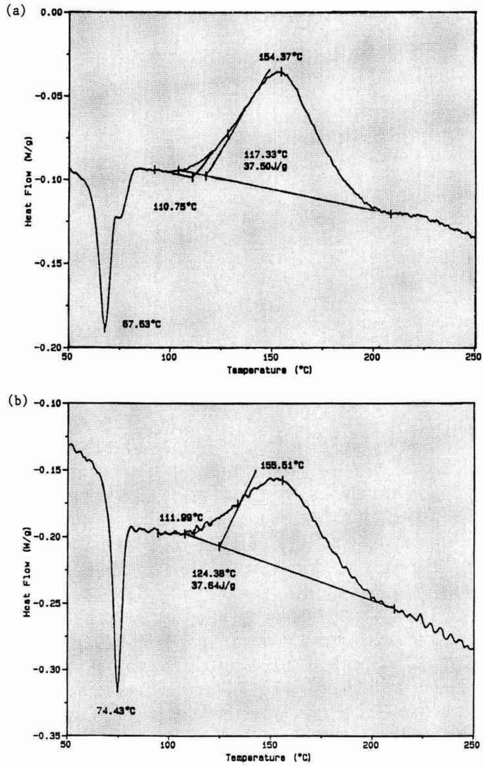


Figure 3—DSC scans of 10 eq% DMPA/DMP powder coating sample: (a)—before; and (b)—after storage stability test. Heating rate was 5°C/min. Sample stored at 40°C for one month

Table 4—DSC Analysis of Hybrid Powder Coatings

			Cure Exotherm Data[c]			
Catalyst	(wt%)[a]	(eq%)[b]	T_{onset} (°C)	T_{max} (°C)	T_{end} (°C)	Enthalpy[d]
PA/DEP	(0.5)	(5.0)	142	173	212	76.4 ± 2.0
	(1.1)	(10)	133	168	207	74.4 ± 4.7
PA/DMP	(0.5)	(5.0)	105	157	195	75.4 ± 2.4
	(1.0)	(10)	108	155	200	70.8 ± 5.5
PA/DME	(0.5)	(5.0)	126	150	195	45.0 ± 5.0
	(0.9)	(10)	68	149	184	68.2 ± 4.3
PA/Morph	(0.6)	(5.0)	141	176	216	74.7 ± 0.6
	(1.1)	(10)	139	172	212	73.6 ± 5.5
MPA/DEP	(0.6)	(5.0)	132	168	207	76.2 ± 4.7
	(1.1)	(10)	134	164	205	78.6 ± 4.1
MPA/DMP	(0.6)	(5.0)	126	159	205	71.8 ± 2.8
	(1.1)	(10)	117	152	187	89.5 ± 3.6
DMPA/DEP	(0.6)	(5.0)	131	167	207	70.7 ± 0.4
	(1.2)	(10)	129	164	197	70.0 ± 6.0
DMPA/DMP	(0.5)	(5.0)	125	160	207	77.4 ± 0.8
	(1.1)	(10)	112	153	197	93.0 ± 3.9
DMPA/DME	(0.5)	(5.0)	109	151	188	66.5 ± 6.6
	(1.0)	(10)	93	148	186	92.7 ± 3.5
CHA/DMP	(0.5)	(5.0)	127	166	210	76.7 ± 3.5
	(1.0)	(10)	91	148	203	76.2 ± 1.0
Hüls B-31	(0.1)	(—)	130	169	224	70.5 ± 0.7

(a) Wt% catalyst based on total resins.
(b) Eq% amic acid relative to epoxy equivalents.
(c) Average of three scans (5°C/min); 4-6 mg samples.
(d) Average kJ/eq epoxide groups and range of values.

samples. This hypothesis is supported by the low onset temperatures observed for the high level PA/DME and DMPA/DME powder coating samples, ca. 68 and 93°C, respectively.

The high level MPA/DMP and DMPA/DMP powder coating samples, which exhibit substantially larger cure enthalpies than the corresponding diethylamine analogs, MPA/DEP and DMPA/DEP, also exhibit lower onset, as well as lower maximum exotherm temperatures. However, in these cases, onset DSC endotherm and TGA weight loss temperatures are not correspondingly lower for the DMP-derived amic acids. Furthermore, TGA analysis indicates that all four amic acids, which have similar melting points, undergo imidization within 10°C of their melting points.

A possible explanation for the apparent higher catalytic activity of the dimethylamine analogs (MPA/DMP and DMPA/DMP) is more effective catalysis relative to the more sterically-hindered diethylamine analogs (MPA/DEP and DMPA/DEP). The dimethylamine analogs may also diffuse more readily in the powder coatings. These hypotheses are consistent with the observed lower onset and lower maximum exotherm temperatures for the high level MPA/DMP and DMPA/DMP powder coatings samples, relative to the DEP analogs.

In contrast to the MPA and DMPA analogs, higher catalytic activity of the dimethylamine analog is not apparent with the high level PA/DMP and PA/DEP powder coatings. Furthermore, the PA/DMP and PA/DEP powder coatings exhibit cure enthalpies, within experimental error of each other, at both catalyst levels. However, the PA/DMP powder coating exhibits both lower onset and lower maximum exotherm temperatures; accordingly the PA/DMP amic acid undergoes imidization at lower temperature, as evidenced by thermal IR (*Table* 2) and TGA (*Table* 3) analysis.

These results can be reconciled by postulating that the dimethylamine analog (PA/DMP) is a more effective catalyst than the more sterically-hindered diethylamine analog (PA/DEP), in accord with the MPA and DMPA findings. This factor would tend to increase the cure exotherm for PA/DMP. However, lower temperature imidization of PA/DMP is also expected to result in more premature reaction (during melt-mixing), as well as greater volatilization, which would tend to lower its cure enthalpy relative to PA/DEP. Thus, potentially greater catalytic activity of PA/DMP may be countered by relatively low temperature imidization in the solid state, which reduces its net effectiveness to that of phthalic anhydride/N,N-diethylaminopropyl/amine.

This hypothesis is consistent with the exceptionally high cure exotherms for the high level MPA/DMP and DMPA/DMP powder coatings, in which the catalytically effective dimethylamino-functional amic acids are not compromised by low temperature imidization in the solid state (as evidenced by TGA analysis, *Table* 3).

We could not predict the effect of methyl substitution adjacent to the aromatic amic acid groups on ease of intramolecular imidization. On the other hand, methyl substitution is expected to increase steric-crowdedness of the amic acid and, thereby, promote imidization by release of steric strain. In support of this tendency, Hawkins has noted that amic acids derived from DMPA and aromatic amines imidize at room temperature; whereas, corresponding amic acids from PA require heating.[7]

On the other hand, methyl substitution is expected to reduce coplanarity of the aromatic substituents, which would tend to retard imidization by spatially separating the reacting amic acid groups, as well as by reducing the nucleophilicity of the amide nitrogen.[8] In the present case, one or two adjacent methyl substituents (MPA and DMPA, respectively) similarly exert a strong retardation effect on imidization relative to the unsubstituted analog (PA).

Conclusions on the relative ease of imidization of phthalic- and cis-1,2 cyclohexyl-based amic acids are more speculative owing to the single aliphatic sample (CHA/DMP). Based on thermal FTIR onset temperatures for the appearance of imide bands (*Table* 2) and TGA onset temperatures for weight loss (*Table* 3), which vary by 5° and 11°, respectively, for PA/DMP and CHA/DMP, one may tentatively conclude similar imidization tendencies for the two ring systems.

Powder Coatings—Storage Stability

To obtain a measure of their storage stability, melt-mixed powder coating samples were stored for one month at 40°C and subsequently analyzed by DSC. Onset, maximum, and end temperatures, as well as enthalpies of the cure exotherm, are provided in *Table* 5 together with the enthalpy change (%) relative to the corresponding pre-stored samples (see *Table* 4). Three samples exhibited reductions in cure enthalpy of greater than 25%, namely the high level PA/Morph, low level CHA/DMP, and Hüls B-31 powder coatings. For all other samples, the enthalpy change was less than 15%.

The large reductions in cure enthalpy by the PA/Morph and CHA/DMP powder coatings may arise from their solubilization and weak catalysis of the epoxide-carboxylic acid reaction by the amic acids during storage. It appears reasonable that these amic acids may exhibit greater solubility than the others investigated. Alternatively, the amic acids may slowly undergo imidization during storage, resulting in catalysis by the imide in storage. In this regard, the PA/Morph and CHA/DMP amic acids exhibit onset temperatures for imidization by thermal FTIR analysis among the lowest of the amic acids investigated.

Table 5—Storage Stability of Powder Coatings[a]

		DSC Cure Exotherm Data[c]				
Catalyst	(wt%)[b]	T_{onset} (°C)	T_{max} (°C)	T_{end} (°C)	Enthalpy[d]	% Change[e]
PA/DEP	(0.5)	125	170	210	68.0 ± 3.6	−11
	(1.1)	120	168	203	75.8 ± 1.5	+1.9
PA/DMP	(0.5)	107	158	203	78.2 ± 3.7	+3.7
	(1.0)	100	155	197	74.0 ± 1.5	+4.5
PA/DME	(0.5)	125	160	195	43.9 ± 2.7	−2.5
	(0.9)	100	147	189	59.1 ± 1.8	−13
PA/Morph	(0.6)	140	177	216	71.2 ± 3.8	−4.7
	(1.1)	141	170	209	51.3 ± 2.3	−30
MPA/DEP	(1.0)	118	168	201	68.2 ± 4.1	−13
MPA/DMP	(1.0)	120	151	192	88.4 ± 4.6	−1.2
DMPA/DEP	(0.6)	130	174	205	64.8 ± 4.2	−8.4
DMPA/DMP	(1.1)	107	155	196	94.9 ± 2.8	+2.0
DMPA/DME	(1.0)	103	148	193	84.7 ± 3.5	−8.6
CHA/DMP	(0.5)	126	150	210	54.2 ± 3.4	−29
	(1.0)	104	152	200	71.3 ± 2.0	−6.4
Hüls B-31	(0.1)	126	170	215	50.6 ± 3.6	−28

(a) Samples stored at 40°C for one month.
(b) Wt% catalyst based on total resins.
(c) Average of three DSC scans (5°C/min); 4-6 mg samples.
(d) Average kJ/eq epoxide groups and range of values.
(e) Enthalpy change (%) relative to pre-stored samples.

Storage stability of the high level MPA/DMP, DMPA/DMP, and DMPA/DME powder coatings was of particular interest, since these coatings provided the highest cure exotherms. As shown in *Table* 5, MPA/DMP and DMPA/DMP retained their high values essentially unchanged; whereas DMPA/DME suffered an enthalpy loss of ca. 9%. The DMPA/DME amic acid has a lower mp by ca. 20-30°C and also exhibits an apparent tendency to undergo low temperature imidization in the solid state, evidenced by TGA and DSC analysis, as compared to the corresponding absence of evidence for low temperature imidization of MPA/DMP and DMPA/DMP. DSC scans for the high level DMPA/DMP powder coatings before and after storage are provided in *Figure* 3.

SUMMARY AND CONCLUSIONS

Ten crystalline amic acids, derived from four carboxylic acid anhydrides and four diamines, possessing both primary and tertiary amine groups, were synthesized and investigated as latent amine catalysts for bisphenol A epoxy-polyester carboxy (hybrid) powder coatings. The amic acids exist as zwitterions, in which the tertiary amine group is protonated, which minimizes both their solubility in the powder coatings and their catalytic activity. On heating, the amic acids underwent thermally induced intramolecular cyclization to imides (with the elimination of water). The nonzwitterionic, cyclic imides contain tertiary amine groups which catalyzed the carboxylic acid-epoxide reaction leading to cure of the powder coatings.

Two of the amic acids, MPA/DMP and DMPA/DMP, exhibited the most promising characteristics as latent catalysts, providing both the largest cure enthalpies and smallest enthalpy changes after one month storage at 40°C. Cure enthalpies of the corresponding MPA/DEP and DMPA/DEP powder coatings were lower, which was attributed to more effective catalytic activity by the less sterically hindered dimethylamino groups (in the DMP analogs) relative to diethylamino groups (in the DEP analogs). The DMP analogs were also expected to diffuse more readily through the powder coating.

The MPA/DEP and DMPA/DEP amic acids also exhibited poorer storage stability, possibly due to greater solubility (than the DMP analogs) and weak catalysis of the epoxide-carboxylic acid reaction during storage. Greater solubility of the diethylamino relative to the dimethylamino analogs does not appear unreasonable.

Cure response of the DMPA/DME amic acid, which melted ca. 20-25°C below the DMPA/DEP and DMPA/DMP analogs, was highly sensitive to concentration levels, which was attributed to low temperature imidization in the solid state, as evidenced by TGA studies. Low temperature imidization was considered to be an important cause of low cure response, since the occurrence of imidization during melt-mixing was expected to result in premature cure, as well as physical loss of the more volatile imide. Imidization as well as solubilization of the amic acid, which may function as a weak catalyst for the epoxide-carboxylic acid reaction, were considered as potential causes for reduced storage stability. Solubilization of the amic acids during melt-mixing could also result in lower cure response.

Our original premise that cure response may be controlled by a melting point phase change appears to be ideally exemplified by the MPA/DMP and DMPA/DMP amic acids. The other acids exhibit poorer storage stability in the powder coatings and/or lower cure response. These deficiencies can be attributed in varying extents to low temperature, solid state imidization of the amic acids, solubilization of the amic acids prior to imidization, and lower catalytic cure response of the corresponding imides.

The amic acids are also expected to function as latent catalysts for other tertiary-amine catalyzed reactions, including reactions of epoxides with anhydrides, phenols and thiols, as well as homopolymerization of epoxides, in both liquid and powder coatings.

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Quinone-Amine Polymers, VIII: Curing Studies on Jeffamine® D-400-p-Benzoquinone Polymer

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The failure of poly(amine-quinone) = 3:2 (PAQ = 2.3) coatings to resist salt spray, even though they are nonwettable by water, was attributed to the use of a volatile solvent and very low solid content, which led to surface imperfections that were aided by low crosslinking density. The addition of several polyamines and epoxides to the polymer, in appropriate solvent, before heat curing, demonstrated that adhesion of the coatings was improved by the addition of the amines. The best salt-water resistance, however, was obtained by the addition of a regular epoxy resin, Epon® 828 (Shell Oil Company).

INTRODUCTION

Jeffamine® D-400 and p-benzoquinone react spontaneously and produce polymers that can displace water from wet, rusty steel surfaces, can be autoclaved with live steam, and survive an accelerated aging test according to ASTM D 1183-70, procedure D.[1] Failure of these polymers to resist salt spray, despite being nonwettable by water after heat curing, could be attributed to a very low crosslinking density. In addition, the use of a low solid content in highly volatile solvents may have created air bubbles when the coatings were spray-applied.

