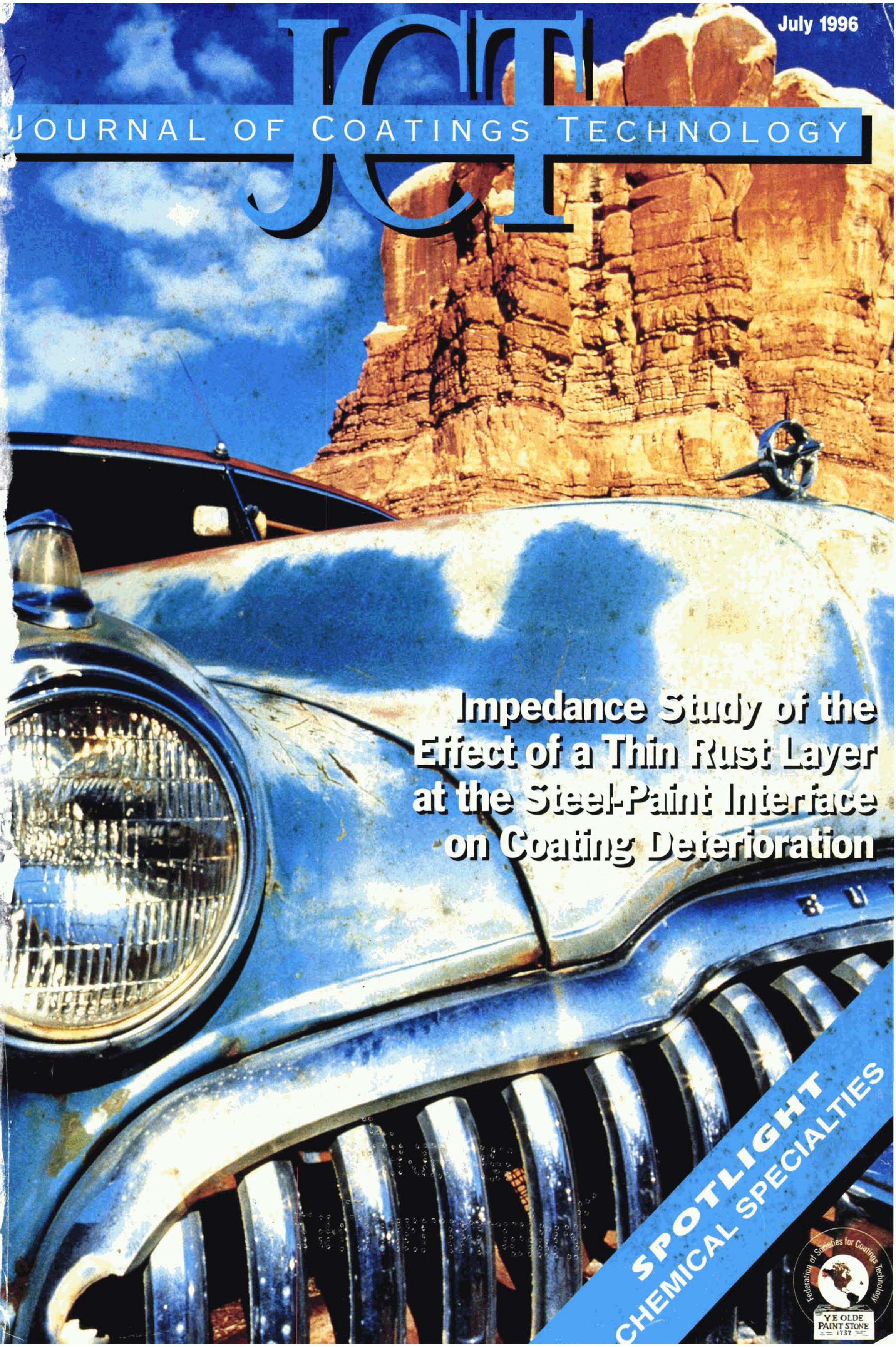
July 1996

JCT
JOURNAL OF COATINGS TECHNOLOGY



Impedance Study of the Effect of a Thin Rust Layer at the Steel-Paint Interface on Coating Deterioration

SPOTLIGHT
CHEMICAL SPECIALTIES

Federation of Societies for Coatings Technology
YE OLDE PAINT STONE 1737

Circle No. 237 on the Reader Service Card

FEDERATION OF SOCIETIES
FOR COATINGS TECHNOLOGY

ice

INTERNATIONAL
COATINGS EXPO
AND TECHNOLOGY CONFERENCE

October 22-25, 1996
McCormick Place North
Chicago, Illinois

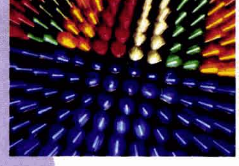
Advance Registration and Housing Information

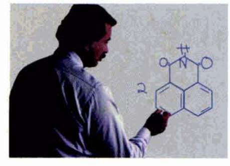
Insights & Innovations

Tell me, and I forget.
Teach me, and I may remember.
Involve me, and I learn.

— Benjamin Franklin

Federation of Societies for Coatings Technology
YE OLDE PAINT STONE 1737





FEDERATION OF SOCIETIES
FOR COATINGS TECHNOLOGY

ice
INTERNATIONAL
COATINGS EXPO
AND TECHNOLOGY CONFERENCE

An Invitation from the President

The FSCT is very excited about the events being planned this year for the annual gathering of our membership and the industry in Chicago. In a departure from past years, the Federation embarks in a new direction, prepared to offer an expanded show and an expanded technical program. Both are geared to bring new information, new technology, and the training experience needed by both the novice and experienced chemist, as well as your management, customers, and suppliers.

The new International Coatings Expo, or "ICE", will easily be the largest coatings manufacturing exposition ever held, with over 300 exhibitors in almost 100,000 sq.ft. of booth space, featuring exhibits covering all aspects of the industry.

Even more impressive will be the newly formed program of seminars and training sessions at the Coatings Technology Conference. Beginning on Tuesday, and running through Thursday, these conference sessions are specifically designed to bring you up to date on the new technologies and processes needed for today's industry professional.

