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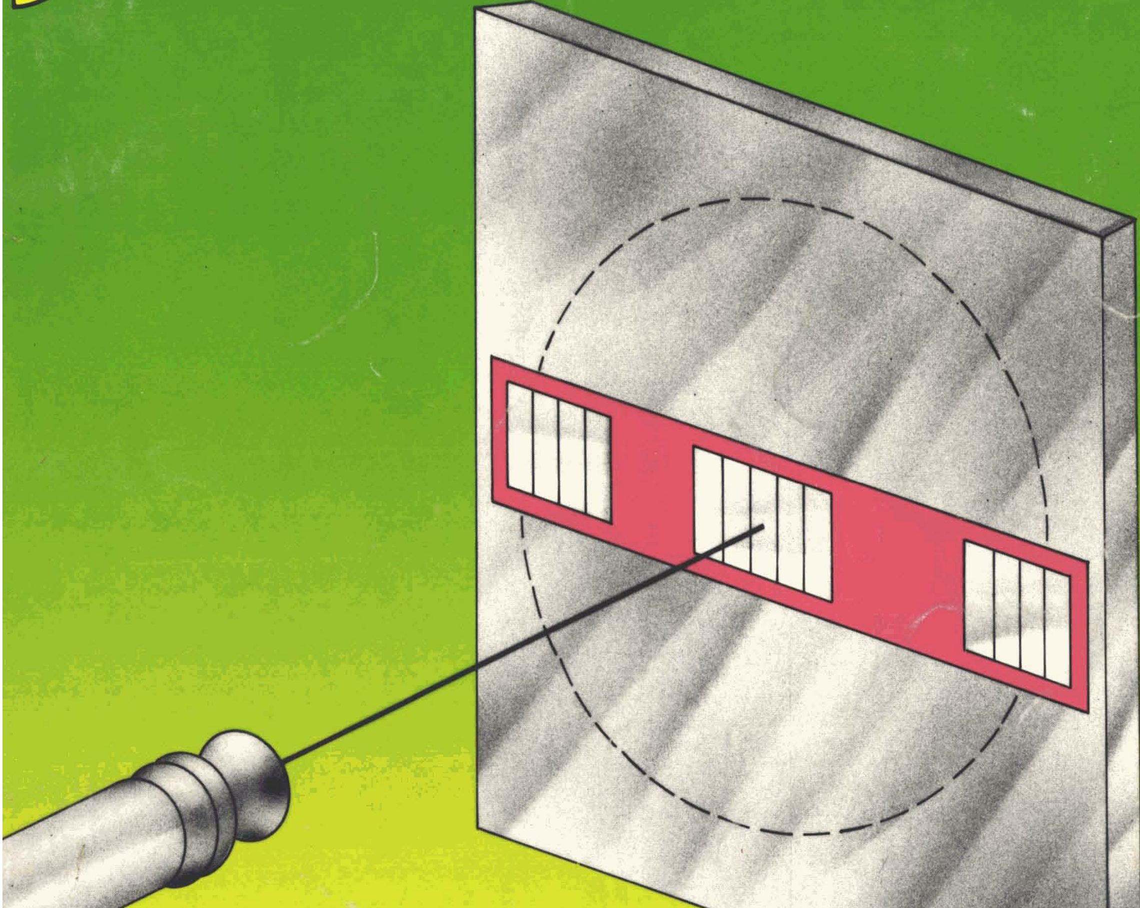

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Technical Articles

Federation News

Departments

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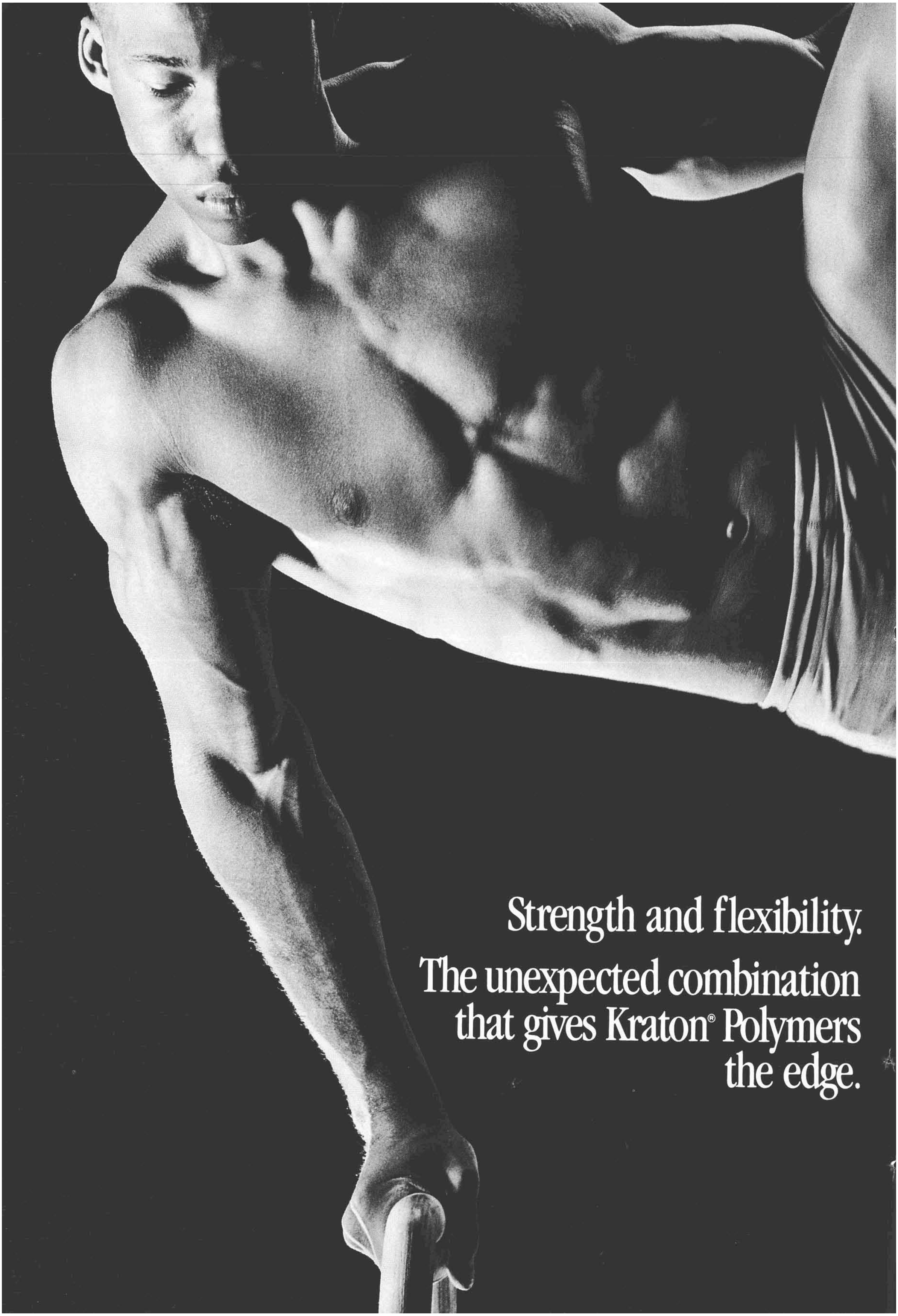
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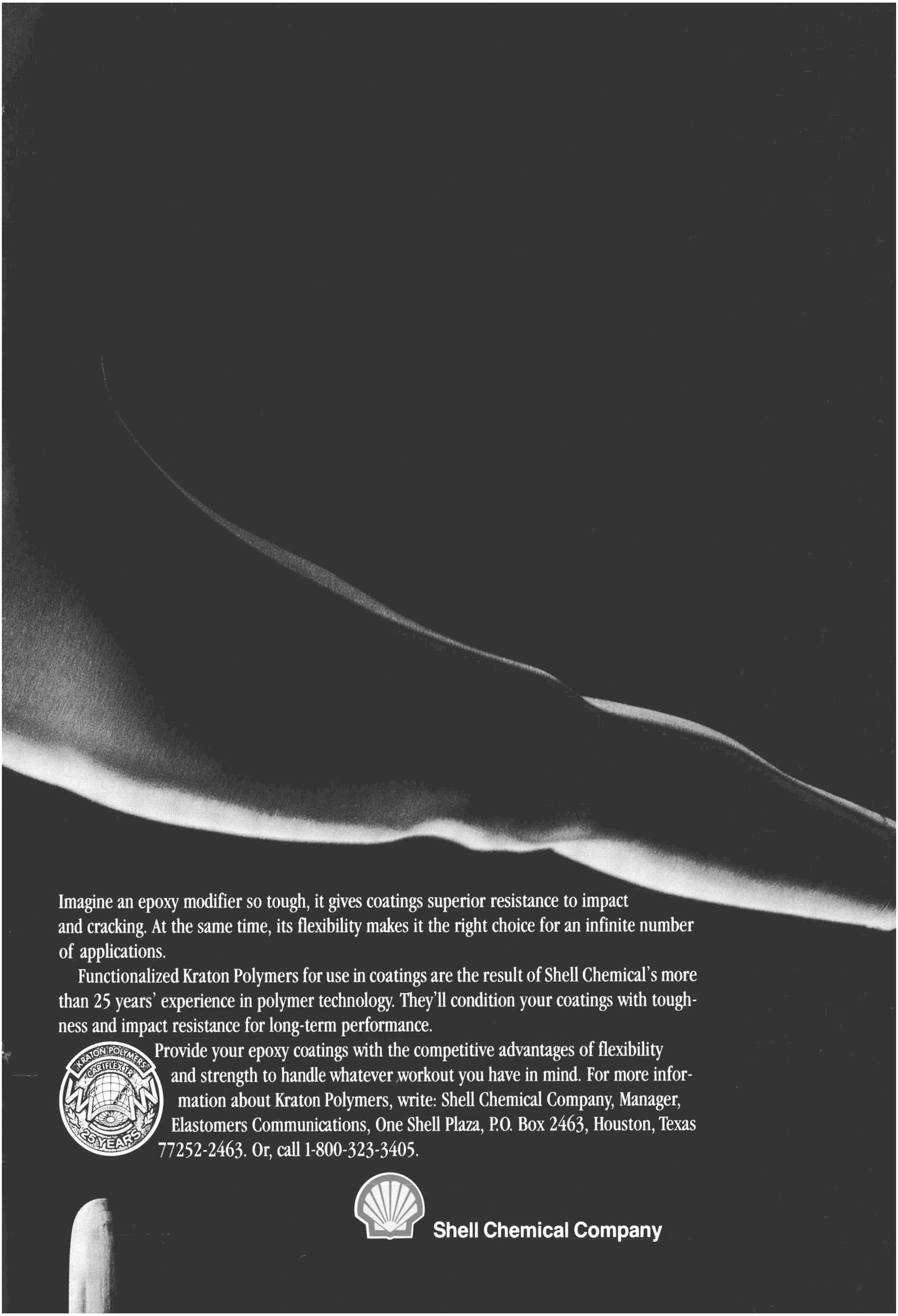

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Comment

A Gift for the Holidays

For the coatings industry, this holiday season may not rank as one of the cheeriest. Challenges abound, from concerns over mounting environmental regulations, shrinking of the industry through mergers and acquisitions, not to mention a deteriorating world economy.

However, the situation may not be so bleak after all. Recently, the Federation published a monograph that explores the evolution of the coatings industry and its developing technology. What emerges is a picture of a diverse and steady industry that has proven its ability to meet the challenges of the past through innovation and revitalization.

In his monograph, "Introduction to Coatings Technology," author Alan Brandau provides a concise description of the basics involved in this industry. He traces the development of coatings from the renderings of Altamira cave dwellers 15,000 years ago to the high tech world of computers and robotics. (Additonal information on the monograph, the 16th in the continuing Federation Series on Coatings Technology, is included in this issue on page 12.)

The future of the industry will be determined by its ability to anticipate and meet changes creatively and profitably. To do this, it will be necessary to attract bright, imaginative people to the coatings field. It is hoped that through publications such as this monograph, the Federation is assisting in this continuing process.

The Federation Wishes Happy Holidays to All and to All a Good Year!

Patricia D. Viola

Patricia D. Viola,
Editor

Abstracts of Papers in This Issue

GLOSS OF COATINGS APPLIED BY ELECTROSTATIC ROTARY-BELL SPRAYING—K. Tachi, C. Okuda, and K. Yamada

Journal of Coatings Technology, 62, No., 791, 19 (Dec. 1990)

The gloss of coatings containing titanium dioxide (TiO_2) pigment is reduced by increasing the rotational speed of a bell-head. The mechanism of the gloss loss, namely roughening the film surface, has been studied by scanning electron microscopic observation of the pigment dispersions in the paint droplets and films sprayed at rotational speeds of 10,000 and 35,000 rpm, and by the measurement of 60° gloss variations during the drying process. Loss of gloss is attributed to paint droplets with uneven pigment dispersion. The droplets are produced by pigment/vehicle centrifugation in a high-speed rotating bell-head, forming a wet film containing pigment-rich and pigment-poor regions. The wet film shrinks nonuniformly, roughening the film surface after the fluidity of the film sufficient for leveling is lost.

A NEW APPROACH TO THE DESIGN OF PIGMENT DISPERSING RESINS—K. Tsutsui et al.

Journal of Coatings Technology, 62, No., 791, 27 (Dec. 1990)

Basic rules for designing pigment dispersing resins were studied using the acrylic resin/conventional pigment dispersion system. Molecular weight, molecular structure of a resin, compatibility to a main binder, and especially, number of acid-base groups and/or acid-base strength were found to be very important factors in improving the pigment dispersibility. Optimum ranges for these factors were also determined based on the experimental results.

POLYESTER RESINS BASED UPON 2-METHYL-1,3-PROPANEDIOL—C.J. Sullivan et al.

Journal of Coatings Technology, 62, No., 791, 37 (Dec. 1990)

2-methyl-1,3-propanediol is a commercially available but relatively unknown diol. In order for the chemist to gauge the utility of this new glycol in polyester resins, a comparative analysis of resins based upon 2-methyl-1,3-propanediol, propylene glycol and 2,2-dimethyl-1,3-propanediol has been performed and is reported here. In addition, 2-methyl-1,3-propanediol based polyesters with different isophthalic to adipic acid ratios have been synthesized and analyzed. Diol comparisons indicate that 2-methyl-1,3-propanediol provides relatively higher levels of internal flexibility. Melamine cured coatings demonstrate that a high level of flexibility and hardness are simultaneously attainable. High levels of isophthalic acid in the 2-methyl-1,3-propanediol based resins are tolerated without risking resin crystallization. QUV weathering, salt spray, detergent, and humidity resistance test results are reported.

DEVELOPMENT OF NEW ADDITIVES TO IMPROVE SCRATCH RESISTANCE AND IMPART SLIP TO SOLVENT-BASED COATINGS SYSTEMS—F. Fink et al

Journal of Coatings Technology, 62, No., 791, 47 (Dec. 1990)

This paper introduces the concept of slip and mar resistance, and characterizes several types of commonly used silicone-based additives. Tests for evaluating slip resistance and metal-marking are described. The relationship between surface slip properties and scratch resistance is discussed. Relative efficacy among classes of silicone-based additives is evaluated. Two parameters affecting additive performance—molecular weight of the siloxane block and degree of organo modification are investigated. Results of this investigation are presented. A direct correlation between additive chemistry and efficacy is demonstrated.

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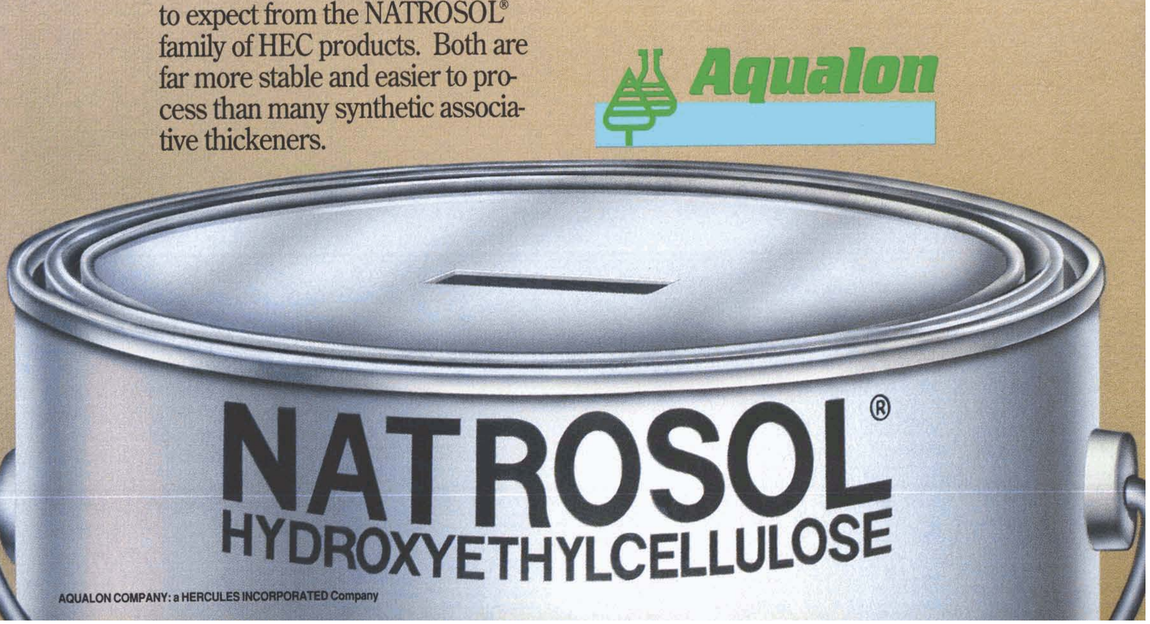

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Kurt F. Weitz, of Toronto Society, Elected 69th President Of the Federation, at Annual Meeting in Washington, D.C.

Kurt F. Weitz, of Toronto, Ont., Canada, became the 69th President of the Federation of Societies for Coatings Technology on October 31, at the Federation's Annual Meeting in Washington, D.C.

William F. Holmes, of National Pigments & Chemicals, Inc., Garland, TX, was named President-Elect and Colin D. Penny, of Hampton Paint Mfg. Company, Hampton, VA, was elected Secretary-Treasurer.

President Weitz

Mr. Weitz most recently served as President-Elect of the Federation. He was Treasurer of the Federation (1988-89), has been a member of the Executive Committee since 1985, and serves on the Board of Directors. He was the Toronto Society Representative to the Board of Directors from 1981 to 1988. Mr. Weitz is a member of the Finance Committee, and was a member of the Roon Awards (six years) and Professional Development Committees, and a Trustee of the Coatings Industry Education Fund. Past-President of the Toronto Society (1974-75), he was graduated from the University of Toronto and has served the coatings industry for 33 years.

Mr. Weitz was employed by Indusmin for 22 years and was engaged with the development of nepheline syenite and feldspar as extenders in paints, plastics, rubber, and adhesives. He is a member of the American Chemical Society and the Society for Plastics Engineers.

President-Elect Holmes

William F. Holmes has been a member of the Board of Directors since 1987. He was the Dallas Society Representative to the Board of Directors from 1973 to 1976. Mr. Holmes was the Secretary-Treasurer of the Coatings Industry Education Fund, serves on the Finance Committee, and is an Ex Officio member of the Professional Development Committee. In addition, he has served as Chairman of the Annual Meeting Host, Membership, and Technical Advisory Committees. Mr. Holmes also was a member of the Educational, Nominating, Annual Meeting Program, and A.F. Voss/*American Paint Journal* Awards Committees. He is a Past-President of the Dallas Society (1979-80) and has served on the Society's Technical Committee.

Mr. Holmes is graduate of Texas Tech University and has served the coatings industry for 34 years.

K.F. Weitz

Secretary-Treasurer Penny

Colin D. Penny is a member of the Board of Directors and is Secretary-Treasurer of the Coatings Industry Education Fund, and a member of the Ad Hoc Building Committee. He also was Chairman of the Planning Committee, Chairman of the Technical Advisory and Paint Show Exhibits' Awards Committees, a member of the Finance Committee, and the Federation delegate to the Scientific Committee (NPCA). Mr. Penny is a Past-President of the Baltimore Society (1974-75) and, in 1976, was presented the Herman H. Shuger Memorial Award of the Baltimore Coatings Industry Awards Council. In addition, he served on the Educational Committee of the Baltimore Society.

Mr. Penny is a graduate of Bristol College of Technology in England. Active in the coatings industry for 43 years, he has been a member of the Oil and Colour Chemists' Association since 1952 and is a Past-President of the Washington Paint Technical Group.

Executive Committee

Jan P. Van Zelm, Regional Sales Manager, Byk Chemie USA, Castaic, CA, has been elected for a three-year term on the Federation Executive Committee. Mr. Van Zelm has been the Los Angeles Society Representative to the Board of Directors since 1984 and is a member of the Nominating Committee. He is a Past-President of the Los Angeles Society (1981-82). Mr. Van Zelm is Co-Chairman of the Society's Educational Committee and a member of the Cal Poly Project Committee. He also served on the Manufacturing Committee and was presented with the Society's Outstanding Service Award.

Educated in the Netherlands, Mr. Van Zelm has been in the coatings industry for 32 years.

Joseph D. Giusto, Vice President—Operations, Lenmar, Inc., Baltimore, MD, was elected to serve a one-year term to fill the unexpired term of Thomas E. Hill. Mr. Giusto has been the Baltimore Society Representative to the Board of Directors since 1985. He was President of the Baltimore Society (1983-84) and served as Chairman of the Membership and Nominating Committees. Mr. Giusto received Society Merit Citations in 1983 and 1985, and was awarded the Herman H. Shuger Memorial Award of the Baltimore Coatings Industry Awards Council in 1986.

Educated at Johns Hopkins University, he has been a part of the coatings industry for 23 years. Mr. Giusto currently is President of the Baltimore Paint and Coatings Association.

Board of Directors

Deryk R. Pawsey, Western Canada Area Manager, Rohm and Haas Canada Inc., Vancouver, B.C., Canada, a Past-President of the Federation (1987-88) has been elected for a two-year term on the Board of Directors. Mr. Pawsey serves on the Finance and Ad Hoc Building Committees. He was Chairman of the Liaison Committee and a member of the Executive Committee for eight years and served as the Pacific Northwest Society Representative to the Board of

(Continued on next page.)

1990-91 Committee Chairmen Appointed by President Weitz

Chairmen of 30 committees of the Federation of Societies for Coatings Technology for 1990-91 have been named by President Kurt Weitz. A complete roster of all committees will be published in the 1991 FSCT Year Book.

An asterisk (*) indicates re-appointment for 1990-91.

A.F. Voss/American Paint & Coatings Journal Awards—Patricia Shaw, of Davlin Coatings, Inc., El Cerrito, CA.*

Annual Meeting Host—Larry Ham, of Stochem, Inc., Brampton, Ont., Canada.

Annual Meeting Program—Gerry Parsons, DeSoto Coatings Ltd., Mississauga, Ont., Canada.

Armin J. Bruning Award—Robert T. Marcus, of PPG Industries, Inc., Allison Park, PA.

By-Laws—Fred G. Schwab, of Coatings Research Group, Inc., Cleveland, OH.*

Corrosion—Jay Austin, of Halox Pigments Corp., Hammond, IN.*

Educational—Donald Boyd, of PPG Industries, Inc., Allison Park, PA.

Environmental Affairs—Sidney Rubin, of Empire State Varnish Co., Inc., Brooklyn, NY.

FSCT Building (Ad Hoc)—James E. Geiger, of Sun Coatings, Inc., Largo, FL.*

FSCT History (Ad Hoc)—Michael W. Malaga, Parma, OH.*

Finance—John C. Ballard, of Kurfees Coatings, Inc., Louisville, KY.

George Baugh Heckel Award—Frank J. Borrelle, Cherry Hill, NJ.

Inter-Society Color Council—Ralph Stanziola Station, NJ.*

Investment—Neil S. Estrada, Los Altos Hills, CA.*

Liaison—James E. Geiger.

Manufacturing—Anne Probizanski, of Ampro Technologies, Riverside, CA.

Joseph J. Mattiello Lecture—John T. Vandeberg, of DeSoto, Inc., Des Plaines, IL.

Membership Services—Brenda Carr, of Coatings Development Co., Painesville, OH.*

Memorial—A. Clarke Boyce, of Nacan Products Ltd., Brampton, Ont., Canada.*

Nominating—John C. Ballard.

Paint Industries' Show—Kenneth R. Hyde, of Akzo Coatings, Inc., Louisville, KY.*

Planning—John J. Oates, Midland Park, NJ.

Professional Development—Roger Woodhull, of California Products Corp., Cambridge, MA.

Publications—Thomas J. Miranda, of Whirlpool Corp., R&D Center, Benton Harbor, MI.*

Roon Awards—George R. Pilcher, of Akzo Coatings, Inc., Columbus, OH.

Society Secretaries—William Georgov, of E.M. Sullivan Associates, Inc., Havertown, PA.

Society Speakers Awards—Graham C. Miles, of PPG Industries (UK) Ltd., Birmingham, England.

Technical Advisory—Gail Pollano, of ICI Resins U.S., Wilmington, MA.

Technical Information Systems—Helen A. Skowronska, Clevland, OH.*

* * * * * * *

Delegates to Other Organizations

National Association of Corrosion Engineers (NACE)—Jay Austin, of Halox Pigments Corp., Hammond, IN.*

National Paint & Coatings Association Scientific Committee (NPCA)—Gail Pollano.

NPCA and Governmental Agencies—Sidney Rubin.

IUPAC—Graham C. Miles.

Steel Structures Painting Council (SSPC)—Jay Austin.*

Kurt Weitz Elected President of FSCT

Continued from page 10

Directors for five years. The 1984 recipient of the Federation's George Baugh Heckel Award, Mr. Pawsey was a six-term Chairman of the Paint Industries' Show Committee, and also was active on the By-Laws, Corrosion, Heckel Award, Professional Development, Specifications, and Technical Information Systems Committees. He was a member of the Editorial Review Board of the JOURNAL OF COATINGS TECHNOLOGY and was a Trustee of the Coatings Industry Education Fund. Mr. Pawsey is a Past-President of the Pacific Northwest Society (1975-76) and received their Outstanding Service Award in 1985. Educated in Eng-land, he has been with Rohm and Haas for 17 years.

Elected to serve two-year terms as Members-at-Large on the Board of Directors are Thad T. Broome, Research Fellow, J.M. Huber Corporation Clay Division, Macon, GA, and Berger G. Justen, Florida Branch Manager, Ribelin Sales, Inc., Tampa, FL.

Mr. Broome is a member of the Paint History Committee. He served as Chairman of the 1989 Annual Meeting Host Committee and was a member of the Technical Advisory Committee. Mr. Broome is a Past-President of the Southern Society (1980-81) and twice served as Chairman of the Atlanta Section of the Society. He was Chairman of the Technical Committee, a member of the Finance Committee, and is the Society Historian. Mr. Broome is a graduate of Georgia State University and has been active in the coatings industry for 30 years.

Mr. Justen is a member of the Educational and Nominating Committees, and was the Southern Society Representative to the Federation Board of Directors from 1981 to 1989. He also was a member of the Environmental Affairs Committee. Mr. Justen is Past-President of the Southern Society (1977-78) and served as Chairman of the Society's By-Laws Committee. He attended the University of Florida and has been a member of the coatings industry for 27 years.

Louis F. Holzknecht, Laboratory Manager, Devoe Coatings Company, Louisville, KY, has been elected to serve a one-year term to fill the unexpired term of Mr. Penny. Mr. Holzknecht is a Past-President of the Louisville Society (1989-90) and was Chairman of the Society's Technical Committee. He was graduated with B.S. and M.S. Degrees from Moorehead State University, and has been active in the coatings industry for 13 years. Mr. Holzknecht has been a member of the American Chemical Society for 20 years.

Corrosion Symposium Announced for 1991 FSCT Annual Meeting

The Corrosion Committee of the Federation of Societies for Coatings Technology is sponsoring a Symposium on "Coatings for Corrosion Control of Non-Ferrous Substrates," at the 1991 FSCT Annual Meeting, which will be held in conjunction with the Paint Industries' Show at the Metro Toronto Convention Center, Toronto, Ontario, Canada, November 4-6.

Symposium programming will focus on new technology, corrosion mechanisms that apply, end users, perceived needs and problems. Substrates would include aluminum, zinc, galvanized steel, magnesium, brass, tin, stainless steel, copper, and plated metallics.

Original papers are invited for presentation by speakers from coatings manufacturers, raw material suppliers, end users, test equipment suppliers, government agencies, universities, and consultants.

Interested participants are requested to submit either a summary plus outline, or the complete paper for review, to: Jay Austin, Chairman, Corrosion Committee, Federation of Societies for Coatings Technology, 492 Norristown Rd., Blue Bell, PA 19422-2350.

FSCT Publishes "Introduction to Coatings Technology," 16th Monograph in New *Series on Coatings Technology*

The Federation has announced the recent publication of "Introduction to Coatings Technology," the 16th monograph in its revised *Series on Coatings Technology.*

In the 48-page booklet, author Alan Brandau, of Consolidated Research, Inc., provides a general overview of the coatings industry, focusing on such topics as color, pigments, solvents, paint additives, polymers, and basic paint manufacturing. Information on the large spectrum of coatings applications and the chemistry of the many systems that are used to satisfy application demands is given. In addition, the evolution of coatings is reviewed as new technology and governmental regulations direct the industry's course.

The Series is intended to serve as a valuable teaching and training resource for the industry. The first monograph published is "Film Formation," by Zeno Wicks, Jr. This 20-page booklet includes discussions on film formation by solvent evaporation from solutions of thermoplastic polymers, from solutions of thermosetting polymers, and by coalescence of polymer particles.

"Introduction to Polymers and Resins," by Joseph Prane, emphasizes the importance of polymeric materials in the coatings industry. Terminology, classification, types, mechanisms, and structures are among the topics presented in the 36-page publication.

The third monograph, the 24-page "Radiation Cured Coatings," is by J.R. Costanza, A.P. Silveri, and J.A. Vona. Emphasis is placed on the technology, equipment, and commercial applications of radiation curing, as well as material and equipment hazards, storage and handling needs, personnel protection, and toxicity concerns.

"Solvents," by William Ellis, is a 30-page booklet which contains information on solubility parameters, evaporation rates, solvent molecular structures, as well as terpene and oxygenated solvents. Mr. Ellis also focuses on solvents from specific resins types, solvent identification and analysis, and safety and toxicity.

The fifth monograph, the 20-page "Coil Coatings," is by Joseph Gaske. In addition to terminology and coating types, emphasis is placed on problems in the application and use of coil coatings, the processing of precoated coiled metal, testing, and problems in the manufacture and marketing of coil coatings.

Dr. Wicks contributed the sixth booklet, "Corrosion Protection by Coatings," to the Series. In this 24-page publication, electrochemical corrosion, corrosion protection by intact coatings and with nonintact film, approaches to formulating corrosion protection coatings, and evaluation and testing procedures are explored.

"Mechanical Properties of Coatings," by Loren W. Hill, introduces the basic concepts involved with the behavior of polymeric materials which help to systematize mechanical property data. Discussion in the 28-page monograph concentrates on physical property determinations, as well as descriptions of test methods.

The 64-page publication, "Automotive Coatings," authored by Bruce N. McBane, features such topics as coating systems, original finish undercoats, elements of original finish topcoats, solvent and diluents, and specialty coatings. The author focuses on application techniques, pigmentation, automotive refinishing, and coating evaluation and quality control.

The ninth monograph, "Coating Film Defects," by Percy E. Pierce and Clifford K. Schoff, explores the causes and cures of common surface appearance problems, such as cratering, fish eyes, flooding, orange peel, telegraphing, and water spotting. Also covered in the 28-page publication are techniques for the characterization of defects, the measurement of surface properties, and general guidelines for the prevention/solution of defects.

The proper choice and use of application equipment to apply a coating is the subject of the monograph, "Application of Paints and Coatings." In this 52-page booklet, author Sidney B. Levinson describes the advantages and limitations involved with the techniques and tools used to coat a product.

"Organic Pigments," a 40-page publication contributed by Peter A. Lewis, is designed to provide the coatings formulator with an indication of the classes of organic pigments that are available in today's marketplace. In addition, the monograph provides an insight into the chemistry involved in the manufacture of each pigment type, together with the properties associated with each pigment type as they relate to the use in a coatings application.

The 12th addition to the Series is "Inorganic Primer Pigments," by Alan Smith. The 28-page booklet focuses on inorganic pigments as they are utilized in primers for the protection of metallic substrates. The properties, advantages, and disadvantages of inhibitive pigments, barrier pigments, film reinforcers, and extenders are also described.

"Marine Coatings," authored by Henry R. Bleile and Stephen Rodgers, is a 28-page publication intended for those who have a need to understand marine coatings, as well as coatings technologists who become involved with the marine industry. Information is provided on coatings technology as it is applied to the severe, unique demands of the marine environment.

The 14th addition to the Series is "Sealants and Caulks," authored by Joseph Prane. The 28-page booklet acquaints coatings technologists with sealant and caulk basics so they may design and test suitable coatings for these surfaces. Included are applications, definitions associated with caulks and sealants, and discussions of joint design and preparation, and sealant classifications, selection, and specifications.

The 32-page "Aerospace and Aircraft Coatings," provides the 15th monograph in the Series. Authored by A.K. Chattopadhyay and M.R. Zentner, the booklet offers background information on the types of coatings used by the U.S. aircraft industry and identifies key factors to be considered in formulating these coatings. Additional topics include typical substrates, pretreatments, application and test methods, and future trends.

The monographs, which sell for $5.00 each, may be ordered by contacting Meryl Cohen, FSCT, 492 Norristown Rd., Blue Bell, PA 19422-2350.

Student-Authored Manuscript Entries Invited For 1991 A.L. Hendry Award Competition

Prospective student authors are invited to submit manuscript entries in the 1991 Southern Society Alfred L. Hendry Award competition.

The Award is a $1000 cash prize for the best paper on some aspect of coatings technology, authored by an undergraduate student currently enrolled in a college program.

Submitted papers must describe the results of original research on a subject related to coatings technology, or present a significantly insightful, comprehensive review of a field of coatings technology. Contributions based on original research may be co-authored by a faculty advisor, but the cash award for either type of paper will be presented only to the undergraduate student, who must be the principal author.

The Award is administered by the Educational Committee of the Federation; the Committee also judges the entries.

Those wishing to enter the competition must send a letter of intent, along with the title of the proposed paper, and a brief abstract, by March 15, to: Hendry Award Competition, c/o FSCT, 492 Norristown Rd., Blue Bell, PA 19422-2350. Deadline for receipt of manuscripts is July 1.

Presentation of the Award will be at the 1991 FSCT Annual Meeting in Toronto, Canada, November 4-6.

The Award, sponsored by the Southern Society for Coatings Technology, commemorates the industry contributions of the late Alfred L. Hendry, President of A.L. Hendry & Co., Tampa, FL, and a Past-President of the Southern Society.

Five Industry Statesmen Honored at NPCA Annual Meeting

During the National Paint and Coatings Association's (NPCA) 103rd Annual Meeting held in Washington, D.C., on October 31-November 2, five individuals received the association's Industry Statesman Award. The awards, given in recognition and appreciation of the recipients' long and devoted service to the paint and coatings industry, were presented at the NPCA luncheon on November 1. Those honored were:

Robert M. Abrams, who was President and Chief Operating Officer of Major Paint Company, Torrance, CA, at the time of his death in November 1988. Mr. Abrams was a member of NPCA's Board of Directors from 1986 to 1988. Also, he was active locally, serving as President of the Southern California Paint and Coatings Association and Vice Chairman of the California Paint Council. Mr. Abrams was a member of the Los Angeles Society for Coatings Technology and was a major donator to the Los Angeles Anti-Graffiti Paint Bank.

Frank X. Dwyer, Chairman of Hüls America, Inc., Piscataway, NJ (formerly Nuodex, Inc.). Mr. Dwyer joined Nuodex in 1949 and has been active in the paint and coatings industry for the past 40 years. Currently, he is Chairman and majority shareholder of International Dioxide, Inc., Clark, NJ, and Director of Ruetgers-Nease, a specialty chemical company in Pennsylvania. Mr. Dwyer is a former member of NPCA's Board of Directors.

Fred W. Montanari, who retired this year as President and Chief Operating Officer of NL Chemicals, Hightstown, NJ, which recently separated into two companies, Rheox and Kronos. Mr. Montanari spent 19 of his 30 years in the paint and coatings industry at NL Chemicals. He served as a member of the NPCA Board of Directors from 1980 to 1983 and from 1987 to 1988. In addition, Mr. Montanari served on the Board of Directors of the Chemical Manufacturers Association, Washington, D.C.

Paul B. Raeder, retired Vice President and General Manager of the Eastern Division of Benjamin Moore & Company, Newark, NJ. Mr. Raeder also was a member of the company's Board of Directors. He joined Benjamin Moore after graduating Becker College, Worcester, MA. Mr. Raeder served as NPCA Vice President of the Northeastern Region from 1986 to 1988. He has been a member of the Metropolitan New York Paint and Coatings Association(MNYPCA) for 12 years, and has held every office in MNYPCA including Presidential Advisor.

John G. Wagner, retired Manager of Marketing Research for The Glidden Company, Strongsville, OH. Mr. Wagner had been employed by Glidden for 20 years. He was graduated from Indiana University and has served for the paint and coatings industry for more than 30 years. In 1971, Mr. Wagner became an active member of NPCA's Paint Consumer Research Program task force, and he was the program's first chairman. He also has been a member of the association's Management Information Committee since 1973, and was Chairman of the committee from 1988 to 1989.