Preliminary experiments where diamines, such as 1,8-diaminoctane, were added to the polymer solution before heat cure resulted in a significant increase in the resistance of coated panels to immersion in artificial sea water for periods up to 500-1000 hr. Maintenance of volatile solvents such as ethanol and a low solid content, that is, 20%, was still upheld.

After appropriate solvent combinations were developed for the polymer,[2] studies were initiated to investigate the effect of the addition of diamines and other reactive compounds to the polymer solutions on the behavior of heat cured coatings. The results of these studies will be reported here.

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MATERIALS AND METHODS

The chemicals used and their sources are as follows: Jeffamine D-400 and Jeffamine T-403, Texaco Inc.; Ethacure® 100, Ethyl Corporation; trimethylhexamethylenediamine, Hüls America; bis (3-aminopropyl)-tetramethyldisiloxane, Petrarch Chemical Company; Tren, Grace Chemical Company; Raybo® 63, Raybo Chemical Company; Tergitol NP-8, Union Carbide; Byk®-306 and Byk-320, Byk Chemie; and XAMA-7, a polyaziridine, Aceto Corporation. All other chemicals and solvents, Adrich Chemical Company.

Drying time was determined in accordance with ASTM D 1640; flash point in accordance with ASTM D 3278, using Setaflash (closed cup); and viscosity in accordance with ASTM D 445 and D 446, using Canon-Fenske viscometer. Adhesion was measured according to ASTM D 3359-83, using a Gardco Paint Adhesion Test Kit. Flexibility was tested according to ASTM D 1737-85, using a pentagon mandrel obtained from Gardco; and film thickness was measured with a Model FN 252 Minitest Coating Thickness gauge obtained from Gardco.

Polymer solutions were applied with wire wound applicators. Heat curing was done at 100-150°C for 4-7 hr, as detailed in the text.

Salt spray tests were performed at David Taylor Research Center, in Annapolis, MD, when needed.

Synthesis of Jeffamine D-400-p-benzoquinone (2:3) Polymer (PAQ = 2:3)[1]

16.0 g (0.04 mol) of Jeffamine D-400 was dissolved in 50 mL ethanol. To this solution, contained in a round-bottomed flask equipped with a reflux condenser, and a stirrer, was added 6.48 g (0.06 mol) of p-benzoquinone in

Table 1—Jeffamine D-400-p-Benzoquinone Polymer 2:3 Formulation. Early Studies

Amine Added	Solids %[a]	Flow	Coating Quality	PAT[b]	Wettability	Acetone Resistance
—	80	good	slightly tacky	3	fairly good	<1
Tren[c]	80	good	non-tacky	3-4	good	>72[d]
XAMA[e]	80	good	glossy	3-4	good	>72[d]
Jeffamine T-403[f]	80	good	very glossy	3-4	good	<1

(a) Solvents: super high flash naphthamethylisobutylketone = 70:30.
(b) Paint adhesion test.
(c) tris (2-amino ethyl) Amine.
(d) After drying resists scratching.
(e) Pentaerythritol-tris-(β-aziridinyl) propionate.
(f) poly-(oxypropanol) Triamine.

50 mL ethanol. The mixture was refluxed in a water bath for 3 hr. The ethanol was removed in a rotary evaporator and the polymer was isolated by pouring the syrup into cold water. It was purified by dissolution in acetone and reprecipitated first in cold, and then hot water, repeatedly.

Washing was continued until the wash water was colorless (about 5 L of water was required). The residue was dried in a vacuum oven at 50°C for 5-6 hr. The polymer was soluble in ethanol, acetone, and DMSO, but insoluble in water and ether.

Preparation and Characterization Of the Coatings

Poly(amine-quinone) (PAQ = 2:3) was dissolved in n-butanol:xylene = (1:4 v/v) and Byk-320 was added at 1% (w/w) of PAQ. Amines were added on an equivalence basis, that is, 1 mol amine per mole repeat unit. Curing was for 6 hr at 110-115°C. When epoxy compounds were used, the addition was 1.5 moles of epoxy per mole of PAQ repeat unit. Curing was for 7 hr at 150°C.

RESULTS

Very early studies utilizing three different amines dissolved in a blend of super high flash naphtha [methylisobutyl ketone = (70:30 v/v)] compared the cured coatings with heat cured PAQ polymer. The results of these studies are given in *Table* 1 and can be summarized as follows:

(1) PAQ alone or cured with added Jeffamine T-403 yields slightly tacky coatings and their solvent resistance is very poor.

(2) The addition of Tren, as well as XAMA-7, provides the best solvent resistance and better nonwettability toward water.

(3) Even though the addition of Tren to the PAQ solution causes some warming, the mixture has a long pot life, over 65 hr.

(4) XAMA-7, however, cannot be used after 65 hr since solid particles appear in the solution. However, this mixture has the best flow characteristics.

(5) The addition of Tren makes spreading poor, but this can be overcome by ketonic cosolvents.

During these studies, crater formation was a constant problem, and after considerable effort, a solution was found in the use of Byk-306 or Byk-320. All polymer solutions after this observation contained these compounds at 1% (w/w) of PAQ instead of Raybo 63 and Tergitol NP-8.

Many other chemicals, including epoxy compounds under different heating regimes, as well as chemical curing at ambient temperature, were tried.

Table 2—Flexibility, Hardness, and Adhesiveness of Cured PAQ[a]

Chemical Added	Mole Ratio[b]	Thickness, Mil	PAT[c]	Gardco Pencil Position	PAT Lead Grade	Bend Test 1/8" Mandrel
None	—	0.9	3B 3B 3B	5	2H	pass
TMHMD	1:1	1.0	4B 5B 4B	6	4H	pass
BAPTMS	1:1	1.2	4B 3B —	5	2H	pass
m-PDA	1:1	0.9	5B 5B 5B	6	4H	pass
Epon 828	1.5:1	1.4	4B 5B 5B	5	2H	pass
RGE	1:1	1.0	4B 5B 5B	6	4H	pass
BDE	1:1	1.0	3B 4B 4B	6	4H	pass
BDDGE	1:1	1.0	3B 3B 3B	5	2H	pass

(a) PAQ = 2:3 was heat cured with the added amines.
(b) Mole of additive; mole of amine in repeat unit.
(c) PAT = paint adhesion test.
TMHMD = trimethylhexamethylenediamine.
BAPTMS = bis (3-aminopropyl) tetramethyldisiloxane.
m-PDA = m-phenylenediamine.
RGE = resorcinolglycidylether.
BDE = 1,3 butadienediepoxide.
BDDGE = 1,4 butanedioldiglycidylether.

Table 3—Effect of Immersion of PAQ[a] in Artificial Sea Water

Chemical Added	432 Hr	1000 Hr
None	Moderate number of blisters, some rusting at water/air interface.	Very few blisters found at the edges of the panel, no peeling. One of the best results obtained.
TMHMD ...	Similar to above.	Blisters covering 50-70% of coated area, no peeling.
BAPTMS ...	Very few blisters, especially at the edges; good.	Blisters in 30-50% of coated area, no peeling.
m-PDA	Moderate number of blisters, some rusting at water/air interface.	Blisters in 50-70% of coated area, no peeling.
Epon 828 ...	No blisters, best result.	Very few blisters at the edges, no peeling, best result.

(a) (PAQ) = 2:3 was heat cured with the added chemicals.
TMHMD = trimethylhexamethylenediamine.
BAPTMS = bis(3-aminopropyl)tetramethyldisiloxane.
m-PDA = m-phenylenediamine.

PAQ was dissolved in n-butanol:xylene = (1:4 w/w) and various chemicals were added in amounts that were listed under the Materials and Methods section, and the resulting solutions were applied to metal panels using wire wound applicators. They were dried and cured thermally as indicated.

Table 2 gives the results of adhesion, hardness, and flexibility tests. The results can be summarized as follows:

(1) All formulations are flexible enough to be bent around ⅛" mandrel.

(2) Adhesion improves with the added amine.

(3) Aromatic diepoxides, including Epon 828, also improve adhesion, while aliphatic diepoxides have less effect.

(4) It is impossible to analyze the effect of hardeners on hardness of the coatings.

Since salt spray equipment was not available, immersion into artificial salt water, prepared according to ASTM D 1183-70, procedure D, for 1000 hr, was used as a screening method. The results of this study are presented in *Table* 3. Ultimate salt spray tests are being performed at the David Taylor Research Center, in Annapolis, MD.

CONCLUSION

Poly(amine-quinone) (PAQ) polymers are highly reactive due to the presence of two imino groups and one quinone ring in each repeat unit. The imino groups enable one to cure with epoxides, isocyanates, and aziridines. Quinone rings, however, can react with amines, as well as the imino groups that are present in the polymer, as depicted in the previous paper. Heat curing of the polymers, without any added amines, is due to the reaction between the imino groups and quinones found in the polymer. However, since the mobility provided to the polymer chains by heating is limited, the quality of the final product was not exceptional. The addition of free amines compensates for this failure by increasing crosslinking density. Since amine substitution decreases the oxidation potential of quinone, the produced polymer chains can be expected to contain disubstituted quinone moieties.

The observation that PAQ can be cured by epoxy resin is quite interesting because epoxy resin, too, can be cured with PAQs and, thus, provide it with toughness without diminishing the mechanical characteristics of the epoxy resin.

ACKNOWLEDGMENT

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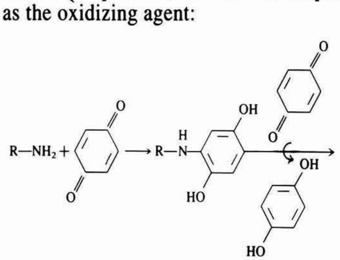
Quinone-Amine Polymers, VII: Selection of Appropriate Solvent Combinations for Jeffamine® D-400-p-Benzoquinone Polymers (PAQ = 2:3)

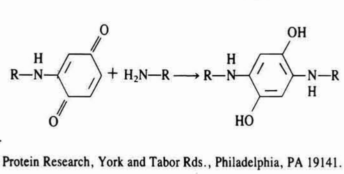
V.S. Nithianandam, F. Chertok, and S. Erhan
Albert Einstein Medical Center*

Using calculated cohesive energy densities and two-dimensional solubility maps, several solvent combinations were found that could dissolve polyamine-quinone = 2:3. Since n-butanol:xylene (1:4v/v) could dissolve the polymer up to 85% solids, studies were confined to this mixture using high aromatic commercial products. It was found that super high flash naphtha, with some alcoholic or ketonic cosolvents, could dissolve the polymer; the solution when cured showed good adhesion to metals.

INTRODUCTION

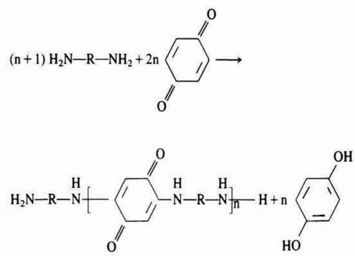
The reaction of p-benzoquinone with amines occurs spontaneously producing a monosubstituted hydroquinone through 1,4 addition. If this substituted hydroquinone is further oxidized to a monosubstituted benzoquinone, it can react with another amine to yield a 2,5 disubstituted hydroquinone. Since amine substitution lowers the oxidation potential of the quinone, even free benzoquinone can function as the oxidizing agent:





*Center for Protein Research, York and Tabor Rds., Philadelphia, PA 19141.

If one reacts a diamine with sufficient benzoquinone one obtains a linear polymer:



Depending upon the chemical nature of the precursors, especially of the amine, one obtains polymers that are soluble and flexible, to insoluble and infusible.

Soluble polymers have an unusual characteristic: a very strong affinity towards metals, including noble metals such as gold and platinum. They also have an affinity toward alloys sufficient to displace water from wet, rusty steel surfaces.[1,2]

The soluble polymers can be cured either thermally or chemically at ambient temperature, and when cured, they become nonwettable by water. This can best be demonstrated by the inability of water-based latex paints to adhere to panels coated with these polymers. All other paints adhere to the polymer surface.

The ability to bind to metals and to displace water from wet, rusty surfaces together with becoming nonwettable by water after curing open up many application possibilities to these polymers: (1) as a primer to protect metals exposed to the environment, (2) as a base for paints that can be used on unprepared surfaces, and (3) as an adhesion promoter that is resistant to moisture.

Originally, curing was affected by heating the coated panels to 120-150°C for 2-5 hr; however, the resulting product failed salt-spray test after only 100 hr. Consequently, heat cure was then performed after the addition of various amines and other chemicals, such as diepoxides, polyaziridines, which improved resistance to salt spray: over 1500 hr.[3]

The first member of this family that was studied in detail was prepared with a commerically available poly (oxypropylene) diamine, Jeffamine® D-400 and the reaction was conducted in ethanol and the polymer was applied onto metals as a 20% solution in the same solvent.

Since these conditions can only be used in a laboratory, a study was undertaken to find out what solvents could be used that are acceptable environmentally and economically, to provide sufficient solid content, flash point, viscosity, and dry-time. The results of the study will be reported here.