Rounding out the convention is, of course, the FSCT's Annual Meeting, including the technical programming highlighted by the Mattiello Lecture by Dr. David Bauer, of Ford Motor Company.

I invite you to be part of the new FSCT and to come share the wealth of information available in Chicago!

Dr. Darlene Brezinski
FSCT President, 1995-96

FSCT Unveils New International Coatings Expo and Technology Conference

"INSIGHTS AND INNOVATIONS"

Encompassing the spectrum of coatings manufacturing, the new format of the FSCT's annual convention will feature a record-breaking exhibition of over 300 supplier companies in the International Coatings Expo. Held in conjunction with the FSCT Annual Meeting Technical Program the "ICE" will present over 100,000 square feet of exhibits. Come meet these suppliers for a face-to-face discussion of your needs and concerns. Problem-solving opportunities abound at "ICE '96"!

New to the 1996 FSCT Annual Meeting is the International Coatings Technology Conference. The conference provides a forum for learning at all levels of the coatings industry, from the newly hired technician to top level management. Each course has been designed for specific areas of your organization, including lab personnel, sales and marketing staff, manufacturing, quality assurance and research and development.

Highlights of the conference include:

- **Five Pre-Convention Training Seminars**, scheduled for Tuesday, October 22, 1996 at the Chicago Hilton & Towers (FSCT Headquarters), including an on-site program on Spray Applications at Binks Manufacturing.
- **An Executive Forum**, covering Technology Management, also scheduled for Tuesday.
- **Four two-day Coatings Technology Conference Courses**, scheduled for Wednesday and Thursday, October 23-24, 1996 at McCormick Place, allowing the attendees time to visit the International Coatings Exposition (ICE).
- **Complimentary Attendance** to the International Coatings Expo and FSCT Annual Meeting Technical Presentations is included as a part of the registration fee for all one- and two-day and full conference registrations.
- **Set of Course Materials** is provided to the attendees of each individual program.

Both you and your company benefit from attendance at this event. Your personal knowledge increases, which in turn improves your value within your organization, while the company stands to benefit from the new ideas and solutions you've learned during the conference. The conference also provides an opportunity for all coatings personnel to participate in the industry's premier event and learn the latest *"Insights and Innovations"* taking place in coatings technology.

Federation of Societies for Coatings Technology
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1996 Annual Meeting Technical Program

In 1996, attendees at the International Coatings Expo (ICE) will have the opportunity to attend several technical sessions as part of their FSCT Annual Meeting registration. This year's technical program includes:

- *Roon Award Competition Papers*, detailing original research presented for the first time
- *APJ/Voss Award Competition Papers*, a selection of FSCT Constituent Society papers developed by the Society's technical committees
- *International Papers*, consisting of the latest advances in coatings development contributed by professionals from around the world
- *Technical Focus Lecture* and the *Mattiello Memorial Lecture*, two special technical offerings

The tentative schedule of Annual Meeting presentations include:

ROON AWARD COMPETITION PAPERS

"A Unifying Model for Understanding Associative Thickener Influences on Waterborne Coatings"
— *J. Edward Glass, Mao Chen and M-R Tarng, North Dakota State University, Fargo, ND and Robert Bucharek and Jack Dickinson, DuPont, Wilmington, DE*

"Rheological Changes During the Drying of a Waterborne Latex Coating"
— *Matthew Gebhard and Frank Löfflath, Rohm & Haas Co., Spring House, PA*

"New Developments in Acrylate Modified Epoxy-Amine Cure Coatings"
— *Michael A. Bailey, Tim Cauffman and Richard Coston, Sartomer Co., Exton, PA*

"Waterborne Coatings: Latex Blends or Core/Shell Latexes"
— *Morand Lambla, Stephane Lepizzera and Tha Pith, Institut Charles Sadron (CRM/EAHP), Strasbourg, France*

"Mechanistic Considerations of Particle Size Effects on Film Properties of Hard/Soft Latex Blends"
— *Sarah Eckersley and Bradley Helmer, The Dow Chemical Co., Midland, MI*

INTERNATIONAL PAPERS

"Component Thinking in Paint Production"
— *Ms. Carola Grundfelt-Forslus, Tikkurila OY, Vantaa, Finland (presented on behalf of SLF)*

"High Durable Coating Systems for Steel Structures and Their Performances"
— *Dr. Hiroyuki Tanabe, Masanori Nagai and Masafumi Kano, Dai Nippon Toryo Co. Ltd., Ohotawara-City, Tochigi-Pref., Japan (presented on behalf of JSCM)*

"Environment-Friendly Antifouling Paint"
— *A. Perichaud and J. Coquillaud, Catalyse Company, (presented on behalf of AFTPVA Section of FATIPEC)*

"Solventless Aliphatic Polyisocyanates Hardeners for Low VOC PU Formulations in the Coatings Industry"
— *Pierre Ardaud and Eugenie Perroud, Rhone-Poulenc, Decines, France (presented on behalf of FATIPEC)*

APJ/VOSS AWARD COMPETITION PAPERS

"An Investigation of the Effects of Formulation on Selected Properties of UV Curable IPN Coating"
— *Detroit Society for Coatings Technology*

"Critical Factors for the Coefficient of Friction Measurements of Coatings"
— *Golden Gate Society for Coatings Technology*

"Direct VOC Analysis of Water Based Coatings by Solid Phase Micro Extraction and Gas Chromatography"
— *Los Angeles Society for Coatings Technology*

"Temperature Dependence on Rheological Behavior in Waterborne Paint Systems"
— *Cleveland Society for Coatings Technology*

TECHNICAL FOCUS LECTURE

This presentation kicks off the technical portion of the Annual Meeting. The Technical Focus Lecture is designed to recognize the ongoing work of a coatings industry practitioner. First presented in 1993, the Technical Focus Lecture has quickly become one of the most popular events at the Annual Meeting.

MATTIELLO MEMORIAL LECTURE

The 1996 Mattiello Lecturer is Dr. David R. Bauer of the Ford Motor Company in Dearborn, MI. The Mattiello Lecture will be delivered on Friday morning at 10:30 a.m. This year marks the 48th year the lecture has been presented at the Annual Meeting.