Construction Contracting Down 10% in 1990

Construction contracting in September was virtually unchanged from the 1990 low that was reached in August, according to the Dodge Index, a seasonally adjusting indicator of future construction activity. The Dodge Index is published by the F.W. Dodge Division of McGraw-Hill, New York, NY.

According to the report, in September, nonbuilding construction (public works and utilities), with a 10% decline from August's rate of contracting, was the latest month's soft spot. Nonresidential building rebounded eight percent in September, while housing held steady at its recently depressed level.

The Dodge Index indicates that at the end of nine months, 1990 construction contracting trailed the value for the year-ago period, when construction contracting was at its all-time peak, by 10 %, the widest margin for the year.

Also, a 13% spurt of commercial/industrial building contrasted with September's generally weak construction market. Two large office building projects temporarily helped to reverse the declining trend of commercial building, but the high rate of vacant space in most cities precludes a sustained recovery. Public works contracting, with an 11% setback in September, tends to be erratic on a month-to-month basis. This year's third quarter, with most of its work concentrated in August, was about average for 1990.

Officials at Dodge stated that although the Federal agencies' appropriations bills for fiscal year 1991 are still unresolved, it can be concluded that highway and other public works programs are sheltered from deep cuts.

Furthermore, the index showed that at the end of three quarters of 1990, all major regions but one showed sizeable declines from their year-ago totals. The Northeast, where the general decline of contracting began, was running 24% behind last year at the end of nine months, followed by the South Atlantic, down 15%. Doing somewhat better than the national average were the South Central, down seven percent, and the West, which declined five percent. The only region still holding even with last year's contracting was the North Central.

U.S. Silica Company Forms New Marketing Groups

A reorganization of the Marketing and Business Development Department at U.S. Silica Company, Berkeley Springs, WV, has been announced. The reorganization has resulted in two distinct groups—the Industrial Group and Specialty Group—to focus marketing, sales, distribution, and technical services to specific markets and applications.

The Industrial Group will concentrate primarily on the glass and ceramics, foundry/casting, and building products markets. The Specialty Group will focus on the paints, coatings, plastics, and adhesives markets.

The Specialty Group will operate under the direction of Joe Scaries, Technical Department Manager, and Tom Powell, Marketing Manager.

Mr. Scaries will be responsible for all product development and technical services related to U.S. Silica's fine ground silica and attapulgite clay products, as well as its calcined kaolin clay and organoclay lines. Also providing technical support will be Joe Mulvey and Matt Lyman.

Mr. Powell will direct all sales and marketing functions for the Specialty Group which includes Regional Sales Managers John Wilson and Ray Weiland. Also, Bill Foutch will be responsible for forming a centralized customer service department. Distributors have been realigned and added to provide expanded service and distribution to the lines of Specialty Products.

Environmentally Acceptable Technologies Sought by U.S. Department of the Army

The U.S. Senate's Armed Services Committee is considering a proposal to provide for defense resources to focus on the massive environmental problems facing the nation and the world.

The U.S. Army is soliciting new and innovative technologies from small business entrepreneurs to assist in the identification and development of environmentally acceptable manufacturing processes, materials, and treatments for use in the manufacture of U.S. Army weapon systems.

The proposal is part of the Department of the Army's Small Business Innovation Research (SBIR) Phase I project efforts regarding environmental matters. The SBIR projects are in the current Department of Defense (DoD) SBIR Program Solicitation for fiscal year 1991. The program solicitation will close on January 11, 1991.

The Armed Services Committee is seeking advanced technologies for the more effective identification, treatment, and cleanup of hazardous wastes and materials.

During 1988, the U.S. Army initiated a program to identify and develop environmentally acceptable manufacturing processes, materials, and treatments. Funded by the DoD, the Army established the Environmentally Acceptable Materials, Treatments, and Processes (EAMTP) thrust under the Manufacturing Technology Program to focus on the development, evaluation, and validation of manufacturing techniques and equipment.

The SBIR program provides a mechanism by which the small business entrepreneur can identify new ideas that will assist the U.S. Army in the current environmental efforts.

The Army is seeking new technologies on environmentally acceptable materials, treatments, and manufacturing processes in the following areas: alternatives for Halon 1301 in tactical vehicle firefighting systems (topic number A91-022); environmentally acceptable cleaning processes (topic number A91-023); environmentally acceptable pretreatment processes (topic number A91-024); environmentally acceptable organic processes and/or coatings (topic number A91-025); and environmentally acceptable inorganic processes and/or coatings (topic number A91-026).

For a copy of DoD's fiscal year 1991 SBIR Program Solicitation, contact Mr. Garcia-Baco, Department of the Army, Headquarters, U.S. Army Materiel Command, 5001 Eisenhower Ave., Alexandria, VA 22333-0001.

ARCO and Mitsui Toatsu To Build Plant in Japan

ARCO Chemical Company, Newtown Square, PA, and Mitsui Toatsu, Japan, have formed MTC ARCO, Inc., a 50%/50% joint venture to manufacture and market Dylark ® engineering resins in Japan.

MTC ARCO is building a Dylark plant at Mitsui Toatsu's manufacturing complex near Osaka. Startup is scheduled for the second quarter of 1991. Prior to plant srartyp, Dylark resins will continue to be imported from ARCO's U.S. plant in Monaca, PA, and will be marketed by MTC ARCO.

ICI Americas Repositions Catalysts Business

ICI Americas Inc., Wilmington, DE, will reposition its catalysts business leading to an extended range of products supported by technology and investment in the United Kingdom.

As the initial step in the repositioning, ICI's Catalysts & Technology Licensing Business (C&TL) has agreed to sell its Chicago-based refinery hydrotreating business to Unilever United States Inc., acting on behalf of Crosfield Chemicals, part of the Unilever Specialty Chemicals Group. This business is part of Katalco, C&TL's North American operation.

The sale price is undisclosed and the transaction represents less than one percent of ICI Group net assets. The sale includes the hydrotreating business and its Chicago manufacturing site, where the existing 125-strong workforce will be retained and transferred to Crosfield.

At the same time ICI is to change the name of its worldwide business to ICI Katalco, headquartered in Billingham, United Kingdom. The business will have new U.S. offices at Oakbrook Terrace, IL.

Investment is planned for ICI's Clitheroe, Lancashire, manufacturing site. The North American market will be covered by sales and marketing offices in Oakbrook Terrace and Houston, TX.

The Clitheroe investment will lead to an extended range of catalysts, including the Puraspec family of catalysts for oil and gas purification, the Hydecat range of catalysts for chlorine effluent clean up, and production of the catalyst for ICI's alternative fluorocarbons, KLEA 134A.

Association Seeking Data On Copper Coatings

The Copper Development Association Inc. is preparing to update its publications and recommendations, for clear coatings for either interior or exterior use on copper and its alloys, based on the latest "state-of-the-art." These coatings may be air dried or baked, and may be permanent or readily removable for refinishing in the field.

The association is seeking to collect the latest data available and products which have been developed since their last publication issued over 15 years ago.

Information on either proprietary products or raw materials, for example, polymers, resins, or additives, from which the desired coating can be formulated, is requested. Solvent-free coatings are desirable, but not mandatory. Promising candidates will be evaluated in the near future and, if successful, will be recommended to the trade.

Recommendations with supporting data, including environmental considerations (no samples), should be sent to Saul Spindel, President, D/L Laboratories, 116 E. 16th St., New York, NY 10003. If there are any questions, Mr. Spindel can be contacted at (212) 777-4410.

Before Joncryl 537, Full Gloss Latex Paint Never Got Such High Marks.

Report Card:

ARCHITECTURAL GLOSS ENAMELS

	Conventional Gloss Latex	**Joncryl 537**	Gloss Alkyd
Gloss (60°)	75	**88**	95
VOC Content (Lbs./Gal.)	1.9	**1.7**	4.5
Flow and Leveling	Fair	**Excellent**	Excellent
Inherent Film Build	Fair	**Excellent**	Excellent

Gloss white formula in supplier's product literature.

If tougher environmental laws mean you'll be adding a high gloss, latex coating to your architectural line, consider the benefit of formulating with Joncryl 537, the polymer that's closing the gap between latex and alkyd.

Our report card stands for itself. In the critical areas of gloss, flow, leveling and film build, water-based Joncryl 537 formulations closely match the performance of solvent-based alkyds, and far surpass conventional gloss latex.

Take a close look at the VOC figures and you'll see how Joncryl 537 can help you meet even the toughest environmental regulations.

Joncryl Rheology-Controlled Emulsions are unique; a non-conventional polymerization process gives Joncryl 537 the application and appearance properties of alkyds with the low VOC of acrylic emulsions.

So look over our report card. The move to latex high gloss can be much easier than you thought possible. For more information about Joncryl 537, call **1-414-631-3920,** or write to SC Johnson Wax, Specialty Chemicals, Racine, WI 53403.

SC Johnson wax
Specialty Chemicals

Regulatory UPDATE

DECEMBER 1990

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.

Superfund—In the waning hours of the 101st Congress, House and Senate budget negotiators made a surprise deal to extend Superfund through 1995.

Early in October, the Senate Finance Committee rejected a bipartisan effort to include Superfund in its budget reconciliation proposal because of too many technical problems and joint jurisdictional logistics. However, at the end of the month, several influential members of the conference committee quietly slipped the measure into the conference budget agreement.

The final agreement extends the Superfund tax for four years—to 1995, and authorizes the program for three years—to 1994. Reportedly, the program comes up short by one year in an effort to push Congress to act on a full reauthorization package. Officials at the EPA have expressed their pleasure with the extension, stating that the Superfund enforcement program has "turned around" and deserves a chance to work.

Although reauthorization proceedings won't begin until 1994, the issue of lender liability will undoubtedly be on the agenda next year. The measure had a good deal of support, and probably would have passed but for lack of time.

Clean Air—For the first time in 13 years, Congress passed legislation to amend the Clean Air Act (S.1630—H. Report 101.952). Congress worked for 16 months before reaching a compromise on the issue which directs EPA to drastically decrease air pollution in major cities, protect human health from toxic air pollutants, and limit the damage caused by acid rain.

President Bush initially threatened to veto the bill because of an unemployment provision designed to aid those who lose their jobs as a result of clean air regulations. The original amendment called for 18 months of unemployment benefits. However, the conference committee instead approved a scaled down version of the provision, which authorizes $250 million for five years to benefit only those workers who participate in job training programs. The President signed the bill into law on November 15.

In early November, in an effort to resolve the mobile source provision, the committee agreed that states cannot adopt vehicle standards that would conflict with California's stringent regulations. Also accepted, at the urging of the business community, was an amendment that allows EPA discretionary enforcement authority not to seek criminal prosecution of businesses that make paperwork errors. Additionally, before a citizen suit can be filed, the citizen must show that a company's violation has been ongoing. The agreement also contains a provision that any company employee who knowingly commits a violation will be held responsible "at or below the senior management level."

Remaining titles in the final version of the Act include issues dealing with nonattainment, controlling CFC's and other ozone-depleting chemicals, permitting, alternative fuels, off-shore drilling, and clean air research.

Hazardous Materials Transportation—Late in October, Congress cleared for the President's signature, legislation that will overhaul the nation's laws governing the transportation of hazardous materials. The Hazardous Materials Transportation Act, S.2936, is designed to prevent the release of toxic chemicals and other hazardous materials while they are being transported across the country.

The legislation imposes fees on companies that transport hazardous materials ranging from $250-$5000 to pay for the program, and authorizes $84.8 million for emergency response programs and training. It also sets up a safety permit program for truck and rail carriers that haul extremely hazardous cargo.

Also waiting to be signed into law is legislation prohibiting the "backhauling" of food in trucks and rail cars that are also used to transport garbage or chemicals. The Sanitary Transportation of Food Act, H.R. 3386, requires the Department of Transportation, in consultation with several other agencies, to issue regulations for nonfood products that are considered unsafe to mix with food or food products. Cargo tanks that haul ultra hazardous materials will be barred from carrying food, and refrigerated trucks will not be permitted to carry garbage and hazardous materials.

Resource Conservation and Recovery Act—Reportedly, the reauthorization of the Resource Conservation and Recovery Act will be the top environmental priority of the 102nd Congress.

Environmental Protection Agency
October 29, 1990—55 FR 45134
Semiannual Regulatory Agenda
Action: Notice

The EPA has announced its semiannual regulatory agenda for the period between October, 1990 and October, 1991. The purpose of the agenda is to inform interested parties of the progress of EPA regulations. For further information, contact Mary Henigin, Regulation Development Branch, U.S. EPA, PM-223, Washington, D.C. 20460; (202) 382-7205.

The following regulations, in the proposed and final stages under various statutes, are among those set forth by EPA.

The Toxic Substance Control Act (TSCA)

Prerule Stage

1. Regulatory Investigation under the Toxic Substances Control Act (TSCA) to Reduce Lead (Pb) Consumption and Use.

Proposed Rule Stage

1. Policy Statement Implementing the Prior Informed Consent Procedures for the Export/Import of Industrial Chemicals.
2. Toxic Chemical "Peak Release" Reporting Rule (Revision).
3. Responses to Petitions Received to Add or Delete Chemicals from the List of Toxic Chemicals Under Section 313 of SARA.
4. Follow-up Rules on Existing Chemicals.
5. Generic Significant New Use Rules (SNUR) for Acrylate Compounds.
6. SARA Section 110 Chemicals Generic Test Rule.
7. Proposal to Exempt Certain Micro-organisms from PMN Requirements Under TSCA 5(h) (4).
8. Premanufacture Notification (PMN) Rule Amendments.
9. Regulatory Investigation of Formaldehyde.
10. Polychlorinated Biphenyls (PCBs): Applications for Exemptions from the Ban on Manufacturing, Processing, and Distribution.
11. Regulatory Investigation of Chlorinated Solvents.
12. Procedures and Criteria for Termination of Polychlorinated Biphenyls (PCBs) Disposal Permits.
13. Amendment to the TSCA Section 8(a) Comprehensive Assessment Information Rule (CAIR).

Final Rule Stage

1. Decision on Test Rules: Final Rules.
2. Follow-up on Non-5(e) New Chemical Substances.
3. Chemical Specific Significant New Use Rules (SNURs) to Extend Provisions of Section 5(e) Orders.
4. Polychlorinated Biphenyls (PCBs): Wet Weight/Dry Weight Clarification.
5. Regulation of Paints Containing Mercury-Based Biocides.
6. Section 8(a) Preliminary Assessment Information Rules.
7. Section 8(d) Health and Safety Data Reporting Rules.

Completed Actions

1. Amendments to Test Rules and Consent Agreements.

Clean Water Act (CWA)

Prerule Stage

1. Plan to Review and Promulgate Effluent Guidelines and Standards.

Proposed Rule Stage

1. Water Quality Standards for Toxic Pollutants.
2. Federal National Pollution Discharge Elimination System (NPDES) in States Where EPA Administers the NPDES Program.
3. Effluent Guidelines for the Organic Chemicals, Plastics and Synthetic Fibers Category.
4. Effluent Guidelines and Standards for the Waste Treatment Category.
5. Revisions to Regulations for Modification of Secondary Treatment Requirements for Municipal Discharge into Marine Waters.
6. NPDES Regulatory Revisions.
7. NPDES Permit Application Standard Form A and Short Form A (Revision).
8. Denial or Restriction of Disposal Sites (Revision).

Final Rule Stage

1. State Revolving Fund Program Implementation Regulations.
2. NPDES Regulations: Stormwater Application Requirements (Revision).
3. Citizen Suit Notice Regulation Under the CWA.

Completed Actions

1. Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the CWA.

Resource Conservation and Recovery Act (RCRA)

Proposed Rule Stage

1. No-Migration Variance for Prohibited Hazardous Waste Land Disposal.
2. Identification and Listing of Hazardous Wastes—De Minimis Exemption Levels.
3. Identification and Listing of Hazardous Wastes from Chlorotoluene Production.
4. Amendments to Biennial Reporting Requirements.
5. Land Disposal Restrictions for Soil and Debris Containing Hazardous Wastes.
6. Corrective Action for Releases to Groundwater from Regulated Hazardous Waste Units.
7. RCRA Subtitle C Financial Test Criteria (Revision).
8. Definition of Hazardous Waste Tank, Surface Impoundment and Waste Pile (Revision).
9. Hazardous Waste Sump Requirements in Response to Rulemaking Petition (Revision).
10. Hazardous Waste Management System: Groundwater Monitoring Constituents (Phase II) and Methods.
11. Materials Source Separation for Municipal Waste Landfills (MSWLFs).
12. Underground Storage Tanks Containing Hazardous Substances—Financial Responsibility Requirements.

Final Rule Stage

1. Underground Storage Tanks Containing Petroleum—Financial Responsibility Requirements: Extension of October 26, 1990 Compliance Deadline.
2. Identification and Listing of Hazardous Wastes—Wood Preserving and Surface Protection Waste.
3. RCRA Definition of Solid Waste (Revision).
4. Solid Waste Disposal Facility Criteria.
5. Disposal of Containerized Liquids in Hazardous Waste Landfills.
6. Burning of Hazardous Waste in Boilers and Industrial Furnaces.
7. Emission Controls for Hazardous Waste Incinerators.
8. Procedures for Issuance of and Administrative Hearings on RCRA Section 9003(h) Corrective Action Orders Regarding Underground Storage Tanks.

Completed Actions

1. Underground Storage Tanks Containing Petroleum—Financial Responsibility Requirements: Extension of the April 26, 1990 Compliance Deadline.
2. Identification and Listing of Hazardous Wastes—De Minimis Exemption Levels.
3. Land Disposal Restrictions for the Third Third of Scheduled Wastes.

Clean Air Act (CAA)

Prerule Stage

1. Development of Source Categories for Hazardous Air Pollutants Subject to Section 112 of the Clean Air Act.
2. Regulations Governing Exemptions from Standards for Hazardous Air Pollutants Due to Early Voluntary Emission Reduction.

Proposed Rule Stage

1. Protection of Stratospheric Ozone (Recycling).
2. Protection of Stratospheric Ozone (Phase-Out).
3. National Ambient Air Quality Standards (NAAQS): Lead (Review).
4. Treatment, Storage, and Disposal Facility Area Source Air Emissions—RCRA Standards.
5. Individual Constituents Standards—Phase III of RCRA Air Emission Standards.

Final Rule Stage

1. NSPS: Polymer and Resin Manufacture.
2. State Implementation Plans: Policy on Post-1987 Ozone and Carbon Monoxide Plan Revisions for Areas Not Attaining the NAAQS.

Completed Actions

1. Federal Promulgation of State Implementation Plan to Protect Visibility.
2. NESHAP: Cadmium

Superfund (CERCLA)

Prerule Stage

1. Addition of Chemicals to the List of Extremely Hazardous Substances Based on their Physical Properties.

Proposed Rule Stage

1. Reportable Quantities of Lead, Lead Components, and Lead-Containing Hazardous Waste Streams.
2. Administrative Hearing Procedure for Superfund Claims.
3. Mandatory Pollution Prevention Reporting in Toxic Release Inventory (TRI).

Final Rule Stage

1. Designation of Extremely Hazardous Substances as CERCLA Hazardous Substances.
2. Reportable Quantities (RQs) for Substances on the Extremely Hazardous Substances List.
3. Hazard Ranking System for Uncontrolled Hazardous Substance Releases.
4. Administrative Hearing Procedures for Class II Penalties Under CERCLA and Emergency Planning and Community Right-to-Know Act.
5. Prior Notice of Citizen Suits Under CERCLA and the Emergency Planing and Community Right-to-Know Act.

Completed Actions

1. Reporting Continuous Releases of Hazardous Substances.
2. Emergency and Hazardous Chemical Inventory Forms and Community Right-to-Know Reporting Requirements.

Department of Transportation
Research and Special Programs Administration
October 29, 1990—55 FR 44738
Semiannual Regulatory Agenda
Action: Notice

The Department of Transportation (DOT) has announced its semiannual summary of current and projected rulemakings, oversight of existing regulations, and completed actions. This agenda covers the period between October, 1990 and October, 1991. By publishing the agenda, it is DOT's intention to increase public awareness of its regulatory activity. For further information, contact Neil R. Eisner, Assistant General Counsel for Regulation and Enforcement, Department of Transportation, 400—7th Street, S.W., Washington, D.C. 20590; (202) 366-4723.

The DOT's Research and Special Programs Administration (RSPA) has identified the following items for regulatory activity within the coming year.

Research and Special Programs Administration (RSPA)

Prerule Stage

1. Registration of Shippers and Carriers of Hazardous Materials.
2. Specifications for Tank Car Tanks.

Proposed Rule Stage

1. Hazardous Materials in Intrastate Commerce.
2. Highway Routing Standards for Certain Types and Quantities of Hazardous Materials.
3. Carriage of Hazardous Materials by Motor Vehicle.
4. Transportation of Hazardous Materials; Miscellaneous Amendments.
5. Prohibited Placarding and Placard Visibility.
6. Transportation of Hazardous Liquid at 20% or Less of Specific Minimum Yield Strength.

Final Rule Stage

1. Performance-Oriented Packaging Standards.
2. Training for Hazardous Materials Transportation.
3. Enforcement of Motor Carrier Financial Responsibility Requirements.
4. Revisions to Hazardous Materials Model Regulations.
5. Supplemental Proposals Concerning the Transportation of Hazardous Materials in Tank Car Tanks and Rail Cars.
6. Performance-Oriented Packaging Standards; Additional Proposals for Flammable Solids, Oxidizers, and Organic Peroxides.

Completed Actions

1. Emergency Response Communication Standards; Corrections in Response to Petition for Reconsideration; Extension of Effective Date.
2. Grant Regulations; State Adoption of One-Call Damage Prevention Programs.

Department of Labor
Occupational Safety and Health Administration
October 29, 1990—55 FR 44680
Semiannual Agenda of Regulations
Action: Notice

The Department of Labor has announced its semiannual agenda of regulations. The agenda has been selected for review or development for the period between October, 1990—October, 1991. For further information, contact Roland G.

Droitsch, Deputy Assistant Secretary for Policy, Office of the Assistant Secretary for Policy, Department of Labor, 200 Constitution Avenue, N.W., Room S-2312, Washington, D.C. 20210; (202) 523-9058.

The following regulations in the proposed and final stages are among those set forth by the Occupational Safety and Health Administration.

Occupational and Health Administration

Proposed Rule Stage

1. Respiratory Protection.
2. Formaldehyde.
3. 1,3-Butadiene.
4. Glycol Ethers: 2-Methoxyethanol, 2-Ethoxyethanol and their Acetates.
5. Methylene Chloride.
6. Medical Surveillance Programs for Employees.
7. Exposure Assessment Programs for Employees Exposed to Hazardous Chemicals.
8. Hazardous Materials (part 1910).
9. Recording and Reporting Occupational Injuries and Illnesses.
10. Control of Hazardous Energy (Lockout/Tagout).

Final Rule Stage

1. Methods of Compliance.
2. Asbestos, Tremolite, Anthophyllite and Actinolite.
3. Confined Space (part 1910).
4. 4,4'-Methylenedianiline.
5. Explosive and Other Dangerous Atmospheres (part 1915).
6. Hazard Communication.
7. Cadmium.
8. Asbestos (Remand).
9. Accreditation of Training Programs for Hazardous Waste Operations (part 1910).

Completed Actions

1. Carcinogen Policy.
2. Ethylene Dibromide (EDB).
3. Formaldehyde (Remand).

States Proposed Legislation and Regulations

California

Air Quality—A. 4049 (Mojonnier) provides a three-year limitation for the bringing of actions to enforce specified laws relating to air pollution, commencing after the discovery of the facts constituting grounds for the action by the State Air Resources Board, air pollution control district, or air quality management district.

Florida

Hazardous Waste—This Department of Environmental Regulation proposal pertains to the toxicity of hazardous waste. For more information, contact Diane Hunt, Hazardous Waste Regulation Section, Division of Waste Management, Department of Environmental Regulation, 2600 Blair Stone Road, Tallahassee, FL 32399-2400.

Kentucky

Underground Storage Tanks—Regulations have been proposed under 401 KAR 42. For more information, contact Susan C. Bush, Director, Division of Waste Management, Frankfort Office Park, 18 Reilly Road, Frankfort, KY 40601.

Louisiana

Hazardous Waste—This proposal updates the state land ban regulations to maintain equivalency with the Federal Land Disposal Restrictions "second third" hazardous waste rule. It also evaluates and sets treatment standards for the "second third" of the listed hazardous wastes and evaluates and sets treatment standards for the "third third" of the listed hazardous wastes, the characteristic wastes, and any remaining hazardous wastes not evaluated during the "first third" and "second third" rulemakings. For more information, contact Joan Albritton, Enforcement and Regulatory Compliance Division, Box 44066, Baton Rouge, LA 70804.

Maine

Air Quality—This proposal establishes ambient air quality standards for toluene and perchloroethylene. For more information, contact Richard T. Greves, State House Station 17, Augusta, ME 04333; (207) 289-2437.

Maryland

Packaging—This proposal incorporates by reference poison prevention packaging regulations. For more information, contact Michele Phinney, Regulations Coordinator, O'Conor Building, Room 229, 201 West Preston St., Baltimore, MD 21201; (301) 225-6499.

Occupational Safety and Health—This proposal revises the Maryland Occupational Safety and Health Regulations for access to information about hazardous and toxic substances. For more information, contact Henry Koellein, Commissioner of Labor and Industry, Fourth Floor, 501 St. Paul Place, Baltimore, MD 21202; (301) 333-4179.

Michigan

Air Quality—S. 1020 (Ehlers) enhances environmental enforcement powers under Environmental Response Act with respect to toxic substances, hazardous waste, and air and water pollution.

Minnesota

Hazardous Waste—One proposal governs standards for owners and operators of hazardous waste facilities. Contact Jeanne Eggleston, Minnesota Pollution Control Agency, 520 Lafayette Road, St. Paul, MN 55155; (612) 643-3476.

Another proposal relates to toxicity characteristics of hazardous waste. Contact Glenn Skuta, Minnesota Pollution Control Agency, 520 Lafayette Road, St. Paul, MN 55155; (612) 643-3478.

Toxic Substances—This proposal provides standards and abatement methods for lead in bare soil on playgrounds and residential property. For more information, contact Placida Venegas, Pollution Control Agency, 520 Lafayette Road, St. Paul, MN 55155; (612) 643-3474.

Household Hazardous Waste—This proposal governs household hazardous waste management plans for solid waste disposal facilities and treatment procedures for collected household hazardous waste. For more information, contact Cindy Perusse, Minnesota Pollution Control Agency, Hazardous Waste Division, 520 Lafayette Road, St. Paul, MN 55155; (612) 643-3475.

New Jersey

Underground Storage Tanks—A. 2527 (Zangari) requires the Department of Environmental Protection to establish, within 18 months of the bill's effective date, a certification program for persons who perform underground tank services.

Toxic Substances—A. 4050 (J. Smith) imposes tax on paint and allied products for lead toxicity projects.

A. 4051 (J. Smith) requires testing of certain children for lead toxicity.

A. 4052 (Bryant) establishes certification program for lead paint abatement workers and inspectors; establishes Lead Abatement Worker Certification Fund.

New York

Occupational Safety and Health—This proposal incorporates by reference Federal safety and health standards used to protect the safety and health of New York State public employees. Includes new standards pertaining to asbestos, hazardous chemicals in laboratories, welding, hazardous waste operations and emergency response, and air contaminants. For more information, contact Maria L. Colavito, Department of Labor, Building 12, State Campus, Albany, NY 12240; (518) 457-3518.

North Carolina

Air Quality—This proposal establishes new source performance standards for hazardous air pollutants; requires compliance with the standards by automobile and light-duty truck manufacturers, coating operations and incinerators; sets forth rules for the control of the emissions of air pollutants from incinerators. For more information, contact Thomas C. Allen, Division of Environmental Management, P.O. Box 27687, Raleigh, NC 27611-7687; (919) 733-3340.

Oregon

Toxic Substances—This proposal pertains to the scope and application of the lead standard. For more information, contact Judy Sugnet, Technical Services Section, Department of Insurance and Finance, Occupational Safety and Health Administration, Labor and Industries Building, Salem, OR 97310; (503) 327-3272.

Pennsylvania

Toxic Substances—This proposal sets forth the guidelines for development of criteria for toxic substances, and lists the water quality criteria and the analytical methods and detection limits for toxic substances. For more information, contact Edward R. Brezina, Chief, Division of Water Quality, Bureau of Water Quality Management, 11th Floor Fulton Building, P.O. Box 2063, Harrisburg, PA 17105-2063; (717) 787-9637.

South Carolina

Air Quality—This proposal adds additional compounds to Section II. B of Standard 8, Toxic Air Pollutants. For more information, contact Otto E. Pearson, Chief, Bureau of Air Quality Control, Department of Health and Environmental Control, 2600 Bull Street, Columbia, SC 29201.

Tennessee

Hazardous Waste—This proposal makes the state regulations equivalent to the federal regulations regarding hazardous waste management; includes certain reference changes, a treatability study sample exemption, the use of other financial mechanisms for liability coverage and various clarifications, relists certain wastes as hazardous which were suspended and adds six wastes to the list of hazardous from specific sources; specifies five different statistical methods to be used in evaluating groundwater monitoring data and outlines sampling procedure and performance standards; renews the Uniform Hazardous Waste Manifest form. For more information, contact the Department of Health and Environment, Division of Solid Waste Management, Customs House, Fourth Floor, 701 Broadway, Nashville, TN 37247-3530.

This proposal retains existing authorization and obtains further authorization to implement the federal hazardous waste management regulatory program in Tennessee in lieu of the Federal Environmental Protection Agency. For more information, contact the Department of Health and Environment, Division of Solid Waste Management, Customs House, Fourth Floor, 701 Broadway, Nashville, TN 37247-3530; (615) 741-3424.

Washington

Hazardous Waste—This proposal establishes requirements for generators, transporters, and management facilities handling dangerous waste in Washington State. For more information, contact Hugh O'Neill, Department of Ecology, Mailstop PV-11, Olympia, WA 98504-8711.

Gloss of Coatings Applied By Electrostatic Rotary-Bell Spraying

Kazuyuki Tachi, Chikaaki Okuda, and Katsunori Yamada
Toyota Central Research & Development Laboratories, Inc.*

The gloss of coatings containing titanium dioxide (TiO_2) pigment is reduced by increasing the rotational speed of a bell-head. The mechanism of the gloss loss, namely roughening the film surface, has been studied by scanning electron microscopic observation of the pigment dispersions in the paint droplets and films sprayed at rotational speeds of 10,000 and 35,000 rpm, and by the measurement of 60° gloss variations during the drying process. Loss of gloss is attributed to paint droplets with uneven pigment dispersion. The droplets are produced by pigment/vehicle centrifugation in a high-speed rotating bell-head, forming a wet film containing pigment-rich and pigment-poor regions. The wet film shrinks nonuniformly, roughening the film surface after the fluidity of the film sufficient for leveling is lost.

INTRODUCTION

The electrostatic spraying of paints is in wide use in industrial processes because of the high transfer efficiency which results from the attractive force between charged paint droplets and a substrate. Electrostatic application is performed using three types of spray equipment: rotary atomizers (bells and disks), hydraulic spray guns, and pneumatic spray guns. The selection of spray equipment is a dominant factor in transfer efficiency. Rotary atomizers usually attain the highest transfer efficiency, and the pneumatic spray guns the lowest.

In the automotive finishing process, electrostatic pneumatic spray guns had been widely used for many years. During the last decade, however, most of them have been replaced by high-speed rotary bells, driven at a peripheral speed above 40 m/s, because of the high transfer efficiency of the bells. The rotary bells also provide the benefit of suppressing "orange peel," resulting in the improvement in the appearance of coating films. The orange peel consists of little bumps with the wavelength of about 1-5 mm.[1,2] Since the orange peel is reduced by increasing the peripheral speed, or rotational speed, that is, by promoting paint atomization,[2,3] the peripheral speed of the rotary bells has steadily increased. Today, they may be operated at over 100 m/s. Consequently, the orange peel was decreased as expected, but a new problem of loss of gloss of coatings arose in some paints. The loss of gloss occurred in the paints containing TiO_2 pigment, and more significantly in the paints of higher pigment concentration, such as white enamel paints.

Although two causes of the loss of gloss had been proposed, the question of which was the dominant cause had not yet been clarified. Iwasaki et al.[4] and Adachi et al.[5] suggested that the paint droplets with little fluidity, produced at higher rotational speeds, roughened the film surface, thus deteriorating the gloss. Konishi et al.,[6] on the other hand, proposed that the loss of gloss was caused by the coverage of the film surface with pigment-rich paint droplets, which were produced by pigment/vehicle centrifugation in the high-speed rotating bell-head, and deposited on the outer portion of the spray pattern.

This paper describes the mechanism by which a loss of gloss occurs when an electrostatic rotary bell is used to spray paints containing TiO_2 pigment.

EXPERIMENTAL

Measurement of Variations of 60° Gloss And Nonvolatile Concentration with Time

A white paint was applied in one coat to a stainless steel panel and seven stainless steel strips arranged as shown in *Figure* 1. The panel previously had been pol-

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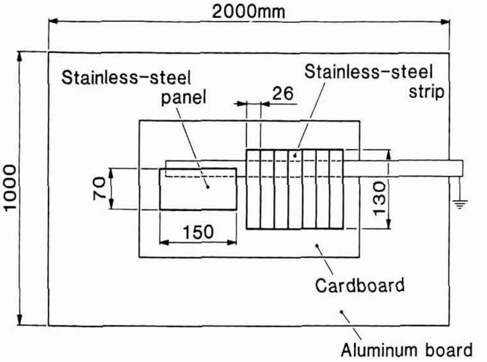

Figure 1—Preparation of specimens for measuring variations of 60° gloss and nonvolatile concentration in the wet film with time after spraying. The aluminum board is carried toward the left with conveyor

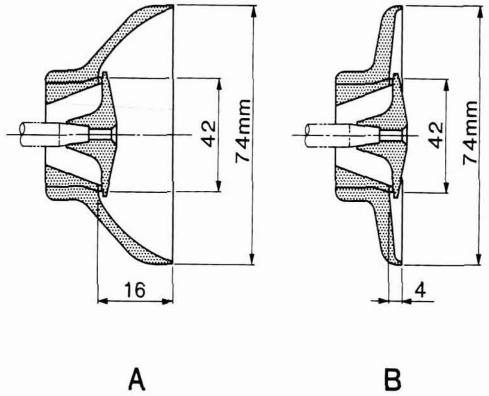

Figure 2—Cross sections of bell-heads. A is commercially available, and B is experimental

ished to a mirror-like surface, and degreased with petroleum benzine. Each stainless steel strip had also been degreased with petroleum benzine, and weighed.

The white paint was prepared by reducing a commercially available topcoat for automobiles to predetermined spray viscosity with the thinner manufactured for the topcoat. The formula of spray paint was as follows: 13.2% by weight short oil alkyd resin (nondrying type); 9.9% oil-free polyester resin; 9.9% butylated melamine resin; 22.8% rutile-type TiO_2 treated by silica and alumina; 0.2% oxide yellow; 37.5% aromatic hydrocarbon; 4.1% n-butyl alcohol; 1.7% methyl alcohol; and 0.6% iso-butyl alcohol. The calculated pigment concentration in the dry film was 41.1% by weight and 16.4% by volume. The TiO_2 pigment had specific gravity of 4.0, and an average primary particle diameter of about 0.29 μm which was determined by scanning electron microscopic observation.

The paint was sprayed with a Ransburg electrostatic rotary bell equipped with two types of bell-heads operated at various rotational speeds in a conveyor line arrangement. The bell-heads are illustrated in *Figure* 2. Both bell-heads were 74 mm in diameter, and were provided with a number of radially and axially extending grooves on the inner wall near the atomizing edge.[7] Bell-head A is commercially available, bell-head B is especially designed to pass the paint through in the shortest possible time. However, bell-head B has the same ability to atomize as bell-head A. Typical spraying parameters are shown in *Table* 1. An appropriate conveyor speed was selected for each rotational speed to produce a dry film thickness of 30 ± 2 μm, since the transfer efficiency depended on the rotational speed. Spray booth temperature was adjusted for each rotational speed to reduce the influence of the rotational speed on the nonvolatile concentration immediately after spraying.

The variation of 60° specular gloss with time t after spraying was measured using the panel placed in a horizontal position. The panel was given a flash period of 9 min after spraying and subsequently baked for 30 min at 140°C (284°F). The 60° gloss was measured several times during the flash period, and after baking, with a Model GM-3D glossmeter (Murakami Color Research Laboratory).

The variation of the nonvolatile concentration NV with time t was determined using the seven strips by weighing the strips at the predetermined times (t = 1, 2, 3, 4, 5, 7, and 9 min) during the flash period and after baking. The nonvolatile concentration NV at time t was determined from the following expression,

$$NV = 100 \cdot W_d/W_w \qquad (1)$$

where W_d and W_w are the film weights after baking and at time t, respectively.

Measurement of Dry Film Surface Roughness

The surface roughness of the dry films applied by bell-head A at the rotational speeds of 10,000 and 35,000 rpm corresponding to the peripheral speeds of about 40 and 140 m/s, respectively, was measured using a Model SE-3C stylus profilometer (Kosaka Laboratory) under a wavelength cutoff of 0.8 mm. The average roughness Ra was determined under the wavelength cutoff of 0.8 mm and a measurement length of 4 mm.