Table 1—Selection of Solvents, Additives and the Flash Point, Viscosity and Dry Times of Selected Samples

	Heat Curing Regime				
Experiment No.	Composition (v/v/v)	Flash Point °/F	Viscosity Lower	Viscosity Upper	Drying Time hr
1 PEQ: Ar 150:HD	= 70:27.0:3.0	148	1586.5	1598.9	>7
2 PEQ: Ar 150:HD	= 70:28.5:1.5	147	2054.5	2096.4	6.5
3 PEQ: Ar 150:HD	= 70:29.1:0.9	148	2357.1	2378.4	6.5
4 PEQ: Ar 150:Prop	= 70:27.0:3.0	146	1682.0	1711.0	>7
5 PEQ: Ar 150:Prop	= 70:28.5:1.5	146	1970.4	1978.7	6.5
6 PEQ: Ar 150:Prop	= 70:29.1:0.9	147	2246.9	2291.5	6.5
7 PEQ: Cyclo 53:HD	= 65:31.5:3.5	115	1442.7	1455.7	4.5-5
8 PEQ: Cyclo 53:HD	= 65:32.2:1.8	111	2060.6	2069.9	4.5-5
9 PEQ: Cyclo 53:HD	= 65:34.0:1.0	110	2430.0	2439.9	4.5-5
10 PEQ: Cyclo 53:Prop	= 65:31.5:3.5	114	1178.5	1182.1	4.5-5
11 PEQ: Cyclo 53:Prop	= 65:32.2:1.8	112	1844.3	1833.3	4.5-5
12 PEQ: Cyclo 53:Prop	= 65:34.0:1.0	110	2199.6	2224.2	4.5-5
13 PEQ: Ar 100:HD	= 65:31.5:3.5	106	1349.2	1370.2	6.25
14 PEQ: Ar 100:HD	= 65:33.2:1.8	103	1731.8	1945.6	5.5
15 PEQ: Ar 100:HD	= 65:34.0:1.0	105	229.7	2330.3	5.5
16 PEQ: Ar 100:Prop	= 65:31.5:3.5	105	1112.9	1130.9	5.5
17 PEQ: Ar 100:Prop	= 65:33.2:1.8	105	1749.0	1796.1	5.5
18 PEQ: Ar 100:Prop	= 65:34.0:1.0	106	2091.4	2145.5	5.5
19 PEQ: TS-28:HD	= 65:31.5:3.5	—	3410.3	3427.3	—
20 PEQ: TS-28:HD	= 65:33.2:1.8	—	4394.9	4584.8	—
21 PEQ: Sup:HD	= 65:31.5:3.5	110	1537.3	1548.2	5.5
22 PEQ: Sup:HD	= 65:33.2:1.8	109	2188.3	2209.7	5.5
23 PEQ: Sup:HD	= 65:34.0:1.0	110	2308.1	2394.3	5
24 PEQ: Sup:Prop	= 65:31.5:3.5	110	1014.4	1005.4	5.5
25 PEQ: Sup:Prop	= 65:33.2:1.8	110	1648.0	1680.0	5.5
26 PEQ: Sup:Prop	= 65:34.0:1.0	109.5	2039.6	2096.0	5
27 PEQ: Pan:HD	= 65:31.5:3.5	155	3318.5	3315.9	>6
28 PEQ: Pan:Prop	= 65:31.5:3.5	150	2566.3	2601.4	>6
39 PEQ: Sup:MEK:Prop	= 70:25.5:3.0:1.5	92.5	578.1	580.0	4.5-5
40 PEQ: Sup:Eth	= 70:25.5:4.5	108	855.4	941.3	4.5-5
41 PEQ: Sup:MEK:Prop	= 85:12.75:1.5:0.75	106	2009.6	2005.0	4.5-5
42 PEQ: Sup:n = BuOH	= 85:10.5:4.5	112-113	1588.0	1578.8	4.5-5
43 PEQ: Sup:MIBK	= 85:10.5:4.5	106	1781.8	1771.6	4.5-5

Ar 150 = Aromatic 150; Ar 100 = Aromatic 100; Cyclo 53 = Cyclosol 53; Sup = Super high flash naphtha; TS-28 = TS-28R; Pan = Panosol AN2K; HD-2-ethyl, 1,3 hexanediol; Prop = Propasol solvent B.; Eth = 2-ethoxy ethanol (cellosolve); MIBK = Methyl-iso-butylketone.

Notes:

(1) Each mixture contains 0.2% of Raybo 63 and 0.2% of Tergitol NP-8, based on solids contents.

(2) The film thickness varies between 1.7 and 2.2 mils.

(3) The viscosity was determined with Canon-Fenske viscometer, expressed as centistokes.

(4) Due to phase separation/incomplete dissolution, only viscosity determination could be performed with questionable results for experiments 19 and 20.

(5) Drying at ambient temperature and pressure.

MATERIALS AND METHODS

The solvents and additives used and their sources are as follows: Aromatic 100 and 150, Exxon; Cyclo Sol®F 53 and TS-28R, Shell; super high flash naphtha, Union Oil; Propasol® Solvent B, and 2-ethyl-1, 3-hexanediol, Union Carbide; Panasol AN2K, Amoco; Raybo® 63, Raybo Chemical Company; Tergitol NP-8, Union Carbide; n-Butanol, 2-ethoxyethanol (cellosolve), methylethylketone (MEK); methylisobutylketone (MIBK) as well as p-benzoquinone, were purchased from Aldrich Chemical Company. Jeffamine D-400 samples were received from Texaco Inc.

Drying time was determined in accordance with ASTM D 1640; flash point in accordance with ASTM D 3278 using Setaflash (closed cup), and viscosity in accordance with ASTM D 445 and D 446 using Canon-Fenske viscometer.

Adhesion was measured according to ASTM D 3359 using a Gardco Paint Adhesion Test Kit; flexibility was tested according to ASTM D 1737-85 using a Pentagon Mandrel manufactured by Paul N. Gardner Co. Film thickness was measured with a model FN 252 Minitest Coating Thickness Gauge obtained from Paul N. Gardner Co.

For this study, polymer solutions were applied with wire-wound applicators.

Synthesis of Jeffamine D-400-p-benzoquinone (2:3) Polymer (PAQ = 2:3)[1]

16.0g (0.04 mol) of Jeffamine D-400 was dissolved in 50 mL ethanol. To this solution, contained in a round-bottomed flask equipped with a reflux condenser, was added 6.48g (0.06 mol) of p-benzoquinone. The mixture was refluxed on a water bath for three hours, the ethanol removed in a rotary evaporator, and the remaining syrup was precipitated by pouring into excess cold water. The product was washed first in cold water then in hot water, after dissolution in acetone.

Washing and redissolving was continued until the wash water was colorless (about 5 L of water was required). The residue was dried in a vacuum oven at 50° C for 4-5 hr. The polymer was soluble in ethanol, acetone, and DMSO, but insoluble in water and ether.

RESULTS

Originally, this polymer was applied as an ethanolic solution (20% solids) and cured thermally after spray coating aluminum and steel Q-panels.[1] Even though the coating could survive boiling water for two hours, autoclaving with live steam for two hours and the accelerated aging test according to ASTM D 1183-70, procedure D, its resistance to salt spray was poor, that is, ca. 100 hr. This situation was later corrected by adding equivalent amounts of various diamines, such as 1,8 diaminooctane, to the polymer solution before heat curing.[4]

Since the purpose of this study was to develop appropriate solvents for this polymer that satisfied various requirements, cohesive energy density of the polymer was calculated using Small's method[5] with Hoy's most recent values.[6] A few solvent combinations were found using two dimensional solubility map.[7] The first combination tried was n-butanol:xylene (1:4 v/v) and because it dissolved the polymer easily at any concentration tried (up to 85% solids), it was decided to base the search on this formula. This was done by looking for commercial solvents and additives which enabled the PAQ formulations to satisfy certain requirements; solid content of 70-85%, flash point of >100°F, and dry time of 4-6 hr while exhibiting appropriate flow, no pinhole or crater formation. Because heat curing had been used from the beginning of these studies, it was decided to cure metal panels that were coated with these formulations by heating them at 100-150°C for varying times. The cured panels were then evaluated for their adhesion, artificial sea water resistance, and flexibility.

The preliminary studies with n-butanol:xylene (1:4 v/v) also had shown flash points to be low, 81-85°F. However, addition of 0.2% Raybo 63 and 0.2% Tergitol NP-8 based on solids content, provided optimal spreading and leveling characteristics. These ratios were found by trial and error. Hence all future solutions were added 0.2% Raybo 63 and Tergitol NP-8.

Table 1 presents the results of these studies and can be summarized as follows:

(1) The polymer does not dissolve in solvents that contain more than 1-2% aliphatics such as TS-28R;

(2) It is impossible to increase solid content beyond 70% without the inclusion of some alcoholic or ketone cosolvents;

(3) Flash points of all compositions fall within acceptable range, that is, >100°F and as expected, it is dependent upon the flash point of the major solvent;

(4) Drying times of all compositions fall within acceptable range, i.e. four to eight hours;

(5) The viscosity of the composition can be controlled in a predictable way by changing the concentrations of the additives. Propasol Solvent B is more effective in reducing the viscosity, when used at same ratio, except in experiments 1 and 4;

(6) So far, super high flash naphtha which is 99.9% aromatics, appears to be the most satisfactory solvent to use;

(7) It appears possible to formulate mixtures of solvents and additives to fit any specification.

Steel panels coated on both sides were immersed in artificial sea water, without the traditional waxing of the edges. After 1000 hr, there were only two to three blisters at the edges and the films looked nearly perfect. The coating passed bend test over 1/8″ mandrel. Adhesion of a coating about 1 mil thick was rated 3B.

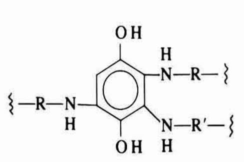
CONCLUSION

Water displacing polyamine-quinione (2:3) polymers were originally prepared in ethanol, using a commercially available diamine, Jeffamine D-400, and p-benzoquinone. They were applied to metal panels again in ethanol, as a dilute solution because at that time they were only laboratory curiosities. After observing their great affinity towards metals, it became necessary to consider using environmentally acceptable solvents, concepts like volatile organic compounds, etc. In this search, in order to save time, we have decided to calculate the cohesive energy densities and solubility parameter of the polymer, utilizing Hoy's method[6] which is based on the additivity principle of molar attraction constants of Small.[5] This was followed by constructing several two-dimensional solubility maps according to Crowley, et al.[7] This led to the selection of several solvent combinations, however, since xylene: butanol (4:1 v/v) could solubilize the polymer with a high solids content (85%), all later studies were confined to this mixture, using commercially available high aromatic compounds. Thus, it was found that super high flash naphtha, with some alcoholic or ketonic cosolvents, could dissolve the polymer and this solution when heat cured showed good adhesion to metals.

Failure of heat cured PAQ coated panels in salt spray tests was quite unexpected, particularly when the coatings passed accelerated aging test ASTM D 1183-70, procedure D. At first this was attributed to low crosslinking density and various diamines, such as 1,8-diamino-octane, which were included in the polymer solution before heat curing. Since a salt spray chamber is not available in the laboratory, immersion of the coated panels in artificial sea water, prepared according to ASTM D 1183-70, procedure D, was used as a screening method and results were quite encouraging, that is, resistance to this solution for over 500 hr by several amine plus heat cured samples. (Salt spray tests that are required to obtain a final answer are being conducted at the David Taylor Research Center.)

Later studies with higher solid content in solvents with slower evaporation rates, coated with wire-wound applicators and with added amines that have survived salt spray for over 1000 hr, however, have suggested that the probable cause of the earlier failures was due to the use of solutions with low solid content (20%) in highly volatile solvents which were sprayed on, creating trapped air bubbles. Nevertheless, addition of diamines still leads to more improved characteristics even with newly developed solvents.

Studies on understanding the crosslinking mechanisms are in progress. It appears that the crosslinking is occurring by 1.4 addition of the added diamines or the imino nitrogens of the polymer onto the quinone moieties that constitute the polymer backbone:



This conclusion is suggested by the inability of fully substituted benzoquinone to react with added amines, which could only occur through quinone-imine formation. Indeed this was the mechanism that was thought to take place originally,[1] diepoxides, on the other hand, react with the imino groups.

These studies demonstrate that it is possible to prepare PAQ solutions, with high solid content, utilizing solvents that are commonly used in the coatings industry, which not only take advantage of the polymer's unique ability to displace water from wet, rusty metal surfaces,[1] but also to provide coatings that are tough, with good adhesion and resistance to corrosive elements.

It is important to point out here further that the soluble members of this family of polymer/oligomers represent the only truly water resistant materials that also bind spontaneously to metals. Bonds between polymers such as epoxy resins, silicones rely on oxygen-oxygen interactions between the oxygen bearing groups on the adhesive and the adhered, are vulnerable to moisture. Thermodynamically, a compound that can displace water cannot be affected by water at a later time.

Studies of Hubbard and his coworkers with quinones and their derivatives, using cyclic voltammetry, has shown that these compounds could adhere even to gold and platinum with sufficient affinity to displace water and to resist a vacuum of 10^{-9} Torr.[8] They have attributed this bonding to "chemisorption" whereby free electrons of electronegative elements are contributed to the electron-poor outer orbitals of transition metals, providing very strong adhesion. Nearly all commercially available anticorrosive agents are amine derivatives, whose binding, too, is due to chemisorption. Since each repeat unit of the polymer contains two quinone oxygens and two imine nitrogens, it is easy to understand why these polymers bind to metals with high affinity.

ACKNOWLEDGMENTS

This study was supported by a contract from the U.S. Navy.

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BALTIMORE .... FEB.

"Epoxy Resins"

The meeting's speaker was Ted Hopper, retired, of Valspar Corporation. His topic was "EPOXY RESINS—THEN AND NOW."

The speaker said that during the early 1950s, when epoxy resins were introduced, they were accepted almost instantaneously. Allocation of epoxy resins took place almost immediately.

Mr. Hopper stated that he believed the reason epoxy resins were such an instant success was because of clever and attention-getting marketing techniques used to introduce the products.

According to the speaker, epoxies have made much progress, with still more growth to occur. Currently, the fastest growing market is powder coating epoxies.

The need for a full low-temperature curing epoxy system still exists, said Mr. Hopper. Also, good color and gloss retention are significant improvements which still need to be refined.

In conclusion, the speaker stated that epoxy resins have made significant contributions to the coatings industry and will continue to do so in the years ahead.

Q. How were epoxy resins discovered?

A. Work was done by Jones and Dabney in Louisville, KY, in the late 1940s. About that same time, work also was being done in Europe by CIBA-GEIGY Corporation. Eventually, Jones and Dabney sold their research project to Shell Chemical Company.

JIM SMITH, *Secretary*

LOUISVILLE .... FEB.

"Solubility Parameter Calculator"

It was announced that Society members Cecil A. Meeks, of Engelhard Corporation, and Horace E. Mahorney, of Progress Paint Company, would conclude their careers in the paint industry on February 28.

The final vote of the proposed amendment to the Society By-Laws, allowing Associate Members to hold office in the Society and updating terminology to reflect the name change in the organization from Paint Technology to Coatings Technology, was conducted. The Active Members in attendance voted in favor of the proposed By-Laws change. The amendment as written was officially approved and became part of the Society By-Laws.

The technical speaker was Houston Society member Richard W. Ryan, of Exxon Chemical Company, whose topic was "A SOLVENT PROPERTY AND SOLUBILITY PARAMETER CALCULATOR."

The speaker began his presentation by describing a solubility parameter calculator as a mainframe computer based program that models the interaction of solvents and plasticizers with resins and polymers. He said the program predicts solvent-blend properties and resin solubility, thus eliminating much of the trial-and-error approach faced by many formulators.

The useful applications of the solubility parameter calculator which were discussed are, reformulating paint to meet stricter VOC requirements, improving coating performance, cutting costs, and developing new formulations. According to Mr. Ryan, some of the specific information which can be produced from the system include: solubility of resins in a specific solvent blend during the drying cycle, evaporation profiles of the solvent blend in your specific system, surface tension, flash points, viscosity and density of coating systems, and raw materials costs.

In conclusion, the speaker stated that the computer can help control costs and increase formulating flexibility.

Q. Can the system handle water-based and water-reducible coatings?

A. Currently, the program for water systems is being developed, however, it is not yet complete. We are working with some of the major resin companies which make emulsions to design the system.

TIMOTHY FORTNEY, *Secretary*

NORTHWESTERN .... MAR.