Tentative Schedule of Programming

Monday, October 21
5:00 pm - 7:00 pm —
Conference Registration, Chicago Hilton
6:00 pm - 8:00 pm —
Executive Forum Dinner,
Chicago Hilton

Tuesday, October 22
7:30 am - 5:00 pm —
Registration, McCormick Place
and Chicago Hilton
(Conference Only)
8:30 am - 4:00 pm —
Pre-Convention Training Seminars, Chicago Hilton
Executive Forum, Chicago Hilton

Wednesday, October 23
7:30 am - 5:00 pm —
Registration, McCormick Place
8:30 am - 4:00 pm —
Technology Conference Courses, McCormick Place
8:30 - 10:00 am —
FSCT Annual Meeting Opening Session,
McCormick Place
10:00 am —
International Coatings Expo Opens, McCormick Place
1:00 pm - 4:30 pm —
FSCT Annual Meeting
Technical Program, McCormick Place
2:00 pm - 4:00 pm —
Social Guest Program, Chicago Hilton

Thursday, October 24
7:30 am - 5:00 pm —
Registration, McCormick Place
8:30 am - 4:00 pm —
Technology Conference Courses,
McCormick Place
9:00 am - 5:00 pm —
International Coatings Expo, McCormick Place
9:00 am - 4:30 pm —
FSCT Annual Meeting Technical Program,
McCormick Place
12:00 noon - 2:00 pm —
FSCT Awards Luncheon
9:00 am - 4:00 pm —
Social Guest Tour, Chicago Hilton

Friday, October 25
7:30 am 12:00 noon —
Registration, McCormick Place
9:00 am - 12:00 noon —
International Coatings Expo, McCormick Place
9:00 am -11:30 am —
FSCT Annual Meeting Technical Program,
McCormick Place

Registration Packages

Registration fees include full admission to the International Coatings Expo as well as the FSCT Annual Meeting and its Technical Presentations and other events as outlined in the registration options below.

EXPO & FSCT ANNUAL MEETING INCLUDES:
- International Coatings Expo (ICE)
- FSCT Annual Meeting and Technical Presentations
- Opening Session
- Mattiello Lecture

FULL COATINGS TECHNOLOGY CONFERENCE AND EXPO INCLUDES:
- One Pre-convention Training Seminar (Tues., Oct. 22)
- One Conference Course (two-day program, Oct. 23-24)
- International Coatings Expo (ICE)
- FSCT Annual Meeting and Technical Presentations
- Mattiello Lecture

COATINGS TECHNOLOGY CONFERENCE INCLUDES:
- One Conference Course (two-day program, Oct. 23-24)
- International Coatings Expo (ICE)
- FSCT Annual Meeting and Technical Presentations
- Mattiello Lecture

EXECUTIVE FORUM INCLUDES:
- Executive Forum Dinner (Mon., Oct. 21)
- Managing Research & Development (Tues., Oct. 22)
- International Coatings Expo (ICE)
- FSCT Annual Meeting and Technical Presentations
- Opening Session
- Mattiello Lecture

PRE-CONVENTION TRAINING SEMINAR INCLUDES:
- One Pre-Convention Training Seminar (Tues., Oct. 22)
- International Coatings Expo (ICE)
- FSCT Annual Meeting and Technical Presentations
- Opening Session
- Mattiello Lecture

SOCIAL GUEST PROGRAM INCLUDES:
- Welcome Social (Oct. 23)
- Continental Breakfast and Tour (Oct. 24)
- International Coatings Expo (ICE)
- Opening Session

(The category Social Guest is not to be used by co-workers or associates in the industry. It applies to the Spouse or Significant Other of the industry attendee.)

Coatings Technology Conference

"EXECUTIVE FORUM"

Managing Technology for Strategic Success in the Coatings Industry

MONDAY EVENING (DINNER)
& TUESDAY (WORKSHOP)
OCTOBER 21-22, 1996
CHICAGO HILTON AND TOWERS

Course Description

This interactive, executive level workshop introduces the participants to the management tools and techniques required to fully link the R&D function with the strategic objective of the business. Based on the principles of "Third Generation R&D," the program uses presentations, group exercises and case studies. The course is designed for R & D group leaders; technical directors; senior chemists; marketing directors or managers; sales directors or managers; small business owners; and anyone with strategic leadership responsibility in their organization.

Attendees will learn:

- Methods to determine the feasibly of new technology
- How to assess the validity of new concepts and ideas
- Ways to use time and money more wisely in the pursuit of new advances in technology
- How to better understand the impact of R&D on the bottom line
- Techniques to associate marketing and technology while pursuing new ideas
- How to assess the R&D climate within the organization and how to identify improvement opportunities
- To examine the technology portfolio and align new strategies with the technological competitive position of the firm
- To create project selection and management processes that really work
- Financial issues related to the assessment of new technological ideas
- Importance of establishing portfolio management techniques to allocate resources strategically

Registration limited to 30 attendees

Course Instructors

- John Martin (Arthur D. Little)
- Eric Carlson (Arthur D. Little)
- Stephen Rudolph (Arthur D. Little)

Program Fees *

- Member (FSCT & NPCA) $395
- Non-Member $495

* Includes dinner on Monday evening. Fees are $50 more on-site.

"PRE-CONVENTION TRAINING SEMINAR"

Faster to Market with Better Products through Design of Experiments

TUESDAY
OCTOBER 22, 1996
CHICAGO HILTON AND TOWERS

Seminar Description

Design of Experiments (DOE) will give the coatings technologist five important benefits: cutting the time from inception to market; increasing product quality; lower raw material costs; research and development productivity; and manufacturable products. The understanding of DOE will allow the attendee to make a greater contribution to his or her company. The course is targeted at laboratory and R&D personnel and project managers and technicians interested in becoming more effective in the R&D function.