Estimation of Pigment Dispersion In Dry Film and Paint Droplet

The dispersion of the TiO_2 pigment in the dry films sprayed at the two rotational speeds was estimated with a Model DS-130 scanning electron microscope (SEM) (Akashi Beam Technology Corporation) under an accelerating voltage of 10 kV. The pigment dispersion in the dry paint droplets collected on the stainless-steel strips was also observed with SEM, and was determined by line analysis using a Model EPM-810Q electron probe microanalyzer (EPMA) (Shimadzu Corporation) under an accelerating voltage of 20 kV and a beam diameter of about 1 μm.

Table 1—Typical Spraying Parameters

Spray viscosity	8×10^{-2} Pa·s (23 s Ford No. 4 cup)
Nonvolatile concentration at spray viscosity	56%
Paint flow rate	100 mL/min
Shaping air flow rate	200 L/min
Applied voltage	−90 kV
Bell distance from substrate	30 cm
Length of stroke of reciprocator	0.85 m
Number of strokes of reciprocator	25 /min
Conveyor speed	1.6 m/min
Number of coatings	1
Flash time	9 min
Spray booth temperature	20°C

Measurement of 60° Gloss and Pigment Concentration Distributions across Spray Pattern

The same white paint was sprayed on the 27 stainless steel strips with a mirror-like surface, arranged as shown in *Figure* 3, using bell-head A at rotational speeds of 10,000 and 35,000 rpm. The stainless steel strips were subjected to baking (140°C, 30 min) after spraying.

The distributions of 60° gloss and TiO_2 pigment concentration across the spray pattern were examined using the strips. The 60° gloss was measured with the above-mentioned glossmeter, and the pigment concentration was determined by the gravimetric method. That is, the dry paint film was weighed before and after baking for 60 min at 1000°C (1832°F) to isolate the pigment from the film.

RESULTS AND DISCUSSION

Effect of Rotational Speed on 60° Gloss

The effect of the rotational speed on the 60° gloss of the dry films obtained with bell-head A is shown in *Figure* 4.

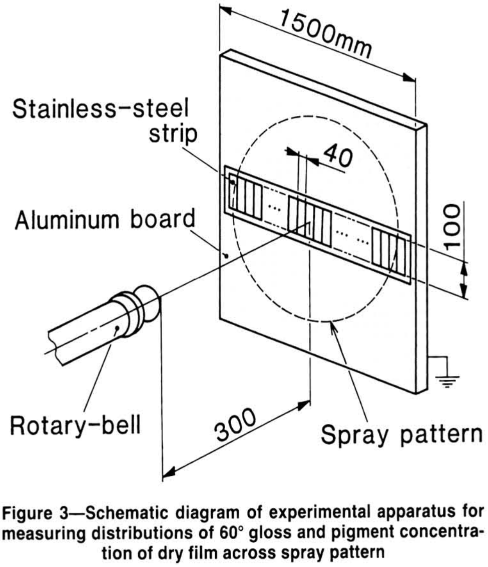

Figure 3—Schematic diagram of experimental apparatus for measuring distributions of 60° gloss and pigment concentration of dry film across spray pattern

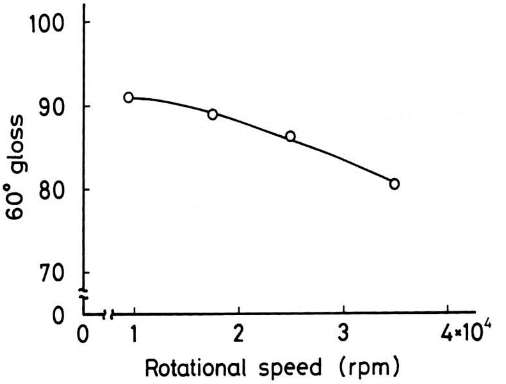

Figure 4—Effect of rotational speed on 60° gloss of dry film for bell-head A

The 60° gloss is reduced with increasing rotational speed, that is, the gloss loss is induced by the increase in rotational speed.

The roughness profiles of the dry films sprayed at rotational speeds of 10,000 and 35,000 rpm are illustrated in *Figure* 5. The average roughnesses Ra at rotational speeds of 10,000 and 35,000 rpm were 0.08 and 0.19 μm, respectively. These results provide evidence that the gloss loss results from the roughened film surface.

The cross sections and surfaces of the dry films are shown in *Figures* 6 and 7, respectively. Though the TiO_2 particles are evenly dispersed in the film sprayed at a rotational speed of 10,000 rpm, the pigment particles are partly concentrated in the film sprayed at 35,000 rpm, forming pigment-rich and pigment-poor regions. These results suggest that the film surface is roughened by the uneven pigment dispersion in the dry film.

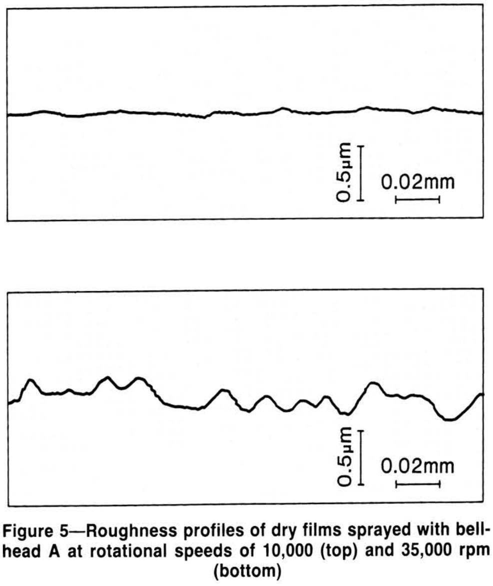

Figure 5—Roughness profiles of dry films sprayed with bell-head A at rotational speeds of 10,000 (top) and 35,000 rpm (bottom)

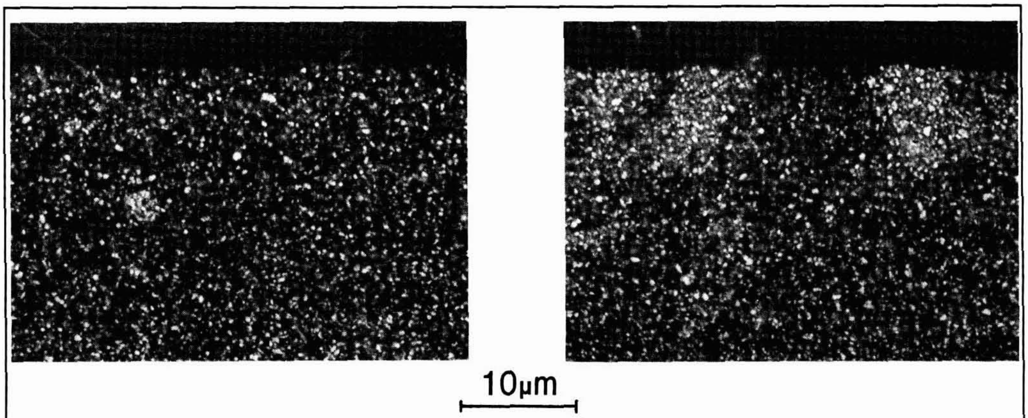

Figure 6—SEM micrographs of cross sections of dry films sprayed with bell-head A at rotational speeds of 10,000 (left) and 35,000 rpm (right)

Variations of Nonvolatile Concentration And 60° Gloss with Time

The variation of the nonvolatile concentration NV with time t is illustrated in *Figure* 8. The nonvolatile concentration gradually increases during the flash period of nine minutes, and even more by baking. This indicates that the viscosity increases, or the fluidity of the wet film decreases, with time during the drying process, due to volatile evaporation. It also indicates that the film shrinks along thickness during the drying process.

The variation of the 60° gloss with time t is illustrated in *Figure* 9. At both 10,000 and 35,000 rpm, the 60° gloss is invariable during the flash period, but is reduced by baking. This indicates that the gloss reduction, presumably caused by roughening of the film surface, begins when the wet film loses fluidity. The gloss reduction by baking is greater at higher rotational speed, though the gloss during the flash period is independent of the rotational speed. These results indicate that the gloss loss caused by the increase in rotational speed is determined by the gloss reduction during baking.

Effect of Film Fluidity on Loss of Gloss

The dependence of the 60° gloss of the dry film on the nonvolatile concentration, NV_0, immediately after spraying, was examined using bell-head A at rotational speeds of 10,000 and 35,000 rpm. NV_0, which was obtained by extrapolating the curve of NV against time t to $t=0$, varied with the spray booth temperature. The results are demonstrated in *Figure* 10. Though the gloss loss due to the increase in rotational speed is modified by decreasing NV_0, it appears at every NV_0. These results indicate that the decrease in the fluidity of the wet film owing to the increase in rotational speed is not a dominating cause of the gloss loss. This is confirmed by the fact that the 60° gloss is constant during the flash period as shown in

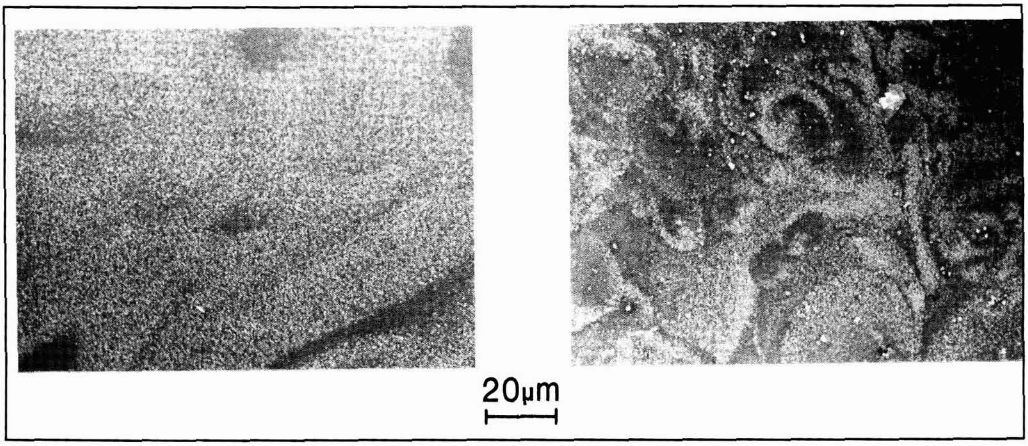

Figure 7—SEM micrographs of surfaces of dry films sprayed with bell-head A at rotational speeds of 10,000 (left) and 35,000 rpm (right)

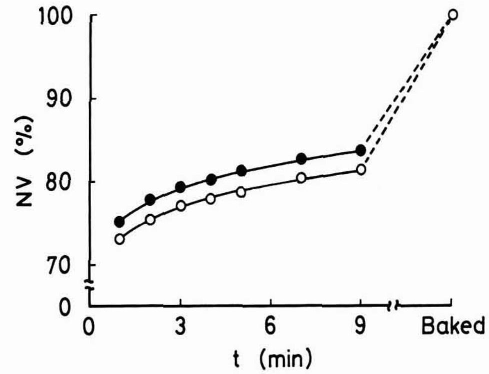

Figure 8—Variations of nonvolatile concentration NV with time t after spraying with bell-head A. Rotational speed: ○ 10,000 rpm, ● 35,000 rpm

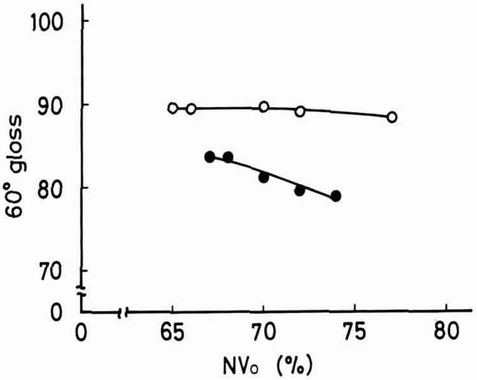

Figure 10—Dependence of 60° gloss of dry film on nonvolatile concentration, NV$_o$ (NV at t=0), at rotational speeds of 10,000 and 35,000 rpm for bell-head A. Rotational speed: ○ 10,000 rpm, ● 35,000 rpm

Figure 9, though the nonvolatile concentration increases due to the volatile evaporation as shown in *Figure* 8.

60° Gloss and Pigment Concentration Distributions across Spray Pattern

The 60° gloss and pigment concentration, C_p, distributions across the spray pattern are shown in *Figure* 11. Though the 60° gloss is reduced by increasing the rotational speed, the pigment concentration is independent of the rotational speed, being equivalent to that of the paint (43.8% by measurement). These results indicate that the gloss loss is not attributed to the pigment concentration in the dry film. Furthermore, the pigment concentration is always constant within the spray pattern, even when the rotational speed is 35,000 rpm. The results show that pigment-rich paint droplets are not produced by the pigment/vehicle centrifugation within the rotating bell-head; if such paint droplets were produced, they would deposit on the outer portion of the spray pattern, increasing the pigment concentration in that part. This is because the specific gravity of the pigment is more than four times that of the vehicle and therefore pigment-rich droplets would have higher density. It follows that the cause of the gloss loss is not the coverage of the film surface with pigment-rich paint droplets.

Pigment Dispersion in Paint Droplet

The pigment dispersion in the dry paint droplets sprayed with bell-head A is shown in *Figure* 12. The SEM observation shows that the pigment particles in the droplet are unevenly dispersed at a rotational speed of 35,000 rpm, even though evenly dispersed at 10,000 rpm. These results are also supported by the EPMA data. The uneven pigment dispersion in the droplet results from the pigment/vehicle centrifugation of the enamel paint. The process is proposed as follows. The pigment particles traverse the paint flow radially toward the inner wall of the bell-head by the centrifugal force, since the specific

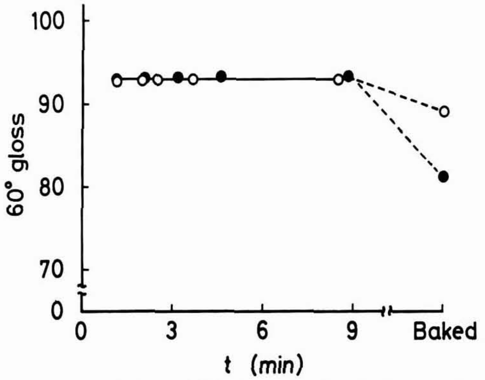

Figure 9. Variations of 60° gloss with time t after spraying with bell-head A. Rotational speed: ○ 10,000 rpm, ● 35,000 rpm

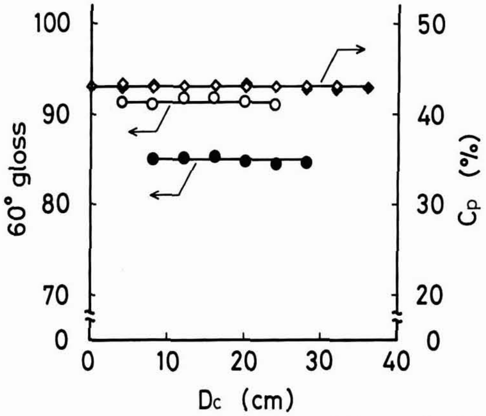

Figure 11—60° gloss and pigment concentration, C_p, distributions across spray pattern for bell-head A. D_c is distance from the pattern center. Rotational speed: ○, ◇ 10,000 rpm; ●, ◆ 35,000 rpm

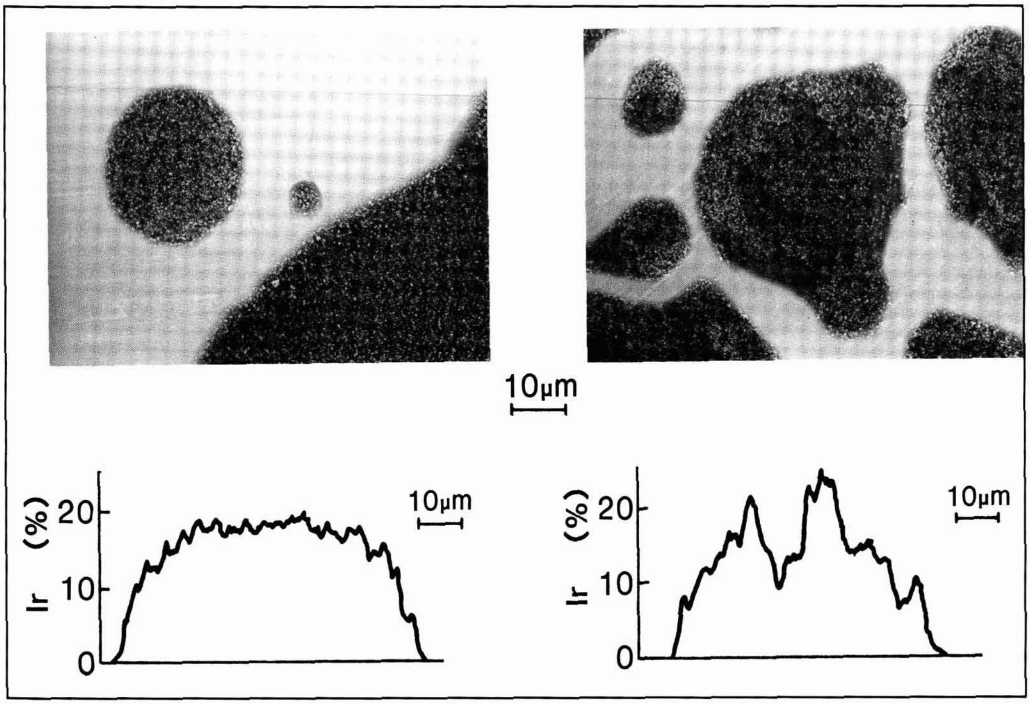

Figure 12—Pigment dispersion in paint droplets sprayed with bell-head A at rotational speeds of 10,000 (left) and 35,000 rpm (right). The micrographs were taken with SEM. The distribution of the X-ray (Ti-Kα) intensity ratio, I_r, across the paint droplet was measured with EPMA

gravity of the pigment is larger than that of the vehicle. The paint flow is separated into a number of filament-like flows by the grooves. The filament-like flows, in which the pigment particles are being concentrated radially, are disintegrated along the flows, forming paint droplets with uneven pigment dispersion. However, the pigment concentration of each paint droplet is equal to that of the paint; neither pigment-rich nor pigment-poor droplets are produced by the pigment/vehicle centrifugation of the enamel paint in the rotating bell-head.

Effect of Bell-Head Shape on 60° Gloss

The effect of the bell-head shape on the 60° gloss of dry films at various rotational speeds is shown in *Figure* 13. Though the 60° gloss is reduced with increasing rotational speed even for bell-head B, the gloss loss is noticeably suppressed compared with bell-head A. This effect is not due to the increase in the fluidity of the wet film, because the nonvolatile concentrations, NV_0, immediately after spraying, are equal for both bell-heads A and B, as shown in *Figure* 14. It is due to the shape of bell-head B, which

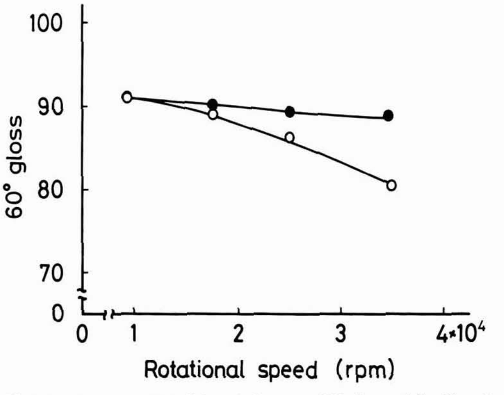

Figure 13—Effect of bell-head shape on 60° gloss of dry film at various rotational speeds. Bell-head: ○ A, ● B

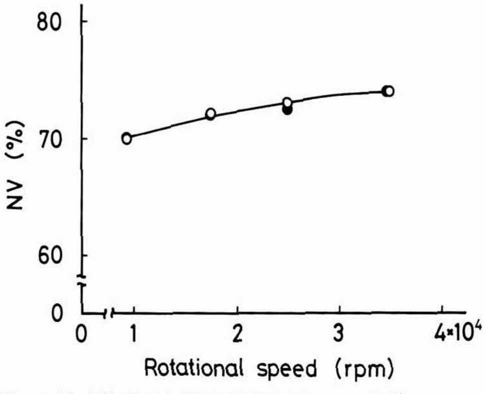

Figure 14—Effect of bell-head shape on nonvolatile concentration NV_0 at various rotational speeds. Bell-head: ○ A, ● B

minimizes pigment/vehicle centrifugation within the bell-head as compared to bell-head A. The results, therefore, confirm that the dominant cause of the loss of gloss is not the reduction in film fluidity, but the uneven pigment dispersion in the paint droplets.

Mechanism of Gloss Loss Caused By Increase in Rotational Speed

A paint containing TiO_2 pigment was subjected to pigment/vehicle centrifugation in a high-speed rotating bell-head to be disintegrated into droplets in each of which the pigment was unevenly dispersed. The droplets were deposited on a substrate, forming a wet film containing pigment-rich and pigment-poor regions. The film shrinkage difference between the pigment-rich and pigment-poor regions caused by crosslinking and evaporation of volatiles is presumed to roughen the film surface during the drying process. However, the nonuniformity does not begin to produce roughness in the film surface as long as there is significant fluidity, because leveling immediately eliminates the roughness. That is, the film surface is roughened, reducing the gloss, after fluidity is lost by crosslinking and evaporation of volatiles.

SUMMARY

In the electrostatic rotary bell spraying of paints containing TiO_2 pigment, the gloss of coatings is reduced as the rotational speed of a bell-head increases. The mechanism of the gloss loss, namely roughening the film surface, has been studied by the SEM observation of the pigment dispersions in the paint droplets and films sprayed at rotational speeds of 10,000 and 35,000 rpm, and by measurement of the gloss variations during the drying process and of the pigment concentration of dry films.

The loss of gloss is attributed to droplets with uneven pigment dispersion, that is, to droplets containing pigment-rich and pigment-poor regions. These droplets result from the pigment/vehicle centrifugation in a high-speed rotating bell-head. However, the pigment overall concentration in each droplet is equal to that in the enamel paints. The droplets deposit on a substrate, forming a wet film with uneven pigment dispersion. The pigment-rich regions shrink less than the pigment-poor regions. However, it is after significant fluidity is lost due to volatile evaporation and crosslinking, and leveling cannot take place, that the wet film shrinks nonuniformly, roughening the surface.

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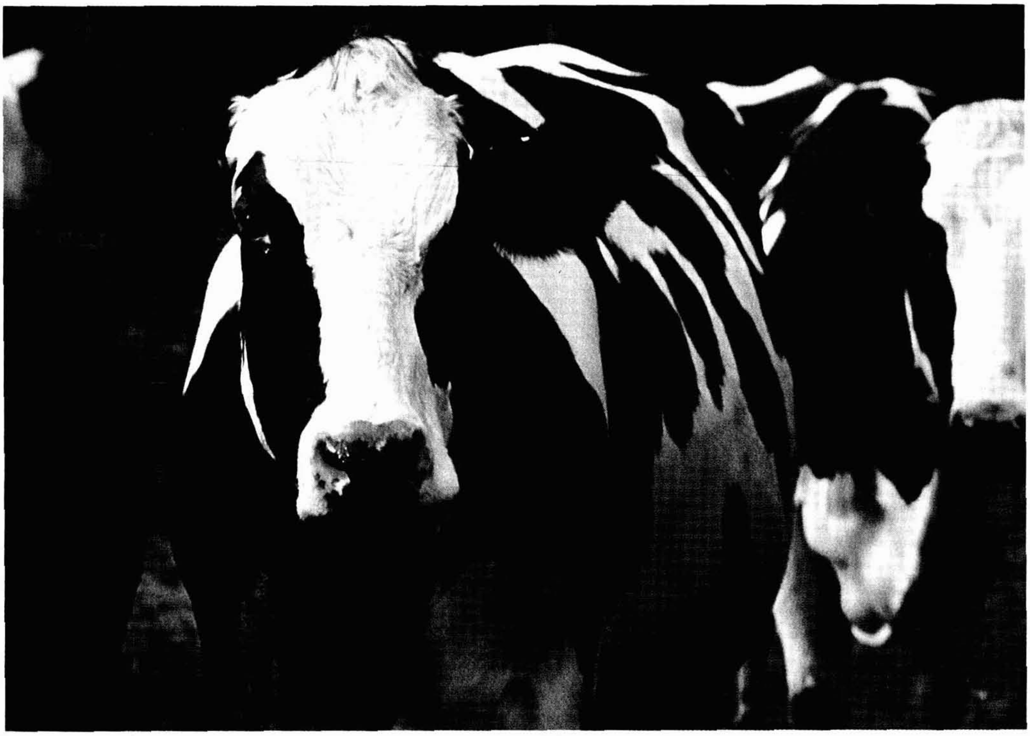

A New Approach to the Design of Pigment Dispersing Resins

Koichi Tsutsui, Harunori Goji, Tasaburo Ueno, and Shouji Ikeda
Nippon Paint Company, Ltd.*

Basic rules for designing pigment dispersing resins were studied using the acrylic resin/conventional pigment dispersion system. Molecular weight, molecular structure of a resin, compatibility to a main binder, and especially, number of acid-base groups and/or acid-base strength were found to be very important factors in improving the pigment dispersibility. Optimum ranges for these factors were also determined based on the experimental results.

INTRODUCTION

Properties of a pigment dispersion, such as rheological and optical properties, are determined by the interaction among three important components of paint: pigment, resin, and solvent. In other words, evaluation of the interaction among these three components is quite important for designing a pigment dispersing resin.

The acid-base concept is very useful for evaluation of this interaction,[1] and this fact was recently proven in our research. An amphoteric alkyd resin, having both acidic and basic groups in its molecular backbone, shows excellent dispersion properties,[2] and plasma surface treatment of organic pigment in acidic or basic atmosphere provides either acidic or basic character on its surface. This acidic or basic surface character is responsible for superior dispersibility when a pigment which has opposite characteristics is dispersed in the resin.[3]

In this experiment, the acid-base concept was applied to an acrylic resin/conventional pigment dispersion system to determine basic rules for the design of pigment dispersing resins. Acrylic resins were selected, since they offer such advantages as easier molecular weight adjustment without changing their composition, and easier introduction of different basic groups into their molecular backbones without a drastic change in molecular weight.

Another objective of this experiment was to find out the effect of star-shaped molecular structure on the pigment dispersion. The main purpose of introducing star-shaped molecular structure into the resin was to diminish the resin viscosity. This decrease is now favored in the coatings industry since it can produce paint which contains less solvent, so-called "high-solids paint," and meets recent anti-pollution requirements.

EXPERIMENTAL

Pigment Dispersing Resins

The following acrylic resins were synthesized by conventional free-radical polymerization methods:

ACIDIC ACRYLIC RESINS (I): Acidic acrylic resins, AR-1, 2, 3, 4, 5, and 6, are different in molecular weight (MW), but are similar in acid-strength and acid-amount. These resin specifications are shown in *Table* 1.

ACIDIC ACRYLIC RESINS (II): Acidic acrylic resins, AC-1, 2, and 3, shown in *Table* 2, are almost identical in acid-strength and MW, but are different in acid-amount.

AMPHOTERIC ACRYLIC RESINS (I): Amphoteric acrylic resins, AM-1, 2, and 3, shown in *Table* 3, are similar in acid-base strength and MW, but are different in base amount.

AMPHOTERIC ACRYLIC RESINS (II): Amphoteric acrylic resins, AP-1, 2, and 3, shown in *Table* 4, are almost identical in acid-strength, acid-base amount, and MW, but are different in base strength.

STAR-SHAPED ACRYLIC RESINS: Star-shaped acrylic resins were prepared by the reaction of terminal carboxyl groups, at one end of an acrylic prepolymer, with oxirane

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Presented in part at the Gordon Research Conference, New Hampshire, August 5, 1988.
*19-17, Ikeda Nakamachi, Neyagawa, Osaka 572, Japan.

Table 1—Acidic Acrylic Resins (I) Specification

	Viscosity (cp)	Acid Amount (mmol/g·solid)	Molecular Weight $\overline{M}n$	Molecular Weight $\overline{M}w$
AR – 1	16.1	0.242	5,800	17,400
AR – 2	22.6	0.237	6,500	19,600
AR – 3	30.5	0.237	10,200	29,400
AR – 4	54.5	0.221	11,800	39,500
AR – 5	64.9	0.244	12,400	44,500
AR – 6	125.0	0.211	17,800	63,400

Nonvolatile contents of resins: 50%.

Table 2—Acidic Acrylic Resins (II) Having Different Acid Amounts

	Acid Amount (mmol/g·solid)	Molecular Weight $\overline{M}n$	Molecular Weight $\overline{M}w$
AC – 1	0.104	11,400	43,900
AC – 2	0.244	12,400	44,500
AC – 3	0.433	10,700	41,900

Nonvolatile contents of resins: 50%.

Table 3—Specification of Amphoteric Acrylic-Resins (I)

	Acid Amount (mmol/g·solid)	Base Amount (mmol/g·solid)	$\overline{M}n$
AM – 1	0.230	0.051	12,200
AM – 2	0.228	0.094	9,200
AM – 3	0.235	0.168	8,600

Nonvolatile contents of resins: 50%.

Table 4—Specification of Amphoteric Acrylic-Resins (II) Having Different Base-Strength

	Acid Amount (mmol/g·solid)	Base Amount (mmol/g·solid)	Pka (monomer)	$\overline{M}n$
AP – 1	0.235	0.125	7 ~ 8	10,600
AP – 2	0.246	0.123	5 ~ 6	9,000
AP – 3	0.248	0.120	~ 0	12,000

Nonvolatile contents of resins: 50%.

groups of poly glycidyl compounds. Star-shaped acrylic/polyester resin was also synthesized in the same manner as the star-shaped acrylic resin, but using a carboxyl terminated polyester prepolymer in place of an acrylic prepolymer. Specifications for these resins are tabulated in *Table* 5, and the resin structure is represented in *Figure* 1.

Pigments

Different types of carbon black, phthalocyanine blue, and titanium dioxide, which are conventionally used in coatings, were selected.

Solvent

Methyl isobutyl ketone (MIBK) was used as a solvent for pigment dispersion, since MIBK is a good solvent for acrylic resins used in this experiment and is widely employed in the coatings.

Determination of Acid (Base) Amounts of Pigment and Resin[2]

PIGMENT: Two grams of pigment were immersed in 30 mL of 0.1 N tetra butyl ammonium hydroxide (TBAH)/MIBK solution and stirred by ultrasonic vibration. Separated from the solution via centrifugation, 10 mL of the supernatant was back-titrated using the 0.01 N $HC10_4$/MIBK solution. The acid amount was calculated from the back-titrated base amount. The same was done for the base, using 0.01 N $HC10_4$/MIBK solution and 0.01 N TBAH/MIBK solution, respectively.

RESIN: One gram of resin was dissolved in MIBK and titrated by 0.01 N TBAH/MIBK solution. The same was done for the base, using 0.01 N $HC10_4$/MIBK solution.

Molecular Weight Measurement

A gel permeation chromatograph, which was constructed in the Analytical Department of Nippon Paint Co., Ltd. was used. The column was KF80M/KF803, supplied by Showa Denko Co., Ltd. The carrier was tetrahydrofuran. Molecular weight was calculated based on polystyrene standard, supplied by Tosoh Corporation.

Preparation of Pigment Dispersion

Pigment was dispersed in the resin solution using a small batch (200 mL) sand-grind mill which was specially designed in our laboratory.[4] The batch was kept at a constant temperature during milling by the circulation of temperature regulated water. Rotor speed was regulated by an electrical feedback circuit, so that the change in viscosity during dispersion did not affect the speed of rotation. Typical mill base formulations are shown in *Table* 6.

Viscosity Measurement

A cone-plate type of viscometer (E-type viscometer made by Tokyo Keiki Co., Ltd.) was used. Viscosities were measured at a shear rate of 19.2 sec^{-1}, and yield

Table 5—Comparison in Viscosity between Star-Shaped and Linear Acrylic Resins

		Viscosity (cp)	Molecular Weight	
			$\overline{Mn}$	$\overline{Mw}$
Star-shaped acrylic resin	1	186	4,640	10,620
	2	209	4,560	11,540
	3	485	7,500	19,500
	4	1,000	10,660	29,820
	5	1,220	10,830	33,340
Linear acrylic resin	1	169	2,680	5,850
	2	300	3,070	6,790
	3	465	5,380	12,750
	4	544	6,830	15,870
	5	765	7,500	18,150
	6	1,440	11,020	30,500

Nonvolatile content of resins: 50%.

values were calculated by Casson's equation[5] from viscosities obtained over a shear rate range of 19.2 to 384 sec^{-1}.

Evaluation of the Degree of Dispersion[6]

The degree of dispersion was measured from the gloss of grind gauge drawdowns. The procedure of measurement was as follows: (1) the dispersion was drawndown on the grind gauge, 0-25 μm range, followed by (2) the measurement of 60° paint gloss at the spot of 10 μm on the grind readings.

RESULTS AND DISCUSSION

Acid-Base Amounts of Conventional Pigments

Several different types of commercial pigments were measured by the method described in the Experimental section. Results are shown in *Table* 7. Acid-base characteristics of these pigments vary widely due to their different surface properties, although their bulk chemical structures are the same. It is clear that carbon black C is an acidic pigment, Cu-phthalocyanine blue A is a basic pigment, and titanium dioxide A is an amphotheric pigment.

Influence of Resin MW on the Pigment Dispersibility

Acidic acrylic resins AR-3, 5, and 6, which are different only in MW, were used for the dispersion of phthalocyanine blue A. Degree of the dispersion in terms of "grind gauge gloss," plotted against time, is shown in *Figure* 2. AR-3, having a lower viscosity, gave the highest dispersion rate, followed by AR-5 and AR-6, in order of increasing viscosity.

This result indicates that the viscosity of the dispersing medium clearly governs the rate of dispersion as long as the interaction between pigment and resin is not so varied within a series of dispersions. This result is also reasonable from the dispersion mechanism, postulated by Washburn,[7] in which the penetration time (t) of a liquid medium into the pores of a pigment agglomerate is given by:

$$t = \frac{K^2 l^2}{R} \cdot \frac{2\eta}{\gamma \cos\theta}$$

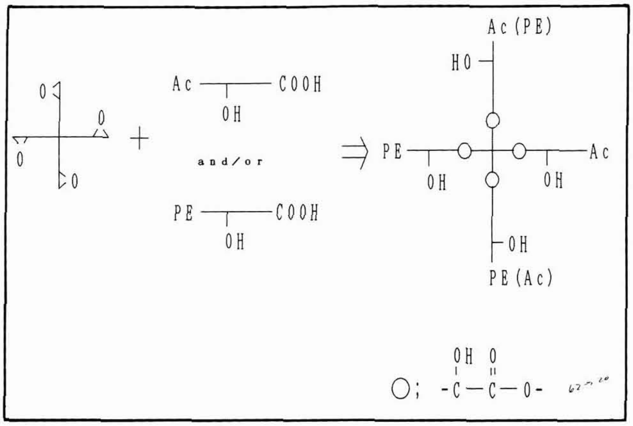


Figure 1—Molecular structure representing a star-shaped acrylic resin

Table 6—Mill Base Formulation

	Pigment (wt %)	Resin (wt %)	Solvent (wt %)	Total (wt %)
Carbon black	10	30	60	100
Phthalocyanine blue	20	30	50	100
Cynquasia red	12	30	58	100

where K = constant for the pore geometry,
ℓ = length of pores,
R = radius of pores,
η = viscosity, and
$\gamma \cos \theta$ = wetting tension of the binder solution.

The lower the viscosity of the medium, the shorter the penetration time of the medium and the faster the rate of dispersion. The dispersion step in paint production follows the kinetic theory as shown previously, while storage stability of the dispersion, another important aspect of paint production, follows the thermodynamic theory. Dispersions of phthalocyanine blue A in resin solutions AR-1, 2, 3, 4, 5, and 6 were stored for 12 days at 60°C. *Figure* 3 indicates the relation of viscosities of the dispersions to those of the liquid mediums. The original straight line for the dispersions before storage becomes a curve having a minimum about the viscosity of 23 cp., corresponding to Mn = 6,000 - 10,000, and Mw = 20,000 - 30,000.

This result suggests that the resin of lower MW does not stabilize the dispersed pigment through steric repulsion between resin molecules adsorbed on the pigments, while the resin of higher MW provides a larger probability of a quasi network structure formation by the stronger interaction between resin molecules surrounding pigment particles. In other words, the selection of the proper MW range of the resin is very important for both efficient dispersion and stable storage.

Effect of Acid-Base Amount on the Pigment Dispersion: Relation Between Basic Pigment and Acidic Resin

Resins AC-1, 2, and 3, having different acid amounts, were used for the dispersion of the basic pigment of phthalocyanine blue A, to determine the effect of acid amount on the pigment dispersion. The MW of these resins were controlled, so that Mn = 10,000 - 11,400 and Mw = 41,900 - 44,500, which are reasonable MW ranges for good dispersion. The change in the degree of dispersion with dispersing time is shown in *Figure* 4. AC-3, having the highest acid amount, achieved the largest dispersion rate in the same dispersing time.

Storage stability of these dispersions, for 20 days at 60°C, was evaluated by the change in η r, which represented the ratio of paste viscosity to resin solution viscosity, in order to avoid the influence of the resin solution viscosity. Results, shown in *Figure* 5, indicate that AC-3 also has a better storage stability than the other two dispersions. Stronger acid-base interaction, due to higher content of acidic groups in the molecular backbones, provides better dispersion properties from both the kinetic and thermodynamic points of view.