Coatings Symposium

The March meeting was the Society's 20th Annual Symposium. This year's theme was "COATINGS—A GLOBAL PERSPECTIVE."

The symposium's first speaker was Dave Olfe, of Valspar Corporation. Mr. Olfe's topic was "STRATEGIC INTERNATIONAL ALLIANCE."

The speaker predicted that the number of paint companies will decline from 10,000 to 5,000 in 10 years. However, sales will increase from $35 billion in 1990 to $70 billion in 2000.

Mr. Olfe noted that Akzo, BASF, Courtaulds, and ICI (Glidden) are presently in the top 10 paint companies in the U.S. The speaker stated that not one of those companies was in the top 10 in 1980.

The speaker stated that the top 10 paint companies in the world have 33% of the market at the present, however, that share will increase to 50% by the year 2000.

Mr. Olfe explained that Japanese paint companies are not expected to buy in the U.S. He also said that the Pacific Rim countries, including China, are the fastest growing nations in terms of paint sales.

In conclusion, the speaker stated the main strategy in license agreement is to supply large domestic customers (the same coating as their U.S. facilities buy) in foreign countries.

The next speaker was Dick Hergenrother, of Mobay Corporation. He discussion was entitled "CHANGES IN POLYURETHANE TECHNOLOGY."

The speaker began his presentation with the statement that the greatest force in new technology is VOC regulations. He said that hydrogen bonding affects the viscosity of the polyols. Also, ketamine formation decreases the viscosity of the polyols.

The symposium's final speaker was Keith Miller, of 3M Company. He talk was on "WASTE MANAGEMENT BY PREVENTION."

The speaker's presentation focused on three main topics: environmental trends in the 1990s, environmental regulations, and the 3M Pollution Prevention Pays (3P) Program.

Mr. Miller discussed the following environmental trend topics: environmental movement; influence of media; environmental consumerism; legislation and regulations; the U.S. review on legislative and regulatory trends; the Clean Air Act; and Europe, the Far East, and Central and South America.

The presentation's next segment focused on waste management by prevention, covering the competitive and environmental risk issues, the environmental risks, and the Pollution Prevention Pays Program.

In conclusion, Mr. Miller discussed the global growth trends in the 1990s and the critical parameters for coatings in the 1990s.

DANIEL W. DECHAINE, *Secretary*

PITTSBURGH .... FEB.

"Material Selection Parameters"

Bill Mansfield, of Valspar Corporation, presented a brief talk on the history and the business background of the Valspar Corporation. The company's roots can be traced back as far as 1806. Valspar is the fifth

Constituent Society Meetings and Secretaries

BALTIMORE (Third Thursday—Snyder's Willow Grove Restaurant, Linthicum, MD). JIM SMITH, Eastech Chemicals, 5700 Tacony St., Philadelphia, PA 19135.

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

CDIC (Second Monday—Location alternates between Columbus, Cincinnati and Dayton). ALIPIO R. RUBIN, JR., Hilton-Davis Chemical Co., 2235 Langdon Farm Rd., Cincinnati, OH 45237.

CHICAGO (First Monday—alternates between Sharko's Restaurant, Villa Park, IL, and Como Inn, Chicago, IL). WILLIAM FOTIS, Valspar Corp., 1191 S. Wheeling Rd., Wheeling, IL 60090.

CLEVELAND (Third Tuesday—Brown Derby, Independence, OH in Sept., Oct., Nov., Feb., March, April; Jan. meeting, Landerhaven, Mayfield Heights). ROY GLOVER, Mahoning Paint Corp., 653 Jones St., P.O. Box 1282, Youngstown, OH 44501.

DALLAS (Thursday following second Wednesday—The Harvey Hotel, Dallas, TX). MIKE EVANS, J.M. Huber Corp., 803 Pleasant Valley, Richardson, TX 75080.

DETROIT (Second Tuesday—meeting sites vary). SCOTT WESTERBEEK, DuPont Co., 945 Stephenson Hwy., Troy, MI 48007.

GOLDEN GATE (Monday before third Wednesday—alternates between Francesco's in Oakland, CA, and Holiday Inn in S. San Franscisco). LARRY G. SAYRE, O'Brien Corp., 450 E. Grand Ave., S. San Francisco, CA 94080.

HOUSTON (Second Wednesday—Sonny Look's Sirlion Inn, Houston, TX). TERRY F. COGAN, Raw Materials Corp., P.O. Box 690285, Houston, TX 77269.

KANSAS CITY (Second Thursday—Cascone's Restaurant, Kansas City, MO). CRAIG HUGHES, Farmland Industries, Inc., P.O. Box 7305, N. Kansas City, MO 64116.

LOS ANGELES (Second Wednesday—Steven's Steakhouse, Commerce, CA). V.C. BUD JENKINS, Ellis Paint Co., 3150 E. Pico Blvd., Los Angeles, CA 90023.

LOUISVILLE (Third Wednesday—Executive West Motor Hotel, Louisville, KY). TIMOTHY FORTNEY, American Dispersion, Inc., P.O. Box 34033, Louisville, KY 40232.

MEXICO (Fourth Thursday—meeting sites vary). ANTONIO JUAREZ, Amercoat Mexicana, via Gustavo Baz 3999, 54030 Tlalnepantla, edo de Mexico.

MONTREAL (First Wednesday—Bill Wong's Restaurant, Montreal). ROBERTO CUBRAL, L.V. Lomas Chemical Co., 1660 Hynus, Dorval, Que., H9P 2N6, Canada.

NEW ENGLAND (Third Thursday—Sheraton Lexington Hotel, Lexington, MA). JOHN LUKENS, D.N. Lukens, Inc., 15 Old Flanders Rd., Westboro, MA 01581.

NEW YORK (Second Tuesday—Landmark II, East Rutherford, NJ). MICHAEL FRANTZ, Daniel Products Co., 400 Claremont Ave., Jersey City, NJ 07304.

NORTHWESTERN (First Tuesday after first Monday—Jax Cafe, Minneapolis, MN). JOSEPH WIRTH, Consolidated Container Corp., 735 N. Third St., Minneapolis, MN 55401.

PACIFIC NORTHWEST (PORTLAND SECTION—Third Tuesday; SEATTLE SECTION—Third Wednesday; BRITISH COLUMBIA SECTION— Third Thursday). JOHN BARTLETT, Pacific Bartlett Co., 11813 S.E. 257th St., Kent, WA 98031.

PHILADELPHIA (Second Thursday—Williamson's Restaurant, GSB Bldg., Bala Cynwyd, PA). WILLIAM J. FABINY, Sermaguard Coatings, 155 S. Limerick Rd., Limerick, PA 19468.

PIEDMONT (Third Wednesday—Ramada Inn Airport, Greensboro, NC). ANNETTE SAUNDERS, Akzo-Reliance, P.O. Box 2124, High Point, NC 27261.

PITTSBURGH (Second Monday—Montemurro's Restaurant, Sharpsburg, PA). JEFFREY STURM, Kop-Coat, Inc., 3020 William Pitt Way, Pittsburgh, PA 15238.

ROCKY MOUNTAIN (Monday following first Wednesday—Zangs Brewery, Denver, CO). ED MCCARTHY, Cyprus Minerals, 8995 E. Nichols, Engelwood, CO 80112.

ST. LOUIS (Third Tuesday—Salad Bowl Restaurant, St. Louis, MO). DENNIS CAHILL, Archway Sales, Inc., 4321 Chouteau Ave., St. Louis, MO 63110.

SOUTHERN (GULF COAST SECTION—third Thursday; CENTRAL FLORIDA SECTION—third Thursday after first Monday; ATLANTA SECTION—third Thursday; MEMPHIS SECTION—bi-monthly on second Tuesday; and MIAMI SECTION—Tuesday prior to Central Florida Section). BILLY M. LEE, Kemira, Inc., P.O. Box 368, Savannah, GA 31402.

TORONTO (Second Monday—Cambridge Motor Hotel, Toronto). MIKE HAZEN, L.V. Lomas Ltd., 99 Summerlea Rd., Brampton, Ont., L6T 4V2, Canada.

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

largest paint company in the U.S., and the 12th largest worldwide.

The meeting's technical speaker was Lee Landauer, of Valspar Corporation. His talk focused on "MATERIAL SELECTION PARAMETERS FOR CORROSION CONTROL IN FOOD CANS."

The presentation provided an overview of the interior coating selection process for metal containers, with an emphasis on corrosion concerns.

Mr. Landauer stated the many reasons for coating cans, including: to control corrosion; to reduce the cost of cans by replacing expensive tin platings with coated steel; to serve as a lubricant in the production process, providing a degree of fabricability; and to keep the aesthetics of the can interior.

According to the speaker, two factors are the key to corrosion control accomplished with an organic coating: chemical resistance and coverage of the metal surface.

The types of interior can coatings available were discussed. Mr. Landauer said the oldest technology remains the lowest cost system available. The system consists of oleoresinous and/or phenolic resins being cooked into a varnish. However, over the last 25 years, he noted that epoxies have taken an ever increasing share of the can market. The speaker stated that by varying the epoxy and amino curing agent, coatings can be tailored to fit specific needs. In the 1930s, vinyls were first used, providing a superior flavor protection and flexibility. The vinyls were used on beer cans. According to Mr. Landauer, a new technology using dispersion vinyls or organosols has displayed potential. The newest technology employs the use of high molecular weight polyester resins. Although the technology is relatively new, it has proven to be flexible.

In conclusion, Mr. Landauer stated that the selection of a specific coating formula for a given end use must be done with great care. Once a coating fitting the many required parameters has been chosen, then the food products themselves will be the final factor in the selection process.

Q. How important are the cost factors in can coatings? Is it a matter of protection at all costs?

A. Cost is important. An example is the feeling that a white can interior would appeal to the housewife as being clean or sanitary. To make a white application would be quite high, resulting in a cost three times that of the traditional gold. So, even though the can maker wants the white, he is not willing to pay for it.

Q. What types of polyesters are being recommended for drawn cans?

A. Very high molecular weight types. These also are much more expensive than the more conventional polyesters.

JEFFREY C. STURM, *Secretary*

Elections

CDIC

Active

Conners, Paul H.—Sherwin-Williams, Columbus, OH.

Associate

Avona, Elizabeth—Michelman, Inc., Cincinnati, OH.

KANSAS CITY

Active

Dispensa, Nick F.—Patco Specialty Div., Kansas City, MO.
Raymond, Douglas G.—Pratt & Lambert, Wichita, KS.

Associate

Latas, Pat M.—Chemtech Industries, Kansas City, MO.

PACIFIC NORTHWEST

Active

Duignan, John F.—Guardsman Products, Inc., Seattle, WA.
Giang, John D.—Gaco Western, Tukwila, WA.
Igielski, Chris T.—Adhesives Technology, Kent, WA.
Kuroda, Brian Y.—Willamette Valley Co., Eugene, OR.
Lambert, Darald W.—Ames Paints (1987) Ltd., Victoria, B.C.
Linton, Edward J.—Cloverdale Paint, Surrey, B.C.
Loewen, E. Les—Color Your World, Vancouver, B.C.
Loria, Diane J.—McWhorter Inc., Portland, OR.
Mack, Robert J.—Willamette Valley Co., Eugene.
Miller, Brent W.—Guardsman Products, Inc., Seattle.
North, Stephen—Benjamin Moore, New Westminster, B.C.
Park, David W.—The Weyerhaeuser Co., Tacoma, WA.
Phillips, Tracy R.—Flecto Coatings Ltd., Richmond, B.C.
Raza, Mir Ali—Guardsman Products, Inc., Seattle.
Sorensen, Villy—Unicrete Products, Calgary, Alberta.
Sportsman, Ron—Guardsman Products, Inc., Seattle.
Subler, Julia K.—Willamette Valley Co., Eugene.
Tomich, Pamela J.—Guardsman Products, Inc., Seattle.

Associate

Bruck, David—Lilyblad Petroleum, Tacoma, WA.
Chudin, George I.—Dow Corning, Vancouver, B.C.
Gaskill, Jon B.—Pacific Coast Chemicals Co., Bellevue, WA.
Hoyle, Peter J.—Esso Chemical Canada, Port Moody, B.C.
Julian, Yvonne—Dow Chemical, Walnut Creek, CA.
Olsen, Gregory F.—Ropak N.W., Kent, WA.
Potter, Roy—Paramount Can Co., Kent.
Ridnell, Anthony M.—The Tryline Co., Seattle, WA.
Taylor, Samuel O.—E.I. Du Pont, Walnut Creek.
Vallette, Charles W.—Aqualon Co., Del Mar, CA.

PITTSBURGH

Active

Miller, Ann M.—Conica Corp., Harmony, PA.
Schmidt, John C.—Watson-Standard Co., Pittsburgh, PA.
Weidner, Richard J.—Valspar Corp., Pittsburgh.

Associate

Fay, Patrick M.—Chemcentral, Gibsonia, PA.
Kirsch, Timothy S.—Chemcentral, Pittsburgh, PA.
Meglio, Olivio—Chemply, Pittsburgh.
Osegueda, John W.—Chemcentral, Pittsburgh.

TORONTO

Active

Crimi, Sam—KG Packaging, Concord, Ont.
Jetha, Sultan—Akzo Coatings Ltd., Rexdale, Ont.
McDonald, Robert T.—ICI Paints, Concord.
Ryley, Diane F.—ICI Paints Canada Ltd., Toronto, Ont.
Shen, Tom—ICI Paints, Concord.

Book Review

RESINS FOR SURFACE COATINGS

Volumes I & II—Second Edition
Edited by
P. Oldring and G. Hayward

Volume III—Second Edition
Edited by
M.J. Husbands, C.J.S. Standen, and G. Hayward

Published by
SITA Technology
203 Gardner House
Broomhill Road
London SW18 4JQ
England (1987)

Reviewed by
Thomas J. Miranda
Whirlpool Corp.
Benton Harbor, MI

This three volume work is directed to paint and ink technologists. It is written in a very readable style and contains a wealth of useful information to the practicing coatings technologist. The first volume, 222 pages, includes an introduction to polymers science, glyceride oils, hard resins and varnishes, and alkyd resins.

The second volume, 309 pages, covers epoxy resins, phenol-formaldehyde and amino resins, polyamides, and vinyl and acrylic resins; a major portion of this second volume is devoted to the last named resins.

The third volume contains 303 pages and discusses polyurethane and polyester resins, water soluble resins, and resins for electrodeposition. The chapter format includes an introduction, industries where used, then a discussion of the chemistry involved. This is followed by a treatment of the raw materials used in the synthesis, the parameters involved in performance properties, calculations involved and formulations for preparing a variety of resins for particular applications.

These volumes are well illustrated and written in a very readable style. The indices are well prepared and detailed. The tables and chemical formulae are very well done. Perhaps a drawback, is that there are no references cited in any of the volumes which might have been more useful to the reader.