Attendees will learn:

- Better planning and project management
- How to better allocate resources through the use of time saving methods
- Techniques to achieve greater certainty of results
- Ways to focus efforts to predict coatings properties
- Methods to develop truer selection criteria/evaluation
- The purpose of various testing procedures and how to know when to use them, and when not to use them
- The importance of not reaching conclusions before experiments
- How to plan an experiment using the six step approach
- Methods to compare "one variable at a time" experiments with factorials
- Why factorial experiments are better than ladders
- Methods of calculating main effects and interactions
- How to prove effects are real (variability and statistical significance)
- Averages, ranges and standard deviations

Instructor

- Charles Rooney (Orr & Boss)

Program Fees*

- Member $195
- Non-Member $295

*Fees are $50 more on-site.

TECHNOLOGY

"PRE-CONVENTION TRAINING SEMINAR"

WORKSHOP
Effective Technical & Scientific Writing

TUESDAY
OCTOBER 22, 1996
CHICAGO HILTON AND TOWERS

Seminar Description

For all levels of laboratory and R&D personnel along with applicators and anyone with responsibility for writing memos, letters, reports, manuals, specifications and proposals on a routine basis. The session includes in-class writing exercises designed for practical application, and allows time for individual attention. Participants are invited to submit writing samples in advance for a confidential review by the instructor.

Attendees will learn:

- Skills and techniques to improve technical communication
- How to improve effectiveness in communicating technological issues
- Methods of data collection and tabulation to maximize impact of data on the presentation
- Proven techniques to make technical issues understandable
- How to translate technical terms for non-technical readers
- How to improve writing skills: structure and format
- Ways to "rethink how you write"
- How to write the first draft of a document
- Approaches to use when writing for another person
- Editing techniques and a review of punctuation and usage

Registration limited to 25 attendees

Instructor

- Sal Iacone (Consultant)

Program Fees*

- Member $195
- Non-Member $295

*Fees are $50 more on-site.

"PRE-CONVENTION TRAINING SEMINAR"

Surfactant Chemistry

TUESDAY
OCTOBER 22, 1996
CHICAGO HILTON AND TOWERS

Seminar Description

For R&D personnel, synthesizers, formulators and applicators in the coatings and ink industries, this course will provide attendees with a better understanding of surfactants and polymers; current information on new technologies and uses in this area; a working knowledge of surfactant synergy in waterborne technology; details on coatings and flows, and information on defoamers.

Attendees will learn:

- The fundamentals about surfactants and polymers
- Details of the physical properties of surfactants
- New uses and technologies of surfactants
- The do's and don'ts of effective formulation
- Surfactant synergism in waterborne coatings technology
- How to develop a broader, open thinking about surfactants
- Various additive options to improve application
- Better appreciation for the variety of materials and their uses
- Greater formulation latitude due to awareness of options

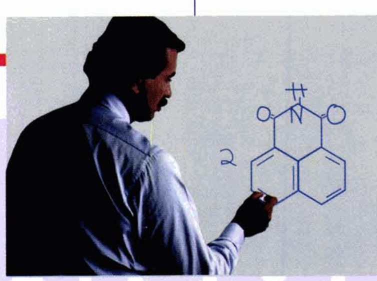
Instructors

- Steve Snow (Dow Corning)
- Bob Stevens (Air Products)
- Ed Orr (BYK Chemie)
- Skip Scriven (University of Minnesota)
- Joel Schwartz (Air Products)

Program Fees*

- Member $195
- Non-Member $295

*Fees are $50 more on-site.



"PRE-CONVENTION TRAINING SEMINAR"

Winning Technical Presentations

TUESDAY, OCTOBER 22, 1996
CHICAGO HILTON AND TOWERS

Seminar Description

For laboratory and R&D personnel at all levels, in addition to marketing and sales staff and anyone else responsible for delivering technical presentations. Attendees will learn how to develop effective visuals; proper speaking techniques and data organization; how to handle question and answer sessions; tips on transferring written information to speaking terms; and how to communicate clearly to all audiences. This program offers a combination of lecture, interaction and small group projects.

Attendees will learn:

- How to effectively develop visuals for technical presentations
- Proper speaking techniques
- How to organize data
- Tips to transfer written information for a speech
- How to handle question and answer sessions
- Presentation style and format
- How to effectively communicate to all audiences
- The ability to aim presentations to any size audience, from one to hundreds
- Design presentations with ease, in considerably less time
- Establish an easily-understood format for group presentations
- How to design a presentation for a convincing delivery

Registration limited to 25 attendees

Instructor

- Carter Johnson (Buying Time Seminars)

Program Fees*

- Member $195
- Non-Member $295

*Fees are $50 more on-site.

"PRE-CONVENTION TRAINING SEMINAR"

Coatings Spray Applications

TUESDAY
OCTOBER 22, 1996
BINKS MANUFACTURING CO., FRANKLIN PARK, IL
(Transportation Provided)

Seminar Description

Provides both experienced and novice applicators, field service personnel, specifiers and formulators with information on current and upcoming technologies as they apply to the application of coatings and finishes. Considered as a Learning Exchange Seminar, attendees will learn how to properly select, maintain and operate spray finishing equipment and to answer a variety of questions related to spray finishing.

Attendees will learn:

- Various types of spray equipment (adjust, tip, size, fanning, technique)
- How to choose equipment wisely
- Problem solving techniques
- Proper care and maintenance of spray equipment
- Electrostatic application of liquid and powder coatings
- Application of coatings by air atomization, airless and air-assisted airless
- Various operator techniques
- High Volume Low Pressure (HVLP)

Attendance is limited.

Instructor

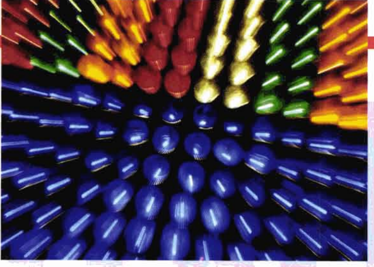
- Jerry Hund (Binks Manufacturing)

Program Fees*

(includes transportation to Binks Manufacturing Co.)

- Member $195
- Non-Member $295

*Fees are $50 more on-site.



CONFERENCE

"TECHNOLOGY CONFERENCE COURSE"

Polymer Chemistry for the Coatings Formulator

WEDNESDAY - THURSDAY
OCTOBER 23-24, 1996
McCORMICK PLACE

Course Description

Provides current information on polymer chemistry for coatings formulators, R&D chemists, and sales and marketing personnel with strong technical backgrounds or interests. Attendees will realize a greater understanding of the essential concepts of polymer science and the underlying principles to determine coating performance. The course helps attendees to develop coatings using scientific principles as opposed to trial and error and is also relevant for ink, sealant and adhesive industry personnel.