RELATION BETWEEN ACIDIC PIGMENT AND ACIDIC RESIN: A typical acidic pigment, carbon black C, was dispersed in solutions of AC-1, 2, and 3, respectively. This dispersion behavior is shown in *Figure* 6. Almost no increase in gloss with dispersion was observed for these three dispersions, and their dispersion behavior was quite similar.

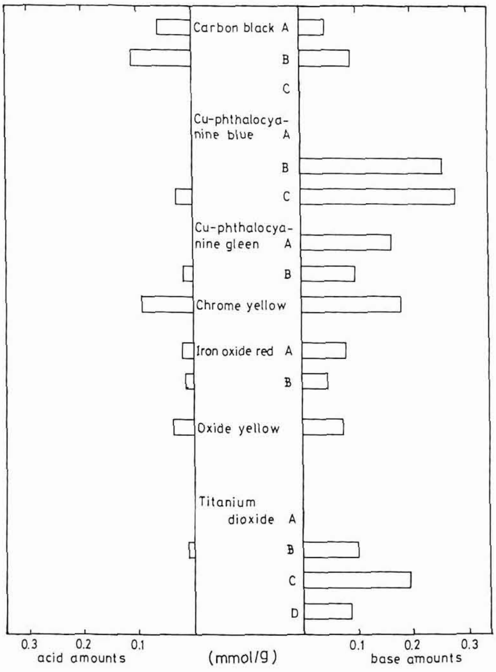
Therefore, it was concluded that the selection of pigment and resin with the same acid or base character, is not a proper combination for a good dispersion. This also says that a mono-functional dispersing resin, such as AC-3, is good for a basic pigment, but not good for an acidic pigment. In other words, a mono-functional resin is not a good choice as a universal dispersing resin.

Effect of Base Amount of an Amphoteric Resin on Either Acidic or Basic Pigment Dispersion

ACIDIC PIGMENT DISPERSION: Resins AM-1, 2, and 3, having similar acid amount but different base amount, were used for the dispersion of the acidic pigment, carbon black C. The degree of dispersion, plotted against dispersing time, is shown in *Figure* 7. It is clear from this figure that the introduction of a basic compound into an acidic resin improved the degree of dispersion tremendously, compared with that of the original, unmodified acidic acrylic resin, AC-2. Moreover, AM-3, having the largest base amount, showed the best performance as a dispersant.

The ratios, ηr, for these three dispersions after three days' storage at 60°C were plotted against the base

Table 7—Acid-Base Amounts of Conventional Pigments



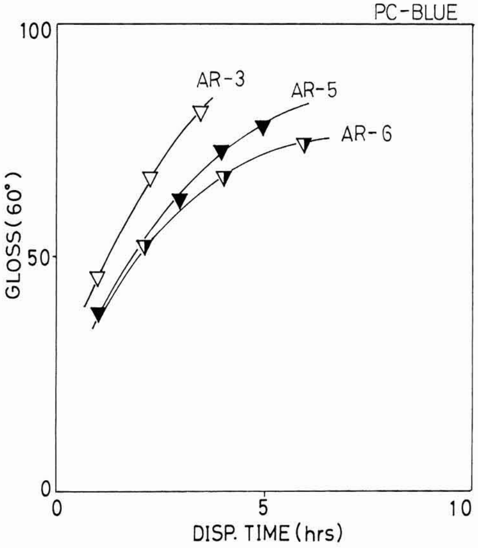


Figure 2—Effect of resin molecular weight on pigment dispersion

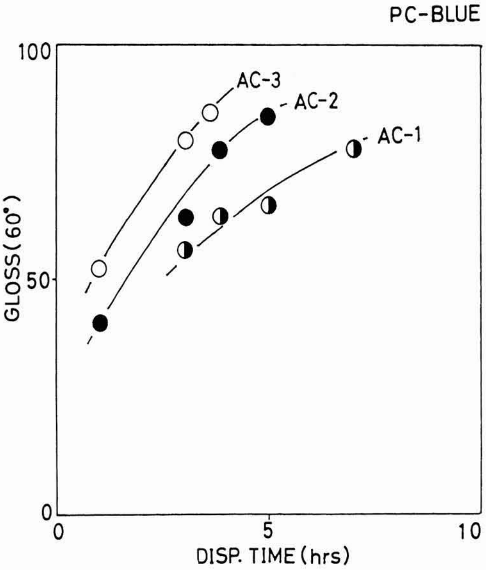


Figure 4—Dispersion behavior of basic pigment/acidic resin dispersion

amount of each resin. Results are shown in *Figure* 8. The ηr rapidly decreases down to the base amount of 0.1. From a practical point of view, a base amount of more than 0.1 is necessary for a good dispersion.

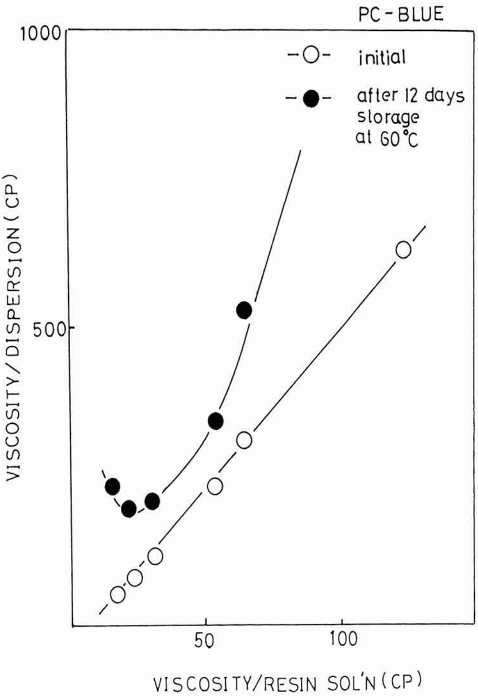


Figure 3—Relation between storage stability of dispersions and viscosity of resin solutions

Basic Pigment Dispersion: Basic pigment, phthalocyanine blue A, was dispersed with amphoteric resins AM-1, 2, and 3, respectively. Results are shown in *Figure* 9. The parent acrylic resin, AC-2, reveals the best dispersibility, followed by AM-1, 2, and 3.

Introduction of basic groups into the resin gives an interference effect in the dispersion, which can be verified by the comparison of AC-2 and AM-2 dispersions. The ηr of these three dispersions after three days' storage at 60°C are plotted against the base amount of each resin. These results are shown in *Figure* 10. It can be seen that introduction of a basic compound, beyond the base amount of 0.15, increases ηr rapidly.

From the storage behavior of these dispersions containing either acidic or basic pigments, it must be concluded that the proper range of base amounts for a good dispersion lies between 0.1 and 0.15.

Effects of Basic Strength of an Amphoteric Resin On Either Acidic or Basic Pigment

Acidic pigment, carbon black C, was dispersed with amphoteric resins AP-1, 2, and 3, and basic pigment, phthalocyanine blue-A, was also dispersed with AP-1, 2, and 3, respectively. Results are shown in *Figures* 11 and 12. For carbon black C, AP-1, having the highest base strength, shows the highest degree of dispersion, followed by AP-2. AP-3 and AC-2 are at almost the same level. On the other hand, the basic pigment, AP-3, having the lowest base strength, shows the highest degree of dispersion of phthalocyanine blue-A. The ηr of the phthalocyanine blue-A dispersions are plotted against the base strength of each resin in *Figure* 13. The ηr increases with base strength, which is similar to the behavior of phthalocyanine blue-A dispersions when the resins have different base amounts.

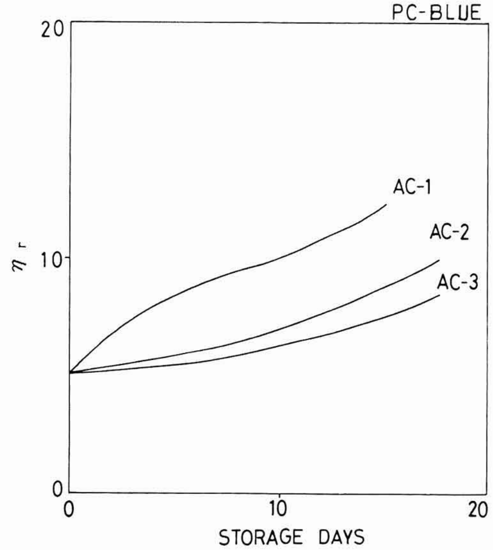


Figure 5—Storage stability of basic pigment/acidic resin dispersion

It suggests that a stronger acidic atmosphere, brought on by an increase either in acid amount or in acid strength, enhances the acid-base interaction and gives a good dispersion of basic pigment. Similarly, a resin with stronger basic properties gives a better dispersion of acidic pigment. In other words, the proper dispersing resin can be designed by adjusting the number of ionic groups and/or the ionic strength of the resin.

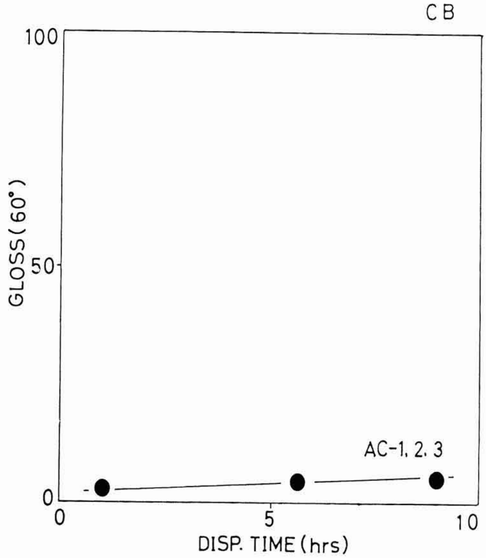


Figure 6—Dispersion behavior of acidic pigment/acidic resin dispersion

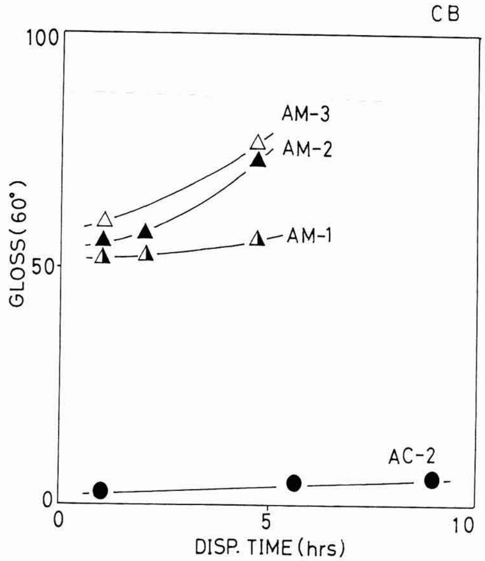


Figure 7—Dispersion behavior of acidic pigment/amphoteric resin dispersion

Viscosity of Star-Shaped Acrylic Resin

Viscosities of both star- and linear-shaped acrylic resins, having comparable acrylic monomer compositions, are plotted against MW of the resins in *Figure* 14.

According to Zimm and Kilb, the ratio, G, of viscosity of a branched polymer $[\eta]_b$ to that of a linear polymer $[\eta]_l$ can be described as:

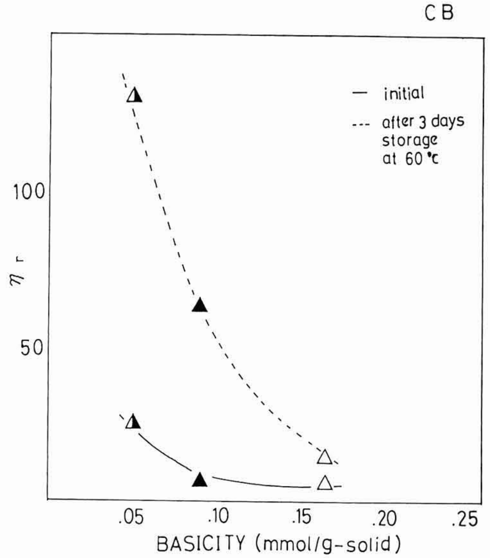


Figure 8—Relation between resin basicity and acidic pigment dispersion stability

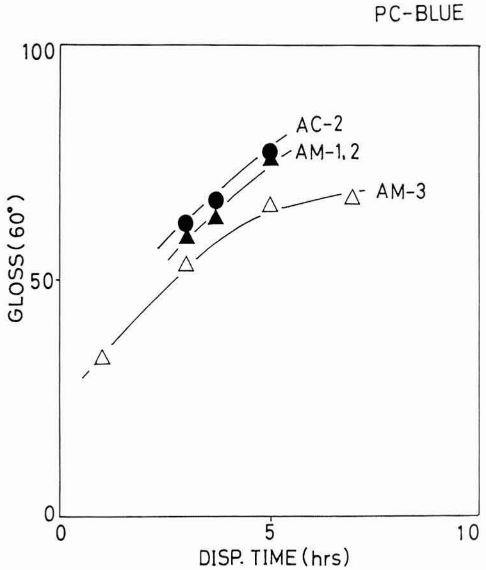


Figure 9—Dispersion behavior of basic pigment/amphoteric resin dispersion

$$G = \frac{[\eta]_b}{[\eta]_l} = \frac{2\sqrt{2}\{0.390\,(f\text{-}1) + 0.196\}}{0.586\, f^{3/2}}$$

when the chain length of each branch is the same, where f is the number of branches in a molecule.[8] Substituting f=4 into this relation, G for a four branched polymer becomes:

$$G = \frac{2\sqrt{2}\,(0.390 \times 3 + 0.196)}{0.586 \times 4^{3/2}} = 0.824$$

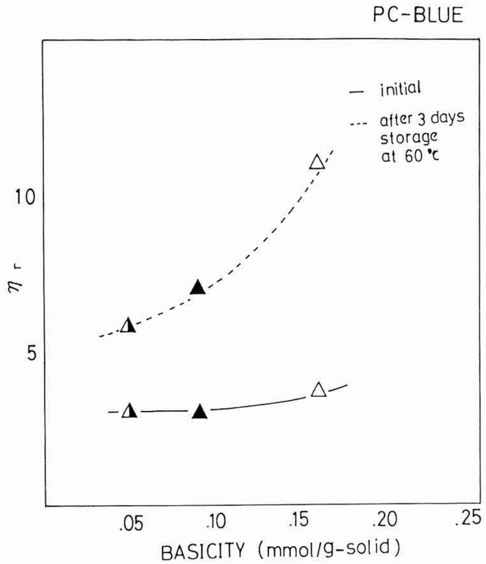


Figure 10—Relation between resin basicity and basic pigment dispersion stability

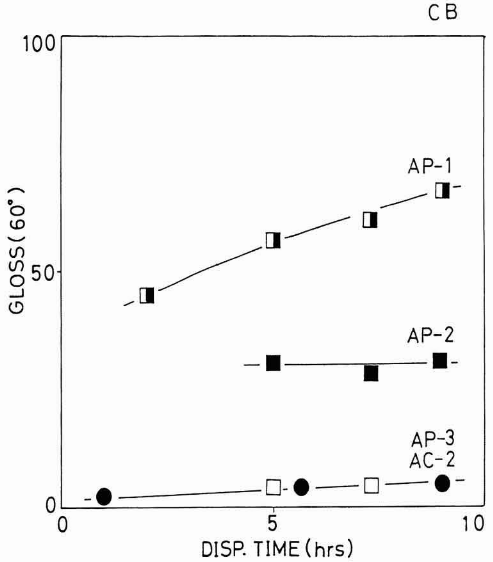


Figure 11—Influence of base strength of amphoteric resin on acidic pigment dispersion

From this theoretical calculation, the viscosity of the star-shaped polymer used in this experiment is expected to be 18% lower than that of the linear polymer. Our experimental results show that viscosities of star-shaped acrylic resins are actually around 20% lower than those of linear acrylic resins. This agrees quite well with the theoretical calculation.

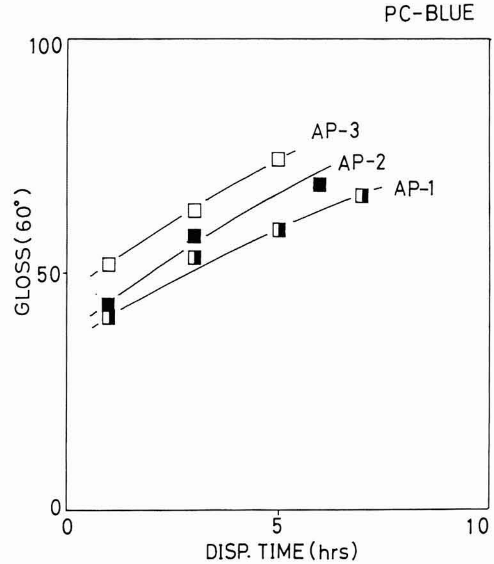
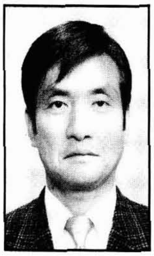


Figure 12—Influence of base strength of amphoteric resin on basic pigment dispersion



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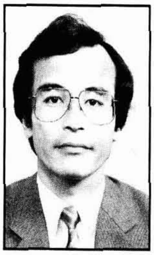

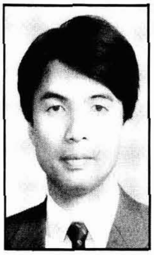

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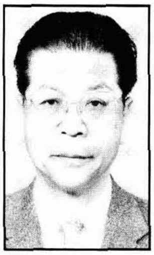

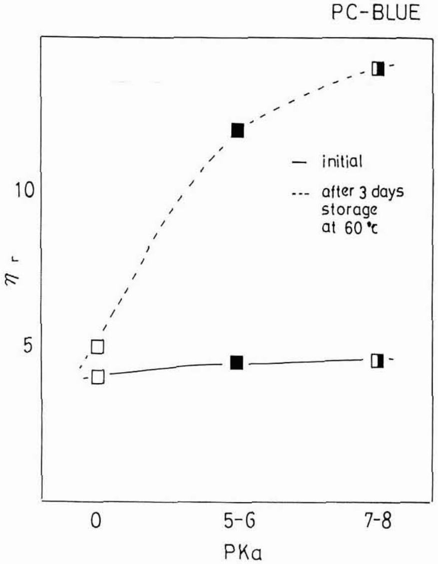

Figure 13—Relation between resin base strength and basic pigment dispersion stability

Practical Advantages of Star-Shaped Pigment Dispersing Resins

Dispersion properties, such as viscosity and yield value, are tabulated in *Table* 8, for a dispersion of amphoteric titanium dioxide in acidic star-shaped acrylic resin compared with linear acrylic resin. The star-shaped acryl-

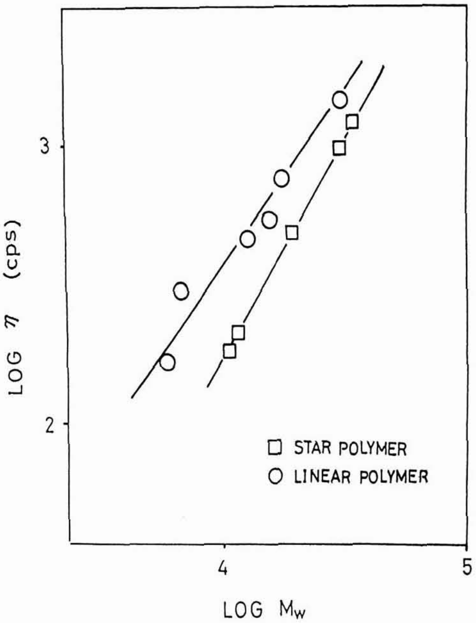

Figure 14—Relation between viscosity and MW of both star-shaped and linear polymer

ic resin performs better as a dispersant. These results can be explained by the lower viscosity of the star-shaped resin and its structural effect on the dispersion stability. Moreover, the presence of the star-shaped acrylic/polyester resin improves compatibility between linear acrylic resin and polyester resin, which minimizes color difference, as shown in *Table* 9. A conventional paint containing both acrylic resin and polyester resin, has a problem in color stability, when either black or blue paint is mixed with white paint. However, this problem is solved when a star-shaped acrylic/polyester resin is used as the dispersing resin. This result is quite reasonable since star-shaped acrylic/polyester resin possesses good compatibility with both acrylic and polyester resins.

Table 8—Comparison in TiO_2 Dispersion Properties between Star-Shaped and Linear Polymers

	Resin Specification		Dispersion Properties		
	$\overline{M}_w$	Acid Amount (mmol/g)	Gloss after 2 hr Milling	Viscosity (cp)	Yield Value (dyn/cm^2)
Acidic star-shaped acrylic resin	41,000	0.14	60	600	0
Acidic linear acrylic resin	35,800	0.14	30	1,600	40

Pigment: TiO_2.

Table 9—Comparison in Color Stability between Star-Shaped and Linear Polymers

	Compatibility with Polyester Resin (Polyester Resin / —)		Color Stability[a]	
	1/1	1/2	Black/White	Blue/White
Acrylic resin........	Haze	Haze	×[b]	×
Star-shaped acrylic/polyester resin	Clear	Clear	○	○

(a) Color stability is evaluated by degree of color flooding.
(b) × : Fail; ○: Excellent.

CONCLUSIONS

The capacity of different types of pigment dispersing resins to disperse pigment is discussed from both the kinetic and thermodynamic points of view, considering both the dispersing process and the effect on storage stability.

Fundamental factors, influencing the design of a pigment dispersing resin, are molecular weight, number of acid-base groups and/or acid-base strength, molecular structure of a resin, and compatibility with a main binder.

The proper molecular weight range for a pigment dispersing acrylic resin is 6,000 - 10,000. The lower molecular weights investigated were not adequate to stabilize the dispersed pigments through steric repulsion between resin molecules. Higher molecular weight of resin, on the other hand, provides high viscosity of a dispersion, perhaps because of the higher probability of a "quasi network structure formation" by the stronger interaction between resin molecules.

Proper base amount of a resin, when the acid amount of a resin is fixed at 0.1-0.2 mmol/g, is 0.1-0.15.* A base amount lower than 0.1 is less effective for the storage stability of the acidic pigment carbon black C. However, a base amount larger than 0.15 increases the viscosity of the dispersion during storage, when the basic pigment phthalocyanine blue A is dispersed.

The acid or base strength of a resin has a similar effect on its ability to disperse pigment as does the acid or base amount of a resin. This might be explained by a stronger acidic (basic) atmosphere, brought on by an increase either in acid (base) groups or in acid (base) strength, which enhances the acid-base interaction and gives a good dispersion.

This also suggests that the most efficient dispersing resin can be designed by adjusting the number of "ionic groups" and/or "ionic strength of the resin."

Molecular structure is also very important for a pigment dispersion. A star-shaped polymer is good for pigment dispersion due to its lower viscosity and the effective steric hindrance caused by bulky molecular constituents. Moreover, this star-shaped molecular structure can provide the improvement in resin compatibility and freedom from color difference. Since this star-shaped molecular structure is able to combine more than two different resins into one compound, good compatibility of this compound with each resin's constituents can be obtained.

ACKNOWLEDGMENT

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*These values are valid for the dispersion system which is studied in this experiment.

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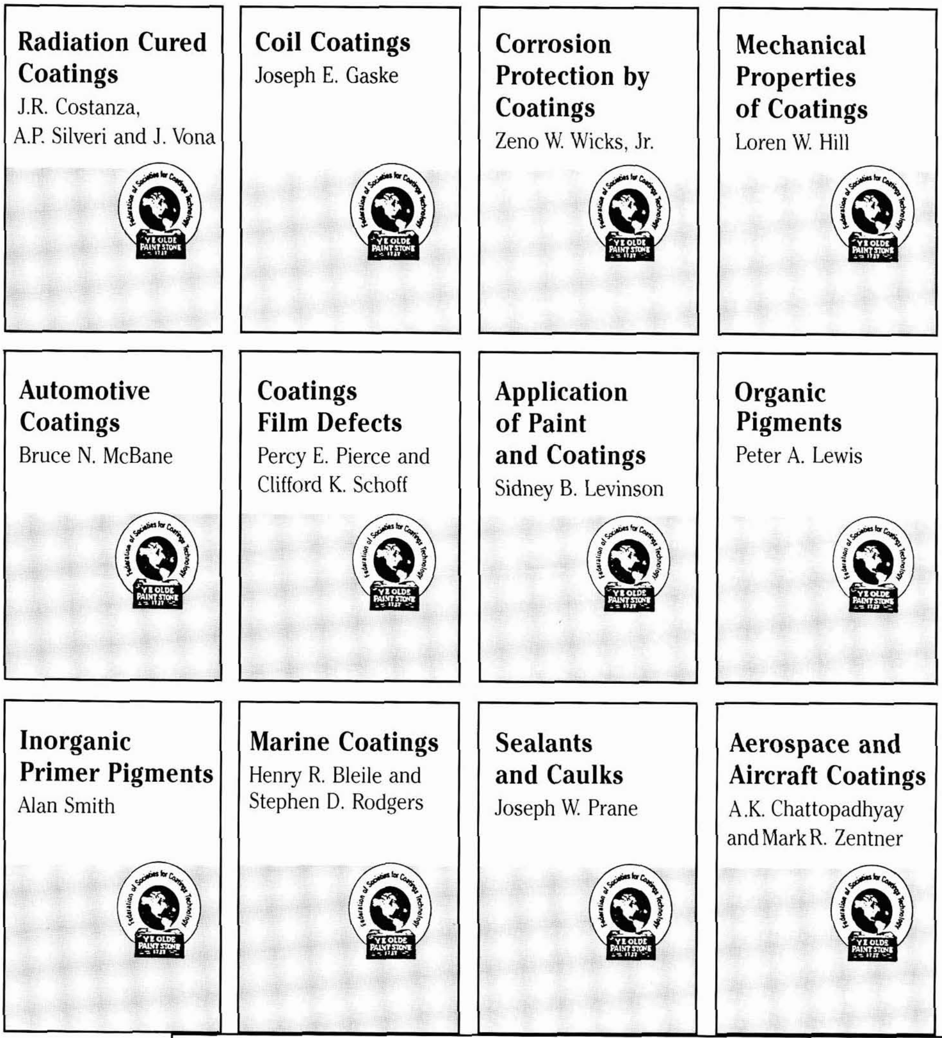

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Polyester Resins Based Upon 2-Methyl-1,3-Propanediol

C.J. Sullivan, D.C. Dehm, E.E. Reich, and M.E. Dillon
ARCO Chemical Company*

2-Methyl-1,3-propanediol is a commercially available but relatively unknown diol. In order for the chemist to gauge the utility of this new glycol in polyester resins, a comparative analysis of resins based upon 2-methyl-1,3-propanediol, propylene glycol and 2,2-dimethyl-1,3-propanediol has been performed and is reported here. In addition, 2-methyl-1,3-propanediol based polyesters with different isophthalic to adipic acid ratios have been synthesized and analyzed. Diol comparisons indicate that 2-methyl-1,3-propanediol provides relatively higher levels of internal flexibility. Melamine cured coatings demonstrate that a high level of flexibility and hardness are simultaneously attainable. High levels of isophthalic acid in the 2-methyl-1,3-propanediol based resins are tolerated without risking resin crystallization. QUV weathering, salt spray, detergent, and humidity resistance test results are reported.

INTRODUCTION

Saturated polyester resins are widely used in coatings because of the excellent array of properties that are obtained when the resins are crosslinked with melamine or isocyanate crosslinking agents.[1,2] In particular, the versatility of redesigning the polyester backbone enables the polymer chemist to fine tune products for specific markets. 2-Methyl-1,3-propanediol has become commercially available and as a new commercial diol, significant utilization as a component in polyester resins is anticipated. However, because 2-methyl-1,3-propanediol is new to the industry, structure/performance correlations are not known and need to be defined prior to the most preliminary polyester design.

The purpose of this work is to elucidate some of the property and performance characteristics that are associated with the 2-methyl-1,3-propanediol structure. As is simplistically depicted in *Figure* 1, diols are reacted with diacids to generate a polyester resin which acts as a binder for the coating. The diol and diacid components necessarily will impact the performance of that coating.

Two strategies for defining structure/property/performance correlations have been followed and the results are reported here. First, 2-methyl-1,3-propanediol is compared with two well known and structurally similar commercial diols, neopentyl glycol (2,2-dimethyl-1,3-propanediol) and propylene glycol, in resin synthesis, enamel formulations, and coating performance. *Figure* 2 depicts the structures of these compounds and *Table* 1 lists physical properties.

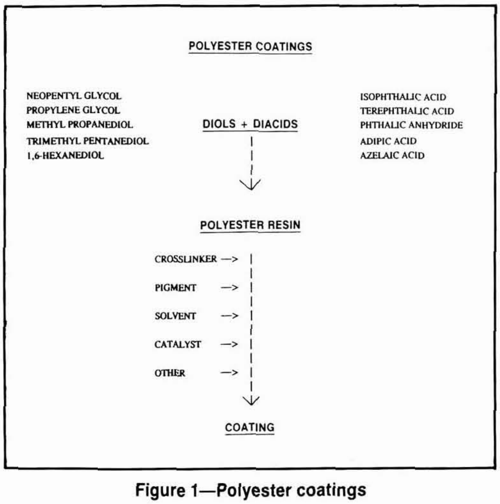

Figure 1—Polyester coatings

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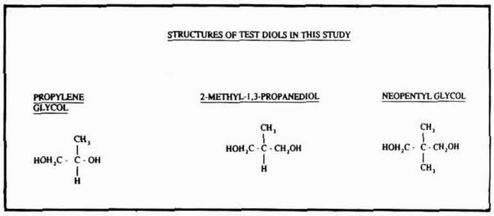

Figure 2—Structures of test diols in this study

Table 1—Physical Properties of Test Diols

	2-Methyl-1,3-Propanediol	Neopentyl Glycol	Propylene Glycol
Melting point	−91°C	125°C	< −60°C
Boiling point	213°C	208°C	189°C
Viscosity @ 25°C, (cps)	168	—	46
Flash point	>230°F	225°F	211°F
Specific gravity	1.015	—	1.0349
Hydroxyls	2 Primary	2 Primary	1 Primary 1 Secondary

The second strategy has been to develop an understanding of how 2-methyl-1,3-propanediol performs with varying diacid composition. In particular, glass transition temperatures (T_g), solvent compatibilities, and polyester crystallization tendencies as well as the ultimate coating performance depend upon the diol and diacid compositions. Several 2-methyl-1,3-propanediol based polyesters with varying ratios of isophthalic acid to adipic acid were synthesized and analyzed. Isophthalic acid and adipic acid were chosen because the performance characteristics of these two diacids are well documented.[2]

In order to enhance the industrial relevancy of this work, the impact of 2-methyl-1,3-propanediol upon coil coatings was investigated. The reasoning for this stems from research on unsaturated polyester molding resins in which 2-methyl-1,3-propanediol provided some unusual and unexpected flexibility without a concurrent drop in strength or hardness.[3] High strength and high flexibility are particularly critical to specialty resin systems such as those used for coil coatings.[4,5]

EXPERIMENTAL

All polyesters were synthesized at 210°C in a 2 L round bottom flask equipped with stirrer, sampling port, thermocouple, nitrogen purge, and a packed, partial condenser. Neopentyl glycol, adipic acid, and isophthalic acid were all obtained from Aldrich Chemical Company and used as is. Propylene glycol and 2-methyl-1,3-propanediol were obtained from ARCO Chemical Company. Conversion of the polyesters was monitored by determining acid number with respect to time with Time = 0 designated as the time at which water condensate began collecting.

Enamels were applied to Bonderite 1000 treated cold-rolled steel with a wire wound rod and cured at 245°C for 75 sec. Peak metal temperature was determined to be 195°C. Overbake curing was done at 245°C for 300 sec. Dry film thickness was 1.0 mil (±0.1).

GPC data was determined on a Waters 244 Chromatograph using PL Gel 5 micron mixed bed columns (Polymer Labs). Samples were dissolved in THF at approximately 0.1 g/10 mL concentration. A 1 mL/min flow rate with THF as the mobile phase was used. The columns were calibrated using polypropylene glycol standards of 3000, 2000, 1000, 725, and 425 number average molecular weights.

Glass transition temperatures were determined on a Perkin Elmer model DSC7 differential scanning calorimeter.

RESULTS—DIOL COMPARISONS

Polyester Resin Syntheses

Polyesters with the compositions detailed in *Table* 2 were synthesized by conventional techniques. The compositions are based upon patent literature which describe a coil coating very similar to Resin PE-100.[6] Resin PE-200 is one-to-one molar substitution of 2-methyl-1,3-propanediol for the neopentyl glycol of Resin PE-100. Both resins have an initial five percent molar excess of hydroxyl functionalities.

Our initial attempt to synthesize the propylene glycol analogue of PE-100 and PE-200 using the same initial hydroxyl excess did not proceed as intended. The rate of reaction, as measured by change in acid number with time, was predictably slow. However, at acid numbers in excess of 50 mg KOH/g, the downward progression of acid numbers seemed to stop. It was suspected that significant glycol losses were occurring. Losses of glycol with concurrent stoichiometric imbalances are well established in the synthesis and manufacture of propylene glycol based unsaturated polyesters for molding resins.[7] The losses are typically attributed to the volatility of

Table 2—Polyester Resin Compositions for Comparing Diol Performance

	PE-100	PE-200	PE-500
Components[a]			
Neopentyl glycol	411.4	—	—
2-Methyl-1,3-propanediol	—	376.8	—
Propylene glycol	—	—	349.9
Isophthalic acid	308.3	325.9	340.5
Phthalic anhydride	126.6	133.8	139.8
Adipic acid	153.7	162.5	169.8
Properties			
Acid number (mg KOH/g)	6.7	6.8	5.4
Hydroxyl number (mg KOH/g)	26	28	40
NVM[b] (wt %)	65	65	65
Color	<1	<1	<1
Viscosity (Gardner)	Z	Y/Z	V/W
T_g (neat)	7°C	−5°C	5°C
Number average mol wt	2200	2300	1370
Polydispersity (Mw/Mn)	2.05	2.07	1.91

(a) Polyesterification conditions: 210°C, N_2 purge, partial condenser set at 105°C, 0.10 wt % FASCAT™ 4100 (M&T Chemicals) in charge.

(b) Volatile material is 3/1 AROMATIC 150 (Exxon Corporation) Propylene Glycol Methyl Ether Acetate (Arco).

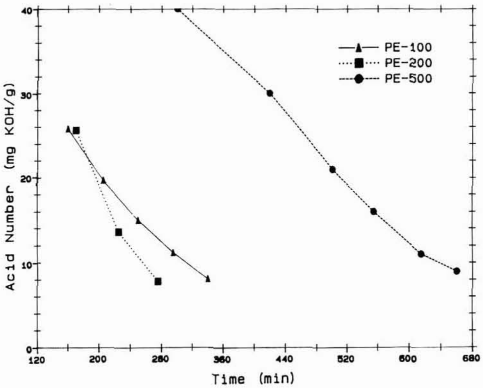

Figure 3—Comparative rates of polyesterification acid number vs time for selected resins

propylene glycol and its tendency to undergo side reactions such as acid catalyzed dehydration and the formation of cyclic ethers.[8]

In order to compensate for glycol losses and avoid an excessively long time in the synthesis kettle at 210°C, a second polyester based upon propylene glycol was synthesized using a hydroxyl excess of 10%. This resin is the resin reported in *Table* 2. This methodology, which is common in the synthesis of unsaturated polyester resins,[7,9] resulted in a higher hydroxyl number and lower viscosity than desired. However, for the purposes of this program, this polyester was deemed suitable for comparison with 2-methyl-1,3-propanediol. In particular, this pair of propylene glycol based resin syntheses underscores the processing difficulty inherent in propylene glycol.

A clear difference between apparent rate of polyesterifications appeared with these resin systems (*Figure* 3). As expected, both 2-methyl-1,3-propanediol and neopentyl glycol demonstrate a higher rate than propylene glycol. However, 2-methyl-1,3-propanediol also displays a higher polyesterification rate when compared to neopentyl glycol. This difference in apparent polyesterification rates is attributed to the greater steric crowding of the neopentyl glycol molecule.

The GPC chromatograms are reproduced in *Figure* 4. Number average molecular weight (M_N) and the polydispersity (weight average molecular weight, M_W divided by number average molecular weight) are included in *Table* 2. Both PE-100 and PE-200 show normal molecular weight distributions with a tail at the low molecular weight end. The PE-500 resin not only has a lower molecular weight—because of the synthesis strategy—but it also has a significant low molecular weight peak. This peak is attributed to the relatively slow reactivity of the secondary hydroxyl of propylene glycol and a concurrent sluggishness for very low molecular weight oligomers to build into larger oligomer units.

The glass transition temperatures of the resins were determined because of the anticipated effect that oligomer T_g has upon the empirical properties of the melamine cured film.[10] The T_g for the respective resins are reported in *Table* 2. In spite of the similarities in the diol constituents, 2-methyl-1,3-propanediol yields a resin with a T_g which is approximately 10° below that of PE-100. Because the molecular weights and molecular weight distributions of PE-100 and PE-200 are approximately the same, known molecular weight effects upon T_g[11] cannot be causing the differences. Therefore, the differences in the T_g indicate a greater degree of chain flexibility and mobility on the part of the less sterically hindered 2-methyl-1,3-propanediol based polyester.[12] This enhanced flexibility would be expected to lead to potentially lower viscosity and softer, more flexible coatings.