This series is a must for laboratories carrying out resin systhesis and formulations and is a valued contribution to the coatings literature.

People

The Federation of Associations of Technicians in the Paint, Varnish, Lacquer, and Printing Ink Industries of Continental Europe (FATIPEC), Paris, France, has announced organizational changes effective January 1 of this year. **Max H.L. Raaff** has been named President of FATIPEC, succeeding **Annik Chauvel**.

Also, **Francis Borel** will take over as General Secretary of FATIPEC. He served as General Secretary of the French Association of Paint, Lacquer, Printing Ink, and Adhesives (AFTPV) from 1972 to 1988, and President of the group from 1988 to 1990. Mr. Borel replaces **Christian Bourgery**, who has been with FATIPEC since its inception 40 years ago.

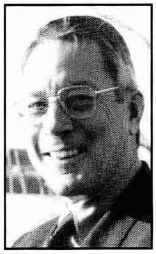
George A. Menendez has been elected Vice President—Marketing by the Board of Directors of Buckman Laboratories International, Inc., Memphis, TN. He will be responsible for several departments, training programs, and a wide variety of marketing policies and issues. Mr. Menendez replaces the retiring **Richard T. Ross**, who is a member of the Southern Society.

The Coatings and Resins Group, PPG Industries, Inc., Allison Park, PA, has announced that **Donald Boyd** has been promoted to Research Associate. He works out of the laboratory facilities at the Research and Development Center in Allison Park. Dr. Boyd, a member of the Pittsburgh Society, is Chairman of the Federation's Educational Steering Committee, and is a Trustee of the Coatings Industry Education Fund.

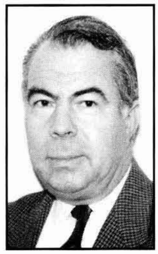
Polymer Technologies, Inc., at University of Detroit Mercy, Detroit, MI, has named **Kurt C. Frisch** President of the company. Formerly Vice President, he also will continue to serve as Director of Research. The founder of Polymer Technologies, Dr. Frisch succeeds **Nicholas J. De Grazia**, who resigned to become President of Lionel Trains, Inc.

He is the first American inducted into the Polyurethane Hall of Fame, and has written, co-authored, or edited 26 books, published more than 200 articles, and is the holder of 52 U.S. patents. Dr. Frisch is a recipient of Medals of Merit from the British Rubber and Plastics Association and the German Foam Society. In 1986, the Society of Plastics Engineering honored him with its Award for Outstanding Achievement in Plastics Education.

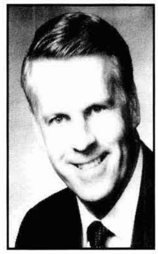
Dr. Frisch is a member of the Detroit Society.



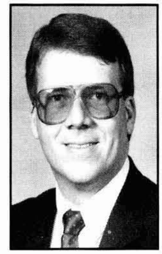
M.H.L. Raaff



F. Borel



J.R. Cowans



R. Francis

John R. Cowans is the new Vice President—Calcium Carbonate for Genstar Stone Products Company, Hunt Valley, MD. His duties include all manufacturing and sales operations involved in the production and marketing of calcium carbonate products used mainly in the manufacture of paints, plastics, paper, and related products. Mr. Cowans has been with Genstar since 1988, serving as Vice President—Support Services.

Witco Corporation, New York, NY, has appointed **Robert R. Pfohl** Manager of the Chicago, IL, Organics Division plant. Previously, he was Production Manager of the facility. Mr. Pfohl joined the division in 1986 as a Process Engineer.

In other news, Witco has named **Richard J. Stimpfl** Vice President of the new International Marketing Department. He had served as Vice President for the company's Argus Division. Mr. Stimpfl has held various responsibilities for domestic and international sales during his career at Witco.

Ranbar Technology Inc., Glenshaw, PA, has named **Rodney Francis** has its new Controller. Most recently, he was Controller of Puritan Paint and Oil Company. In addition, Mr. Francis has held various positions with PPG Industries and Joy Manufacturing Company.

The Society of Manufacturing Engineers (SME), Dearborn, MI, has announced the promotion of **Eileen McGuire** to Manager—Professional Interests. In her new position, Ms. McGuire is responsible for all Technical Associations and Groups. She began her career with SME in 1988 as Manager of several of the group's associations.

Also, **Cheri Willetts** was appointed Manager—Association for Finishing Processes of SME and Composites Manufacturing Association of SME, in the Professional Interests Department. She will explore environmental issues for possible SME activities and units. Ms. Willetts brings 20 years of experience to the position.

Dr. Alan Gent, the Dr. Harold A. Morton Professor of Polymer Engineering and Polymer Physics at The University of Akron, Akron, OH, has been named to the National Academy of Engineering. He has been a University of Akron faculty member since 1961.

Dr. Gent served on the National Research Council panel that evaluated the solid-rocket boosters following the 1986 Challenger accident. Last year, he received the Charles Goodyear Medal from the American Chemical Society's Rubber Division for his work in adhesion, fracture mechanics, stress analysis of bonded rubber cylinders and blocks, rubber elasticity, and the mechanics of elastic foams. Dr. Gent has received several major national awards and an international research award, and has published more than 150 articles dealing with the physical behavior of polymers.

In addition, his other awards include the George Stafford Whitby Award for distinguished teaching and academic research, the 3M Award for excellence in adhesion science from the Adhesion Society, the Society of Plastics Engineers' International Research Award, the Adhesives Awards of the American Society for Testing and Materials, the Plastics and Rubber Institute's Colwyn Medal, the Society of Rheology's Bingham Medal, and the Mobay Award presented by the Cellular Plastics Division of the Society of Plastics Industry.

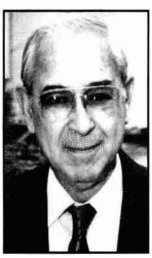
Dr. Kenneth L. Hoy to Receive 1991 ACS Roy W. Tess Award in Coatings

The American Chemical Society (ACS), Washington, D.C., has named **Dr. Kenneth L. Hoy**, retired from Union Carbide, the winner of the 1991 Roy W. Tess Award in Coatings. The announcement was made by the Officers and Award Committee of the Division of Polymeric Materials: Science and Engineering (PMSE) of ACS. Dr. Hoy will be presented the Tess Award during the 202nd Annual Meeting of the ACS, in New York, NY, on August 25-30.

The award, established to recognize outstanding contributions in the fields of coatings science, technology, and engineering, will be presented to Dr. Hoy in acknowledgment of his significant achievements in a variety of areas. Work on the theory on plastisol gelation, the development of relationships between glass transition temperature of organic materials and their plasticizing efficiency, work with structure-property relationships, solubility parameters, particle morphology, and, most recently, the development and practical application of supercritical carbon dioxide as a solvent to replace hydrocarbons in spray coatings are some of his achievements. Dr. Hoy's work has led to a wide variety of product and equipment development, including the introduction of polycaprolactone polyols into the coatings industry, the development of the "Solvit" program, the market entry of both poly (vinyl chloride-ethylene) and vinyl acetate-butyl acrylate-vinyl chloride terpolymer emulsions, and the Unicarb™ system.

Dr. Hoy's reputation as a seminal thinker in the fields of coatings science and technology is evident in his work in 14 journals and book publications, 41 patents, and 18 presentations delivered at forums such as the Gordon Research Conference and the Athens International Conference. The body of his work, created over the length of his distinguished career, has established him as a key innovator in the industry.

Dr. Hoy earned the B.S. Degree in Pharmacy from the University of Wyoming in 1950, and the Ph.D. Degree in Pharmaceutical Chemistry from the University of North Carolina in 1955. Upon graduation, he joined Union Carbide Corporation as a Senior Chemist and, as his distinguished career unfolded, rose to the position of Senior Corporate Fellow in 1985. Dr. Hoy held this position until his retirement in 1990.



Also, Dr. Hoy presented the 1978 Joseph J. Mattiello Memorial Lecture of the Federation of Societies for Coatings Technology. He was the Chairman of the 1974 Gordon Research Conference on Chemistry and Physics of Coatings and Films. In 1982, Dr. Hoy received the Scientific Achievement Award, given by the Kanawha Valley Section of the ACS.

During the ACS Annual Meeting in August, a symposium and reception will be held in honor of Dr. Hoy.

Unocal Chemicals Division, Schaumburg, IL, has announced the promotions of **Mark Cheplen** and **Don Aromando** to Regional Marketing Managers. Both men are responsible for new product development, introduction and promotion, primarily in the coatings, adhesives, plastics, cosmetics, and chemical compounding markets.

Mr. Cheplen will handle Unocal's Atlanta, GA, distribution center. He previously served as a regional staff-level Technical Manager.

Mr. Aromando is responsible for the territory served by Unocal Chemicals' Clark, NJ distribution center. He was the Baltimore, MD, region Sales Representative for the company prior to this promotion.

Also, the Chemicals Division has named **C.E. Cook** Manager—New Products. His new duties include product sales, distribution operations, and the evaluation and implementation of new products. Previously, Mr. Cook had held a variety of sales and marketing management positions.

David Smith has joined Rust-Oleum Corporation, Vernon Hills, IL, as Director—Industrial Sales, North Region. He will oversee sales of industrial coatings through distribution in the northeastern U.S. and Canada. Prior to joining Rust-Oleum, Mr. Smith was a District Manager for Black & Decker.

Bayer USA Inc., Pittsburgh, PA, has announced that President and Chief Executive Officer **Konrad M. Weis** has elected to retire effective July 1. He has been with the Bayer Group for 36 years and has held a variety of research, manufacturing, and staff positions of increasing responsibility at Bayer AG. Dr. Weis will be succeeded by **Helge H. Wehmeier**, President and Chief Executive Officer of Agfa Corporation, Bayer USA's imaging technologies company. A member of the Bayer USA Executive Committee and Board of Directors since 1989, Mr. Wehmeier has been with Bayer AG since 1965.

Thomas Lucas has been named Vice President—Sales for Inland Leidy, Inc., Baltimore, MD. He has been with Inland Leidy for 12 years and previously served as Southern Area Sales Manager. Mr. Lucas is a member of the Baltimore Society.

Charles L. Benjamin has been appointed Vice President—Worldwide Business Management by ARCO Chemical Company, Newtown Square, PA. He returns to ARCO's worldwide headquarters after two-and-one-half years at the company's European head office in Maidenhead, England. Mr. Benjamin has held various positions during his 12-year career with ARCO.

Titan Tool, Inc., Oakland, NJ, has promoted **Paul C. Henrici** to Vice President—Sales and Marketing. In his new position, Mr. Henrici will continue to oversee both national and international sales and marketing operations for Titan, its products, and services. He has been with the company for 12 years, and served most recently as Director—Sales and Marketing.

John E. Anderson has been appointed to the new position of Corporate Director—Quality, for The Dexter Corporation, Windsor Locks, CT. In this new position, he will lead the company in total quality concepts and processes worldwide. Mr. Anderson served most recently as Vice President—Total Quality, Specialty Materials & Services Group.

The new officers for the National Association of Corrosion Engineers (NACE), Houston, TX, were installed during the association's 47th Annual International Conference in March. The officer appointments are as follows: President—**William F. Gundaker**, of Ebasco Services Inc.; Vice President—**Robert P. Brown**, of R.P. Brown & Associates Corrosion Engineering Consultants; Treasurer—**Charles G. Arnold**, of Dow Chemical USA; and Director-at-Large—**Barry C. Syrett**, of Electric Power Research Institute.

F.R. Hall Company, St. Louis, MO, has announced three appointments. **James N. McDerby** has been named Vice President-General Manager. He has been with the company for six years and served most recently as Vice President—Sales. Mr. McDerby is a member of the St. Louis Society.

H. Jeff Laurent was promoted to Vice President—Sales for F.R. Hall and will relocate to the St. Louis office. Formerly Regional Sales Manager in Kansas City, he has been with the company for 11 years. Mr. Laurent is President of the Kansas City Society.

In addition, **Gonzalo Martin** was appointed Vice President—Controller. He has been with F.R. Hall for six years.

The Glidden Company, Cleveland, OH, has announced the retirement of President **John S. Dumble**. He has been with the company for more than 30 years, beginning his career with Glidden at the company's eastern region headquarters in Reading, PA, in 1960. Mr. Dumble became President of Glidden in 1984.

Named to succeed Mr. Dumble is **John Danzeisen**, currently Chief Financial Officer for ICI Paints. He has been with ICI since 1970, primarily in the general management and financial areas within different ICI business groups. Mr. Danzeisen also has held various technical service and business analysis positions in the ICI Specialty Chemicals, Dyes, and Textile Chemicals business groups.

Mark Weber has been appointed Corporate Director—Human Resources for Avecor, Inc., Vonore, TN. He brings over 12 years of experience in employee relations for several large Tennessee-based companies to the position. Mr. Weber will be responsible for administering a company-wide program of human resource functions.

Colorgen Inc., Billerica, MA, has appointed **Stephen E. Speer** Manager—National Accounts. He will be responsible for all marketing programs directed at penetration of national accounts. Mr. Speer also will direct all communications and contacts with prospects on a national basis.

In other news, Colorgen has named **Bob Haulk** Field Service Manager for the new Field Service Office in Houston, TX. He will create and manage this office, and will coordinate and provide direct customer support both during the initial system installation phase and post-installation.

Robert A. Haley, Jr. has been promoted to Executive Vice President and Corporate Sales Manager by Finnaren & Haley Paint Company, Conshohocken, PA. He had been involved in the Purchasing Department and industrial sales. Mr. Haley has been with the company since 1980.

The Painting and Decorating Contractors of America (PDCA), Fairfax, VA, has announced that **Robert L. Cusumano**, of Sun Art Painting, Riviera Beach, FL, has been elected National President of the organization. He has served on the PDCA Executive Committee since 1987, and prior to that time, was a Regional Vice President and Chairman of PDCA's Insurance, Safety and Loss Control Committee. Locally, he was President of the Palm Beach Chapter and Florida Council of PDCA. Mr. Cusumano assumed his present office during PDCA's 107th Annual Convention, in Atlanta, GA, on February 22.

Lonza Inc., Fair Lawn, NJ, has announced **John Pazdera** as its new Manager—Regulatory Services. He will manage all regulatory functions, including registrations, with regard to the FDA, the EPA, AgCanada, the CDFA, and various state governments. Most recently, Mr. Pazdera served as Government Affairs Specialist for Boyle-Midway/Reckitt & Colman.

The Board of Directors of the National Paint and Coatings Association (NPCA), Washington, D.C., has approved the nomination of **B.F. Mautz, Jr.**, of Mautz Paint Company, as NPCA's new Vice President. He will serve at this post until NPCA's 1991 Annual Meeting in October, at which time Mr. Mautz will advance to President. He succeeds **John S. Dumble**, of The Glidden Company, who has retired.