Attendees will learn:

- Fundamental principles behind chain-growth and step-growth polymerization
- The basic principles of emulsion polymerization and how it differs from solution polymerization
- Crosslinking reactions and how they modify film performance
- The most important classes of polymers used in coatings, what types of properties can be expected from each type, and how polymer chemistry can be used to modify those properties
- How polymer structure is related to the rheology and mechanical properties of polymers
- How polymers are characterized with modern analytical techniques.

Instructors

- Frank Jones (Eastern Michigan University)
- Fritz Walker (Air Products and Chemicals)
- David Nordstrom (DuPont Automotive)
- Alvin C. Lavoie (Rohm & Haas)
- Jennifer Cogar (McWhorter, Inc.)
- Patricia Lesko (Rohm & Haas)
- Paul R. Baukema (Akzo Nobel Coatings, Inc.)
- Dr. Terry Potter (Bayer Corp.)
- Bill Simonsick (DuPont Marshall Labs)
- David A. Dubowik (Air Products and Chemicals)
- Nicholas Albrecht (Cytec Industries, Inc.)
- Manoj Gupta (BASF Corp.)

Program Fees

- Member $395
- Non-Member $495

*Fees are $50 more on-site.

"TECHNOLOGY CONFERENCE COURSE"

Advances in Coatings Characterization

WEDNESDAY - THURSDAY
OCTOBER 23-24, 1996
McCORMICK PLACE

Course Description

Provides a quick review of key analytical techniques in the coatings industry, along with an update on recent methods. Attendees will also see examples of successful application of these techniques to solve practical paint and coatings problems. This course is targeted towards laboratory directors, QC managers, customers/specifiers, graphic arts industry personnel and analytical personnel.

Attendees will learn:

- The basics of coatings characterization
- Recent developments such as criteria and new equipment
- Ways to study problems through an awareness of what is available (practical equipment, services, etc.)
- Effective use of microscopies (optical, electron, and atomic force)
- Infrared of coatings
- Raman and other spectroscopies
- Ways to effectively use various analytical techniques (surface, thermal and particle size)
- Fundamentals of rheology

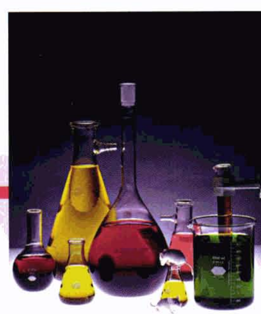
Instructors

- Marek Urban (North Dakota State)
- Mike Claybourn (ICI Paints)
- Andy Gilicinski (Air Products)
- Rich Granata (Lehigh University)
- Peter Kamarchik (PPG Industries)
- Paula Clark (Air Products)
- Mike Reading (ICI Paints)

Program Fees*

- Member $395
- Non-Member $495

*Fees are $50 more on-site.



TECHNOLOGY

"TECHNOLOGY CONFERENCE COURSE"

Substrates and Coatings

WEDNESDAY - THURSDAY
OCTOBER 23-24, 1996
McCORMICK PLACE

Course Description

Provides attendees with a better understanding of the effects substrates have on coatings performance. Attendees will learn of the various considerations which must be examined in order to develop the right coating for the right substrate. "Substrates and Coatings" is aimed at formulators, laboratory and R&D chemists, technical service and sales personnel, along with coatings specifiers. Individuals from the ink industry, and those who develop substrates will also benefit by attending this event.

Attendees will learn:

- An understanding of the physical nature of wood, plastics, metal and concrete
- Definitions of various substrate types and surfaces (wood, plastic, metal, etc.)
- The effects of coatings application and performance on various substrates
- How to overcome or compensate for substrate problems by proper formulation
- How to formulate the right coating for the right substrate
- Methods to "unlearn" the misconception that one size coating fits all substrates
- Better knowledge of coatings/substrate interaction
- Problem solving skills
- Techniques to save time and money in the formulation process

Instructors

- Sam Williams (USDA Forest Products Lab)
- Eric Kline (KTA Tator)
- Simon Boocock (SSPC)
- Doug Grossman (Q Panel)
- Jim McGuiness (Red Spot)
- Bruce Thill (Dow Chemical)

Program Fees*

- Member $395
- Non-Member $495

*Fees are $50 more on-site.

"TECHNOLOGY CONFERENCE COURSE"

"BACK TO BASICS" General Overview of Coatings Technology

WEDNESDAY - THURSDAY
OCTOBER 23-24, 1996
McCORMICK PLACE

Course Description

For chemists new to the industry or with minimal experience, lab technicians, and sales, marketing and field support personnel. The program will provide attendees with an overview of coatings types; a review of basic coatings composition; and cost savings ideas for formulation. Participants will gain a better understanding of the physical properties associated with coatings and be given tips on troubleshooting techniques.

Attendees will learn:

- Overview and history of coatings
- Information on the various types of coatings
- A review of the four basic components of coatings
- Proven ideas to save money in the formulation process
- Troubleshooting techniques to spot and solve problems quickly
- A better understanding of physical properties of coatings
- How to work more efficiently
- Techniques for better interaction w/ suppliers
- The latest information on pigments, resins, and additives
- Testing methods
- The effect of various application methods have on coatings performance

Program Fees*

- Member $395
- Non-Member $495

*Fees are $50 more on-site.