The T_g of PE-500 is about the same as PE-100 and considerably higher than PE-200. Because the molecular weight of the PE-500 resin is lower than the other two, a direct assessment of relative chain flexibility cannot be wholly accurate. However, it can be argued that because decreasing molecular weight depresses T_g, the lower molecular weight PE-500 must have less internal mobility and less chain flexibility than PE-200.

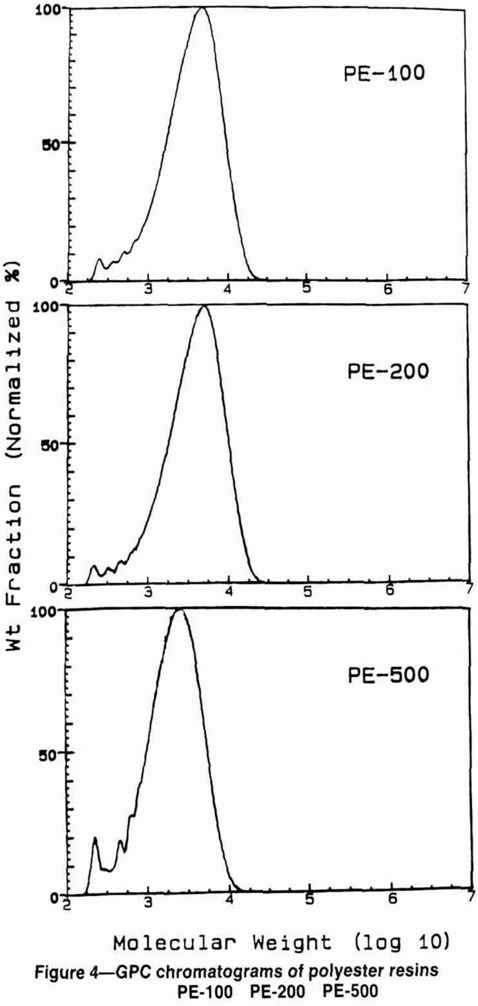

Figure 4—GPC chromatograms of polyester resins PE-100 PE-200 PE-500

Table 3—Coil Enamels for Diol Comparisons

	CC-PE-100	CC-PE-200	CC-PE-500
Components[a]			
Resin solution	471.8	468.0	415.9
Titanium dioxide[b]	338.7	338.4	322.6
Melamine[c]	32.3	34.0	49.8
Propylene glycol methyl ether acetate[d]	150.2	152.6	153.5
Flow additive[e]	0.3	0.3	0.6
Catalyst[f]	6.7	6.7	6.5
High flash aromatic[g]	—	—	51.2
Enamel Constants			
Pigment/binder	1/1	1/1	1/1
Grams melamine/eq OH	225	225	225
Viscosity, Zahn #4	22	21	9
Nonvolatile material (wt %)	67	68	65

(a) Pigment ground to + 7.5 Hegman with 75% of resin solution.
(b) Titanox® 2090, NL Industries.
(c) Cymel® 303, American Cyanamid.
(d) Arcosolv® PMAcetate, ARCO Chemical Company.
(e) Fluorad® FC-430, 3M Corporation.
(f) 25% pTSA in isopropanol.
(g) Aromatic® 150, Exxon Corporation.

Table 4—Comparative Enamel Performance[a] Effect of Diol Component in Polyester Binder

	CC-PE-100	CC-PE-200	CC-PE-500
Cure cycle (°C/sec)	245/75	245/75	245/75
Peak metal temperature	195°C	195°C	195°C
Pencil hardness	3H	3H	5H
Sward hardness	40	14	44
Gloss 60°/20°	94/82	89/80	97/80
T-bend	O-T	O-T	2-T
Post T-bend dry heat (30 min, 200°F)	Passes	Passes	Fails
Post T-bend water submersion (min passed 190-200°F)	2 min	2 min	<1 min
Impact, direct	160	160	160
reverse	160	160	160
Overbake resistance			
Cure cycle (°C/sec)	245/200	245/200	245/200
Gloss retention, 60°/20°	99%/94%	100%/96%	98%/94%
T-bend	OT	OT	4-T
Impact, reverse	160	160	120

(a) On 3 in. × 6 in. Bonderite® 1000 treated cold-rolled steel.

Enamel Formulations and Performance

Table 3 lists the enamel formulations generated with the previously described resin systems. The 100, 200, and 500 nomenclature refers back to the respective resin systems. The performance characteristics of these coil enamels are listed in *Table* 4.

Propylene glycol of Resin PE-500 clearly leads to a harder, less flexible coating than both the neopentyl glycol based system and the 2-methyl-1,3-propanediol based system. This is possibly attributed to the greater stiffness of the PE-500 polyester (as suggested by T_g data for the neat resin).

Interestingly, the only significant difference between the 2-methyl-1,3-propanediol based product and the neopentyl glycol based system is in the Sward hardness results. Although 2-methyl-1,3-propanediol yields a hard film as measured by pencil hardness, the film apparently possesses a significant level of flexibility and elasticity because of its ability to dampen the oscillations of the Sward rocker hardness test device.

The stain resistance of these resins was also investigated and the results are collected in *Table* 5. All possess moderate stain resistance characteristics, but it is interesting to note that in spite of the lower surface hardness of CC-PE-200, as measured by the Sward technique, this 2-methyl-1,3-propanediol based resin system demonstrates stain resistance which is roughly equivalent to the neopentyl glycol based system (CC-PE-100).

EXPERIMENTAL RESULTS—VARYING DIACID COMPOSITIONS

Resin Syntheses

Polyesters with varying isophthalic acid to adipic acid ratios were synthesized and the compositions are reported in *Table* 6. These resins were chosen primarily out of simplicity in order to emphasize the effect of 2-methyl-1,3-propanediol upon properties.

The basic properties including T_g and GPC molecular weight results are also included in *Table* 6. The GPC chromatograms indicate normal molecular weight distributions with a small, low molecular tail as was found for PE-100 and PE-200. The T_g of the resins increases with increasing isophthalic content as would be expected. Higher isophthalic content should reduce chain flexibility and internal mobility and therefore increase the T_g.

A critically important parameter for polyesters for coatings application is the shelf life in a particular solvent. Polyesters, particularly high aromatic content polyesters, are notoriously prone to crystallize from a solvent some time after being synthesized.[13] The resins in this series, with the exception of PE-2200, did not show this tendency. All showed no signs of crystallizing after six months storage in the indicated solvent system. After 12 months, only PE-2200 had some haziness and crystal formation.

In contrast, a neopentyl glycol polyester with 72 mol % isophthalic and 28 mol % adipic—as in PE-2172—was

Table 5—Stain Resistance of Enamels Effect of Diol Constituent in Binder

Diol Component	CC-PE-100 Neopentyl	CC-PE-200 Methyl Propane	CC-PE-500 Propylene Glycol
Stains[a]			
Lipstick	10	10	10
Ketchup	10	9	10
Mustard	6	6	8
Shoe polish	6	6	6
Iodine	0	0	0

(a) Covered spot, 24 hr, relative scale of 0 to 10, 10 = no stain, 0 = complete degradation.

Table 6—2-Methyl-1,3-Propanediol Based Polyester Resin Systems: Varying Isophthalic/Adipic Ratios

	Resin Codes					
	PE-2150	**PE-2172**	**PE-2182**	**PE-2186**	**PE-2192**	**PE-2200**
Components[a]						
2-Methyl-1,3-propanediol	376.9	370.9	367.8	366.7	364.7	362.9
Isophthalic acid	331.5	469.3	532.3	554.2	590.2	637.1
Adipic acid	291.6	159.8	99.9	79.1	45.1	0
Mol % isophthalic	50	72	82	86	92	100
Properties						
Acid number (mg KOH/g)	4.2	5.2	4	6.5	4.6	7.8
Hydroxyl number (mg KOH/g)	27	25	25	23	20	28
NVM (wt %, det.)[b]	64	65	63	62	63	66
Color, Gardner	<1	<1	<1	<1	<1	<1
Viscosity, Gardner-Holdt	Z3	Z3	Z3	Z4	Z5	Z5
T_g (neat)	N.A.	−3°C	8°C	13°C	23°C	32°C
Number average mol wt	N.A.	2870	2920	3230	3660	2410
Polydispersity (Mw/Mn)	N.A.	2.03	2.06	2.08	2.14	1.96

(a) Polyesterification conditions: 210°C, N_2 purge, partial condenser set at 105°C, 0.10 wt % FASCAT 4100 in charge.
(b) Volatile material is 3/1 Aromatic 150 Propylene Glycol Methyl Ether Acetate.

made and dissolved in the same solvent system. Within one week, the entire resin system crystallized to form a solid plug with solvent dispersed in it.

The lack of crystallinity of the 2-methyl-1,3-propanediol based polyesters is not unknown. The polyester of terephthalic acid and 2-methyl-1,3-propanediol has been reported to be noncrystalline.[12] The combination of having an odd number of carbon atoms between the oxygen atoms and the unsymmetrical substitution on the three carbon chain contribute to inhibit close packing arrangements which are necessary for polyester crystallization.[12]

Comparative rate data for the polyesterifications of three of the resin systems reported in *Table* 6 are graphically displayed in *Figure* 5. As anticipated, higher isophthalic acid content yields longer cook times, but in comparison to the data in *Figure* 3, the 2-methyl-1,3-propanediol/high isophthalic systems appear to be commercially attractive.

Enamel Formulations and Performance

Coating enamels were formulated for each of the resins of *Table* 6 and the exact formulations are recorded in *Table* 7. Performance data is collected in *Table* 8.

All films demonstrated +200 MEK double rubs with the exception of CC-PE-2150 which had a MEK double rubs resistance of 100. CC-PE-2150 was an exceedingly soft film. The remaining enamels show excellent performance profiles. As the isophthalic acid content increases, the Sward hardness also increases and the pencil hardness increases slightly. However, the T-Bend flexibility characteristics remain good. Enamel CC-PE-2200 shows some weakness upon post T-Bend stress testing, but the fact that such a high aromatic content polyester yields a film flexible enough to pass a 0-T test is unusual.

An interesting correlation between T_g of the base polyester and Sward hardness of the melamine crosslinked coating appears in this series of resins. In *Table* 9, the T_g of the base resin is compared to the Sward hardness of the final coating. Clearly, as the T_g of the resin rises, so does the Sward hardness of the coating. Apparently, Sward values in the mid 40s appear to be a maximum for these melamine coatings.

The T_g of the films was not determined although in hindsight, this would be a worthwhile determination. In addition, it would be worthwhile to perform dynamic mechanical analysis upon the free films in order to determine the T_g of the film and possibly identify lower order transitions[10,14] that may provide additional insight into the correlation between structure and empirical properties.

The stain resistance of these enamels was also investigated and the results are reported in *Table* 10. As expected, with higher isophthalic acid content and harder coatings associated with the higher isophthalic content, better stain resistance is achieved.

Weatherability and Resistance Properties

QUV WEATHERABILITY—QUV testing is a valuable first approximation for assessing outdoor weatherability

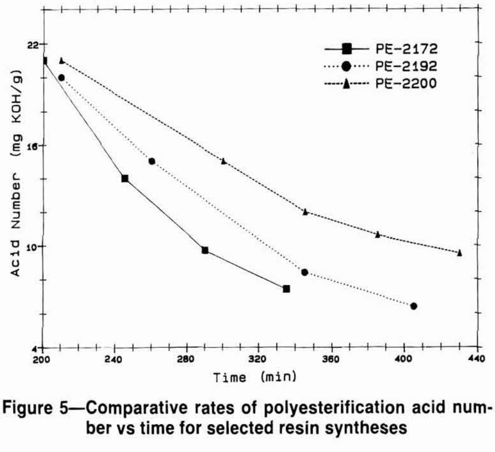

Figure 5—Comparative rates of polyesterification acid number vs time for selected resin syntheses

Table 7—2-Methyl-1,3-Propanediol Based Coil Enamels Relationship of Isophthalic/Adipic Acid Ratio

	Enamel Codes[a]					
	CC-PE-2150	CC-PE-2172	CC-PE-2182	CC-PE-2186	CC-PE-2192	CC-PE-2200
Components[b]						
Resin solution	476.4	473.4	463.0	484.4	471.6	468.3
Titanium dioxide[c]	331.4	337.9	322.9	327.6	322.1	338.0
Melamine[d]	33.3	30.8	32.3	27.3	25.7	34.0
Propylene glycol methyl ether acetate[e]	112.4	150.9	130.5	124.3	130.0	152.3
High flash aromatic[f]	39.3	—	44.1	29.1	43.6	—
Flow additive[g]	0.6	0.3	0.6	0.6	0.6	0.6
Catalyst[h]	6.6	6.7	6.6	6.7	6.4	6.8
Enamel Constants						
Pigment/binder	1/1	1/1	1/1	1/1	1/1	1/1
Grams melamine/eq OH	225	225	225	225	225	225
NVM (wt %, det.)	65	68	65	64	65	66
Viscosity (Zahn #4, sec)	33	43	33	44	55	52

(a) Enamel code corresponds to resin codes of *Table* 6.
(b) Pigment ground to +7.5 Hegman with 75% of resin solution.
(c) Titanox 2090.
(d) Cymel 303.
(e) Arcosolv PM Acetate.
(f) Aromatic 150.
(g) Flourad FC-430.
(h) 25% pTSA in Isopropanol.

characteristics of coatings. The QUV weatherability data determined in accordance with ASTM G-23 are reported in *Table* 11 for all of the coating systems with the exception of CC-PE-2150.

A plot of 60° gloss retention versus time for four of the test resins is provided in *Figure* 6. Neopentyl glycol based resins perform very well in QUV weathering studies. The CC-PE-100 coating shows little change in the 60° gloss after 500 hr but then deteriorates rapidly. CC-PE-200, which is the one for one molar replacement of 2-methyl-1,3-propanediol for neopentyl glycol clearly does not perform as well as CC-PE-100. However, the CC-PE-200 is much better than the propylene glycol analogue, CC-PE-500.

Interestingly, when the diacid component of the polyester resin is changed as is the case for CC-PE-2186, an improvement in QUV weatherability is observed when compared to CC-PE-200. CC-PE-2186 shows very little loss in 60° gloss after 300 hr and then begins deteriorating. The higher aromatic content of the coating is expected to lead to an increase in UV induced decomposition; however, in this series of polyesters the higher aromatic content is providing some protection. A possible explanation for this effect may be that the higher aromatic content

Table 8—2-Methyl-1,3-Propanediol Based Coil Enamel Performance Relationships with Varying Isophthalic/Adipic Ratios

	Enamel Code					
	CC-PE-2150	CC-PE-2172	CC-PE-2182	CC-PE-2186	CC-PE-2192	CC-PE-2000
Performance[a]						
Pencil hardness	B	3H	4H	4H	4H	5H
Sward hardness	0	12	30	48	40	44
Gloss, 60°/20°	74/58	83/74	89/75	85/74	83/69	100/84
Adhesion	5	5	5	5	5	4
T-bend	O-T	O-T	O-T	O-T	O-T	O-T
Post T-bend dry heat (30 min, 200°F)	Fail	Pass	Pass	Pass	Pass	Fail
Post T-bend water subm. (min passed 190°F)	<1	>5	>5	>5	4	1
Impact, direct (in.-lb)	160	160	160	160	160	160
reverse (in.-lb)	160	160	160	160	160	160
Overbake resistance						
Gloss retention, 60°	N.A.	99%	99%	98%	99%	99%
20°	N.A.	95%	96%	93%	95%	96%
T-bend	N.A.	O-T	O-T	O-T	O-T	O-T
Impact, reverse (in.-lb)	N.A.	160	160	160	160	160

(a) On 3 in. × 6 in. Bonderite 1000 treated cold-rolled steel.

Table 9—Comparison of T_g of Polyester Resin and Sward Hardness of Their Melamine Crosslinked Coating

	Resin T_g[a]	Coating Sward[b]
PE-2150	< −20°C	0
PE-2172	−3°C	12
PE-2182	8°C	30
PE-2186	13°C	48
PE-2192	23°C	40
PE-2200	32°C	44

(a) Taken from *Table* 6.
(b) Taken from *Table* 8.

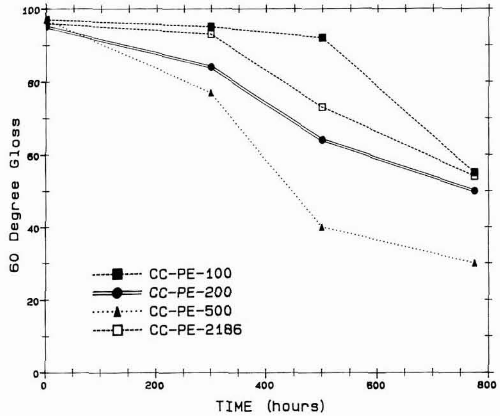

Figure 6—Effect of accelerated weathering upon 60° gloss for selected coatings

Table 10—Stain Resistance of 2-Methyl-1,3-Propanediol Based Enamels Relationship with Isophthalic/Adipic Ratio

	Enamel Code					
Stain	CC-PE-2150	CC-PE-2172	CC-PE-2182	CC-PE-2186	CC-PE-2192	CC-PE-2200
Lipstick	8	10	10	10	10	10
Ketchup	9	9	10	10	10	10
Mustard	6	8	8	10	10	10
Shoe polish	6	6	8	10	10	10
Iodine	0	0	0	0	0	0

(a) Covered spot, 24 hr, relative scale of 0 to 10, 10 = no stain, 0 = complete degradation.

Table 11—Accelerated Weathering Test Results

Accelerated Weathering—ASTM G-23 CC-PE		100	200	500	2172	2182	2186	2192	2200
Gloss 60									
Initial	Units	97	95	97	94	93	96	89	101
300 hr	Units	95	84	77	88	89	93	86	92
500 hr	Units	92	64	40	67	65	73	72	64
775 hr	Units	55	50	30	52	51	54	61	56
Change %		−43.2	−47.4	−69.1	−44.7	−45.2	−43.7	−31.5	−44.5
Gloss 20									
Initial	Units	81	80	74	81	75	84	73	85
300 hr	Units	73	45	37	46	47	73	72	76
500 hr	Units	54	18	3	20	17	24	17	13
775 hr	Units	7	8	2	10	8	10	15	13
Change %		−91.3	−90.0	−97.3	−87.6	−89.3	−88.1	−79.4	−96.5
Chalking[a]		10	10	9	10	10	10	10	9
Color change—ASTM D 2244									
Delta E		1.55	1.02	1.49	1.04	0.86	0.94	1.05	1.43

(a) 0 to 10 scale, 10 = best.

Table 12—Resistance Properties of Test Coatings[a]

CC-PE		100	200	500	2172	2182	2186	2192	2200
Humidity Resistance									
ASTM D 4585	1075 hr								
Blistering		10	10	10	10	10	10	10	10
Rusting		10	10	10	10	10	10	10	10
Detergent Resistance									
ASTM D 2248									
36 hr		10	8F	8F	8F	8F	8F	8F	8F
120 hr		6F	6MD	6M	6M	6M	6M	6M	6F
Overnight recovery		8F	8M	6M	8F	6M	6M	6M	8F
Salt Spray Resistance									
ASTM B117	1075 hr								
Overall	Blistering	4F	4F	4M/4F	4F	6M/6F	6F/6M	6M/6F	6F/8F
	Rusting	9/8	4/6	4/6	8/6	8/6	9	4/6	6
Scoreline	Blistering	4M/2F	2M/4M	4M	2D	2M/D	2D/2F	2D/4MD	6F
	Rusting	6	6/4	6	6/8	6	6	6	6

(a) 0 to 10 scale, 10 = best. F = few, M = medium, D = dense.

inhibits hydrolysis and surface erosion caused by moisture and therefore little surface damage occurs during the first 300 hr.

Water immersion, detergent resistance, and salt spray resistance data are compiled in *Table* 12. All of the test coating systems demonstrate very good hydrolytic resistance as indicated by the water immersion testing. All of the coatings also displayed basically good detergent and salt spray resistance with only minor differences among the coatings.

CONCLUSIONS

The objective of this research has been to elucidate the property/performance characteristics of 2-methyl-1,3-propanediol in order to give polyester resin chemists some concept as to how this new diol can be used in polyester coatings for tomorrow's needs. The dual strategy approach which we adopted—one-to-one diol comparisons and varying diacid composition—has yielded a preliminary performance profile for 2-methyl-1,3-propanediol effects in saturated polyester coatings.

In comparison to neopentyl glycol and propylene glycol in polyester resin syntheses, 2-methyl-1,3-propanediol demonstrates a higher rate of polyesterification and yields polyesters with lower T_g than the comparable neopentyl glycol or propylene glycol based polyesters. The lower T_g of the 2-methyl-1,3-propanediol based polyesters is attributed to a greater degree of internal flexibility and chain mobility. This flexibility is carried through to the final coating and yields softer, more flexible films than comparably synthesized and cured neopentyl glycol and propylene glycol resins.

The variation of diacid composition in the polyester backbone demonstrated that broad variation and polyester redesign is readily achievable with 2-methyl-1,3-propanediol because there is very little tendency for the resulting polyesters to crystallize. Most of the high isophthalic acid content polyesters displayed shelf lives in excess of 12 months. Furthermore, varying the diacid ratio demonstrated that the coating hardness could be readily adjusted to meet specific targets.

The durability characteristics of the 2-methyl-1,3-propanediol based polyester coatings proved to be very good. QUV weatherability data suggest that this diol will be superior to propylene glycol but somewhat less weatherable than identically formulated neopentyl glycol based resins. Interestingly, the QUV results suggest that high isophthalic content polyesters with 2-methyl-1,3-propanediol will exhibit good weatherability. Broad changes in isophthalic content does not appear to make significant changes in humidity, detergent, and salt spray resistance.

ACKNOWLEDGMENTS

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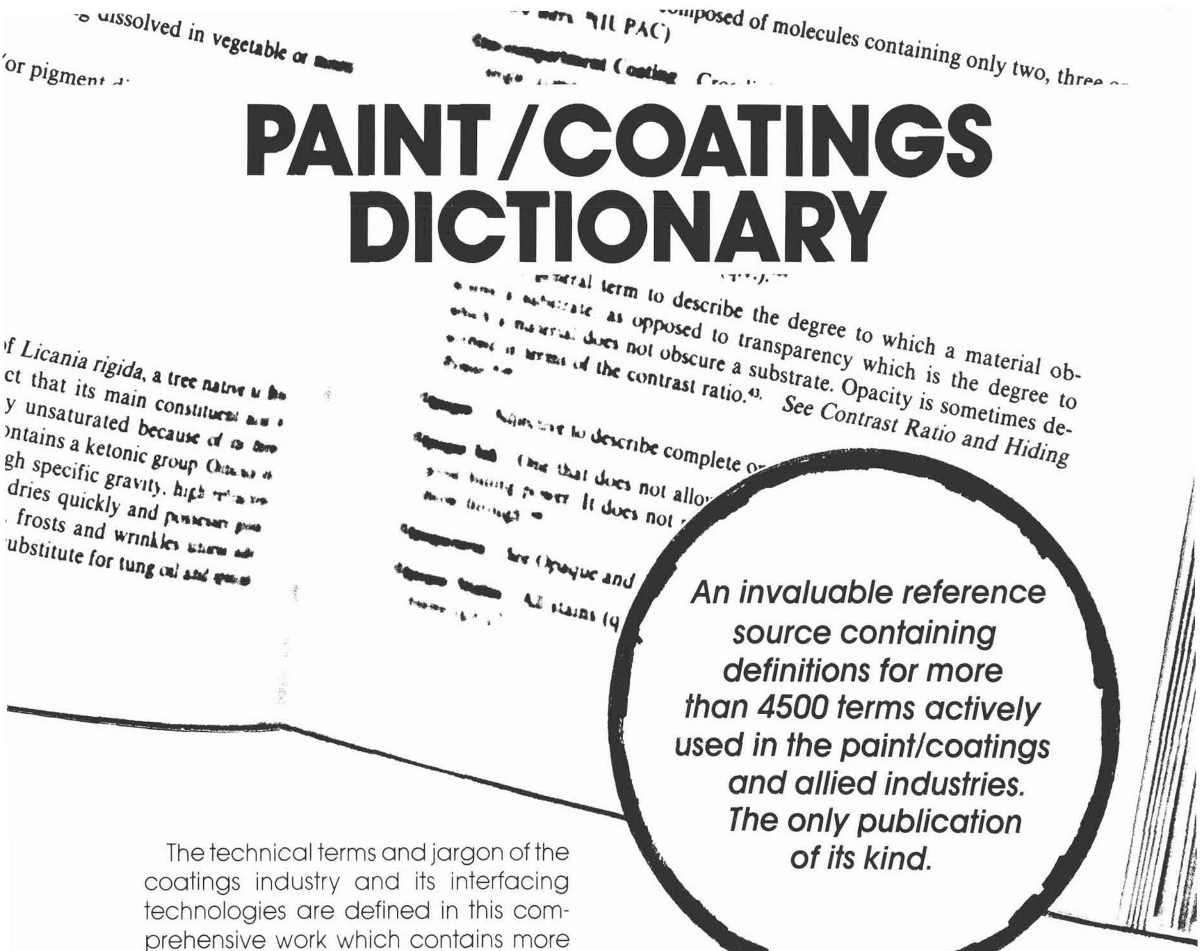

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Development of New Additives to Improve Scratch Resistance and Impart Slip To Solvent-Based Coatings Systems

Ferdinand Fink, Wernfried Heilen, Roland Berger and Jay Adams
Tego Chemie Service USA*

This paper introduces the concept of slip and mar resistance, and characterizes several types of commonly used silicone-based additives. Tests for evaluating slip resistance and metal-marking are described. The relationship between surface slip properties and scratch resistance is discussed. Relative efficacy among classes of silicone-based additives is evaluated. Two parameters affecting additive performance—molecular weight of the siloxane block and degree of organo modification are investigated. Results of this investigation are presented. A direct correlation between additive chemistry and efficacy is demonstrated.

INTRODUCTION

Coatings systems are very susceptible to damage when in contact with solid objects. They can be easily damaged, especially after drying, when the paint film has not yet cured and in the case of baking enamels, when the cured films have not yet cooled. Visual appearance is extremely important for coatings used on consumer goods, from automobiles to appliances to packaging. There are also technical reasons for protecting coatings from damage: Scratches are discontinuities where air-borne contaminants and corrosive agents can become attached, starting the chain of adsorption into the film which can lead to the formation of corrosion cells.

Today, a variety of additives which impart slip properties to coatings are available on the market. The principle underlying mar and slip additives is simple: A hard object touching the paint film containing the additive can be deflected due to the surface lubricity of the additive. A greater apparent film hardness is the result. This paper focuses on the class of slip additives based on silicone chemistry.

SLIP ADDITIVES USE

Silicone-based mar and slip additives are used in applications ranging from automotive coatings, where they protect the not fully hardened freshly applied enamels, to can coatings, where protection for the coating during filling and distribution is provided, to furniture finishes and packaging inks.

PHYSICAL BASIS OF SCRATCH RESISTANCE AND SURFACE SLIP

In everyday language, a scratch is the first visible sign of damage. It takes the form of a line or an irreversible deformation of a surface.[1] An essential distinction is made between two typical types of scratches which can be observed under the microscope. The first type is characterized by a groove or furrow, with irregular pieces being thrown up along the scratch line. This kind of scratch is typical of particularly hard and brittle surfaces. The second type shows "walls" thrown up at both sides of the scratch. This type is characteristic of soft, plastic-like surfaces.

Scratch resistance is a quality which cannot be defined exactly in the physical sense. The quality "scratch resistance" is dependent on wear and tear (abrasion) insofar as scratches are localized whereas abrasion is a global phenomenon. Likewise, scratch resistance is independent of hardness, as some elastomers are also scratch resis-

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Presented by Mr. Adams at the 67th Annual Meeting of the Federation of Societies for Coatings Technology, in New Orleans, LA, on November 8, 1989.

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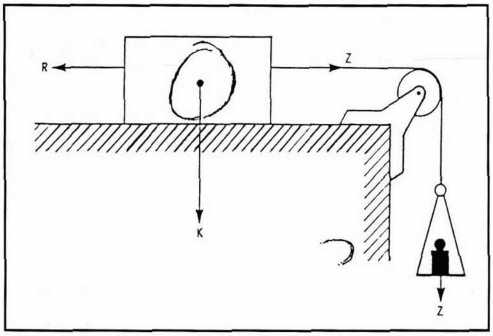


Figure 1—Measurement of friction, where R = frictional force, K = load and Z = tensile force

tant.[2] The fact that an additive migrating to a paint surface during drying can increase the scratch resistance of the coating indicates that scratch resistance is not a function of coating hardness.

Mar resistance not only implies scratch resistance, but also resistance to contamination, such as metal marking.[3] Common subjective tests for mar resistance might include coin rubbing (to evaluate metal marking), fingernail rubbing (where differences between instruments can be extreme), and wood deformation (a common test for hot-hardness). Even the pencil hardness test is a good mar resistance test, since the relative amount of graphite deposited on a surface, even if the surface were not deformed, provides an indication of relative resistance to contamination by rubbing. ASTM Standard D 3363 (Film Hardness by Pencil Test) cautions the technician to beware of compounds that tend to lubricate the film.[4]

Slip is the relative movement between two bodies in contact. If an object is moved along a surface, a resistance will occur, acting in a direction opposite the movement. This resisting force is also called frictional force, and is illustrated in *Figure* 1.

To set a static body in motion, the static friction must first be overcome. Once the slip movement has begun, the frictional resistance decreases slightly and becomes the slip resistance. Friction is the result of the unevenness of the two surfaces in contact, as shown in *Figure* 2.

Even surfaces which are considered absolutely flat show a certain degree of unevenness when viewed under the microscope. If surfaces of different hardness move against one another, the harder surfaces may break down the uneven or protruding surface irregularities of the softer surface, resulting in abrasion or scratching.

To reduce friction, surfaces must either be polished, or a lubricating film may be placed between the two surfaces. Friction between two surfaces can be seen, therefore, to consist of solid friction, fluid or viscous friction, and a combination of both solid and fluid friction. The relationship between the types of friction was worked out by Striebeck.[5] *Figure* 3 gives a schematic view of a friction curve, showing the change in the value of the coefficient of friction (μ) in relation to the sliding velocity of lubricated bearings. Immediately after the starting point, the Striebeck curve illustrates dry friction, which is the overcoming of static friction. Mixed fluid and static friction follow, until a minima is reached. Moving to the right along the curve, the effect of fluid friction, or the area where the lubricating film does not allow the two surfaces to touch, can be seen. The pressure of the lubricating film in this area is higher than the pressure the two surfaces exert on one another. In the literature, the term lubrication[6] has been adopted to describe a phase in which a sufficiently stable fluid film has formed on the surface to prevent dry friction, but in which no measurable dynamic fluid pressure has yet formed. In the Striebeck curve, this phase is the area where motion begins. Boundary-type lubrication plays an important role when, for example, waxes are used as lubricating agents which melt due to friction generated, increasing the fluid thickness, thus raising the dynamic pressure.

The relationship of friction, applied force (load), and yield point can be summarized by the following equations:

$$k = F\omega \cdot \sigma$$

where

k = load used
$F\omega$ = actual contact surface area
σ = yield point of the substrate.

Due to the high specific load at the contact points, the surfaces may either bond or adhere at these points. If the surfaces are rubbed against one another, the existing points of contact shear off. The required force is:

$$R = F\omega \cdot T$$

where

R = frictional force
$F\omega$ = actual contact surface area
T = shear strength of the adhering points.

Combining the two equations gives:

$$\frac{\text{Frictional Force}}{\text{load}} = \frac{R}{k} = \frac{R}{F \cdot \sigma} = \frac{F\omega \cdot T}{F\omega \cdot \sigma} = \frac{T}{\sigma}$$

or

$$\mu = \frac{\text{shear strength of the points of adhesion}}{\text{Yield Point}}$$

Although this relationship does not have any quantitative value, it gives a qualitative indication of the order of damage to a paint film.

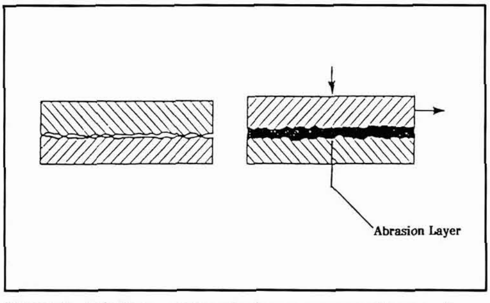


Figure 2—Friction as a result of unevenness of two surfaces in contact

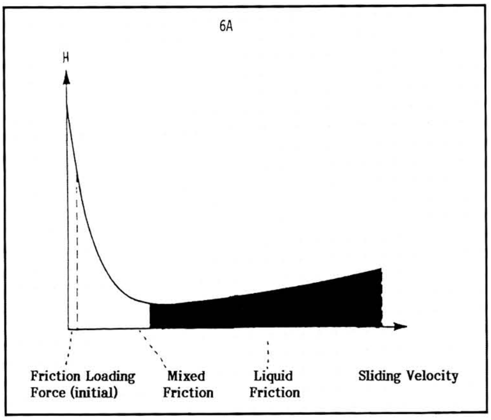


Figure 3—Striebeck curve

The yield point of a coating layer is determined by its formulation. Shear strength is determined by the properties of the binder. The only way to reduce the coefficient of friction is to reduce the number of points of adhesion. This can be achieved by covering the film surface with a very thin layer of a substance which prevents bonding. This technique is also applicable to the lubrication of bearings. Apart from release effects, fluid at the film surface must achieve a certain degree of lubrication. In practical applications, it is impossible to apply a lubricating film to the finished coating layer. However, a suitable product might be incorporated during production. This product must be either surface active, or must reach the surface during the drying process. Surface active substances have the advantage of improved wet-surface leveling characteristics, which further reduces the number of possible adhesion points.

REQUIREMENTS ADDITIVES MUST FULFILL

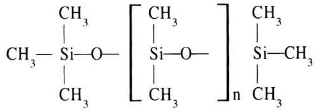
Apart from the surface hardness of the coating system, which is formulation dependent, the coefficient of friction between the coating layer and the abrasive object is the determining factor in predicting scratch resistance. This is where the manufacturer of scratch-resisting additives invests efforts to optimize products. A functional additive needs to migrate to the film surface during the drying process, forming a film which not only adheres to the coating, but also favorably influences its flow and leveling properties. In addition, this film must have lubricating qualities, expressed as the ability to carry a load in a very thin layer.

Improving the scratch resistance of a coating should not diminish its technical qualities, in particular its recoatability. Compounds based on silicone chemistry have been used for this purpose since their first introduction to the market more than 30 years ago. The balance of this paper describes several types of silicone-based compounds currently in use, and attempts to correlate structure to performance, by means of a variety of tests, which shall be discussed in detail.

CHEMISTRY OF THE MOST COMMONLY USED SILICONE-BASED SLIP ADDITIVES

Polydimethylsiloxanes

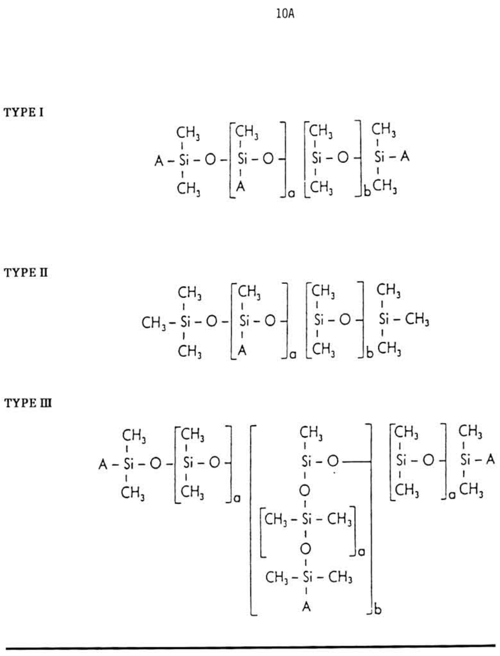
Polydimethylsiloxanes are linear polymeric polysiloxane compounds in liquid form, having the following structure:



$$CH_3-\overset{CH_3}{\underset{CH_3}{Si}}-O-\left[\overset{CH_3}{\underset{CH_3}{Si}}-O-\right]_n\overset{CH_3}{\underset{CH_3}{Si}}-CH_3$$

In addition to their very high surface activity, they are soluble in a variety of commonly available solvents used in coatings formulation. Their first use in the marketplace was as flow and leveling agents. Polydimethylsiloxanes having a bimodal, or even a broad molecular weight distribution, were favored. The leveling effect was due to the low surface tension supplied by the low molecular weight portions.

The higher molecular weight portions gave only moderate slip. These higher molecular weight portions also exhibited limited compatibility with a variety of coatings, causing surface defects such as cratering, fish eyes, and loss of intercoat adhesion. This tendency to cause as many problems as the additives attempted to solve is still remembered by many paint experts as the "silicone curse." Since the 1960s, silicone oils (the higher molecular weight polydimethylsiloxanes) have been modified to



Scheme 1—A = –Z C_2H_4O—n C_3H_6O—m, with R = hydrogen, alkyl, acyl, Z = bivalent group

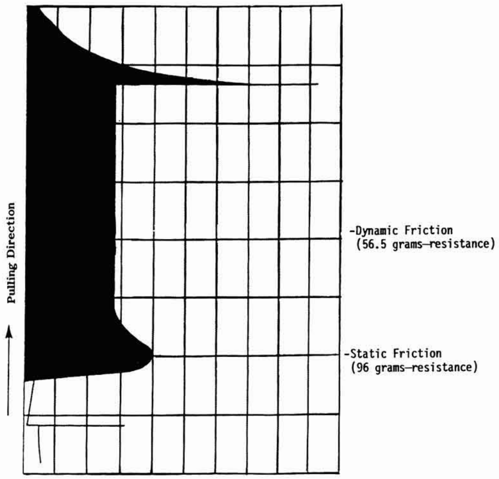


Figure 4—Friction curve of a slip additive

increase their compatibility with a wider variety of coatings, and to reduce undesirable side effects.