Also, the Board has approved the nomination of **Paul D. Dague**, of Jones-Blair Company, as the association's new Treasurer. He will replace Mr. Mautz. Mr. Dague will serve as Treasurer until October, when he will advance to Vice President.

John Danzeisen, of The Glidden Company, has been appointed to fill Mr. Dumble's seat on the NPCA Board of Directors.

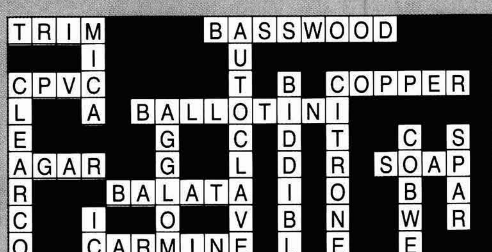
The appointment of **Michael J. McCann** to Sales Manager has been announced by Ruco Polymer Corporation, Hicksville, NY. He has 26 years of experience in sales, marketing, and business operations in the chemicals industries. Prior to his new position, Mr. McCann served as Business Manager—Solvents for BP Chemicals America. He is a member of the New York Society.

Obituary

Dr. Werner R. Husen, founder of the W.R. Husen Company, died on January 29. He was 90 years old.

Mr. Husen worked as a Chemist for various companies in the Chicago area prior to joining Krumbhaar Chemical Company, Kearney, NJ, as a Technical Representative in 1942. He worked his way to Director of Sales for Krumbhaar before founding his own company.

Mr. Husen was a member of the New York Society for Coatings Technology, the New York Paint and Coatings Association, and the New York Printing Ink Association.



Solution to April's "CrossLinks"

Golden Gate Society Manufacturing Committee To Present Conference on "Paint Technology"

A conference on "Paint Technology and Quality for the 90s" will be held at the Holiday Inn, in South San Francisco, CA, on June 17. The event is sponsored by the Manufacturing Committee of the Golden Gate Society for Coatings Technology.

The all-day program is designed to provide methods of manufacturing and control. The equipment described is intended to help manufacturers achieve emission goals. Also, the conference is expected to help manufacturers become more efficient and less wasteful.

Topics slated for presentation include:

"Computer Controlled Production for Industrial Paint Plants"—Puis Eigenmann, of Buhler, Inc.;

"Statistical Quality and Process Control"—Bill Abercrombie, of J.M. Huber Corporation;

"Criteria for Dispersion Equipment Control"—Christ Zoga, of Premier Mill Corporation;

"Further Developments in Micro Fine Wet Grinding"—Edward Cossama, of Draisewerke, Inc.;

"Formula Base Software"—Christy Hudson, of Pacific Micro Software Engineering;

"Recycling of Paint in the Plant"—Herbert C. Paulson, of Daly's Wood Finishing Products;

"Computer Control Manufacturing"—Ken Edwards, of Dunn-Edwards; and

"Performance Oriented Packaging"—Mike McQuiston, of B.W. Norton Company.

Members of the Golden Gate Conference Committee who helped organize the conference program include: Chairman Louie Sanguinetti, of Jasco Chemical; Co-Chairman Ron Hughes, of Ashland Chemical; Co-Chairman E. "Bud" Harmon, Consultant; Adrian Adkins, of Schoofs, Inc.; Ray Benedetti, of Triangle Coatings; Ted Favata, Consultant; Dave Filson, of Clorox; Don Mazzone, of O'Brien Corporation; Tina Onderbeke, of Dowd & Guild, Inc.; Kevin Porterfield, of Pfizer, Inc.; A. Gordon Rook, Consultant; Carol Seaborn, of PDCA; Leo Schinasi, of Hüls America; Ken Trautwein, of Frank W. Dunne Company; and Rocky Williams, of Napa Valley Paint Company.

For more information on the "Paint Technology and Quality" conference, write Ron Hughes, Ashland Chemical, 8600 Enterprise, Newark, CA 94560.

Paints and Coatings Air Quality Regulations Subject of Short Course at UC, Berkeley

The University of California, Berkeley is conducting a three-and-one-half day course on "Getting into Compliance with Air Quality Regulations for Paints, Coatings, and Printing Facilities," at The Cathedral Hill Hotel, in San Francisco, CA, on June 4-7. The class is being sponsored by Continuing Education in Engineering, University Extension, UC, Berkeley.

The purpose of the course is to present information about the air pollution regulations which affect the use of paints and coatings. Also, participants will be provided with the tools required to bring coating facilities into compliance with the existing Clear Air Act and new Clear Air Act Amendments.

Course topics to be discussed include: why paints and coatings cause air pollution; what needs to be known about a coating system; evaluating quality of volatile organic compounds (VOC) information and basic VOC calculations; how the new Clean Air Act will affect surface coating facilities; basic understanding of surface coating rules and common terminology; an overview of other surface coating rules; and an overview of air quality regulations for surface coating operations.

In addition, the following subject areas are on the agenda: add-on control equipment alternatives; BACT analysis for surface coating operations; measuring transfer efficiency; minimizing hazardous waste from a paints and coatings facility; compiling a realistic compliance plan and schedule for a noncompliant coating facility; what to expect from an air quality inspection; commercially available low VOC liquid coatings; and powder coatings.

The instructers for the course include: Ron Johnson, Principle, Ron Joseph & Associates, Inc.; Ayjay Wilson, Professional Engineer, California's South Coast Air Quality Management District; and John Howell, Jr., Project Director, Roy F. Weston

For further course details, write Continuing Education in Engineering, University Extension, University of California, 2223 Fulton St., Berkeley, CA 94720.

Western Coatings Societies 21st Biennial Event To Be Held at Disneyland Hotel, March 23-25, 1993

The Western Coatings Societies' 21st Biennial Symposium and Show will be held at the Disneyland Hotel and Convention Center, in Anaheim, CA, on March 23-25, 1993. The event is sponsored by the Golden Gate, Los Angeles, Pacific Northwest, and Rocky Mountain Societies for Coatings Technology.

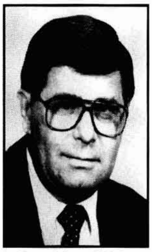
The theme of this 21st Biennial program is "Visions—Opportunities—Challenges." The event will feature exhibits and technical programs.

Chairmen for this symposium and show are: General Chairman—Geneva H. Wells, of H.M. Royal of CA, Inc.; Co-Chairman—Sandra L. Dickinson, of Harcros Chemicals, Inc.; Advisor—Andrew R. Ellis, of Kronos, Inc.; Entertainment—Bruce Cotton, of Pluess-Staufer, Inc.; Exhibits—William Zimmerman, of Sinclair Paint Company; Printing—Ronald R. Elliott, of J.R. Elliott Enterprises, Inc.; Publicity—Melinda K. Rutledge, of Rheox, Inc.; Registration—James D. Hall, of Major Paint Company; Technical—John C. Kulnane, of Ameritone Paint Corporation; and Secretary/Treasurer—Richard C. Sutherland, II, of E.T. Horn Company.

Southern Society Annual Meeting Program Includes Opening Comments by Federation President Kurt Weitz

The 55th Annual Conference of the Southern Society for Coatings Technology was held at the Peabody Hotel, in Memphis, TN, on April 3-5. The theme of this year's meeting was "Surviving and Prospering in the 90s."

The opening comments were given by Federation President Kurt F. Weitz, who welcomed the 250 registrants to this annual event. The keynote speaker was Jake Ferro, of J.M. Huber Corp. Mr. Ferro's talk was entitled, "Management Concepts to Improve Productivity." Federation Executive Vice President Robert F. Ziegler spoke at the Society Luncheon. Mr. Ziegler discussed the relationship between the Federation and its 26 Constituent Societies.



President Weitz

Presentations on management, operations, industry forecasts, environmental issues, and formulation technologies highlighted the technical program. The topics and speakers were as follows:

"Coatings—Global Forecast for the 90s"—Rich Johnson, of Cargill, Inc.;

"Microbiocides for the 90s"—James Harrell, of Buckman Laboratories, Inc.;

"Quality Benchmarking"—Tom Hill, of Pratt & Lambert, Inc.;

"Environmental and Regulatory Outlook for the 90s"—Robert Gilliam, of Reichhold Chemicals, Inc.;

"Materials Management and the Just-in-Time Environment"—Larry McKenzie, of Eastman Chemical Company;

"Silanes—What Makes Them Better"—Greg Tregre (student), of the University of Southern Mississippi;

"What the Architectural Formulator Should Know About Polymer Emulsions and Paint Technology"—Ronnie Brown, of Unocal Chemicals Division;

"Aqueous Resin Technology"—Gail Pollano, of ICI Resins;

"Marketing Aids for the 90s"—Mike Spangler, of Hüls America and Don Waldenland, of Colwell General; and

"Resin Technology for the 90s"—Richard Johnson, of Cargill, Inc.

The spouses program featured a "See Memphis" tour which included visits to the Brooks Museum of Art, the historic Fontaine House, the National Ornamental Metal Museum, the A. Schwab's Dry Goods Store on historic Beale Street, and a "hard hat" tour of the Great American Pyramid.

Chairman of this year's event was Vernon Sauls, of McCullough & Benton. The Program Chairman was Wayne West,

Western New York Society Awards Scholarships

The Western New York Society for Coatings Technology has announced that it has awarded three scholarships of $600 each to three full-time students. The scholarships were made possible by matching funds from the Buffalo Paint and Coatings Association.

The recipients of the scholarship funds are: Jason A. North, a sophomore Chemistry major at Clarkson Institute of Technology; Michelle L. Moser, a freshman majoring in Business Administration at Roberts Wesleyan; and William R. Meyer, a sophomore at Cayuga Community College, whose major is Journalism.

Named as alternate scholarship winners are: Julie Ann Luck, Richard Schlagter, and Jennifer Lakey.

Other educational activities of the Society included the contribution of $600 for projects related to the coatings industry at the Western New York Science Congress Fair. Also, the Federation's Educational Committee videotape, "The Choice," was shown to junior and senior high school science groups.

FOCUS Conference, April 17 in Detroit Highlighted "Complying with the DNR"

The 16th Annual Future of Coatings Under Study (FOCUS) Conference was held at the University of Detroit/Mercy College, Detroit, MI, on April 17. The FOCUS symposium was sponsored by the Detroit Society for Coatings Technology.

The theme of this year's conference was "Complying with the DNR While Remaining Solvent." The presentations at the symposium included:

"Impending Environmental Concerns: VOC Regulations for the Car Refinish Market"—Raymond Sieradzki, of Sikkens Coatings Division, Akzo Coatings Inc.;

"Transfer Efficiency"—George Brewer;

"VOC Compliant Polyurethane Coatings for the Transportation Industry"—Roger Rumer, of Mobay Corporation;

"Utilizing the Hansen Solubility Parameter Theory in the Reformulation of Solvent-Based Coatings"—Wesley L. Archer, of Dow Chemical Company;

"Waterborne Silicone Organic Hybrids"—Dipak Narula, of Dow Corning Corporation;

"Powder Coatings"—Speaker to be announced, of PPG Industries, Inc.; and

"Aqueous Polyurethane Dispersions Based on TMXDI, Applications and Chemistry"—Robert Cody, of Stanford Research Labs., American Cyanamid Company.

Annual Cleveland Society Technical Conference To Explore Advances in Additive Technology

The Educational Committee of the Cleveland Society for Coatings Technology will sponsor its 34th Annual Technical Conference at the B.F. Goodrich R&D Center, Brecksville, OH, on June 6. The theme of this year's program is "Advances in Additive Technology—Water-Based, High Solids, and Powder."

The program will focus on the needs for additives in water-based, high-solids, and powder coatings in the coatings industry. The objectives of the conference are to stimulate research and to exchange knowledge on the complex interaction of additives in the high-solids, water-based, and powder coatings industries.

Scheduled presentations and speakers include:

"An Introduction to Additives"—Robert W. Vash, of Byk Chemie;

"Calcium Sulfonate Gel-Additive for Efficient Rheology Control"—Demetrios Stephanadis, of Lubrizol Corporation'

"Acrylic Copolymer Additives to Improve Film Defects"—Gary Julian, of B.F. Goodrich;

"New Associative Water Soluble Thickeners"—Emmett Partain, of Union Carbide;

"Surface Treated Pigments—A 90s Solution to Some of Coatings' Problems"—Romesh Kumar, of Hoechst Celanese Corporation;

"Latest Developments in Additives for Architectural Coatings"—Speaker to be announced, Rohm and Haas Company;

"Naturally Occurring Associative Thickeners"—Alexander Jamison, of Case Western Reserve University; and

Speaker to be announced, The Dow Chemical Company.

Additional information and brochures are available from: Devilla Moncrief, Cleveland Society Educational Committee Chairman, Sherwin-Williams International, 601 Canal Rd., Cleveland, OH 44113.

Canadian Plastics Institute Releases Seminar Slate

The Canadian Plastics Institute (CPI), Don Mills, Ontario, Canada, has announced a schedule of courses to be presented during 1991.

Slated conferences and dates are: "Introduction to Plastics Technology"—May 27-28, Halifax, Nova Scotia, October 21-22, London, Ont., and November 18-19, Toronto, Ont.; "Design in Plastics"—September 9-10, Edmonton, Alberta; "Hands on Injection Molding"—September 16-17, Toronto; "Hands on Blow Molding"—October 29-30, Toronto; "Plastics and the Environment"—November 25, Vancouver, British Columbia; and "Blends and Alloys"—December 9, Toronto.

The "Plastics Technology" course is designed to focus on the basic concepts and state-of-the-art developments in the following areas: resins, compounds, blends, and alloys; RP/C; injection molding; blow molding; extrusion; prototyping, etc.; and applicable markets. Also, the conference will feature a discussion on plastics and the environment. Incineration, recycling, landfill, ozone depletion, and more will be covered during this two-day class.

The objective of the "Plastics and the Environment" course is to bring both the private and public sectors up-to-date on global and domestic trends in legislation, industry initiatives, and waste management technologies for plastics. Specific subject areas to be included during the conference include: "The Plastics Industry," "The Solid Waste Crisis: An Overview of Legislation and Regulation," "Industry Initiatives," "Barrhaven Project," "Introduction to Recycling Plastics," "Degradable Plastics," "Designing Plastics Packaging for the Environment," "Research and Development Trends in Plastics Waste," and "Energy from Waste Technology."

Additional conference details are available from CPI, 1262 Don Mills Rd., Suite #48, Don Mills, Ont. M3B 2W7, Canada.

OCCA to Sponsor Symposium On Lithographic Printing

The Oil and Colour Chemists Association (OCCA), Wembley, Middlesex, England, is sponsoring a symposium on "Lithographic Printing—From Raw Materials to Waste Recycling—The Integrated Approach," in Brussels, The Netherlands, on November 20-21.

The international program is designed to provide a forum for an up-to-date assessment of many of the aspects of the lithographic printing process and will consider future trends in the light of expected legislation and emerging electronic technology.