CONFERENCE

FSCT Publications Order Form

Buyer Information

YOUR COMPANY: Check the one block which applies most specifically to the company or organization with which you are affiliated:

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

YOUR POSITION: Check the one block which best describes your position in your company or organization:

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

Billing Address

❒ **FSCT Member** ❒ **Non-Member**

Name ______________________
Title ______________________
Company ______________________
Address ______________________
City & State ______________________
Country ____________ Postal Code ____________
Phone ____________ FAX ____________

Shipping Address (if different)

Name ______________________
Title ______________________
Company ______________________
Address ______________________
City & State ______________________
Country ____________ Postal Code ____________
Phone ____________ FAX ____________

Method of Payment

Please check one:

❒ Charge to the following card:
❒ MC ❒ VISA
❒ AMEX ❒ DISCOVER

Exp. Date: ____________

❒ Check # ____________
(checks must be payable in U.S. Funds on U.S. Bank)

❒ P.O. # ____________

Credit Card Number: ______________________

Name ______________________ (print cardholder's name)

Signature ______________________

Total Amount Due: ____________

(No shipping or handling charges on prepaid orders. PA residents, please add 6% sales tax.)

Orders

(Less 10% for Full Series Purchase)

Series	Member $15	Non-Mem. $25	Quantity Ordered
Film Formation	❒	❒	___
Radiation Cured Coatings	❒	❒	___
Introduction to Polymers and Resins	❒	❒	___
Coil Coatings	❒	❒	___
Corrosion Protection by Coatings	❒	❒	___
Mechanical Properties of Coatings	❒	❒	___
Automotive Coatings	❒	❒	___
Coating Film Defects	❒	❒	___
Application of Paints and Coatings	❒	❒	___
Organic Pigments, Second Edition	❒	❒	___
Inorganic Primer Pigments	❒	❒	___
Marine Coatings	❒	❒	___
Sealants and Caulks	❒	❒	___
Aerospace and Aircraft Coatings	❒	❒	___
Introduction to Coatings Technology	❒	❒	___
Cationic Radiation Curing	❒	❒	___
Rheology	❒	❒	___
Powder Coatings	❒	❒	___
Introduction to Pigments	❒	❒	___
Painting of Plastics	❒	❒	___
Metal Surface Characteristics Affecting Organic Coatings	❒	❒	___
Color and Appearance	❒	❒	___
White Pigments	❒	❒	___
Methodologies for Predicting the Service Lives of Coatings Systems	❒	❒	___
Silicones	❒	❒	___
Adhesion Aspects of Polymeric Coatings	❒	❒	___

JCT: ________ (specify no. of yrs.) (annual subscrip. included w/FSCT membership)

	U.S. & Canada	Europe (Air Mail)	Other Countries
1 Year	❒ $40	❒ $70	❒ $55
2 Years	❒ $75	❒ $135	❒ $105
3 Years	❒ $110	❒ $200	❒ $155

Coatings Encyclopedic Dictionary*	❒ Soft Cover	❒ $80	❒ $105	___
	❒ Hard Cover	❒ $105	❒ $135	___
Glossary of Color Terms		❒ $6 (one price)		___
Infrared Spectroscopy Atlas		❒ $150	❒ $200	___
Pictorial Standards		❒ $100 (one price)		___
Sci*Quest*		❒ $750	❒ $800	___

* *Volume discount on five or more.*

Federation of Societies for Coatings Technology
492 Norristown Rd., Blue Bell, PA 19422 Phone: (610) 940-0777 Fax: (610) 940-0292

FSCT Publications are also available at:
Jesus Camacho, ANAFAPYT, Gabriel Mancera 309,
Col. Del Valle, 03100 Mexico, D.F., Mexico

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1996 International Coatings Expo

List of Exhibitors

(As of May 31, 1996)

FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY

INTERNATIONAL COATINGS EXPO AND TECHNOLOGY CONFERENCE

A. P. Dataweigh Systems
Aceto Corp.
ACT Laboratories, Inc.
Adhesive Age
Advanced Software Designs
Air Products & Chemicals, Inc.
Akzo Nobel Chemicals &
 Akzo Nobel Resins
Alcan Toyo America, Inc
Alnor Oil Co.
American Chemical Society,
 Information & Services
American Colors
Amoco Chemical Co.
ANGUS Chemical Co.
Anker Labelers USA Inc.
Aqualon Co.
Araki Iron Works, Co. Ltd.
ARCO Chemical Co.
Arizona Instruments Corp.
Arizona Oxides Inc.
Ashland Chemical Co.
Atlas Electric Devices
Atotech USA Inc
Aztec Peroxides, Inc.
B.A.G. Corp.
BASF Corp.
BatchMaster Software, Inc.
Bayer Corp.
Blacoh Fluid Control, Inc
Borden Inc.
Bowers Process Equipment Inc.
British Standards Institution, Inc.
Brookfield Engineering Lab.
Buckman Laboratories
Buhler Inc.
Burgess Pigment Co.
BYK-Chemie USA
BYK-Gardner, Inc.
C.I.P. Products/Sellers
 Cleaning Systems
Cabot Corp., CAB-O-SIL
 & Special Blacks Div.
Calgon Corp.
Cardolite Corp.
CB Mills
CCP
Center for Applied Engineering
Chemical & Engineering News
Chemical Manufacturers Assoc.
Chemical Marketing Reporter
Chemical Week
Chemir/Polytech
 Laboratories, Inc.
Ciba (Additives,
 Pigments, & Plastics Divs.)
Cimbar Performance Minerals
Civacon
Clariant Corp.
Clawson Container Co.
Coatings Magazine
Color Corp.
Columbian Chemicals Co.
Consolidated Research, Inc.
Cortec Corp.
CR Minerals Corp.
Crosfield Co.
Cytec Industries Inc.
D/L Laboratories
Daniel Products Co., Inc.
Datacolor International
J. De Vree & Co. N.V.
DeFelsko Corp.
Degussa Corp.
Distil-Kleen, Inc. (Disti)
Dominion Colour Corp.
The Dow Chemical Co.
Dow Corning Corp.
Draiswerke GmbH
Draiswerke, Inc.
Drew Industrial Div., Ashland
 Chemical Co,
Dry Branch Kaolin Co.
DSM Resins U.S., Inc.
DuPont Nylon Intermediates
 & Specialties
Eagle Zinc Co.
Eastern Michigan University
Eastman Chemical Co.
Ebonex Corp.
ECC International
Eiger Machinery, Inc.
Elf Atochem North America, Inc.
EMCO Chemical Distributors, Inc.
Engelhard Corp.
Engineered Polymer Solutions, Inc.
Epworth Manufacturing Co., Inc.
Erie Chemical Sales
Etna Products Inc.
 Specialty Chemical Division
European Coatings Journal
Exxon Chemical Co.
Federation of Societies for
 Coatings Technology
The Feldspar Corp.
Fillite
Filter Specialists, Inc.
Fischer Technology Inc.
Fluid Management
FMJ International
 Publications Ltd.
Fuji Silysia Chemical, Ltd.
H.B. Fuller Co.
Gamry Instruments, Inc.
Paul N. Gardner Co., Inc.
Garrison Industries, Inc.
Georgia Pacific Resins, Inc.
BFGoodrich Co.
 Specialty Chemicals
The Goodyear Tire & Rubber Co.,
 Chemical Division
Grace Davison
Haake, Inc.
Halox Pigments
J.W. Hanson Co., Inc.
Harcros Pigments Inc.
Henkel Corp.
HERO Industries Limited
Heucotech Ltd.
Hickson Specialties
Hilton Davis Co.
Hockmeyer Equipment Corp.
Hoechst Celanese Corp.
Horiba Instruments Inc.
J.M. Huber Corp.,
 Engineered Minerals Div.
Hüls America, Inc.
Hunterlab
Huntsman Corp.
ICIS-LOR
Ideal Equipment Co., Ltd.
Ideal Manufacturing & Sales Corp.
IGT Reprotest Inc.
INDCO Inc.
Industrial Oil Products Corp.
Ink World Magazine
Inmark, Inc.
International Compliance Center
International Resources, Inc.
International Specialty Chemicals
International Specialty Products (ISP)
ITT Marlow/ITT A-C Pump
S.C. Johnson Polymers
Journal of Coatings Technology
K-T Feldspar Corp.
Kady International
Kemira Pigments Inc.
Kenrich Petrochemicals, Inc.
King Industries, Inc.
Kline & Co.
Kraft Chemical Co.
KTA-Tator Inc.
Laporte/SCP-
 Laponite Rheological Additives
LaQue Corrosion Services
Lawter International
The Leneta Co.
Liquid Controls Corp.
Littleford Day Inc.
Longview Fibre
The Lubrizol Corp.
Lucas Meyer, Inc.
Luzenac America
3M/Zeelan Industries
Macbeth, Div. of Kollmorgen
Magnesium Elektron, Inc.
Malvern Minerals Co.
Mapico
The McCrone Group
McWhorter Technologies
The Mearl Corp.
Micro Powders, Inc.
Microfluidics Corp.
Micromeritics
Micromet Instrument
Millipore Corp.
Milwhite, Inc.
Ming-Zu Chemical Industries
MiniFibers, Inc.
Minolta Corp.
Mississippi Lime Co.
UMR Coatings Institute
Modern Paint & Coatings Magazine
Monsanto Co.
Morton International
Muetek Analytic Inc.
Myers Engineering
Nacan Products Ltd.
Nace International
Nametre Co.
National Paint & Coatings Assoc.
Netzsch Incorporated
Neupak, Inc.
New Way Packaging Machinery, Inc.
North Dakota State University
 Polymers & Coatings Dept.
NYCO Minerals
Ohio Polychemical Co.
Olin Corp.
Omnimark Instrument Corp.
OSi Specialties Group/Witco Group
Oxychem
Paint & Coatings Industry Magazine
Paint Research Assoc.
Parasol System, Inc.
Parker Hannfin Corp.
Particle Sizing Systems, Inc.
Peninsula Polymers, Inc.
Phenoxy Associates
Pico Chemical Corp.
Pioneer Packaging Machinery, Inc.
Polar Minerals
Poly-Resyn, Inc.
PPG Specialty Chemicals
PQ Corp./ Potters Industries
Precision Dispensing
Premier Mill Corp.
Q-Panel Lab Products Corp.
Q-Sales and Leasing
Quackenbush Co., Inc.
K.J. Quinn & Co., Inc.
Raabe Corp.
RadTech International N. A.
Ranbar Technology, Inc.
Reichhold Chemicals, Inc.
Rheometric Scientific
Rheox, Inc.
Rhone-Poulenc, Inc.
Rohm and Haas Co.
Ronningen-Petter
Charles Ross & Son Co.
Royce Associates,
Russell Finex, Inc.
San Esters Corp.
Sartomer Co.
Schenectady International, Inc.
Schlumberger Measurement Div.
Schold Machine Co.
SEPR
Shamrock Technologies, Inc.
Shell Chemical Co.
Sherwin Williams Chemicals
Silberline Mfg. Co., Inc.
Singleton Corp.
Software 2000, Inc.
Southern Clay Products, Inc.
Univ. of Southern Mississippi
Specialty Minerals, Inc.
Spraymation, Inc.
Startex Chemical
Sub-Tropical Testing Service
Sud-Chemie Rheologicals
Summit Precision Polymers Corp.
Sun Chemical Corp.
Taber Industries
Taotek North America, Inc.
Tayca Corp.
Teemark Corp.
Tego Chemie Service USA
Thiele Engineering Co.
Thomas Scientific
Troy Corp.
U.S. Aluminum, Inc.
U.S. Borax, Inc.
U.S. Silica Co.
UCB Chemicals
Unimin Corp.
Union Carbide Corp.
Union Process, Inc.
United Mineral & Chemical Corp.
Van De Mark Group
Van Waters & Rogers Inc.
R.T. Vanderbilt Co., Inc.
Versa-Matic Pump Co.
VORTI-SIV Division,
 MM Industries, Inc.
Wacker Silicones Corp.
Westerlins Maskinfabrik AB
Western Equipment Co.
Wilden Pump
Witco Corp.
World Minerals Inc.
X-Rite, Inc.
Yamada America, Inc.
Zaclon, Inc.
Carl Zeiss, Inc.,
 Microscope Division
Zeneca Biocides
Zeneca Resins

Social Guest Program

Activities for Social Guest registrants begin on Wednesday afternoon with a Welcome Social at the Chicago Hilton and Towers hotel.