Modified Polydimethylsiloxanes

The silicone oils previously described are primarily linear compounds, which may also contain a small percentage of cyclic dimethylsiloxanes, resulting from the production process. The possible variety of organo-silicone compounds resulting from polydimethylsiloxane modification is significantly greater than that of pure silicone oils. Typical varieties of compounds resulting from modification are the linear Types I and II and the branched Typed III illustrated in *Scheme* 1.

The A groups in the illustrated structures can be either the same or different. They can exhibit either polar or nonpolar characteristics. By carefully selecting the appropriate modifying groups A and the groups' statistical ratio to the siloxane backbone of the molecule, additives imparting desirable properties in coatings can be produced. In this way, surface activity, slip properties, and degree of film compatibility (control of surface defects) can be influenced by polymer manipulation.

Although the illustrated structural formulas form only a small part of the possible spectrum of possibilities, they exhibit the specific characteristics of the majority of siloxane-based compounds used as slip additives.

Polyoxyalkylenesiloxane Copolymers (Polysiloxane/Polyether Block Copolymers)

The most commonly used group of siloxane-based compounds finding application as slip additives is comb-like or branched structures where the illustrated modification **A** is a polyoxyalkylene group. Bonding to the siloxane backbone is achieved by means of an oxygen bridge or a bivalent alkylene radical. Most of the compounds of this class contain polyether blocks in which oxyethylene and oxypropylene groups are statistically distributed. The mass ratio between the siloxane block and the polyether blocks, as well as the structure of the polyether blocks, are primarily responsible for determining the application properties of the slip additive.

Table 1—Average Value and Standard Deviations of Several Measurements of the Sliding Friction of Paint Surfaces

	Average Value (20 Measurements) Grams-Resistance	Standard Deviation (Grams-Resistance, STD)
Coating without additive . .	248	±34, 13.7%
Coating with Additive 1 . .	96	± 5, 5.2%
Coating with Additive 2 . .	56	± 3, 5.4%
Coating with Additive 3 . .	84	± 5, 5.9%

Polyoxyalkylene Methylalkylsiloxane Copolymers

If polyether groups, as well as long chain alkyl groups, are incorporated in the comb-like polymers of Type II or in the branched polymers of Type III, the resultant slip additives show an improved compatibility with organic binders. Their effect on slip properties is not as pronounced as the polysiloxane polyether block copolymers described previously, however. This can be partly explained by the fact that they cause a lower surface tension reduction in organic systems than the compounds containing only methyl and polyether groups.

Other Modifications

In addition to the modifying groups described, slip compounds consisting of polydimethylsiloxanes modified with esters and aryl-substituted alkyl groups are commercially available. Ester modification appears to improve recoatability, making the additives suitable for use in primers or midcoats.

MEASUREMENT OF SLIP PROPERTIES

At this writing, there is no standard method available for measuring the slip properties of coating films. Therefore, our tests were carried out primarily in accordance with DIN 53375, which is used to determine the frictional behavior of plastic foils. According to this standard, two foils in contact with each other are equally held on a defined surface with a certain weight. Both surfaces are moved against one another. The resulting opposing force is then measured.

In our tests, a metal object of a given weight and surface area is coated on the contact side with commercially available velvet-like material backed with a self-adhesive film. By means of a wire, this weight is connected with a dynamometer. A panel coated with the test coating is fastened to a measuring platform. During the execution of the test, the measuring platform is moved away from the dynamometer at a constant speed. When the test panel starts to move under the applied weight, the force indicated is equivalent to (and subsequently greater than) the static friction. If the test platform is moved further, the counter-force levels out to a lower value corresponding to the sliding friction. The weight used in

Table 2—Average Value and Standard Deviations of Several Measurements of the Sliding Angle of Paint Surfaces

	Slip Value (grams-resistance) and Std. Deviation	Slip Angle	Coefficient of Sliding Friction and Std. Deviation
Paint without additive...	248 ± 13.7%	24 ± 3°	0.445 ± 13.9%
Paint with Additive 1 ...	96 ± 5.2%	12 ± 3°	0.223 ± 21.2%
Paint with Additive 2 ...	56 ± 5.4%	9 ± 2°	0.158 ± 23.1%
Paint with Additive 3 ...	84 ± 5.9%	11 ± 3°	0.194 ± 28.3%

our tests is 500 grams, with a load-bearing surface of 10 cm^2. Four speeds can be selected (between 6.4 and 25.6 mm/sec).

Figure 4 illustrates a typical graph of a sliding curve for coatings containing a slip additive. As a standard value, the counter-force (in terms of grams-resistance) which corresponds to the sliding friction can be taken. The measuring accuracy was obtained with a standard deviation of ± 6% in a series of 20 tests. Consequently, those values at either end of the scale varying from each other by 12% are significantly different, whereas those varying from each other by approximately 18% show highly significant differences (refer to *Table* 1). The variation in the measured values for films not containing slip additives is, however, considerably greater.

Another method[7] for measuring slip properties of an even surface is by direct measurement of the coefficient of friction. To do this, a panel coated with the coating to be measured is placed on a plate which can be lifted from one side. A weight similar to that described is placed on the high end of the panel. The weight-loaded side of the panel is then lifted at a constant velocity and the angle between panel and surface at which the weight starts to slide is measured. The coefficient of friction is obtained from the equation:

$$\mu = \tan \theta$$

where

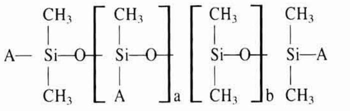
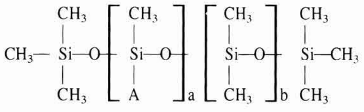
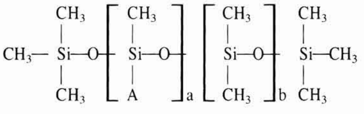
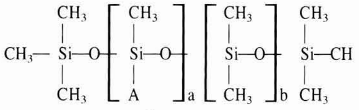
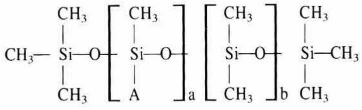
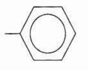
θ corresponds to the angle at which the weight slides consistently.

This is the basis for ASTM Test Method D 4518. We have also carried out comparative measurements according to this method. However, reproducibility of measured values is much worse than the reproducibility of the values in the first method. This appears to be due to the particularly small angles involved, making accurate reading of the scale a problem. Test results are shown in *Table* 2.

Evaluation of Intercoat Adhesion in Laminated Coating Films Containing a Slip Additive

One of the preconditions for the effectiveness of a slip additive is its surface activity. It is through surface activity that the additive migrates to the surface of the coating, forming a low energy film which serves to reduce friction. It is, however, relatively difficult to wet low energy

Table 3—Structures of Tested Additives

	Structure	Modification	Siloxane Content
Additive 1	 $A-\mathrm{Si}(CH_3)_2-O-[\mathrm{Si}(CH_3)(A)-O]_a-[\mathrm{Si}(CH_3)_2-O]_b-\mathrm{Si}(CH_3)_2-A$	$A \rightarrow -Z-O-[C_2H_4O]_n[C_3H_6O]_mR$ $Z \rightarrow -C_3H_6-$	Medium
Additive 2	 $CH_3-\mathrm{Si}(CH_3)_2-O-[\mathrm{Si}(CH_3)(A)-O]_a-[\mathrm{Si}(CH_3)_2-O]_b-\mathrm{Si}(CH_3)_2-CH_3$	$A \rightarrow -Z-O-[C_2H_4O]_n[C_3H_6O]_mR$ $Z \rightarrow -C_3H_6-$	Low
Additive 3	 $CH_3-\mathrm{Si}(CH_3)_2-O-[\mathrm{Si}(CH_3)(A)-O]_a-[\mathrm{Si}(CH_3)_2-O]_b-\mathrm{Si}(CH_3)_2-CH_3$	$A \rightarrow -Z-O-[C_2H_4O]_n[C_3H_6O]_mR$ and $-C_nH_{2n+1}$ $b = 0$ $Z \rightarrow -C_3H_6-$	Medium
Additive 4	 $CH_3-\mathrm{Si}(CH_3)_2-O-[\mathrm{Si}(CH_3)(A)-O]_a-[\mathrm{Si}(CH_3)_2-O]_b-\mathrm{Si}(CH_3)_2-CH$	$A \rightarrow -Z-O-[C_2H_4O]_n[C_3H_6O]_mR$ $Z \rightarrow -C_3H_6-$	Medium
Additive 5	 $CH_3-\mathrm{Si}(CH_3)_2-O-[\mathrm{Si}(CH_3)(A)-O]_a-[\mathrm{Si}(CH_3)_2-O]_b-\mathrm{Si}(CH_3)_2-CH_3$	$A \rightarrow -C_nH_{2n}-$ 	High

surfaces. It is also more difficult to recoat them. In addition, the intercoat adhesion of coatings containing slip additives is not always good. Adhesion of an intermediate layer is, however, not only determined by the surface tension of the two surfaces in contact, but also is strongly dependent on the interaction between basecoat and topcoat. Every paint technician knows from personal experience that silicones are compounds having a particular tendency to produce disturbances of adhesion. It is also known that simple methods, such as the cross hatch adhesion test, give an indication as to the quality of intercoat adhesion. A quantitative measurement of the adhesive force, however, cannot be obtained by these methods. In this case, the peel-off method seems to be more suitable for the chemist to evaluate intercoat adhesion. These caveats aside, in this study we have restricted ourselves to showing the cross hatch values, as these give sufficient information for practical applications.

To give a clearer focus to our work, we present results obtained using the above-mentioned test methods. We are aware that a number of other, very interesting test methods to determine scratch resistance and intercoat adhesion are achieving acceptance in the coatings industry.

EXPERIMENTAL

Review of Experimental Procedures

Standard formulations representative of specific applications were chosen to evaluate the slip properties of additives. In the following examples where only slip values were measured, we coated aluminum panels with the test paint, using a doctor blade. Slip values (expressed in grams-resistance) were measured after 24-hr conditioning at room temperature. In the case of baking systems, paints were cured using normal curing schedules, after allowing time for solvent flash-off.

Evaluation of intercoat adhesion required a more involved procedure. Phosphated panels were coated with paint containing test additive and were cured. Subsequently, this layer was baked for 30 min at 150°. A second coat of paint without additive was then applied and cured as previously described. To more exactly measure the degree of intercoat adhesion, this second coating was pigmented differently than the first coat.

Cross hatch test evaluations using differently pigmented coatings show very clearly that intercoat adhesion fractures between the interfaces occur. Correlation of the measured intercoat adhesion value with the tested additive versus a control (no additive) can be determined if neither differently pigmented layer contains a slip additive. In no case were the baking coatings exposed to overbake conditions.

Test Results

It is rather difficult to correlate differences in effectiveness of the various additives with their specific chemical modifications. This is, however, necessary, if more than a superficial judgement is to be made. We have already learned from the description of common silicone additives that they can show considerable differences both in their overall structure and in the nature and percentage of their modifying groups. If a conclusion is to be reached,

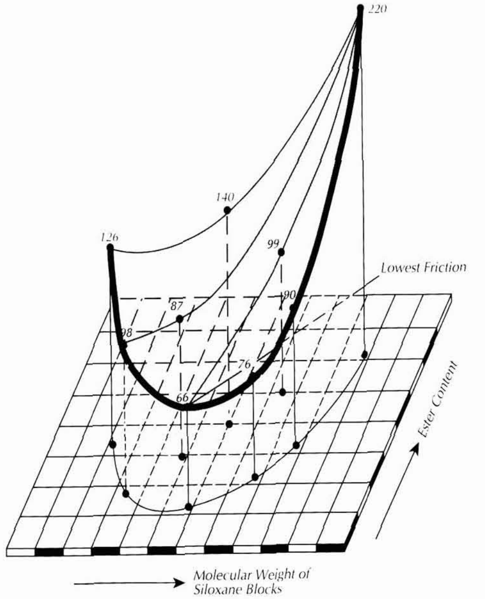


Figure 5—Optimization of ester modified siloxane showing effect of constituents on friction levels

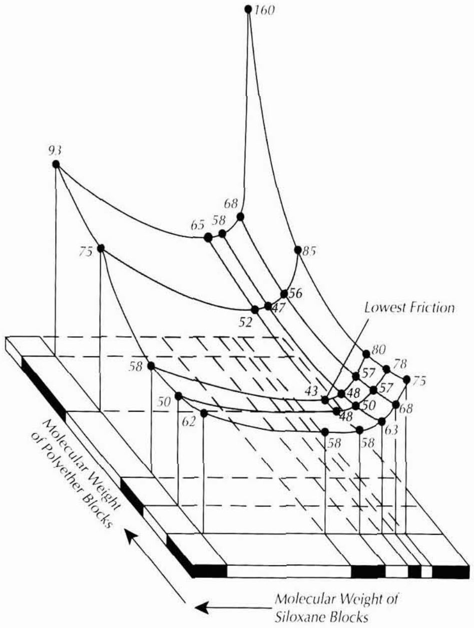


Figure 6—Optimization of slip properties of polyether modified siloxanes

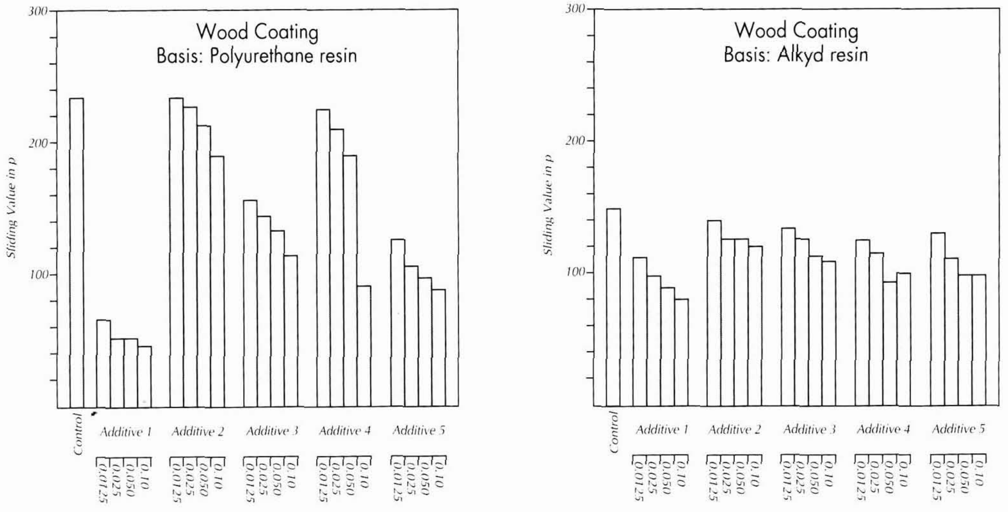


Figure 7—Effect of different slip additives on sliding properties of a wood coating

based on the effects of structural changes responsible for the different application parameters (surface activity, slip, mar resistance), more comprehensive and sophisticated testing would have to be carried out. The scope of this paper is to look at only one typical molecular structure, where the primary criterion is the ability to change one or more parameters. These are, in most cases, structural parameters, such as the ratio of modified to unmodified siloxane groups, type of modification, polarity, molecular weight, etc. Structures of the tested additives are shown in *Table* 3.

This problem can be illustrated by means of two examples. *Figure* 5 shows the results of a test series carried out to optimize ester modified siloxanes. In one investigation, optimum structure of the base siloxane giving good slip properties and system compatibility was determined by varying two parameters: (1) molecular weight of siloxanes having the same structure, and (2) number of ester groups of the same structure as the organo-modification.

These two parameters were varied in different combinations. Optimum values were determined in a polar paint system to which 0.1 weight percent of the respective ester-modified siloxanes to be tested were added. The measured slip values (in grams-resistance) are shown in *Figure* 5. Measured slip values are illustrated by lines originating from the coordinates representing the molecular weight and the degree of ester modification. To facilitate reading of the graph, the tops of the lines have been joined. This three-dimensional graph shows very clearly that the frictional resistance of slip additives of the same type can be minimized by means of selectively varying their structural parameters. Other properties also can be illustrated and evaluated in the same way. A combination of different diagrams may enable a determination of an acceptable compromise of properties.

A second example illustrates a model of the optimization of polyether siloxanes. In preliminary trials, the most suitable structure of the siloxane block and the optimum ratio of ethylene glycol to propylene glycol in the polyether blocks was determined. These results are shown in a two-parameter test series illustrated by *Figure* 6. In this case, the molecular weights of siloxanes having the same structure were varied with the molecular weights of polyethers having the same EO/PO ratio. The minimum value shown (43 grams-resistance) clearly indicates that chemical parameters display a considerable influence on the effectiveness of an additive. Preliminary test results measured efficacy of the additives in a single paint. Subsequent investigations of the polyether siloxanes show that the optimum product from this series should provide equally good slip values (40-55 grams-resistance) in systems containing binders ranging from moderately to strongly polar.

In *Figures* 5 and 6, it becomes obvious that a simple statement that a slip additive is better than another by virtue of structural differences alone is only an interpretation based on a particular test result, and does not provide adequate reasons as to why this may be so. However, we have to make use of certain simple assumptions in order to categorize the different additives and their effects in different coating systems. In addition to structural differences of the additives, we need to consider system polarity and binder critical surface tension.

If a sampling of commercially available siloxane-based additives is tested in different coating systems, the majority of the additives would show very good results in one or more of the systems tested. At the same time, they will be found to be ineffective in other systems. *Figure* 7 illustrates our results with five typical additives used in six representative coating formulations.

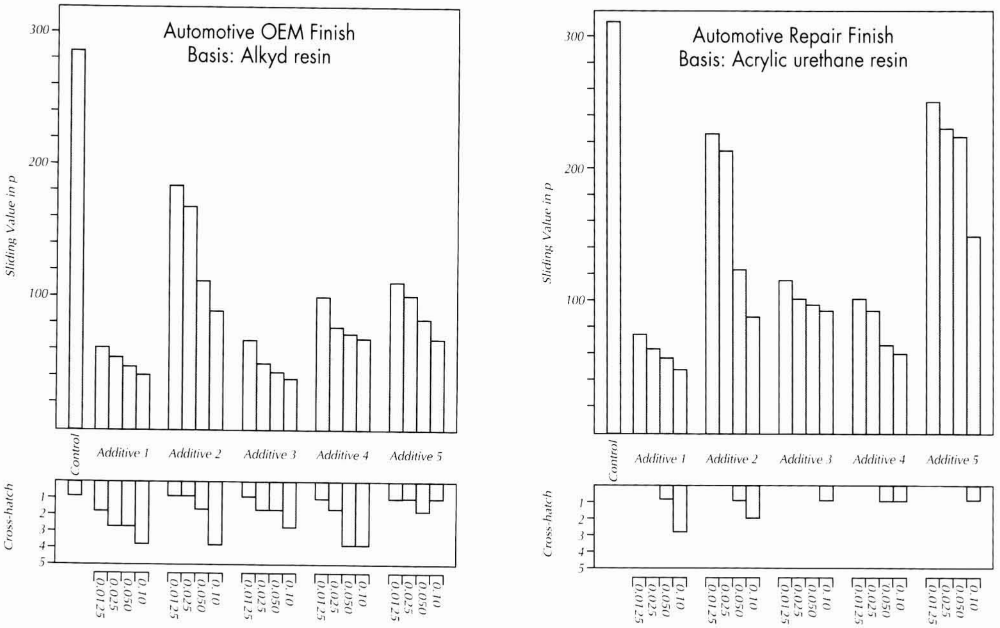


Figure 8—Slip and cross hatch values of additives used in automotive finishes

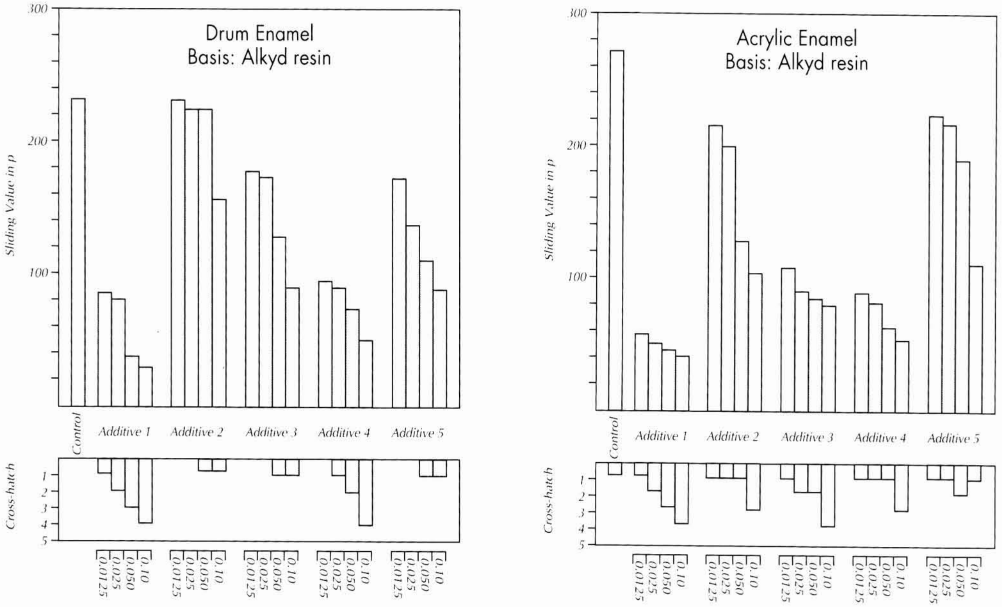


Figure 9—Effects of different slip additives on the sliding properties and intercoat adhesion of a drum enamel and an industrial acrylic enamel

Table 4—Values of 0.05% Additive (Active) in Various Coatings

	Alkyd Drum Paint				Acrylic Enamel				Automotive OEM Finish				Auto Repair Finish				Wood Coating		Alkyd Wood Coating	
	Slip Value	Rating	Cross hatch	Rating	Slip Value	Rating	Cross hatch	Rating	Slip Value	Rating	Cross hatch	Rating	Slip Value	Rating	Cross hatch	Rating	Slip Value	Rating	Slip Value	Rating
Additive 1	38	1	3	3	47	1	3	3	45	1	3	2	56	1	1	2	85	1	56	1
Additive 2	223	5	1	1	123	4	1	1	116	4	2	1	121	4	1	2	130	5	211	5
Additive 3	120	3	1	1	94	3	2	2	47	1	2	1	105	3	0	1	115	4	131	3
Additive 4	77	2	2	2	65	2	1	1	65	2	4	3	72	2	1	2	94	2	187	4
Additive 5	206	4	1	1	123	1	2	2	209	5	2	1	246	5	0	1	100	3	97	2

All of the additives were used in concentrations of between 0.0125% and 0.1%, based on total formulation weight. We based the additive concentration on active matter, to compensate for those additives supplied as solvent cut-backs. In the diagrams, the slip values (in grams-resistance) and also the cross hatch values (with the exception of wood coatings) are shown in relation to the quantities of additives used.

In both *Figures* 8 and 9, slip values as well as cross hatch adhesion values are a function of the additive concentration. Wood coatings based on isocyanate curing systems are considered to be critical in their tendency to accept even small concentration of slip additives without adverse effects. Here, only Additive 1 allows a drastic reduction of the coefficient of friction when used at low concentration. Additives 4 and 5 only show sufficient effectiveness when used in concentrations exceeding 0.05% active matter. When used in nitrocellulose-alkyd paints, all additives tested gave only moderate results, although Additive 1 exhibited a considerably higher slip effect than the other four additives.

In an industrial drum paint, Additive 1 was also the most effective. It became obvious that there was a correlation between slip and intercoat adhesion. As the cross hatch values do not run parallel to the slip values in any of the examples, other influences must be taken into consideration. Further tests will be necessary to obtain a more meaningful correlation. *Figure* 8 shows the effects of different additives on slip properties and intercoat adhesion of automotive paints. In both the automotive original equipment and repair paints, Additive 1 was particularly effective. Intercoat adhesion suffered in the original equipment paint with the use of this additive, however.

A summary of the individual measurements is shown in *Table* 4. Additive 1 appears to have universal applicability. In all of the coatings tests, Additive 1 produced the lowest slip values, with lower concentrations than the other additives. This can be interpreted to mean that less additive can be used to achieve comparable slip effect. Reduced additive concentration can lessen the danger of intercoat adhesion problems. The poor performance of Additive 1 in the automotive original equipment paint indicates the importance of evaluating not only slip properties, but also intercoat adhesion.

Table 5—Metal Marking Test

Additive	Slip Value (gram-loading)	Force to Achieve Metal Marking (grams)
1	48	4000
2	64	3750
3	108	1250
4	160	1000

Metal Marking Test

As mentioned previously, apart from the measurement of slip values, several other methods of a more or less subjective nature are available for evaluating scratch resistance. These methods include the rubbing of a coating surface with a coin, exerting considerable pressure over a very small contact area. As a result, abrasion marks occur. This is known as metal marking.

When the metal object penetrates the upper surface of the coating, the hard pigment particles abrade the softer metal, due to a lack of surface lubricity. If the sliding effect is sufficient, the metal marks are not produced.

We have tried to make this test more objective by using a weight with runners made of soft metal. Construction of the runners allows for a weight load of up to several kilograms. The sliding object is pulled over the paint surface in the same way as described. Under high weight loads, the soft metal runners left their marks on the paint, although in some cases, the marks were difficult to detect with the naked eye. Higher mass loadings did not appear to produce improved results. Therefore, runners consisting of pencil leads, approximately 5 mm wide and 2.5 mm thick, were used. Under pressure, the runners produced a clearly distinguishable graphite abrasion. Measurements were carried out on white pigmented paint films of approximately 3 mils thickness. The runners were fixed below the sled in such a way that the pair was positioned 5 cm apart, with the widest side in contact with the paint film. The object was then pulled over the paint with an initial weight load of 250 grams. If no marks were visible, the procedure was repeated with further weight load increments of 250 grams, until abrasion marks became visible. The weight used to produce visible abrasion marks served as a standard unit. *Table* 5 contains the results of the four different additives evaluated.

Similar results were obtained with a polyester based baking enamel. Although the results have not yet been fully satisfactory, they show the same tendency as the measurement of the slip values: Surfaces with a low slip value show abrasions marks only under high weight loadings. With increasing slip values, the abrasion marks begin to occur under lower loadings. These results indicate that a highly effective lubricating agent drastically reduces the danger of damage to a paint surface.

CONCLUSION

We have illustrated that by measuring slip properties, the scratch resistance of paint films can be evaluated. This conclusion also is supported by the relationship between surface slip and lubricity, as indicated in the work of Striebeck. Although it is difficult to associate optimum slip properties (and also scratch resistance) with the chemical nature of the product, we show that controlled variation of specific parameters can be used to optimize compounds which provide protection against scratches.

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Society Meetings

BALTIMORE .... SEPTEMBER

"Titanium Dioxide"

Calvin C. Tatman, of SCM Chemicals, Inc., gave a presentation on "Titanium Dioxide—Particle Size Control for Designated Performance in Waterborne Coatings Systems."

Mr. Tatman summarized the reasons that new generations of titanium dioxide are needed. He noted that there is an increase in the amount of coatings which are higher volume solids, waterborne or powder coatings. However, the old grades of TiO_2 offer limited optical and performance properties in these newer coatings.

Various surface treatments of the different grades of titanium dioxide were discussed. The speaker explained that inorganic oxides are used to create hardness in enamel grades of TiO_2. Organic compounds are used to provide good wetting and dispersion of the other grades. According to Mr. Tatman, as surface treatment increases, the yellowness of the pigment also increases, while the tint strength, gloss, and hiding power decrease. In aqueous systems, low surface treatment and higher TiO_2 content are desired. Lower surface treatment keeps the particle sizes smaller and dispersant demand is less.

Mr. Tatman stated that the new generation TiO_2 has greater hiding power, excellent gloss retention, and better chalking resistance. This is due to a narrow particle size distribution and special surface treatment.

Mr. Tatman emphasized the need for titanium dioxide manufacturers and coatings producers to work more closely together. He concluded his presentation by maintaining that the best results in coatings will be achieved by controlling pigment particle size.

Jim Smith, *Secretary*

CHICAGO .... SEPTEMBER

"Automating the Manufacturing Process"

Members voted unanimously on the proposition of incorporating the Chicago Society as a nonprofit organization in the state of Illinois.

The evening's technical speaker was Christy Hudson, of Pacific Micro. She spoke on "Automating the Manufacturing Process with Personal Computers."

Elaborating on the use and benefits of personal computers for the coatings and allied industries, Ms. Hudson demonstrated formula analysis costing, inventory control, product labeling and compliance methods for MSDS and SARA. In addition, she showed how to adjust batch sizes to accommodate to the inventory on hand and how to plan purchasing to cover needed adjustments of inventory to make unplanned batches.

In conclusion, Ms. Hudson discussed how specific software systems can be used to provide valuable information for automating the day-to-day changes needed by most coatings manufacturers to improve the speed and accuracy of operations.

Clifford O. Schwahn, *Publicity*

CHICAGO .... OCTOBER

"Stabilization of Anticorrosive Pigments"

The meeting's technical presentation, "Stabilization of Anticorrosive Pigments in Waterborne Styrene Acrylic Coatings," was provided by Albert Gesenhues, of Goodyear Tire & Rubber.

Mr. Gesenhues revealed Goodyear had studied the factors affecting the water and corrosion resistance of waterborne coatings. He stated that the method of stabilization of the anticorrosive pigment and vehicle combination was found to be one of the most important factors in formulating a satisfactory paint.

According to the speaker, pigments that contain some water soluble multivalent cations give the best corrosion resistance, but contribute to paint instability. This is a result of the reaction of the cations with the carboxyl groups in the vehicle that are present to give adhesion to the substrate. Traditionally, stabilization of waterborne primers has been achieved through the use of dispersants and surfactants that affect corrosion resistance.

Mr. Gesenhues presented an alternative method in which the multivalent cations, along with a volatile diamine, gave stability to the paint, while later allowing the cations to be released when the amine evaporated. Thus, corrosion resistance was provided by the inhibition of the substrate.

Since the choice of pigment and amount of amine varies with the type of substrate, a number of formula suggestions were given. The speaker provided a table for assisting the formulator in choosing the best formula for each substrate.

Clifford O. Schwahn, *Publicity*

CDIC .... OCTOBER

"Crystalline Silica"

The technical speaker of the evening was Joseph L. Scaries, of U.S. Silica Company. Mr. Scaries' presentation focused on "Health and Safety Issues, and Benefits of Using Crystalline Silica."

The benefits derived from the use of ground crystalline silica as a functional extender in polymer composites were discussed. According to the speaker, the particle shape and density provide low resin demand, resulting in higher loadings. He stated that these are especially important in today's high solids coatings where crystalline silica fillers can make the difference between meeting or not meeting current VOC limits.

To date, however, crystalline silica and its polymorphs have been identified as hazardous, Mr. Scaries revealed. He explained that the amorphous silicas are perceived as nuisance dusts, except if they contain a percentage of other hazardous ingredients over the amount identified by OSHA to be hazardous. Silica dust is identified as respirable when 10 microns or less in size. A clean working environment, adequate dust collection, and government approved respirators, when necessary, are therefore required when working with respirable crystalline silica.

Mr. Scaries traced the governmental regulations that have had an impact on the use of crystalline silica. He discussed the controversy in both scientific and medical communities over the conclusions of the International Agency for Research on Cancer (IARC) that resulted in listing crystalline silica as a group 2A carcinogen. Based on the current regulations, all producers of

CHRISTY HUDSON, of Pacific Micro, addressed the September meeting of the Chicago Society

BIRMINGHAM PAINT, VARNISH AND LAQUER CLUB OFFICERS—Standing (l-r): President-Elect Designate—Tony Wallington; Society Representative—Gerry Gough; Treasurer—Bernard Myatt; Michael Wright; and Meetings Secretary—Peter Hassall. Seated: Past-President and Membership Committee Chairman—David Penrice; President-Elect—Bob McD. Barrett; President—Graham Miles; Georgina Walker-Popov; and Secretary — David Morris

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crystalline silica or materials and products that contain more than 0.1% crystalline silica by weight are required to label their material with a carcinogenic warning label.

Mr. Scaries discussed the dilemma faced by crystalline users in meeting these regulations. He emphasized that the responsibility in deciding the risks of using various materials is one which should be shared by responsible scientists, medical professionals, business people, laborers, and family members, and it is up to everyone to review the hazardous nature of a material and decide how hazardous it really is to us and to the people around us.

The educational speaker of the evening, Dr. Kathleen Akin, Chiropractor, gave an informative talk on chiropractic medicine and the use of preventive maintenance plans to eliminate backache and other ailments.

Al Rubin, *Secretary*

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.

KANSAS CITY ....SEPTEMBER

"Arylsilane Polymers"

Immediate Past-President Mark Algaier, of Hillyard Chemical, presented the President's briefcase to H. Jeff Laurent, of F.R. Hall, Inc. As the incoming President, Mr. Laurent thanked Mr. Algaier for his service to the Society and presented him with a Past-President's pin. Bruce Holly, of Hüls America, presented the Hüls gavel, symbolizing the office of President, for the Society to Mr. Laurent.

Shelby Thames, of the University of Southern Mississippi, spoke on "Arylsilane Polymers."

Dr. Thames introduced new developments in organosilicon chemistry which he predicted would define a new class of high performance coatings. He focused on the comparison between the chemistry, structure/property relationship, and performance characteristics of silicon and carbon chemistry in coatings application. Highlighting recent research conducted at the University of Southern Mississippi, Dr. Thames stated that the method of silicon incorporation into polyesters and polyurethanes occurs through the formation of a silicon to phenyl bond (an arylsilane) as opposed to the usual silicon to oxygen bond (a silicone). The solubility and thermal stability of such arylsilanes enable the development of polyesters and polyurethanes made from these arylsilanes.

Test results, presented by Dr. Thames, led to the following conclusions: arylsilanes lower glass transition temperature; they are more thermostable than carbon compounds; and in urethanes, they display complete resistance to yellowing, especially as the degree of aromaticity increases. Finally, arylsilanes may be used to enhance solubility without reducing thermostability, thereby allowing both high molecular weight and high performance.

Q. What prevents this technology from being put to use in today's coatings?

A. At this point in time, the costs for applying such chemistry would be prohibitive.

CRAIG HUGHES, *Secretary*

LOS ANGELES .... OCTOBER

"Rheological Modifiers"

Dave Muggee, of E.T. Horn Co., Environmental Committee Chairman, informed the membership that anyone producing new chemicals is subject to the TOSCA reporting requirements to EPA every four years. This year, EPA has extended the Inventory Update Rule reporting period 60 days, until February 21, 1991. This action is being taken because of a delay in the availability of reporting materials.

Richard G. Brown, of Aqualon Company, gave a presentation on "RHEOLOGICAL MODIFIERS FOR WATERBORNE SYSTEMS."

Dr. Brown provided a broad overview of the types of materials used to modify the flow properties of aqueous systems. Emphasis was given to application and use of the materials in waterborne coatings, particularly latex paints. Discussion included the effects of cellulosic thickeners on the flow properties of the paints.

Q. Due to the surface tension activity of the HM-HEC, is there any tendency for there to be activity at the substrate-coating interface which may interfere with long-term adhesion? If so, would I have to reduce the concentration of other surfactants to keep this from happening?

A. Generally, no, we don't see a problem . . . If you make a surface-active species, it's going to go to try find an interface. However, in studies we've done, where we've cut sections through coatings and done IR analysis, we see that the HM-HEC polymers are evenly distributed through the film. They are high molecular weight materials which are bound to dispersed phase components and therefore very hard to migrate through the coating.

V.C. BUD JENKINS, *Secretary*

NORTHWESTERN ...... OCTOBER

"Carbon Black Pigments"

Society Representative Richard Fricker, of Valspar Corp., announced that he will be retiring and moving to Alabama. Larry Brandenburger was named new Society Representative.

Educational Committee Chairman Ed Erickson, of Hirshfields Paint Manufacturing Co., reported on the committee's efforts and provided a report on the Federation's donations to various educational institutions, with North Dakota State University receiving $10,000 this year.

Joan Lamberg, of Horton-Earl Corp., presented the Hüls gavel to Incoming President Terry Strom, of Ti-Kromatic Paints, Inc.

The first technical presentation, given by Maria Nargiello, of Degussa Corporation, was entitled "CARBON BLACK PIGMENTS FOR COATINGS PRODUCTION/PROPERTIES, APPLICATION AND DISPERSION."

Ms. Nargiello stated that particle size, structure and surface chemistry of carbon black pigment determine jetness, masstone, tinting, and transparency of the coating. The process used to extract the pigment determines the particle size with the furnace process yielding the smallest particle size. She explained that the method of dispersion and type of resin used determine what type of carbon black is best for each application.

Ron Lowrance, of Wacker Silicones, provided the second talk, entitled, "MEETING THE CHALLENGE OF THE 90S WITH VOC COMPLIANCE COATINGS."