The symposium will consist of three sessions covering raw materials, the printing process (including in-line coating) together with factors which influence its quality, and the disposal of printed matter and waste materials.

Prospective authors are welcome to submit papers for presentation at the symposium to Simon Lawrence, Honorary Research & Development Officer, CIBA-GEIGY Pigments Plc, Hawkhead Rd., Paisley, Renfrewshire PA2 7BG, Scotland. Abstracts should be submitted no later than June 30. All papers presented will be published in *Surface Coatings International*, the journal of OCCA.

For further symposium details, contact Yvonne Waterman, OCCA, Priory House, 967 Harrow Rd., Wembley, Middlesex, England HA0 2SF.

Surface Analysis System

A six-page, full color brochure which describes a new surface analysis system is in print. The literature provides an overview of the features and benefits of the system, with numerous supporting spectra. For additional details on the PHI 6600 Dynamic SIMS surface analysis system, contact Steve Deppa, Perkin-Elmer, Physical Electronics Div., 6509 Flying Cloud Dr., Eden Prairie, MN 55344.

Corrosion Software

New corrosion measurement software capable of operating a line of computer-controlled potentiostats for the purpose of performing nine different corrosion techniques has been introduced. The software offers user-friendly features, including pull-down menus and data export to word processing or spreadsheet packages. For more information on SoftCorr™ II, contact Andy Palus, EG&G Princeton Applied Research Corp., P.O. Box 2565, Princeton, NJ 08543.

Testing Laboratories

The *ASTM Directory of Testing Laboratories* which lists 1,400 laboratories and references to several hundred branch locations is available. The 1991 version of the Directory contains 400 new listings. The publication is priced at $52 for members and $65 for nonmembers. For more information, contact Philip L. Lively, ASTM Publications Div., 1916 Race St., Philadelphia, PA 19103-1187.

Liquid Chromatography

A new, 16-page, four-color brochure describing a range of high performance liquid chromatography systems and components has been published. The catalog provides an overview of: the LC Analyst Expert Methods Development System and the Integral 4000 Liquid Chromatograph; modular systems (isocratic, binary, and quaternary); and systems configured for specific applications (Peptide Mapping System, HPLC System for PCR Analysis, Carbamate Analysis System, and Gel Permeation Chromatography System). For a copy of "HPLC. Systems for Solutions," write The Perkin-Elmer Corp., 761 Main Ave., Norwalk, CT 06859-0310.

Aerogel

Technical literature highlights an aerogel that is 95% air and is designed to have a high level of insulating capabilities. The aerogel is silica-based and produced without chlorofluorocarbons. For additional data on the aerogel, contact Sangeeta D. Ramamurthi, Battelle, 505 King Ave., Columbus, OH 43201-2693.

Thermosets

A new 24-page booklet which explains the basic aspects of rheological testing and its application to thermoset polymers and products is in print. The literature contains over 40 graphs and illustrations. For a copy of "Understanding Rheological Testing: Thermosets," write: Marketing, Rheometrics, Inc., One Possumtown Rd., Piscataway, NJ 08854.

Organic Chemicals

A line of specialty organic chemicals for varied end uses is the subject of a 56-page brochure. The publication is designed to serve as a guide to the selection of intermediates for use in textiles, coatings and inks, pharmaceuticals, and metal working and plating. Write Henkel Corp., Textile Chemicals, Customer Technical Service Dept., P.O. Box 34428, Charlotte, NC 28234 for a copy of the brochure.

Amino Resin

Literature describes an amino resin with the following properties: low temperature curing; hardness and flexibility; and solvent resistance. The crosslinking resin has applications in lawn and garden furniture, automotive trim, extrusion coatings for building products, appliances, and general industrial uses. For more information on Powderlink® 1174 resin, write American Cyanamid Co., One Cyanamid Plaza, Wayne, NJ 07470.

Additives

A full line of additives for PVC-processing is the focus of a new, six-page, four-color technical brochure. Product uses and a selection of performance additives are detailed in a chart with specifications and characteristics. A copy of the "Additives for PVC-Processing" brochure is available from: George Walsh, Unichema North America, 4650 S. Racine Ave., Chicago, IL 60609.

Urethane Primers

Technical literature describes two aluminum pigmented primers which may be topcoated with aliphatic or aromatic polyurethanes. The brochure discusses the features of the primers, their basic uses, and applications. For a copy of Bulletin No. DS10-7322 on Chemglaze 9420 and 9720, write Lord Corp., Industrial Coatings, 2000 W. Grandview Blvd., P.O. Box 10038, Erie, PA 16514-0038.

Defoamers

Two defoamers designed to reduce volatile organic compound emissions are the subject of a product release. The defoamers contain only minimal amounts of the solvents and other low molecular weight compounds. Write Air Products and Chemicals, Inc., Performance Chemicals Div., 7201 Hamilton Blvd., Allentown, PA 18195-1501 for details on Surfynol® DF-58 and DF-75 defoamers.

Glossmeter

A glossmeter designed to measure the surface finish on a very small area is the focus of technical literature. The unit also can be used on curved surfaces. Data on the Microgloss 155/SO glossmeter is obtainable from: A. Routs, Sheen Instruments Ltd., 9 Waldegrave Rd., Teddington, Middlesex TW11 8LD, England.

Precipitated Silicas

A process which reacts silazane with precipitated silica to produce a finely divided particle with high levels of hydrophobicity is the focus of a data sheet. The new products are designed to offer the dual functionalities of rheology and water repellency in liquid systems. For more details on Tullanox HM 250 and 250D, contact William F. Slade, Tulco, Inc., 9 Bishop Rd., Ayer, MA 01432.

Lab Disperser

A new lab disperser with electronic speed control is featured in a technical bulletin. The basic lab disperser is stand mounted and powered by a 0-16,000 RPM universal one horsepower electric motor. Data on the CM-100 are available from: D.H. Melton Co., Inc., 1531 Ponderosa Ave., P.O. Box 5318, Fullerton, CA 92635.

Adhesives and Sealants Applications

A new, six-page brochure describes a company's plastics capabilities for the adhesives and sealants markets. The publication includes a complete listing of lines of polyols, polymeric MDI, pure and modified MDI, epoxy resins, epoxy novolacs, and epoxy resins for adhesive and sealants formulations. To receive a copy of "Polyurethane and Epoxy Products for Adhesives and Sealants," (Form No. 296-00905-690), write to: The Dow Chemical Co., Corporate Communications, Midland, MI 48674.

Waterborne Systems

A six-page folder designed as a reference to a line of acrylics, latexes, and vehicles for a range of waterborne systems has been published. A chart provides data on properties such as solids, pH, density, particle size, viscosity, and minimum filming temperature. A copy of "UCAR® Acrylics, Latexes, and Vehicles," designated F-44977N, can be obtained from Union Carbide Chemicals and Plastics Co. Inc., UCAR Emulsion Systems, Dept. L4488, 39 Old Ridgebury Rd., Danbury, CT 06817-0001.

Modeling and Analysis Software

Literature focuses on software designed to provide the user with rheological testing software which can be specifically tailored to the individual needs of the user. The program control reduces the operator interaction to a minimum, while standardizing test control for precision. Contact Laura A. Migliore, Bohlin Reologi, Inc., 2540 Rte. 130, #105, Cranbury, NJ 08512 for more information.

Paint System

A paint system for dip coating or flow coating refrigeration evaporator coils is highlighted in a product release. The system, designed specifically for the appliance industry, is a low VOC, water reducible and low cure cycle coating. Further details on the Black Magic™ Paint System are obtainable from: Man-Gill Chemical, 23000 St. Clair Ave., Cleveland, OH 44117.

Polytetramethylene Ether Glycol

A new molecular weight grade of polytetramethylene ether glycol is the focus of literature. The product is designed for use in applications requiring a property balance between 1000-2000. For additional information on Terethane 1400, write Du Pont Co., External Affairs Dept., Wilmington, DE 19898.

Coating Thickness Measurement System

A new compact x-ray fluorescence plating/coating thickness measurement system is highlighted in a product bulletin. The system is designed with state-of-the-art instrumentation, and computer hardware and software packages to reduce inspection time and plated parts while improving accuracy. Write CMI International, 2301 Arthur Ave., Elk Grove Village, IL 60007 for details on the XRX system.

Floor Finish

A new, colorless translucent finish for interior wooden floors is the subject of a product release. The coating is a formulated clear satin matte finish designed to accentuate the natural grain and texture of wooden floors, while providing a nonyellowing, wear-resistant durable protective finish. Further data on Cetol TFF can be obtained by writing Akzo Coatings Inc., Decorative Finishes, P.O. Box 7062, Troy, MI 48007-7062.

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.

1991

(May 13-16)—Federation "Spring Week." Seminar on the 13th and 14th; Board of Directors Meeting on May 15; and Society Officers Meeting on May 16. Sheraton Society Hill Hotel, Philadelphia, PA.

(Nov. 4-6)—69th Annual Meeting and 56th Paint Industries' Show. Convention Center, Toronto, Ontario, Canada.

1992

(Oct. 21-23)—70th Annual Meeting and 57th Paint Industries' Show. McCormick Place, Chicago, IL.

1993

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

1994

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

SPECIAL SOCIETY MEETINGS

1991

(May 2-4)—Pacific Northwest Society. Annual Symposium. Meridien Hotel, Vancouver, British Columbia, Canada. (John P. Berghuis, Kronos Canada, Inc., 3450 Wellington Ave., Vancouver, B.C., Canada V5R 4Y4).

(June 3-5)—"Resins for Coatings." Course sponsored by the Mexico Society. Cocoyoc Country Club, Mexico. (Gerardo del Rio, Telephone: 52 (5) 5-43-64-88; Fax: 52 (5) 6-82-79-75; or Jorge Rodriguez, Telephone: 52 (36) 12-72-72; Fax: 52 (36) 11-52-18).

(June 5)—"Increasing Productivity Through Employee Development and Motivation." Seminar jointly sponsored by the Chicago Society and the Chicago Paint and Coatings Association. (John G. DeVaney, Cabot Corp., 2655 Irving St., Portage, IN 46368).

(June 6)—Cleveland Society. 34th Annual Technical Conference. B.F. Goodrich R&D Center, Brecksville, OH. (Devilla Moncrief, Sherwin-Williams Co., Cleveland Technical Center, 601 Canal Rd., Cleveland, OH 44113).

(June 17)—"Paint Technology and Quality for the 90s." Conference sponsored by the Golden Gate Society Manufacturing Committee. Holiday Inn, S. San Francisco, CA. (Ron Hughes, Ashland Chemical, 8600 Enterprise, Newark, CA 94560).

(June 7-8)—Joint Meeting of the St. Louis and Kansas City Societies. Holiday Inn, Lake of the Ozarks, MO.

(Aug. 22-24)—Mexico Society. "Fourth Annual Technical Conference." Guadalajara, Jalisco. (Gerardo del Rio, Telephone: 52 (5) 5-43-64-88; Fax: 52 (5) 6-82-79-75; or Jorge Rodriguez, Telephone: 52 (36) 12-72-72; Fax: 52 (36) 11-52-18).

OTHER ORGANIZATIONS

1991

(May 12-15)—AOCS 82nd Annual Meeting & Expo. Sponsored by The American Oil Chemists' Society. Chicago Marriott Hotel, Chicago, IL. (Myra Barenberg, AOCS, P.O. Box 3489, Champaign, IL 61826-3489).

(May 13-17)—"Spray Finishing Technology Workshop." Sponsored by Bowling Green State University and DeVilbiss Ransburg Industrial Liquid Systems. Toledo, OH. (Richard A. Kruppa, Professor of Manufacturing Technology, College of Technology, Bowling Green State University, Bowling Green, OH 43403).

(May 13-18)—"Interpretation of IR and Raman Spectroscopy Course, Lectures, and Workshops." Vanderbilt University, Nashville, TN. (Fisk Infrared Institute, Box 15, Fisk University, Nashville, TN 37203).

(May 14-16)—PaintCon '91. Conference and exhibition sponsored by *Industrial Finishing* magazine. O'Hare Expo Center, Chicago (Rosemont), IL. (PaintCon '91, 2400 E. Devon Ave., Ste. 205, Des Plaines, IL 60018).

(May 15-17)—Sixth Annual Conference of the Architectural Spray Coaters Association (ASCA). Loews Ventana Canyon Resort, Tucson, AZ. (ASCA, 230 W. Wells St., Ste. 311, Milwaukee, WI 53203).

(May 20-24)—"Adhesion Principles and Practice for Coatings and Polymer Scientists." Short course sponsored by Kent State University (KSU), Kent, OH. (Carl J. Knauss, Director, Cooperative and Continuing Education, Chemistry, KSU, Kent, OH 44242).

(May 22-24)—NAMRC XIX, the 19th North American Manufacturing Research Conference. Sponsored by the Society of Manufacturing Engineers. Rolla, MO. (Ronald Kohser, Associate Professor of Metallurgy, University of Missouri-Rolla, Rolla, MO).

(May 22-24)—"Environmental Protection, Control and Monitoring." Conference organized by the European Region of the Instrument Society of America (ISA) and co-sponsored by BAMBICA, The Association for Instrumentation, Control and Automation Industry in the U.K., and The Institute of Measurement Control in the U.K. Birmingham, England. (ISA, 67 Alexander Dr., P.O. Box 12277, Research Triangle Park, NC 27709).

(May 23-24)—Seventh International Symposium on "Theory and Trends in Electrostatic Coating Technology." The University of Western Ontario, London, Ont., Canada. (Prof. I.I. Inculet, Director, Applied Electrostatics Research Centre, The University of Western Ontario, London, Ont., Canada N6A 5B9).

(May 29-31)—Fourth International Symposium on Polymer Analysis and Characterization; June 1-2—Short course "Major Polymer Characterization Techniques and Methods." Baltimore Inner Harbor, MD. (Judith A. Watson, Professional Association Management, 750 Audubon, East Lansing, MI 48823).

(June 3-7)—22nd Annual Short Course on "Advances in Emulsion Polymerization and Latex Technology." Sponsored by Lehigh University, Bethlehem, PA. (Mohamed S. El-Aasser, Emulsion Polymers Institute, Lehigh University, 111 Research Dr., Bethlehem, PA 18015).

(June 4-7)—"Getting into Compliance with Air Quality Regulations for Paints, Coatings, and Printing Facilities." Course sponsored by University of California, Berkeley. The Cathedral Hill Hotel, San Francisco, CA. (Continuing Education in Engineering, University Extension, University of California, 2223 Fulton St., Berkeley, CA 94720).

(June 5-7)—5th International Conference on Crosslinked Polymers. Sponsored by State University of New York (SUNY). Luzern, Switzerland. (Angelos V. Patsis, Institute in Materials Science, SUNY, New Paltz, NY 12561).

(June 10-14)—"High Solids and Low-VOC Coatings." Short course sponsored by North Dakota State University (NDSU), Fargo, ND. (NDSU Continuing Education, P.O. Box 5819, University Station, Fargo, ND 58105-5819).

(June 12-14)—International Bridge Conference: Painting Seminar on the 12th. Administered by Steel Structures Painting Council (SSPC) and sponsored by the Engineers Society of Western Pennsylvania. SSPC Bridge Painting Forum on the 13th and 14th. Sponsored by SSPC. The Pittsburgh Hilton, Pittsburgh, PA. (SSPC, 4400 Fifth Ave., Pittsburgh, PA 15213-2683).

(June 12-14)—SURCON '91, "Developments in the Science of Surface Coatings." Moat House International Hotel, Stratford-upon-Avon, England. (Simon Lawrence, CIBA-GEIGY Pigments, Hawkhead Rd., Paisley, Renfrewshire PA2 7BG, Scotland).

(June 17-28)—"Coatings Science." Short course sponsored by North Dakota State University (NDSU), Fargo, ND. (NDSU Continuing Education, P.O. Box 9, University Station, Fargo, ND 58105-5819).

(June 19-21)—First International Symposium on Environmental Effects on Advanced Materials. Sponsored by National Association of Corrosion Engineers (NACE). Catamaran Resort Hotel, San Diego, CA. (NACE Customer Service Dept., P.O. Box 218340, Houston, TX 77218).

(July 7-12)—Seventh International Conference on Surface and Colloid Science (ICSCS). Sponsored by the International Association of Colloid and Interface Scientists, Université de Technologie de Compiègne, France. (M. Clausse, Secretariat of the 7th ICSCS, c/o Wagons-Lits Tourisme, B.P. 244, 92307 Levallois-Perret Cedex, France).

(July 8-12)—17th International Conference in Organic Coatings Science and Technology. Sponsored by State University of New York (SUNY). Athens, Greece. (Angelos V. Patsis, Institute in Materials Science, SUNY, New Paltz, NY 12561).

(July 17-19)—Introductory Short Course on "Basic Coatings for Sales and Marketing Personnel." Sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (Norma Fleming, Sr. Continuing Education Coordinator, UMR, 119 M.E. Annex, Rolla, MO 65401-0249).

(July 22-26)—"Coatings Science for Coatings Technicians" Short Course. Sponsored by the University of Southern Mississippi (USM), Hattiesburg, MS. (Ruth Holifield or Shelby Thames, Dept. of Polymer Science, USM, Southern Station, P.O. Box 10076, Hattiesburg, MS 39406).

(July 29-Aug. 2)—Gordon Research Conference on the Chemistry and Physics of Coatings and Films. Colby-Sawyer College, New London, NH. (George Pilcher, Akzo Coatings, Inc., 1313 Windsor Ave., P.O. Box 147, Columbus, OH 43216-0147).

(Aug. 5-9)—"Coatings Science for Coatings Chemists" Short Course. Sponsored by the University of Southern Mississippi (USM), Hattiesburg, MS. (Ruth Holifield or Shelby Thames, Dept. of Polymer Science, USM, Southern Station, P.O. Box 10076, Hattiesburg, MS 39406).

(Sept. 3-5)—2nd International Paint Congress. Sponsored by The Brazilian Association of Paint Manufacturers (ABRAFATI). Anhembi Convention Centre, São Paulo, Brazil. (Específica S/C Ltd., Rua Augusta, 2516—2nd Floor, Ste. 22, 01412, São Paulo, SP, Brazil).

(Sept. 9-13)—63rd Introductory Short Course on "The Basic Composition of Coatings." Sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (Norma Fleming, Sr. Continuing Education Coordinator, UMR, 119 M.E. Annex, Rolla, MO 65401-0249).

(Sept. 10-12)—North American Hazardous Materials Management Conference and Exhibition. Sponsored by *HazMat World* magazine. Cobo Hall, Detroit, MI. (Tower Conference Management Co., 800 Roosevelt Rd., Bldg. E, Ste. 408, Glen Ellyn, IL 60137).

(Sept. 17-20)—Eurocoat 91. XIX International Congress/Exibition. Nice, France. (A. Chauvel, AFTPV, 5, rue Etex, 75018 Paris, France).

(Sept. 24-26)—The Polyurethanes World Congress 1991. Co-sponsored by the European Isocyanate Producers Association and the Polyurethane Division of The Society of Plastics Industry (SPI), Inc. of the USA. Acropolis Arts & Convention Center, Nice, France. (Fran Lichtenberg, Polyurethane Div., SPI, 355 Lexington Ave., New York, NY 10017).

(Sept. 29-Oct. 2)—RADTECH Europe '91 Conference and Exhibition. Edinburgh Exhibition and Trade Centre, Edinburgh, Scotland. (Exhibit Manager, RADTECH 91, c/o FMJ International Publications Ltd., Queensway House, 2 Queensway, Redhill, Surrey, RH1 1QS, United Kingdom or Conference Secretary, RADTECH '91, c/o PRA, Waldegrave Rd., Teddington, Middlesex, TW11 8LD, England).

(October)—ASTM Committee B-8 on Metallic and Inorganic Coatings meeting. Philadelphia, PA. (George A. DiBari, International Nickel Co., Park 80 West—Plaza Two, Saddle Brook, NJ 07662).

(Oct. 2-4)—Hazardous Materials Management Conference and Exhibition/South (HazMat/South). Sponsored by *HazMat World* magazine. Georgia World Congress Center, Atlanta, GA. (Tower Conference Management Co., 800 Roosevelt Rd., Bldg. E, Ste. 408, Glen Ellyn, IL 60137-5835).

(Oct. 7-10)—"Introduction to Coatings Technology." Short course sponsored by Kent State University (KSU), Kent, OH. (Carl J. Knauss, Director, Cooperative and Continuing Education, Chemistry, KSU, Kent, OH 44242).

(Oct. 9-11)—"Verbundwerk '91." 3rd International Trade Fair on Composite Technology, Reinforced Plastics, Metals, and Ceramics. Rhein-Main-Halls, Wiesbaden, Germany. (Diana Schnabel, DEMAT, Postbox 110 611, 6000 Frankfurt 11, Germany).

(Oct. 16-18)—"Accelerated and Natural Weathering Techniques for Coatings and Polymers." Short course sponsored by Kent State University (KSU), Kent, OH. (Carl J. Knauss, Director, Cooperative and Continuing Education, Chemistry, KSU, Kent, OH 44242).

(Oct. 21–24)—Euro–Asian Interfinish '91 Conference. (Aviezer Israeli, Chairman, The Metal Finishing Society of Israel, Ortra Ltd., P.O. Box 50432, Tel–Aviv 61500, Israel).

(Oct. 21-25)—23rd Introductory Short Course on "Paint Formulation." Sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (Norma Fleming, Sr. Continuing Education Coordinator, UMR, 119 M.E. Annex, Rolla, MO 65401-0249).

(Oct. 28-Nov. 1)—"Fundamentals of Chromatographic Analysis." Short course sponsored by Kent State University (KSU), Kent, OH. (Carl J. Knauss, Director, Cooperative and Continuing Education, Chemistry, KSU, Kent, OH 44242).

(Oct. 28-Nov. 1)—Ninth International Conference on "Photopolymers," on Oct. 28-30, and Fourth International Conference on "Polyimides," on Oct. 30–Nov. 1. Sponsored by the Society of Plastics Engineers, Inc. (SPE). The Nevele Country Club, Ellenville, NY. (Prabodh Shah, c/o SPE, Mid Hudson Section, P.O. Box 546, Hopewell Junction, NY 12533).

(Nov. 4-5)—"Electrochemical Impedance: Analysis and Interpretation." Symposium sponsored by ASTM Committee G-1 on Corrosion of Metals. San Diego, CA. (John R. Scully, Sandia National Labs., Org. 1834, P.O. Box 5800, Albuquerque, NM 87185).

(Nov. 6-8)—POWDEX. Organized by Cahners Exhibition Group. Georgia World Congress Center, Atlanta, GA. (Angela Piermarini, Show Manager, Cahners Exposition Group, 1350 E. Touhy Ave., P.O. Box 5060, Des Plaines, IL 60017-5060).

(Nov. 7-8)—"Paint Volatile Organic Compounds." Course presented by ASTM, Toronto, Ont., Canada. (Kathy Dickinson, ASTM, 1916 Race St., Philadelphia, PA 19103).

(Nov. 8-12)—1991 International Surface Finishing & Coatings Exhibition (SF China '91) and the 1991 International PC Board Making & Electro-Chemicals Exhibition (PCB China '91). Shanghai Exhibition Center, Shanghai, P.R. China. (Sinostar International Ltd., 10A Harvest Moon House, 337-339 Nathan Rd., Kowloon, Hong Kong).

(Nov. 10-15)—1991 National Conference and Exhibition of Steel Structures Painting Council (SSPC). Long Beach Convention Center, Long Beach, CA. (SSPC, 4400 Fifth Ave., Pittsburgh, PA 15213-2683).

(Nov. 20–21)—"Lithographic Printing—From Raw Materials to Waste Recycling—The Integrated Approach." International symposium sponsored by the Oil & Colour Chemists' Association (OCCA). Brussels, The Netherlands. (Yvonne Waterman, OCCA, Priory House, 967 Harrow Rd., Wembley, Middlesex, England HA0 2SF).

1992

(Feb. 18–20)—Hazardous Materials Management Conference and Exhibition/Northern California. San Jose Convention Center, San Jose, CA. (Tower Conference Management Co., 800 Roosevelt Rd., Bldg. E—Suite 408, Glen Ellyn, IL 60137–5835).

(Feb. 23-26)—Williamsburg Conference, "Comparison of Color Images Presented in Different Media." Co-sponsored by the Inter-Society Color Council and the Technical Association of Graphic Arts, Colonial Williamsburg, VA. (Milton Pearson, RIT Research Corp., 75 Highpower Rd., Rochester, NY 14623).

(June 15-17)—Euroformula '92. International Trade Fair. RAI International Exhibition and Congress Centre. Amsterdam, the Netherlands. (RAI, Europaplein, 1078 GZ, Amsterdam,the Netherlands).

(Oct. 25-30)—Fourth Corrosion and Protection Iberoamerican Congress and First Panamerican Congress on Corrosion and Protection. Mar del Plata, Argentina. (CIDEPINT, 52 entre 121 y 122, 1900 La Plata, Argentina, South America).

Advertisers Index

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'Humbug' from Hillman

We are indebted to Dr. Gordon Pawelchak of the Pacific Northwest Society. From his old college files, Gordon has exhumed a scientific treatise on electricity, which offers us previously little known, valuable information. Here we have it, very slightly edited for space considerations.

Lecture on Electricity

What in the world is electricity? Where does it go after it leaves the toaster?

Here is a simple experiment that will teach you an important lesson. On a cool dry day, scuff your feet along a carpet, then reach into a friend's mouth and touch one of his dental fillings. Notice how your friend will twitch violently and cry out in pain. This teaches us that electricity can be a very powerful force.

It also teaches us how an electrical circuit works. When you scuffed your feet, you picked up a batch of "electrons," which are very small objects that carpet manufacturers weave into carpets so that they will attract dirt. The electrons travel through your bloodstream and collect in your finger, where they will form a spark that leaps to your friend's filling, then travels down to his feet and back to the carpet, thus completing the circuit. If you scuffed your feet long enough without touching anything, you would build up so many electrons that your finger would explode.

Although we tend to take our electric lights, radios, mixers, etc., for granted, hundreds of years ago people did not have any of these things, which is just as well because there was no place to plug them in. Then along came the first electrical pioneer, Benjamin Franklin, who flew a kite in a lightning storm and received a serious electrical shock. This proved that lightning was powered by the same forces as carpets. It damaged Franklin's brain so severely that he started speaking in incomprehensible maxims such as: "A penny saved is a penny earned." Eventually, he had to be given a job running the Post Office.

In 1780, Luigi Galvani discovered that when he attached two different kinds of metal to the leg of a frog, an electrical current developed, and the frog's leg kicked, even though it was no longer attached to the frog, which was dead anyway. Galvani's discovery led to enormous advances in the field of amphibian medicine. Today, skilled veterinary surgeons can take a frog that has been seriously injured or killed, implant pieces of metal in its muscles, and watch it hop back in the pond just like any normal frog, except for the fact that it sinks like a stone.

The greatest electrical pioneer of all was Thomas Edison, who was a brilliant inventor, despite the fact that he had little formal education and lived in New Jersey. Edison's first major invention, in 1877, was the phonograph, which could soon be found in thousands of American homes where it basically sat until 1923, when the record was invented. But Edison's greatest achievement came in 1879 when he invented the Electric Company. Edison's design was a brilliant adaptation of the simple electric circuit. The Electric Company sends electricity through the wire to a customer, then immediately gets it back through another wire. Then (this is the brilliant part) sends it right back to the customer again.

This means the Electric Company can sell a customer the same batch of electricity thousands of times a day and never get caught, since very few customers take the time to examine their electricity closely. In fact, the last year in which any new electricity was made in the United States was 1937; the Electric Companies have merely been reselling it ever since, which is why they have so much free time to apply for rate increases.

Thanks to men like Edison and Franklin and frogs like Galvani's, we receive almost unlimited benefits from electricity. For example, scientists have developed the laser, an electronic appliance that emits a beam of light so powerful that it can vaporize a bulldozer 2000 yards away, yet so precise that doctors can use it to perform delicate operations on the eyeball, provided they remember to change the power setting from "Vaporize Bulldozer" to "Delicate."

—Author Unknown

I was pleased to have a note from my friend Julius Nemeth with a quote that *Forbes Magazine* dared to publish under the heading, "Critical View," as follows:

"Painting: n. The art of protecting flat surfaces from the weather and exposing them to the critic.

Formerly, painting and sculpture were combined in the same work; the ancients painted their statues. The only present alliance between the two arts is that the modern painter chisels his patrons."

—The Devils Dictionary by Ambrose Bierce

Dick Kiefer saw this sign in a Philadelphia shoe repair shop:

We doctor shoes,
Heel them,
Attend their dyeing,
And save their soles.

Humbug's family gets into our act with a contribution from daughter-in-law, Pat Hillman. Pat, expert in "Information Systems," credits the following quotes to Robert I. Stevens, who is a 40-year veteran in the field.

—It is always dangerous to make forecasts, especially in the future (Sam Goldwyn).

—Here lies Tony the waiter. It took God to catch his eye.

—The length of a meeting rises with the square of the people present.

—Nothing is impossible to the man who doesn't have to do it himself.

—No matter how many rooms there are in a motel, the person who starts an old noisy car will always be under your window.

—Don't put off any complicated project until tomorrow that you can order a subordinate to do today.

—Herb Hillman
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