According to the speaker, VOC compliance coatings offer excellent weather resistance in even the harshest environment. Heat resistance and corrosion resistance can also be considered benefits. Phenyl silicones offer the better heat and oxidation resistance and shelf stability. Mr. Lowrance stated that methyl silicones are superior in hot hardness, water repellency, low temperature properties, chemical resistance, rate of cure and thermal shock resistance.

JOE WIRTH, *Secretary*

PHILADELPHIA ...... SEPTEMBER

"Controlling Biological Contamination"

President-Elect Peter Kuzma, of VIP Products Corp., presented the Past-President's pin to Immediate Past-President Orville Brown, of M.A. Bruder & Sons, Inc.

Mr. Kuzma announced that the Federation's 1991 Spring Week, to be held in Philadelphia on May 13-16, will be hosted by the Philadelphia Society.

Educational Committee Chairman, Richard Granata, of Lehigh University, announced that the first coatings course offered by the Society this past spring attracted 28 participants and was a success. Plans are being made to repeat it in the near future.

Society Honorary Member J. Richard K Kiefer, Jr., presented the members of the Board of Directors for 1990-91, including: Educational Committee Chairman—Dr. Granata; Technical Committee Chairman—Julio Aviles, of Kronos, Inc.; Membership Chairman—Marshall Jones, of Van Horn, Metz and Co.; Society Representative—Wayne Kraus, of Aqualon Company; Treasurer—Brian O'Connor, of McWhorter Resins; Secretary—William Fabiny, of Sermagard Coatings; President-Elect—Mr. Kuzma; and President—Christophen Huhn, of Arizona Chemical Co.

Technical speaker for the evening was William Machemer, of Troy Chemical Corp., who spoke on "CONTROLLING BIOLOGICAL

PITTSBURGH SOCIETY OFFICERS for 1990-91 include (l-r): President-Elect—Joe Powell; Society Representative—Raymond Uhlig; Treasurer—Michael Scott; President—Mary Carole Storme; and Secretary—Jeff Sturm

CONTAMINATION IN COATINGS MANUFACTURING PROCESSES."

Mr. Machemer explained that the work presented was the result of work promulgated by a request by the Southern Society. As the ban on heavy metal based biocides widens, coatings manufacturers throughout the country face problems during the transition to nonmetallic biocides.

According to the speaker, this transition requires a clear understanding of the alternative biocides and how to use them. Improper formulation techniques, usage levels, and/or plant hygiene can affect production through microbiological contamination.

The first step in combating microorganisms in coating plants is knowing how contaminants enter a plant. The speaker detailed ways in which this happens. He then discussed some of the ways microorganisms can adversely affect coatings, including viscosity loss, putrefaction, gas release, and visible growth.

Mr. Machemer stated that, in order to combat the effects of microorganisms, microbiological laboratory testing is necessary to determine the effectiveness of preservatives in various coatings systems. He pointed out that testing of mercurial and nonmercurial preservatives have produced a number of observations relative to their performance. He alerted the audience to several factors which the responsible formulator must consider in determining what preservative system to use in any coating system. Unless coatings manufacturers pay careful attention to plant hygiene during conversion from mercurial to nonmercurial preservatives and implement a regular maintenance program, serious consequences in the form of contaminated products will eventually occur, he cautioned.

In conclusion, Mr. Machemer emphasized that the potential costs of contamination are measured in unusable product, lost time, returns and restocking charges.

WILLIAM J. FABINY, *Secretary*

PIEDMONT ....SEPTEMBER

"Organic Pigment Technology"

Immediate Past-President Forest Fleming thanked the membership for its support during his tenure. Officers named for 1990-1991 include: Treasurer—Dennis Gillespie, of Lomas Minerals and Chemicals; Secretary—Annette Saunders, of Akzo.; Vice-President—Ruby Johannesen, of Southchem, Inc.; and President—Gary Waters, of Sadolin Paint Products, Inc.

A presentation on "MAJOR TRENDS IN ORGANIC PIGMENT TECHNOLOGY" was provided by Hugh Smith, of Sun Chemical Corp.

Dr. Smith gave an overview of the changing nature of pigment technology, with focus on major trends that are impacting the pigment industry worldwide. He explained how the interaction of DCMA (the trade association for the pigments industry) with government agencies has provided representation for pigment manufacturers, especially in the face of increasing regulatory pressure. He noted that in recent years, there has been a lessening of pigment synthesis compared to the first half of this century. Dr. Smith noted the difficulty in getting approval for new substances due to government regulations. As a result, there is increased effort to improve existing physical characteristics rather than chemical characteristics. The aim in the pigment industry, according to Dr. Smith, is in reacting the surface of the pigment so that it is more receptive, more dispersible, more compatible, and more efficient for the customer.

Dr. Smith highlighted another trend made much clearer with the current situation in the Middle East—sensitivity toward raw materials availability.

These concerns have led to a revolution in the instrumentation availability to improve the products we use. Sophisticated equipment from HPLC to electron microscopy has increased learning in characterizing products. This in turn requires a growing complexity toward product testing.

Dr. Smith concluded by saying that many people and government agencies are looking for new requirements for pigments, and that the pigment industry has risen to the occasion.

ANNETTE SAUNDERS, *Secretary*

PITTSBURGH ....SEPTEMBER

"Hazardous Wastes"

Alan Zoller, of Alan C. Zoller Company, presented the Hüls gavel to Mary Carole Storme, of Valspar Corp.

Ms. Storme presented Jim Lore, of Watson Standard Co., with a gift expressing appreciation for his dedication and accomplishments as Society President for 1989-90.

New officers and committee members for the upcoming year were introduced, including: President—Ms. Storme; President-Elect—Joseph Powell, of Union Carbide Corp.; Secretary—Jeffrey C. Sturm, of Kop-Coat, Inc.; and Treasurer—Mike Scott, of Watson Standard Co. Ray Uhlig will continue to serve as Society Representative.

Chairman of the Society Technical Committee, Richard Trudel, of Valspar Corp., suggested that the committee publish a newsletter which could feature new products, regulations from the EPA, VOC regulations, etc. He called for volunteers to serve on the committee.

Ed Threlkeld, of Ashland Chemical Co., spoke on "HAZARDOUS WASTES . . . EVERYTHING YOU DIDN'T WANT TO KNOW."

Mr. Threlkeld, the Society's Environmental Affairs Committee Chairman, discussed new regulations which came into effect in 1990. He noted that as science is able to measure smaller amounts of toxic substances, the government keeps lowering the allowable limits.

Mr. Threlkeld explained that the Clean Air Act is the major concern for the coatings industry in this decade. In the past, only two chemicals had been highly regulated as air pollutants—vinyl chloride and benzene. Now at least 300 more chemicals will be added to the list, he said.

He detailed the 10 chemicals which make up the government's "hit list" of the largest air emission pollutants. He noted that under new regulations industry will be faced with MACT, Maximum Achievable Control Technology. This will result in reductions of the total amounts of pollutants allowed from a source. In addition, time frames will be established consisting of: 10% compliance in two years, 25% in four years, 50% in nine years and 100% in 10 years.

Mr. Threlkeld stated that, effective September 25, 1990, Toxicity Characteristic Leaching Procedure (TCLP) replaced the Extractive Procedure (EP TOX) testing method for the dumping of leachable hazardous wastes in land fills. Twenty five new organic compounds have been added to the 14 metals and pesticides which formerly required testing.

He explained that RCRA regulations allow facilities to make a determination as to whether a waste is hazardous based upon process knowledge. However, if any doubt exists, the waste should be tested.

JEFFREY C. STRUM, *Secretary*

ST. LOUIS ....SEPTEMBER

Plant Tour

Immediate Past-President Howard Jerome handed the office of the President over to Terry Gelhot, of Carboline Co., by passing the customary gavel. Mrs. Gelhot introduced new officers and committee chairmen: Vice President—Stan Soboleski, Jr., of U.S. Paint Corp.; Secretary—Dennis Cahill, of Archway Sales, Inc.; Treasurer—Michael Schnurman, of Sinnett-Elpaco Coatings Corp.; Assistant Treasurer—Chuck Reitter, of American Paint Journal Co.; Educational Committee Chairman—Jim Lindsley, of Akzo; Manufacturing Chairman—Mike Hefferon; and Membership/Friendship Fund—Howard Jerome, of Mozel Equipment Co.

DENNIS CAHILL, *Secretary*

Future Society Meetings

Birmingham

(Jan. 10)—"The Benefits of Color Computer Measurement Equipment in the Coatings Industry"—Colin Wilkinson, Kirkstol Colour Service.

(Feb. 7)—"Can Lines"—R.P. Clarke, Nacanlo Ltd.

(Mar. 7)—"Modern Dispersion Equipment for Surface Coatings"—Colin Bow, Netzsch Ltd.

(Apr. 4)—"1992: A Legislative Update for the Paint Industry"—Tony Newbold, Paintmakers Association of Great Britain.

(May 2)—62nd Annual General Meeting.

Cleveland

(Jan. 15)—Joint Meeting with Cleveland PCA.

(Feb. 19)—"The Use of Ropaque Opaque Polymers in Architectural Coatings"—Dr. Elmer Williams, Jr., Rohm and Haas Co.

(Mar. 19)—"Choosing the Most Effective Dispersants for High Solids Coatings Systems"—Marvin Schnall, Troy Chemical Corp.

(Apr. 16)—"Coatings Characterization by Thermal Methods"—Michael Neag, The Glidden Company.

(May 21)—"Formulation of New Varnishes for Old Master Paintings"—Dr. E. Rene´ de la Rie, National Gallery of Art.

Kansas City

(Jan. 10)—"Polyethylene Additives for the Coatings Industry"—Larry Novak.

(Feb. 7)—"Environmental Monitoring, Establishing a Baseline for Future Real Estate Transactions and Potential Litigation"—Steve Loosbrock, Terracon.

(Mar. 14)—"New Products From UCC"—Dave Darr, Union Carbide.

(May 10)—"Deforestation and Its Effects on our Global Environment"—Sierra Club Representative.

(June)—Joint Meeting of St. Louis/Kansas City Societies

Louisville

(Jan. 16)—Past-Presidents' Night.

(Feb. 20)—"A Solvent Property and Solubility Parameter Calculator"—Dan King, Exxon Chemical Co.

Montreal

(Jan. 9)—Waste Management—Mini Symposium.

(Feb. 6)—"Type 2 Urethane Associative + Latex Paint = Value Added Performance"—Robert Dey, Rheox, Inc.

(Mar. 6)—"Precipitated Calcium Carbonate to Extend TiO_2"—Georges Green, Pfizer Minerals.

(Apr. 3)—"Modified S/B to the Rescue for Meeting VOC and Still Produce Quality Coating"—V.L. Stevens, The Dow Chemical Co.

(May 1)—Progress Report on Technical Committee Projects—A. Brisson, Technical Committee

New York

(Jan. 15)—"Improve Quality Now—Here's How"—Daniel Baker, McWhorter, Inc.

(Feb. 7)—Joint Regulatory and Legislative Update Meeting for the NYSCT/MNYPCA.

(Mar. 12)—"Polyurethanes in Powder Coatings for Wire and Cable"—Robert Henderson, Mobay Corp.

(Apr. 9)—Diatomaceous Silica Topics—Title to Be Announced— Sid Lauren.

(May 14)—PaVAC Night—"Low VOC Architectural Coatings"—Richard Johnson, Cargill.

Philadelphia

(Jan. 16)—Joint Meeting with the Philadelphia PCA, "The Persian Gulf Crisis and Petrochemicals."

(Feb. 14)—"Meeting the Challenge of the Nineties with VOC Compliant Silicones"—Ronald E. Lowrance, Wacker Silicones.

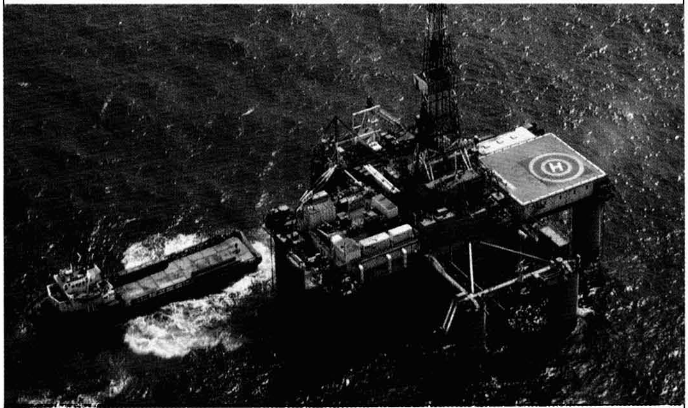
Rocky Mountain

(Jan. 7)—"Peroxide Cured Resins/Cook Composites"—Dennis Ryder, Freeman.

(Mar. 11)—"Anti-Microbials/Mercury Replacement"—Martin Landau, Hüls America.

(Apr. 8)—"Pigmented Coatings Problems and Solutions Associated with Particular Size"—Elio Cohen, Daniel Products Co.

(May 6)—"Rama-Poly Alka-Methacrylate"—Joachim Buchse, Rohm Tech.



Elections

BALTIMORE

Active

Eckler, Paul E.—Alcolac, Baltimore, MD.
Ellepola, Wimal S.D.B.—Lenmar Inc., Baltimore.
Miller, Robert T.—Duron Paints Inc., Beltsville, MD.
Nutter, Aaron R.—Bruning Paint Co., Baltimore.
Sauer, Consuelo—Duron Paints Inc., Beltsville.

Associate

Missell, Timothy A.—Aqualon Co., Wilmington, DE.
Moore, Linda J.—Lenmar Inc., Baltimore, MD.
Reed, Tony G.—Rheox Inc., Bensalem, PA.
Williamson, Augustus E.—SCM Chemicals, Baltimore.

BIRMINGHAM

Active

Lewis, Peter J.—P&O Aerosols, Walton-on-Trent, Staffs.
Reid, Duncan H.—Portals Ltd., Basingstoke, Hampshire.

CDIC

Active

Betts, Paul N.—Yenkin Majestic, Columbus, OH.
Cheeks, Charles N.—DAP Inc., Dayton, OH.
Goble, Mark A.—Akzo Chemical, Columbus.
Guiles, Roy I.—Yenkin Majestic, Columbus.
Hoefer, Scott A.—Fischer Industrial Coatings, West Chester, OH.
Jang, Taeyoung—Yenkin Majestic, Columbus.
McGroarty, Michael L.—R.C.P., Inc., Columbus.
Payne, Evis L.—Akzo Coatings, Inc., Columbus.
Polan, David L.—W.R. Bonsal Co., Mason, OH.
Reasoner, Mark C.—Honda of America Mfg., Marysville, OH.
Thomas, Christopher A.—Hüls America Inc., Lockland, OH.
Turner, Stanley R.—Ashland Chemical Inc., Columbus, OH.

Associate

Brecher, Howard S.—Michelman Inc., Cincinnati, OH.
Knox, Mike—Hilton Davis Co., Cincinnati.
McAllister, John W.—DarTech Inc., Miamisburg, OH.
Seifried, Mark A.—Daicolor-Pope Inc., Edgewood, KY.
Zapp, David E.—Penn Color Inc., Southgate, KY.

CHICAGO

Active

Derose, Kevin—General Paint & Chemical, Cary, IL.
Engel, David A.—Morton International, Woodstock, IL.
England, Arthur D.—Dexter Corp., Waukegan, IL.
Gilvary, John P.—Elpaco Coatings Corp., Elkhart, IN.
Hendrickson, Gary D.—Unimin Corp., Gurnee, IL.
Jasenof, Kenneth E.—Morton International, Batavia, IL.
Nelson, Mark—Color Corp. of America, Rockford, IL.
Parekh, Girish G.—Dexter Corp., Waukegan.
Plooy, Ronald J.—Creative Coatings Ltd., Waukesha, WI.
Remissong, Jon—Color Corp. of America, Rockford.
Sexton, Karen M.—Rheox Inc., Lisle, IL.
Vermilya, Andrea R.—General Paint & Chemical, Cary.
Vysoky, James A.—ANGUS Chemical Co., Northbrook, IL.
Wyatt, Maxwell E.—Elpaco Coatings Corp., Elkhart.

Associate

Ciez, Margaret A.—Morton International, Lansing, IL.
DiTucci, Al J.—Rohm and Haas Co., Niles, IL.
Fechner, Michael O.—ANGUS Chemical Co., Northbrook, IL.
Lafko, George G.—Union Carbide Corp., Lisle.
Peacock, Stella L.W.—Kerr McGee Chemical, West Chicago, IL.
Sheehan, Jerome C.—Lubrizol Corp., Wickliffe, OH.
Wiff, John E.—Neville Chemical Co., Sterling, IL.

CLEVELAND

Active

Hazen, James R.—The Glidden Co., Strongsville, OH.
Krysiak, Raymond A.—Waterlox Chemical, Cleveland, OH.
Sitter, Darcie A.—Lord Corp., Erie, PA.
Tuckerman, Richard—The Glidden Co., Strongsville, OH.

Associate

Basel, James J.—North Pak, Macedonia, OH.
DiFeo, Jack—Unocal Chemicals, Rootstown, OH.
Falsone, John J.—B.F. Goodrich SP&C Div., Brecksville, OH.
Homm, John Jr.—North Pak, Macedonia.
Mammano, Michael—North Pak, Macedonia.
Murray, Christopher D.—North Pak, Macedonia.
Westfall, Mark—Kerr-McGee Chemical Corp., Hudson, OH.

Educator/Student

Payer, Joe H.—Case Western Reserve University, Cleveland, OH.

Retired

Waldo, Kenneth C. Jr.—Cleveland, OH.

KANSAS CITY

Associate

Overmyer, Todd L.—Dow Chemical Co., Shawnee Mission, KS.
Riek, Sally A.—Chemtech Industries, Kansas City, MO.

LOS ANGELES

Active

Forster, Wendell L.—McWhorter Inc., Los Angeles, CA.
Granofsky, Barry P.—Ebco Devel Lab., Fullerton, CA.
Ray, Frank A.—Spectra-Tone Paint, S. El Monte, CA.
Shimoyama, Isao—La Palma, CA.
Teran, Ivan J.—Guardsman Products, South Gate, CA.

Associate

Bosch, Jose Maria—Prisa De California, Tijuana, Mexico.
Rangel, Jose—Pyochem Inc., Irvine, CA.
Seevens, Charles A.—Pacific Anchor, Valencia, CA.

LOUISVILLE

Active

Duncan, John W.—National Paint, Nashville, TN.
Dye, Garry J.—Akzo Coatings Inc., Louisville, KY.
Graziano, Martha M.—United Catalysts, Louisville.
Hurt, Laura D.—Kurfees Paint, Louisville.
Kaiser, John H.—Hi-Tek Polymers, Louisville.
Lamar, William T.—Progress Paint Co., Louisville.
Link, Terry M.—Marcus Paint Co., Louisville.
Lohff, Rudy R.—Akzo Coatings Inc., Louisville.
Long, Jack L.—United Catalysts Inc., Stockbridge, GA.
Maisch, Chuck D.—United Catalysts Inc., Louisville.
Marcus, Steven M.—Marcus Paint Co., Louisville.
Price, Anthony W.—Akzo Coatings Inc., Louisville.
Reynolds, Ronald J.—National Paint, Nashville, TN.
Smith, Pauline M.—Akzo Coatings Inc., Louisville.
Thompson, Kathy B.—United Catalysts Inc., Louisville.
Walker, Ernest Jr.—Rhone-Poulenc, Inc., Louisville.

Associate

Ellegood, Charles D.—Alucobond Technologies, Benton, KY.
Ericson, Gilbert L.—Troy Chemical, Newark, NJ.
Keane, Mary M.—Michelman, Inc., Cincinnati, OH.
Van de Ryt, James K.—Chemcentral-Louisville, Louisville, KY.

NEW ENGLAND

Active

Metz, Scott E.—James River Corp., Johnston, RI.
Paradise, Steven J.—James River Corp., Johnston.
Shea, Brian R.—T.H. Glennon Co., Inc., Salisbury, MA.
Sherwood, Philip W.—FSP Research, Inc., Milford, CT.
Von Behren, Jack—Decart, Inc., Morrisville, VT.
Wright, Michael E.—James River Corp., Johnston, RI.

Associate

Benson, Robert E.—Young's Environmental Services, Inc., Oxford, MA.
Cunningham, Richard A.—Borden & Remington, Fall River, MA.
DeWolf, Henry D.—DeWolf Marketing, Inc., E. Providence, RI.
Rothemich, Frank H.—Amcan Industries, Warwick, RI.

NORTHWESTERN

Active

Asmus, Gary L.—3M Co., St. Paul, MN.
Clinch, Barbara—H.B. Fuller Co., Vadnais Heights, MN.
Henning, Calvin C.—Frost Paint & Oil Co., Minneapolis, MN.
Henning, Denise R.—Frost Paint & Oil Co., Minneapolis.
Lovgren, Ann M.—Ti-Kromatic, St. Paul.
Wentz, John R.—The Valspar Corp., Minneapolis.

Associate

Larson, Michael A.—Grefco, Inc., Golden Valley, MN.

PHILADELPHIA

Active

Ceska, Gary W.—Sartomer, Exton, PA.
Gormley, James J.—Central Sprinkler, Lansdale, PA.
Johnsen, Richard A.—Silberline Mfg. Co., Inc., Tamaqua, PA.
Polston, Norman L.—Polston Enterprises, Philadelphia, PA.
Rossiello, Patricia V.—Aqualon Co., Wilmington, DE.

Associate

Gray, Harold B.—Aqualon Co., Wilmington, DE.
King, David—GE-Silicone Products, Cranford, NJ.

PIEDMONT

Active

Thompson, David R.—American Colors Inc., Stallings, NC.

Associate

Baker, A. Dale—A.B. Kohl Sales Co., Roswell, GA.

Retired

Clifford, Charles H.—Roanoke, VA.

PITTSBURGH

Active

Nowakowski, Peter M.—PPG Industries, Inc., Monroeville, PA.
Wind, Donald G.—Valspar Corp., Pittsburgh, PA.

Associate

Fetchin, Paul D.—Neville Chemical Co., Pittsburgh, PA.
Jones, David B.—Durr Marketing Associates, Pittsburgh.

ST. LOUIS

Active

Bishop, William—Cargill, Inc., Carpentersville, IL.
Fulton, Christopher—McDonnell Douglas, Florissant, MO.
Ishikawa, Masahiko—U.S. Paint Corp., St. Louis, MO.
Jennings, Michael T.—Akzo Resins Lanchem, E. St. Louis, MO.
Tierney, John H. Jr.—U.S. Paint Corp., St. Louis.
Walker, Albert T.—U.S. Paint Corp., St. Louis.
Wohlstadter, Mark D.—U.S. Paint Corp., St. Louis.
Zahnweh, Robert R.—Brod-Dugan, St. Louis.

Associate

Baranek, Bud B.—C.L. Smith, St. Louis, MO.
Beck, Thomas M.—Mozel Inc., St. Louis.
Bub, William J.—Dow Chemical Co., St. Louis.
Clever, Terrance R.—Alcoa, Bauxite, AR.
Cortner, Bud—U.S. Paint Corp., St. Louis.
Cunningham, Thomas J.—U.S. Paint Corp., St. Louis.
Fradkin, Gary M.—U.S. Paint Corp., St. Louis.
Hanclich, Nancy—BASF Corp., Creve Coeur, MO.
Laflin, Tim—NYCO, University City, MO.
McDonnell, David A.—Rhone-Poulenc, Louisville, KY.
McDonough, Michael E.—U.S. Can Co., Crestwood, MO.
Mitchell, Jim D. Jr.—Mozel Inc., St. Louis.
Mrzlock, Sharon M.—ChemCentral-St. Louis, Maryland Heights, MO.
Murphy, George J.—Netzsch Inc., Exton, PA.
Polak, Joseph J.—Henkel Corp., Downers Grove, IL.
Reynolds, Phillip C.—Byk-Chemie USA, St. Louis.
Smith, C.L.—CL Smith Container, St. Louis.
Sullivan, John—Interfibe Corp., Solon, OH.
Thomsen, Flip—U.S. Paint Corp., St. Louis.
Williams, Warren O.—Archway Sales Inc., St. Louis.

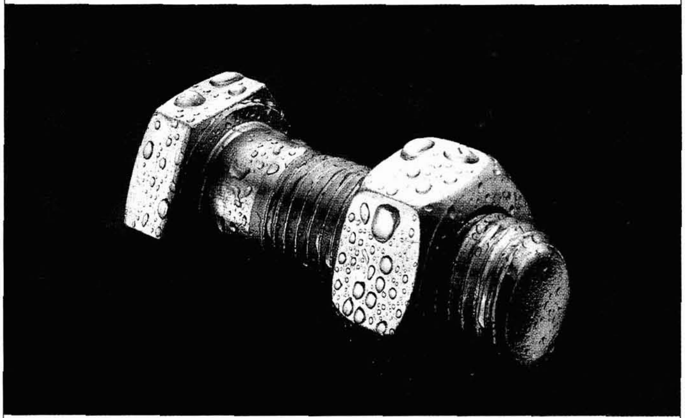
TORONTO

Active

Chan, Paul S.L.—Ashland Chemical, Mississauga, Ont.
Ng, Phil—Para Paints, Brampton, Ont.

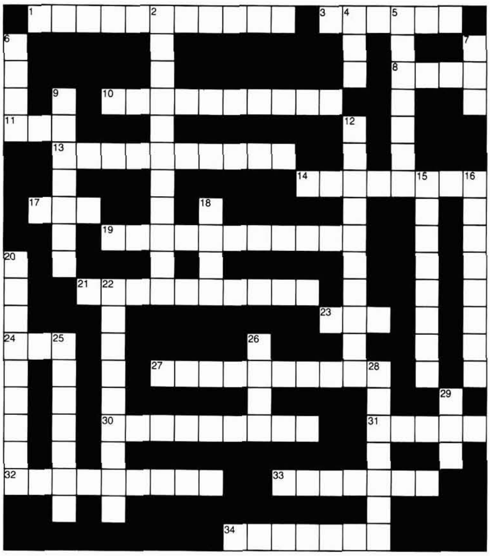
Associate

Behan, Frank L.—Campbell Lewis Associates, Oakville, Ont.
Pitt, John G.—Dominion Colour, Toronto, Ont.



CroSSLinkS

by Earl Hill



No. 39

Solution
to be
Published in
January issue

ACROSS

1. Our government lays these on us
3. To confuse; found in a tank
8. What is found on a can?
10. What material keeps the fungus out?
11. Taproom, e.g.
13. Type of paint
14. A type of man or woman
17. To dilute, as e.g., a resin
19. Term concerning film formation of a latex
21. Where do we go for help?
23. ________ less spray paint
24. What goes on an F-Style can?
27. Found in a spray can
30. What is a closed vessel used for a chemical reaction?
31. Opposite of stator
32. To smallify
33. Aluminum mineral; paint filler
34. Bug killer

DOWN

2. To stick together
4. Tree; residue from 30 Across
5. Synthetic red dyestuff, F________.
6. To pat on, e.g., paint
7. Unit of viscosity measurement
9. Type of printing
12. A composition containing fine pigments
15. A composition containing fine particles
16. Opposite of hardware
18. British standards association (Abr.)
20. Which metal is one of the auxiliary driers?
22. Helps to get things started
25. What we sell
26. Follower of alpha
28. What drives a mixer in a tank?
29. Evaporative component (Abr.)

People

Bruce Zwicker has been appointed Product Manager for the Cab-O-Sil Division of Cabot Corporation, Tuscola, IL. Mr. Zwicker will be responsible for the Cab-O-Sil® fumed silica treated and aqueous dispersion product lines, as well as new product development. He is a member of the Chicago Society.

Also, **John DeVaney** has been named Midwest Regional Sales Manager for the division. He will be responsible for the states of northern Illinois, northern Indiana, Wisconsin, Minnesota, Iowa, Nebraska, North Dakota, and South Dakota.

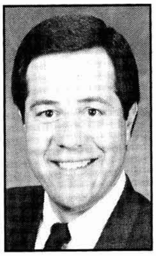
Edwin R. Gaskell, Manager of Resins, has retired from Guertin Bros. Polymers, Winnipeg, Manitoba, Canada. Mr. Gaskell founded the California Resin Company and constructed several resin plants around the San Francisco Bay area. He recently completed the new computerized resin plant for Guertin Bros. in Winnipeg. Mr. Gaskell was a member of the Golden Gate Society for 34 years, and is currently Vice Chairman of the Winnipeg Section of the Northwestern Society.

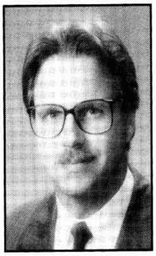
SCM Chemicals, Baltimore, MD, has named **Thomas A. Wenzel** to the position of Area Sales Manager/West Coast. Mr. Wenzel joins SCM after spending three years as a Sales Representative for Pfizer Pigments and four years with the Minerals Division of Pfizer, Inc., in Southern California.

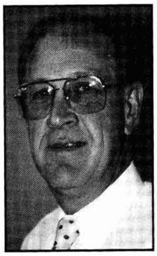
Willard L. Wooten has joined the staff of Velsicol Chemical Corporation, Rosemont, IL, as Market Manager for its newly acquired benzophenone technical flake product line. Mr. Wooten brings to this position extensive chemical industry experience which includes product management and technical positions with Diamond Shamrock Corporation, GAF Corporation, Lockheed Propulsion Company, and the U.S. Air Force.

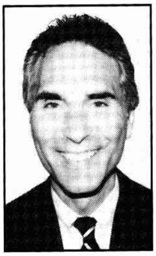
The announcement of two senior managerial changes has been made by ICI Americas, Wilmington, DE. **E.D.M. Eades**, President, ICI Films, has assumed a position on Special Assignment in the Office of the Chairman. Concurrent with Dr. Eades' new assignment and changes being made in the senior organization of ICI Films worldwide, **James A. Alles** has been named President, ICI Films, in the U.S.

In addition, **Hugh E. Miller**, Vice Chairman of ICI Americas, Inc., has announced his retirement after 21 years of service to ICI and its predecessor companies.


B. Zwicker

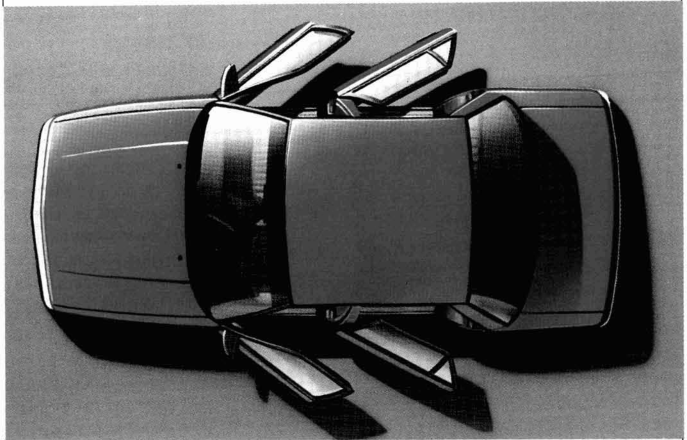

J. DeVaney


W.D. Lee


R. Biddle

Wesley D. Lee has been appointed President and Chief Executive Officer for Eagle-Picher Minerals, Inc., a subsidiary of Eagle-Picher Industries, Inc., Reno, NV. Mr. Lee brings to this position an extensive background in executive management, marketing, and engineering in North America and abroad.

Reichhold Chemicals, Inc., Research Triangle Park, NC, has announced the appointment of **Rodney Biddle** as Director of Marketing for the company's Coating Polymers and Resins Division. Mr. Biddle previously served as Director of Strategic Planning and Business Development for Reichhold's Emulsion Polymers Division.



Stanley B. Schroeder, Group Leader of the Mill Applied Wood Coatings Department for The Glidden Company, Strongsville, OH, is the 1990 recipient of ASTM's Henry A. Gardner Award. The award, presented by ASTM Committee D-1 on Paint and Related Coatings and Materials, recognizes Mr. Schroeder for his outstanding contributions in the operation of Subcommittee D01.52 in Factory-Coated Wood Building Products. He is a member of the Cleveland Society.

John P. (Jack) McNally has joined the technical sales staff of Deeks and Company, Cincinnati, OH. Mr. McNally will work out of the company's Cleveland, OH office and will be responsible for servicing northeastern Ohio, western New York, and western Pennsylvania customers.

Henkel Corporation, Gulph Mills, PA, has announced new leadership for two of its five operating groups. Named as Executive Vice President of the Organic Products Group is **Neville E. McDonald**, a 25-year veteran in the chemical industry whose career has included assignments in the United Kingdom, Europe, Canada, and the United States. Mr. McDonald replaces **Howard W. Gross**, who will continue as Executive Vice President and concentrate on Henkel's export business and other activities outside the U.S. Appointed Executive Vice President of the Functional Products Group is **James S. Lee**, whose 25 years in the chemical industry include assignments in technical product development and sales and marketing. Mr. Lee replaces **Jochen P. Heidrich**, who will return to Duesseldorf, Germany, for an assignment with the Henkel Group, the parent company of Henkel Corporation.

James E. Morrison has joined ANGUS Chemical Company, Northbrook, IL, as Vice President/Finance. Before joining ANGUS, Mr. Morrison was the Manager, Corporate Financial Analysis.

The Flood Company, Hudson, OH, has elected **Peter B. Statham** to its Board of Directors. Mr. Statham, an employee of Flood since 1979, serves as Vice President of Marketing for the company's lines of wood finishes, specialty coatings, masonry, waterproofing products, and roof coatings.

Also, **Cecil A. Given** has been named to the position of Sales Manager. He will be responsible for managing the company's national network of manufacturers' sales representatives. **George W. Washington** has been named Advertising Manager. He will oversee Flood's advertising, public relations, and sales promotion activities.

Man-Gill Chemical Company, Cleveland, OH, has announced the appointment of **John E. Kohl** as President and Chief Operating Officer for all divisions of the company. Simultaneous with Mr. Kohl's appointment, **Alfred B. Williams** has joined the firm as Executive Vice President of the Chemical Group.

Gerd Warnecke has been designated as Vice President, Operations/Europe as announced by the Columbian Chemical Company, Atlanta, GA. Mr. Warnecke joined Columbian in 1986 as Director/Engineering and Quality Assurance and most recently held the position of Vice President/Manufacturing. He will be based in Hannover, Germany.

In another move, **Clifton D. McCloskey** has been appointed General Manager of Columbian Chemicals U.K./Sevalco Ltd. based in Birmingham, England. He will report to Mr. Warnecke.

Robert L. Post, Jr. has been retained by the Materials Research Society (MRS), Pittsburgh, PA as its Public Affairs Representative in Washington, D.C. Mr. Post will serve from now through the end of 1990 as a consultant to the Society. He joins MRS from his most recent positions as Executive Director of the National Critical Materials Council.

Cargill, Incorporated, Minneapolis, MN, has announced the following appointments within the Chemical Products Division: **Daniel Cox**—National Sales Manager; **Frank Calma**—Technical Sales Representative/Mississippi, Tennessee, and parts of Alabama; and **Jennifer Gratzle**—Sales Representative/Chicago, IL, the Quad Cities area, and Louisville, KY.

Tom H. Barrett, Chairman of Goodyear, Akron, OH, has been elected to the Board of Directors of Air Products & Chemicals Inc., Allentown, PA. Mr. Barrett also is a Director of A.O. Smith Corporation, Rubbermaid Inc., the Rubber Manufacturers Association, and the Highway Users Federation.

Glenn J. Conger has accepted the position of Director of the Industrial Minerals Group in the Marketing and Sales Department of the J.M. Huber Corporation, Clays Division, Macon, GA. Mr. Conger will direct the expansion of specialty market applications of Huber's kaolin clay and structured pigment products.

In addition, **Gary Cooper** has been named Manager of Communications in the Marketing and Sales Department. Mr. Cooper joined Huber in 1987 and previously held the positions of Community Relations Administrator and Marketing Services Administrator.

The International Specialty Chemicals Group of Morton International, Chicago, IL, has named **William A. Wulfsohn** Director of Marketing for Industrial Coatings. In this position, Mr. Wulfsohn will provide guidance for Morton's Industrial Coatings program worldwide. He will also direct the activities of product line managers in the United States.

Cyprus Industrial Minerals Company, Englewood, CO, announced that **Marcy S. Baugh** has joined the Cyprus Technical Group as Industry Specialist/Coatings. Ms. Baugh will assist Cyprus' customers with technical and scientific support, including formulation analysis and evaluation, product development and improvement, and raw material performance maximization and cost containment. Prior to joining Cyprus, she was Technical Director at Colorado Paint Company. Ms. Baugh is a Past-President of the Rocky Mountain Society.

Quantum Chemical Corporation, New York, NY, has elected **Frank J. Ryan** to its Board of Directors. Mr. Ryan served as President and Chief Operating Officer of Air Products and Chemicals prior to his retirement in March 1990.

Datalogix Formula Systems, Valhalla, NY, has appointed **David Stein**, former Vice President of Operations, to the position of Vice President of Marketing. Mr. Stein will be responsible for the management of the company's marketing department and will oversee all advertising, public relations, strategic marketing activities, product management, and business partner relationships.

The retirement of **Edward J. Twohig** has been announced by Kyanize Paints, Everett, MA. Mr. Twohig served 43 years with Kyanize in the role of Chief Chemist until 1978 when he became Technical Director.

Obituary

Richard G. Light, Chairman of Whittaker, Clark & Daniels, Inc., South Plainfield, NJ, died September 15, 1990. He was 58 years old.

Mr. Light joined the company in 1976 as Controller and was promoted to positions of increasing responsibility including Treasurer and President. He was named Chief Executive Officer in 1986, and Chairman of the Board in 1989.

Robert Karr Kitson, President of Blue Ridge Talc Company, Henry, VA, died September 19, 1990. He was 62 years old.

Mr. Kitson served as President of Blue Ridge Talc, an independent paint and caulk manufacturer and processor of dry pigments, since 1959.

Missouri-Rolla Announces 1991 Short Course Dates

The Coatings and Polymer Science Program in the Department of Chemistry at the University of Missouri-Rolla (UMR), Rolla, MO, has announced its short course schedule for 1991.

The 62nd and 63rd introductory short course "The Basic Composition of Coatings" is scheduled for March 11-15 and September 9-13. The course is designed to introduce the newcomer, as well as those involved in raw material manufacture, sales, and technical service, to the technical aspects of paint composition, manufacture, testing, and use.

Topics to be discussed include: history of paint; materials used in manufacture; simple formulating techniques that can be put to immediate use; introduction to the equipment used to make and test modern protective coatings, and modern chemical instrumentation applied to coatings; and simple costing that allows beginners to start on a stable economic basis.

Particular attention will be given to the needs of newcomers to the coatings industry in laboratories, production units, or marketing groups.

Time will be allowed for private, in-depth conversations to explore special problems. Featured guest lecturers from industry will discuss new ideas.

The 22nd and 23rd introductory short course "Paint Formulation" is slated for March 25-29 and October 21-25. The class will consist of classroom and laboratory work designed to teach the formulation of paints to meet specific requirements.

Included among the subjects to be discussed are: basic raw materials and their influences on the performance of the finished coating; formulation and testing of coatings in the laboratory to meet the specific demands of the job; limitations of plant production equipment and formulation variables for moving a coating from the lab to the plant; modern chemical instrumentation as applied to coatings; and statistical experimental design.

The introductory short course "Basic Coatings for Sales and Marketing Personnel" will be conducted on July 17-19. The class is aimed at sales and marketing personnel in the coatings industry.

The course includes: composition of coatings; relationships between composition and performance characteristics; customers' specifications and testing techniques as related to formulation criteria; and business aspects of coatings.

An open forum session, designed for the beginning salesperson, will be featured during the short course.

Continuing Education Units will be awarded for successful completion of each short course.

For further short course details, contact Michael R. Van De Mark, Director, Coatings and Polymer Science Program, UMR, Rolla, MO 65401-0249.

OCCA to Sponsor Surcon '91 In England, on June 12-14

The technical program for Surcon '91, sponsored by the Oil and Colour Chemists' Association (OCCA), Wembley, Middlesex, England, has been completed. The event will be held at the Moat House International Hotel, in Stratford-upon-Avon, England, on June 12-14, 1991.

Surcon '91 is the first in a series of biennial conferences organized by OCCA and will feature reviews and supporting papers, developing the technical themes of the reviews.

A total of 22 invited papers, drawn from major international companies and research organizations, will be presented.

Delivering the opening keynote address for Surcon '91 will be Herman Scopes, Principal Executive Officer of ICI Paints.

For more details on the conference, contact Chris Pacey-Day, OCCA, Priory House, 967 Harrow Rd., Wembley, Middlesex, England HA0 2SF.

Second Annual Research Fellowship Offered By Henkel Corporation

Application for the second annual Henkel Corporation Research Fellowship must be made by February 1, 1991. The award supports the advanced academic study of surface and colloid chemistry.

Under the fellowship, Henkel will contribute $20,000 for each of two years to students working toward Ph.D. Degrees in surface and colloid chemistry at graduate schools in the U.S. The fellowship is administered by the American Chemical Society's Division of Colloid and Surface Chemistry.

The funds are to be used entirely for the Fellow's stipend, scientific travel, and other direct research costs. The award is intended to support outstanding graduate students during their final two years (preferably, their third and fourth years) of doctoral thesis research. This research must represent a significant advance in understanding fundamental chemical processes in interfacial systems.

Applicants must independently prepare a proposal based on their thesis research plans and containing: a 100-word research proposal abstract; a detailed research proposal (eight double-spaced pages) with background and literature survey, specific project goals, methods, and critical scientific decision points, and required equipment and supplies; a brief (1-2 paragraph) statement of career goals and how this fellowship can contribute to achieving these goals; a project budget delineating the distribution of funds between stipend, travel, equipment, supplies, and other direct costs, and also submit a letter of budget approval from the department chairman (the funds may not be used for overhead costs, or tuition and fees, which must be waived by the university); a curriculum vitae, with reprints of any publications, and undergraduate and graduate transcripts; and letters of recommendation from the research advisor and two additional references (research advisor to include a statement of available research facilities).

When the second annual award is granted, two recipients will receive the fellowship concurrently.

Notice of the second annual award is being transmitted to approximately 600 accredited departments of chemistry and chemical engineering at colleges and universities in the U.S.

For funding to commence in the fall semester, 1991, three copies of the above documents should be submitted by February 1, to the Selection Committee Chairman, Dr. David I. Devore, Henkel Corp., 300 Brookside Ave., Ambler, PA 19002.

CALL FOR PAPERS

Symposium on *"Electrochemical Impedance: Analysis and Interpretation"*
Sponsored by ASTM Committee G-1 on Corrosion of Metals
November 4-5, 1991 • San Diego, CA

Prospective authors are invited to submit papers for the "Electrochemical Impedance: Analysis and Interpretation" Symposium sponsored by ASTM Committee G-1 on Corrosion of Metals, in San Diego, CA, on November 4-5, 1991. The symposium will be held preceding the November 6-8, 1991 standards development meetings of Committee G-1.

Papers are requested on the application of electrochemical impedance measurements to corrosion prediction and evaluation emphasizing data analysis and interpretation.

The technical program will consist of invited and submitted papers covering the following areas:

Verification/Validity of Results—Kramers-Kronig transformation methods; experimental methods to verify results; and electrical equivalent circuit analog methods;

Modeling/Calculations to Interpret Results—electrochemical kinetic modeling; electrical equivalent circuit analog methods/fitting procedures; complex nonlinear least squares methods; and deconvolution methods.

Interpretation and Analysis for Practical Corrosion Prediction—corrosion rate determination; low conductivity environments; organic and inorganic coatings on metals; passivity of metals; anodization/conversion coatings; pitting/crevice corrosion; dealloying; flow induced corrosion; and reaction rate parameters; and

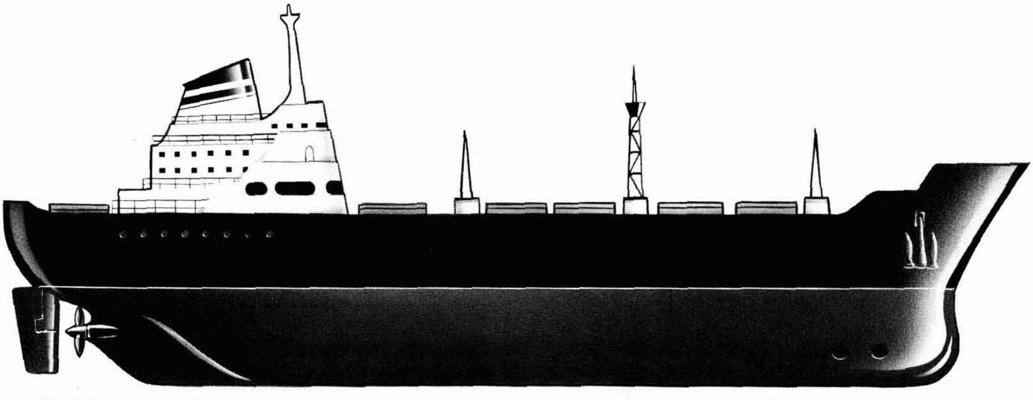
Other Experimental Methods to Enhance Data Interpretation—harmonic spectroscopy for analysis on non-linear systems; photoelectrochemical impedance; and fast Fourier transform methods.

Papers are being sought on such topics as: the impact of problems encountered with instrumentation and test methods on data interpretation, improvements in methods for modeling, interpretation, and analysis of results, improvements in techniques and methods for corrosion evaluation and prediction, and applications to a variety of corrosion problems.

Prospective authors are requested to submit a 300-500 word abstract along with the ASTM submittal form by January 4, 1991 to Dorothy Savini, Symposia Operations, ASTM, 1916 Race St., Philadelphia, PA 19103-1187. Authors will be notified by March 1, 1991 of their acceptance for presentation.

A technical publication based upon the symposium proceedings is anticipated. Final manuscripts for this publication are due by September 6, 1991.

More information is available from symposium chairmen: John R. Scully, Sandia National Laboratories, Org. 1834, P.O. Box 5800, Albuquerque, NM 87185; David C. Silverman, Monsanto F2W4, 800 N. Lindbergh Blvd., St. Louis, MO 63167; and Martin W. Kendig, Rockwell International Science Center, 1049 Camino Dos Rios, Thousand Oaks, CA 91360.



Carbon Black

Capabilities and services in carbon black manufacture and technology are described in a recently published four-color brochure. The literature discusses the facilities, licensing, recent product developments, process technology, and testing services being offered. Copies of the capabilities brochure may be obtained from the Concarb Div., Witco Corp., 10500 Richmond Ave., P.O. Box 42817, Houston, TX 77242-2817.

Containers

A line of shipping and storage containers for hazardous liquids has been introduced through literature. The containers reportedly combine the chemical resistance of a polyethylene tank with the strength of a quarter-inch double wire mesh and structural steel enclosure. The bins are available in capacities of 250, 350, and 550 gallons. Additional information on Poly Jumbo™ Bin shipping and storage containers for hazardous liquids is available from Clawson Tank Co., 4701 White Lake Rd., Clarkston, MI 48016-0350.

Corrosion Chamber

Technical information has been released on a new cyclic corrosion test. The test reportedly uses frequent cycling, a forced air dry-off cycle, and a different corrosive solution to allow a better simulation of typical industrial and marine conditions. Contact Q-Panel Co., 26200 First St., Cleveland, OH 44145 for further details on the Mebon Prohesion® chamber.

Fluid Mixing

A 161-page book which provides an introduction to mixers and fluid mixing technology has been released. Six easy-to-follow chapters cover fluid regimes, impeller design, flow control, fluid blending, and various applications. Each chapter includes photos, charts, and illustrations. For ordering information, contact Betty Felix, Lightnin, 135 Mt. Read Blvd., Rochester, NY 14603.

Psychrometric Tables

Copies of the original 1941 Weather Bureau Psychrometric Tables for obtaining vapor pressure, relative humidity, and temperature of the dew point have been made available, while supplies last. For more information, contact Frank Reuter, Marketing Manager, Zorelco Ltd., P.O. Box 25500, Dept. B25, Cleveland, OH 44125-0500.

Waterborne Polymer

The introduction of a waterborne, air drying vinyl acrylic copolymer has been made through literature. The copolymer reportedly provides good barrier properties and flexibility for fire retardant textile coatings used in such applications as furnishing fabrics and automotive interiors. Technical information on Haloflex DP-563 copolymer can be obtained by contacting ICI Resins US, 730 Main St., Wilmington, MA 01887-0677.

Solenoid Valve

The development of a three-way corrosion resistant solenoid valve which operates in situations involving high inlet and high back pressures has been announce through literature. This product is designed to handle corrosives such as acids, caustics, and ultrapure liquids, and is available in sizes 1/4 in. and 1/2 in. NPT. Contact Plast-O-Matic Valves, Inc., 430 Route 46, Totowa, NJ 07512 for more details on the solenoid valve.

Weight Filler

Technical data has been released on an electronic weight filler for containers ranging from two to seven gallons. Available nozzles include top fill, open pail, or subsurface. Contact Ambrose Co., 20325-71st Ave., N.E., Ste. D, Arlington, WA 98223 for more information on the Model 1553 electronic weight filler.

Inhibitive Pigment

Information is obtainable on a strontium-zinc complex, nontoxic, chromate-free pigment. The pigment was developed to provide corrosion resistance equivalent to zinc chromate and other chromate pigments in a variety of trade paints and industrial coatings. Product data on HALOX SZP-391 is available by contacting Halox Pigments, Div. of Hammond Lead Products, 2340-165th St., Hammond, IN 46320.

Acrylic Polymers

A line of acrylic polymers used in decorative and high performance powder coatings, such as TGIC and urethanes, is the subject of recently released literature. The polymers reportedly can be used as the primary vehicle in a paint formulation or as a modifier for common polyester resins. Contact S.C. Johnson Wax, 1525 Howe St., Racine, WI 53403.

Weathering Handbook

A comprehensive guide which includes the theory of photophysics and photochemistry, degradation mechanisms of important industrial materials and products, testing methods and conditions, and climatic data for worldwide locations has been published. For information on how to order the 517-page book "Weathering Handbook," contact ChemTec Publishing, 38 Earswick Dr., Toronto, Ont., M1E 1C6, Canada.

Tank Feed System

A two-page bulletin detailing a chemical handling shipping and storage tank feed system for bulk chemical consumers has been published. The illustrated bulletin describes the features of the system and provides a detailed drawing. Addition information on the Jumbo Feed System for chemical handling is available from the Clawson Tank Co., 4701 White Lake Rd., Clarkston, MI 48016-0350.

Ionizing Transvector

Data has been released on an ionizing transvector which is designed to neutralize static electricity and blow off contaminants from a wide area. Available in 6 in., 12 in., 18 in., and 24 in. standard lenghts, the units consume 4.3 SCFM of filtered compressed air per inch of length at 80 PSIG. For more information on these and other static control products, write Application Engineering Dept., Vortec Corp., 10125 Carver Rd., Cincinnati, OH 45242-9976.

Polyols

A series of ester and ether polyols suited for the manufacture of polyurethane oligomers used to formulate coatings for radiation curing systems has been introduced through literature. Properly formulated, the polyols reportedly can impart flexibility and solvent- and abrasion-resistance to polyurethane oligomers. For technical data on Fomrez® ester and ether polyols, write Organics Div., Witco Corp., Dept. U, 2701 Lake St., Melrose Park, IL 60160-3041.

Fluorescence Spectroscopy

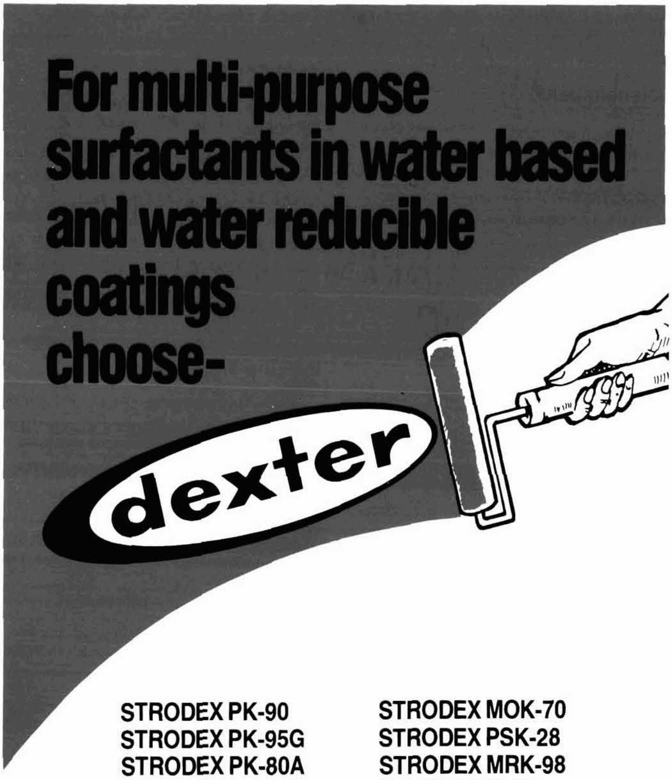
A complete line of supplies and accessories for UV/visible and fluorescence spectroscopy is described in a 52-page catalog. For a free copy of the catalog, contact PE Express, The Perkin-Elmer Corp., 761 Main Ave., Norwalk, CT 06859-0156.

Infrared Technology

A four-color, illustrated brochure on advanced infrared paint drying methods and equipment for the automotive finishing industry has been made available. The bulletin contains information on new infrared technology and associated equipment that speeds up drying or curing and improves the appearance of powder, water-based, and solvent-based coatings used in automotive, industrial finishing, and metal decorating markets. Copies of the six-page brochure may be obtained by writing Thermal Innovations Corp., 2516 Highway 35, Manasquan, NJ 08736.

Modified Phenoxy Resins

An eight-page booklet detailing modified phenoxy resins designed for flexibility and deep draw has been issued. According to the brochure, these modified phenoxy resins readily crosslink with melamine, urea-formaldehyde, phenolic, and isocyanate-functional crosslinkers. Copies of the booklet, "UCAR® Modified Phenoxy Resins PKHM-10, -30, and -301 for Flexibility and Deep Draw," designated F-60758, are available from Union Carbide Chemicals and Plastics Co., Inc., UCAR Coatings Resins, Dept. L4489, 39 Old Ridgebury Rd., Danbury, CT 06817-0001.



Ultraviolet Radiometer

A data sheet has been issued describing a line of products which measures ultraviolet incident radiation. The compact, handheld unit has been designed to be used in any environment where inspection and adjustment of ultraviolet sources are critical. For more details on the Minolta UM-1 Ultraviolet Radiometer, write Minolta Corp., Industrial Meter Div., 101 Williams Dr., Ramsey, NJ 07446.

Air Pollution Control

A system which uses high temperatures to convert airborne pollutants to simple carbon dioxide and water vapor has been introduced through literature. Used to limit the pounds of VOCs released into the atmosphere, the system can be used in a number of industries, including printing, coating, laminating, enameling, chemical processing, and others. Contact Reeco®, Box 600, 520 Speedwell Ave., Morris Plains, NJ 07950-2127 for more detailed information on the RE-THERM® system.

Cadmium Pigments

A data sheet has been released on a line of low-dust, cadmium pigments. The pigments reportedly can help reduce the potential for airborne exposure to cadmium in the workplace. Contact Englehard Corp., Specialty Minerals and Colors Group, Menlo Park CN28, Edison, NJ 08818 for more information on the MINDUST™ cadmium pigments line.

Wood Stains

A line of weather-resistant exterior wood stains which are engineered to meet architectural specifications on a national, state, and local level is the topic of a recently released data sheet. Application and cleanup are environmentally safe and user friendly. For additional information on "UV-Weather Master" stain, contact Coating Corp. of America, 8100 Secura Way, Santa Fe Springs, CA 90670.

Thermogravimetric Analysis

The availability of a thermogravimetric analysis (TGA) system designed to meet the basic thermal analysis testing needs for quality control laboratories and plastics processors has been announced through literature. The system allows analysts to conduct composition analysis on multi-component systems and to determine materials thermal stability. Write TA Instruments, Concord Plaza, Quillen Bldg., 3411 Silverside Rd., Wilmington, DE 19810 for a fact sheet on the TGA 50 system.

VOC Guide Specifications

VOC complying coating systems for the areas of California, New York/New Jersey, and Maricopa County, Arizona are outlined in recently released guide specifications. The 12-page booklet contains a painting schedule which arranges product selections by substrate for exterior and interior exposures. Inquiries for additional information should be identified as "VOC Guide Specs," and sent to The Sherwin-Williams Co., c/o Robert Silverman Co., 1375 Euclid Ave., Cleveland, OH 44115.

Weathering Chamber

Technical information is obtainable on a table-top weathering chamber which provides accelerated testing for the effects of sunlight and ultraviolet radiation. Practical applications include routine production tests, inspection of incoming goods, quality control, and research and development testing. For more information on the Suntest CPS, write Thomas Faulkner, DSET Laboratories, Box 1850 Black Canyon Stage I, Phoenix, AZ 85027.

Nonmercurial Bactericide

The newest member of a line of nonmercurial bactericides has been introduced through literature. The product is a water soluble liquid organic bactericide that reportedly provides in-can preservative properties to a variety of paint formulations at concentrations below the recommended use level of other nonmercurial bactericides. Technical notes on Troysan® 186 may be obtained by contacting Troy Customer Service, One Avenue L, Newark, NJ 07105.

Interferometer System

A six-page, full-color brochure detailing an interferometer system has been published. The bulletin includes sample screens depicting transmitted wavefronts, angle error in 90° prisms, magnetic disk substrates, wavefront shape, quality, slope, Seidel aberrations, and Point Spread Function. Technical data on the Mark IVxp interferometer system can be obtained by contacting Zygo Corp., Laurel Brook Rd., P.O. Box 448, Middlefield, CT 06455-0448.

Micropore System

A micropore analysis system that includes four independent data reduction techniques is the subject of recently released literature. Types of analyses include micropore size and pore volume, micropore distribution, and micropore surface area. Contact Micromeritics, One Micromeritics Dr., Norcross, GA 30093-1877 for more information on the ASAP 2000 Micropore System.

Epoxy Curing Agents

A product guide listing epoxy curing agents and reactive diluents is in print. Presented in easy-to-read chart form, the guide describes the typical physical properties and principal applications for more than 180 curing agents and diluents developed to meet the needs of the coatings, adhesives, electrical, construction, and reinforced plastics industries. For a copy of the new product guide, contact Pacific Anchor Chemical Corp., c/o Air Products and Chemicals, Inc., 7201 Hamilton Blvd., Allentown, PA 18195-1501.

Aqueous Cleaning Equipment

A data sheet has been released on aqueous cleaning equipment designed to deliver good cleaning results without the environmental hazards associated with previous cleaning methods. The machine is pneumatically-powered and can be used for decarbonizing, stripping, phosphatizing, quenching, pickling, and for applying protective coatings in addition to its cleaning and degreasing operations. For further details on Magnus® industrial cleaning equipment, write Man-Gill Chemical Co., 23000 St. Clair Ave., Cleveland, OH 44117.

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

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

(May 12-17)—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.

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.

SPECIAL SOCIETY MEETINGS

1991

(Feb. 6-8)—Southern Society. 18th Annual Water-Borne, Higher-Solids, and Powder Coatings Symposium. Co-sponsored by the Department of Polymer Science at the University of Southern Mississippi (USM). New Orleans, LA. (Robson F. Storey and Shelby F. Thames, Co-Organizers, WBHS&PC Symposium, Dept. of Polymer Science, USM, Southern Station, P.O. Box 10076, Hattiesburg, MS 39406-0076).

(Feb. 18-20)—Western Coatings Societies' 20th Biennial Symposium and Show. Hilton Hotel, San Francisco, CA. (Patricia Stull, Pacific Coast Chemicals, 2424—4th St., Berkeley, CA 94710).

(Mar. 13-15)—Dallas and Houston Societies. Southwestern Paint Convention. Dallas, TX.

(Apr. 3-6)—Southern Society Annual Meeting. The Peabody Hotel, Memphis, TN. (Vernon Sauls, McCullough & Benton, P.O. Box 272360, Tampa, FL 33688).

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

OTHER ORGANIZATIONS

1991

(Jan. 20-23)—"Odor Evaluation." Seminar held in conjunction with ASTM's Committee D-1 on Paint and Related Coatings and Materials meeting. Embassy Suites Hotel, Ft. Lauderdale, FL. (Scott Orthey, ASTM, 1916 Race St., Philadelphia, PA 19103).

(Jan. 28-30)—"Concrete: Surface Preparation, Coatings and Linings, and Inspection Techniques." Symposium sponsored by National Association of Corrosion Engineers (NACE). J.W. Marriott Hotel, Houston, TX. (NACE Education and Training Dept., P.O. Box 218340, Houston, TX 77218).

(Jan. 28-Feb. 1)—American Electroplaters and Surface Finishers Society (AESF) Week featuring The Surface Finishing Electronics Applications Symposium. Hyatt Orlando Hotel, Kissimmee, FL. (AESF Education Services Dept., 12644 Research Pkwy., Orlando, FL 32826).

(Feb.)—Inter-Society Color Council Williamsburg Conference. Williamsburg, VA. (Louis A. Graham, Lou Graham & Associates, Inc., 1207 Colonial Ave., Greensboro, NC 27408).

(Feb. 3-8)—"Protective Coatings and Linings." Course sponsored by the National Association of Corrosion Engineers (NACE), London, England. (NACE Europe, P.O. Box 251, Guildford, Surrey, GU1 3DJ, United Kingdom).

(Feb. 3-8)—"Cathodic Protection: Theory and Data Interpretation." Course sponsored by the National Association of Corrosion Engineers (NACE), London, England. (NACE Europe, P.O. Box 251, Guildford, Surrey, GU1 3DJ, United Kingdom).

(Feb. 17-20)—14th Annual Meeting of The Adhesion Society, Bellview Biltmore Hotel, Clearwater, FL. (Howard M. Clearfield, IBM T.J. Watson Research Center, P.O. Box 218, M/S 38-145, Yorktown Heights, NY 10598).

(Feb. 17-22)—"Basic Coating Inspection." Session I of the International Coating Inspector Training and Certification Program. Sponsored by the National Association of Corrosion Engineers (NACE), Sheffield, England. (NACE Europe, P.O. Box 251, Guildford, Surrey, GU1 3DJ, United Kingdom).

(Feb. 17-22)—"Intermediate Coating Inspection." Session II of the International Coating Inspector Training and Certification Program. Sponsored by the National Association of Corrosion Engineers (NACE), Sheffield, England. (NACE Europe, P.O. Box 251, Guildford, Surrey, GU1 3DJ, United Kingdom).

(Feb. 19-22)— PDCA Annual Convention and Paint and Paper Pro Show. Sponsored by Painting and Decorating Contractors of America (PDCA). Atlanta Marriott Marquis, Atlanta, GA. (PDCA, 3913 Old Lee Highway, Ste. 33-B, Fairfax, VA 22030).

(Mar. 4-8)—Corrosion/91 sponsored by the National Association of Corrosion Engineers (NACE). Cincinnati, OH. (NACE, Conference Manager, P.O. Box 218340, Houston, TX 77218).

(Mar. 11-15)—62nd Introductory Short Course on the Basic Composition of Coatings. Sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (Norma R. Fleming, Sr. Continuing Education Coordinator, UMR, 119 M.E. Annex, Rolla, MO 65401-0249).

(Mar. 12-15)—Corrosion/91. Sponsored by National Association of Corrosion Engineers (NACE). Cincinnati Convention Center, Cincinnati, OH. (NACE, P.O. Box 218340, Houston, TX 77218).

(Mar. 18-20)—"Polymer Blends and Alloys: Phase Behavior, Characterization, Morphology, Alloying Technology." Short course sponsored by The Institute of Materials Science, State University of New York (SUNY), New Paltz, NY. (Institute of Materials Science, SUNY, New Paltz, NY 12561).

(Mar. 18-20)—Fourth Annual Conference on Lead Paint Removal from Industrial Structures. Sponsored by Steel Structures Painting Council (SSPC). Omni Charlotte Hotel, Charlotte, NC. (Rose Mary Surgent, SSPC Meetings Manager, SSPC, 4400 Fifth Ave., Pittsburgh, PA 15213-2683).

(Mar. 19-21)—"farbe + lack 91." The First Congress Exhibition for *the Coating, Printing Inks, Adhesives, and Sealants Industry*. Sponsored by *farbe + lack*. Nuremberg Exhibition Grounds, West Germany. (Klaus Geissler, Manager, Events Division, Curt R. Vincentz Verlag, Postfach 62 47, 3000 Hannover 1, West Germany).

(Mar. 25-29)—22nd Introductory Short Course on Paint Formulation. Sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (Norma R. Fleming, Sr. Continuing Education Coordinator, UMR, 119 M.E. Annex, Rolla, MO 65401-0249).

(Apr. 3-5)—Hazardous Materials Management Conference and Exhibition/Central (HazMat/Central '91). O'Hare Exposition Center, Rosemont, IL. (Tower Conference Management Co., 800 Roosevelt Rd., Bldg. E—Ste. 408, Glen Ellyn, IL 60137-5835).

(Apr. 22-25)—The Euro-Asian *Interfinish Isreal 1991*. Conference sponsored by the Metal Finishing Society of Isreal. Herzlia, Isreal. (Secretariat, Ortra, Ltd., 2 Kaufman St., Tel-Aviv 61500, Isreal).

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

(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 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 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).

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'Humbug' from Hillman

To all my bemused, confused, occasionally amused and patiently tolerant readers—"May the holidays find your cups filled with joy, excellent health, and good fortune!"

Steve Betit, President of our local Lions Club recently handed me the poignant bit of poetry that follows. It was printed on an ancient, yellowed, and fragile piece of paper—probably of an era shortly after the production of the Dead Sea Scrolls. The contents will serve to attest to its age.

There was a man who came to town
To see what he could find around,
Stopped at a restaurant—a swell affair
And sat him down upon a chair.

He scanned the menu through and through
To see what just one pence could do.
The only thing would do at all
Would be to order one meat ball.

He called the waiter from the hall
and softly ordered one meatball.
The waiter bellowed down the hall,
"This gentleman wants one meatball."

The people stared, both one and all
To see who ordered one meatball.
The gentleman, now ill at ease,
Softly whispered, "Some bread, sir, please."

The waiter shouted from the hall,
"You get no bread with one meatball."
The poor old man then went outside,
And shot himself until he died.

There is a moral to this all—
Don't order bread with one meatball!

"Yes. Ma'am," said the sailor, relating his experiences to an elderly lady, "I was shipwrecked and lived for a week on a tin of sardines."

"Dear me," said the lady, "how did you keep from falling off?"

The marine drill sergeant, in frustration, barked, "All right, you dummies, fall out!" With more confusion than order, every man in the company, except one, fell out and scattered.

The sergeant glared at the remaining recruit and said, "Well?"

The rookie smiled and replied, "There sure were a lot of them, weren't there, Sarge?"

When a friend last went to his doctor complaining of the various aches and pains that come with the passing years, the doctor responded with, "You know, I can't make you young again." My friend said, "Who's asking you to make me young? I just want to keep getting older."

The horse and mule live thirty years,
And know nothing of wine and beers;
The goat and sheep at twenty die,
And never taste of scotch and rye;
The cow drinks water by the ton,
And at eighteen is mostly done;
The dog at fifteen cashes in,
Without the aid of rum or gin;
The cat in milk and water soaks,
And then in twelve short years, it croaks;
And modest, sober bone-dry hen
Lays eggs for nogs, then dies at ten;
In fact, all animals are strictly dry,
They sinless live and swiftly die;
But sinful, ginful, rumsoaked men
Survive for three-score years and ten;
And some of us, though mighty few,
Stay pickled 'til we're ninety two!

George Pugh
—*1973 Farmer's Almanac*

George Bernard Shaw once invited Sir Winston Churchill to an opening, by wire, thus—

HAVE RESERVED TWO TICKETS FOR MY FIRST NIGHT. COME AND BRING A FRIEND IF YOU HAVE ONE.
SHAW

Shaw received the following:

IMPOSSIBLE TO COME THE FIRST NIGHT. WILL COME TO SECOND NIGHT IF YOU HAVE ONE.
CHURCHILL

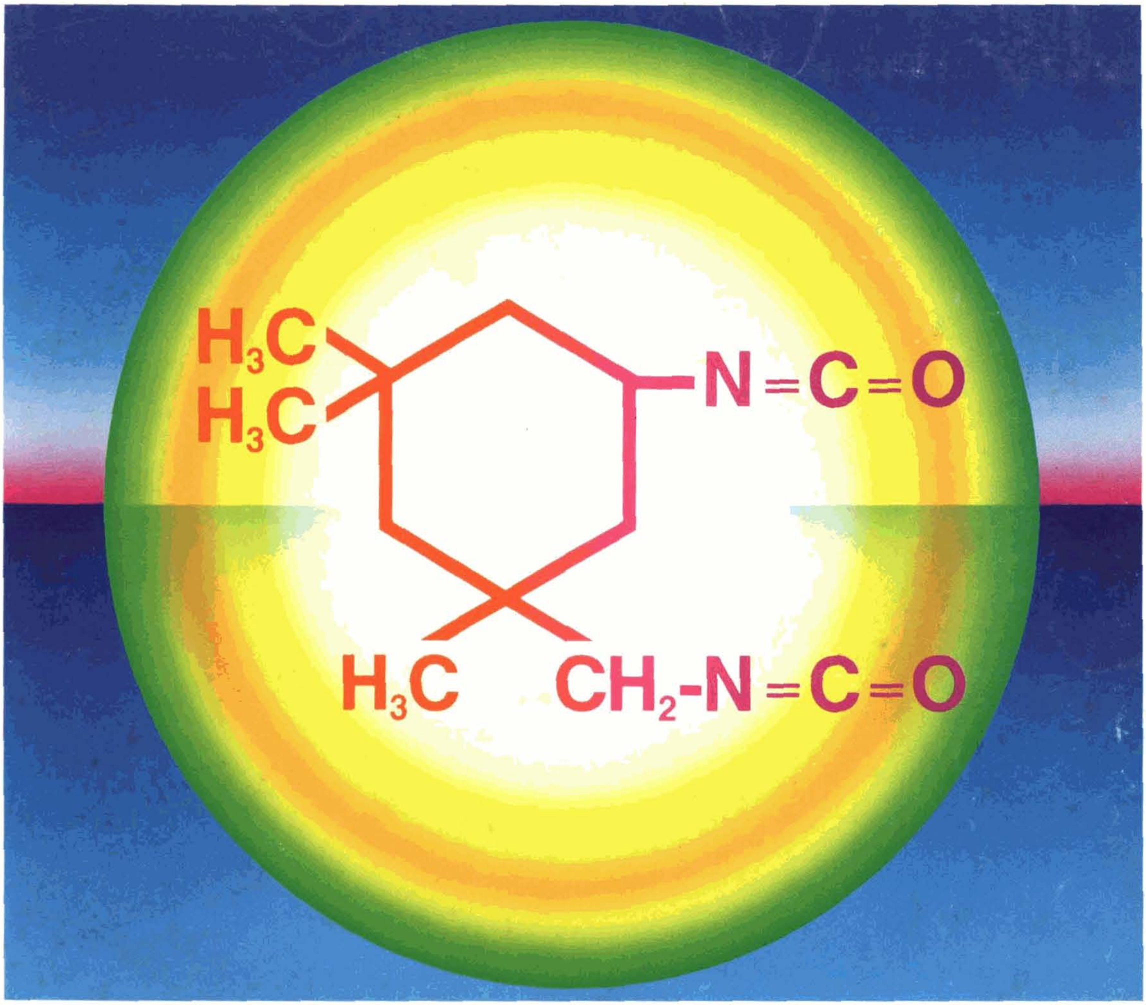
There was a loud knock at Mrs. Murphy's door. When she opened it, the red-faced gent at the door demanded, "Be you the Widow Murphy?"

"I am Mrs. Murphy," she said indignantly, "but I be no widow."

"You be'nt, eh?" cackled the visitor, "wait 'til you see what they're bringing upstairs!"

Bennett Cerf

—Herb Hillman
Humbug's Nest
P.O. Box 135
Whitingham, VT 05361



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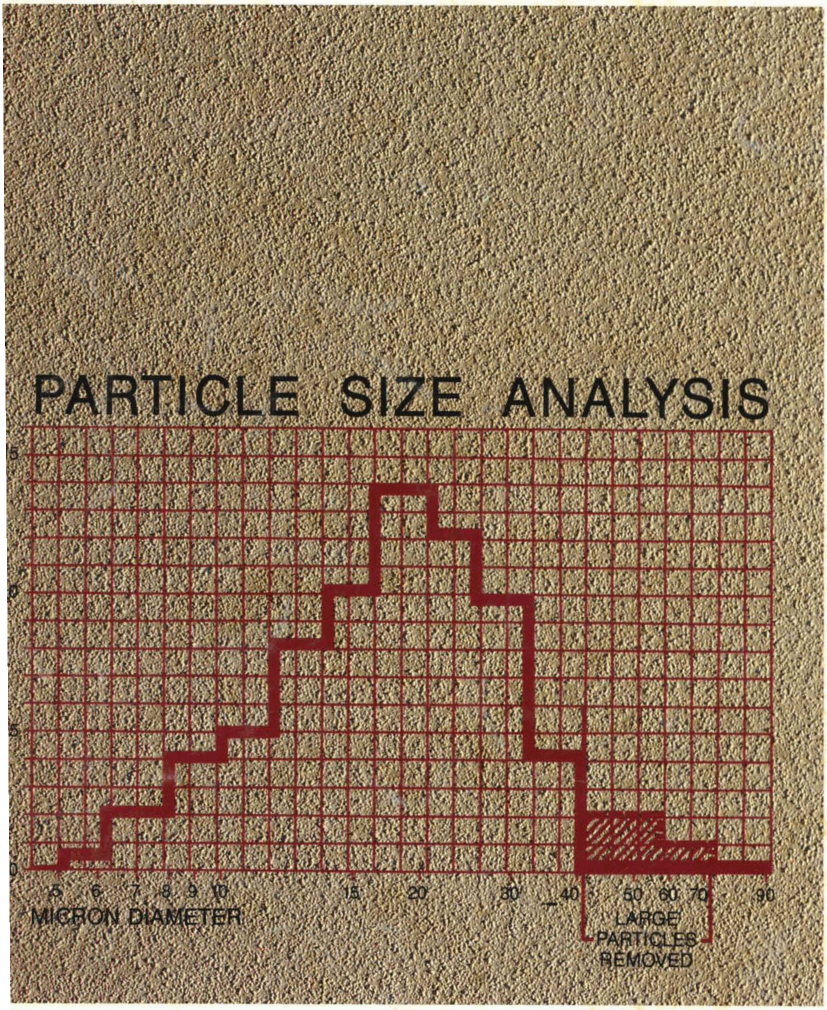

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