On Thursday, Social Guests enjoy a continental breakfast and afterwards depart on motorcoaches for a tour of Chicago's downtown area. A visit to the Art Institute of Chicago will be included in the tour. Participants will view the traveling exhibition of the works of Edgar Degas. Organized by the National Gallery in London and the Art Institute of Chicago, the exhibit features his later works between 1886 when he participated in the last impressionists exhibit and 1917, the year of his death.

An exclusive luncheon for Social Guests will be included in the tour.

The fee for Social Guests of $60 in advance and $70 onsite includes the Social Guests activities, 3-days admittance to the Expo, and attendance to the Opening Session. Space is limited and pre-registration is strongly suggested.

Shuttle Service

Shuttle service between the official ICE hotels and the McCormick Place North will be offered according to the following schedule:

Tues., Oct. 22	7:30 am - 6:00 pm
Wed., Oct. 23	7:30 am - 6:00 pm
Thurs., Oct. 24	7:30 am - 6:00 pm
Fri., Oct. 25	7:30 am - 3:00 pm

Ground Transportation

From O'Hare International Airport: Shuttle bus service is available via Continental's Airport Express; fare is $14.75 one way. Taxi fares run upwards of $25 to the downtown hotels. The Chicago Transit Authority (CTA) operates rail service from O'Hare to downtown Chicago for $1.25 one way.

From Midway Airport: Shuttle bus service is available via Continental's Airport Express; fare is $10.75 one way. Taxi fares run upwards of $18 to the downtown hotels.

Hotel Reservation Instructions

To place a reservation, complete the hotel reservation form and contact the ICE Housing Bureau "One-Stop Chicago" serviced by the Chicago Convention and Tourism Bureau. A one-night's deposit of $125 is required to process each reservation.

You may phone, fax, or mail your reservations to One-Stop Chicago. Use only one method to place your reservation to avoid a duplication of requests and deposits being processed.

A confirmation of your reservation will be mailed to you by One Stop Chicago.

The cut-off date is September 23. After September 23, reservations will be accepted on a space available basis only.

Deposits are refundable provided that reservations are canceled with hotels at least 72 hours prior to the date of arrival. Before October 2, notify One-Stop Chicago of cancellations. After October 2, contact the hotel directly.

FSCT Convention Hotels

There are eight official ICE hotels in Chicago. Serving as the headquarters property will be the Chicago Hilton and Towers. Convention rates for each hotel are noted below.

Chicago Hilton & Towers
(FSCT HEADQUARTERS)
Main..............................$140, 165, 190 single
$160, 185, 210 double
Towers level................ $235 single, 255 double

Palmer House Hilton
(NPCA HEADQUARTERS)
Main.............................. $160,180,195 single
$180,200, 215 double
Towers level............. $230 single, 250 double

Hyatt Regency .... $142 single or double

Fairmont .... $164 single or double

Essex Inn .... $108 single or double

Clarion Executive Plaza .... $125 single or double

Renaissance Chicago .... $160 single or double

Hyatt on Printers Row .... $151 single or double

KEY TO CHICAGO MAP

1. **Chicago Hilton and Towers**
2. **Clarion Executive Plaza Hotel**
3. **Essex Inn**
4. **Fairmont Hotel - At Illinois Center**
5. **Hyatt on Printers Row**
6. **Hyatt Regency Chicago**
7. **Palmer House Hilton**
8. **Renaissance Chicago**

1996 Housing Application Form

Reservations must be placed with the Housing Bureau. Hotels will not accept reservations directly. Reservations must be received by **September 23, 1996.**

1. To Make Reservations

TO CALL:
U.S. & Canada (toll-free)
800-424-5248
Domestic & Overseas
847-940-2152

Prior to calling, have the following available:
- Name of Convention (**'ICE 96'**)
- Your 1st, 2nd, 3rd, & 4th choice of hotel
- Arrival/Departure dates
- Number of rooms required
- Type of room needed (single, double, etc.)
- Credit card #, expiration date
- Names of room occupants
- Address
- Phone and fax numbers

TO FAX:
U.S. & Canada (toll-free)
800-521-6017
Domestic & Overseas
847-940-2386

- Please print or type all items to ensure accuracy
- Complete each part below in detail for correct and rapid computer processing
- Form may be duplicated or supplemental room list must be attached using same format as below

TO MAIL:

Send completed form and payment to:
One Stop Chicago
P.O. Box 825
Deerfield, IL 60015-0825

Prior to October 2, all reservations, changes, and cancellations must be made with One Stop Chicago. After this date, these changes must be made with the hotel directly. Reservation deposits are refundable provided that they are cancelled with the hotel at least 72 hours prior to date of arrival.

2. Hotel Information

Select 4 hotels of your choice to facilitate processing. Requests are given priority in the order received. First choice is assigned IF AVAILABLE. Be sure to list definite arrival and departure dates.

1st ______________________ Rate________ 3rd ______________________ Rate________
2nd ______________________ Rate________ 4th ______________________ Rate________

Names of Occupants	Room Type*	Arrival	Departure
	❑ single ❑ dbl/dbl ❑ double		
	❑ single ❑ dbl/dbl ❑ double		
	❑ single ❑ dbl/dbl ❑ double		
	❑ single ❑ dbl/dbl ❑ double		
	❑ single ❑ dbl/dbl ❑ double		

* Room Key: single (1 person, 1 bed); double (2 people, 1 bed); double/double (2 people, 2 beds).
Requests for the Chicago Hilton and the Palmer House will be limited to 10 rooms per exhibitor company.

3. Deposit Information

Advance deposit required at the time of booking. Reservations will not be processed without a deposit. Deposits are $125 per room. Deposits may be made by major credit card or check (U.S. dollars). Your credit card will be billed immediately.

❑ Enclosed is my check payable to One Stop Chicago for the amount of $ ________

Please bill my: ❑ AMEX ❑ MC ❑ Visa

Credit Card Number ______________________ Expiration Date ____________

Name of Card Holder ______________________ Signature ______________________

4. Send Confirmations to:

Name: ______________________ Telephone: ______________________

Company: ______________________ FAX: ______________________

Address: ______________________

City/State (Province): ______________________ Zip Code (Mailing Code): ____________

Country (if other than U.S.): ______________________

♿ ______________________ requires special assistance. Please attach a written description of your needs.

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Registration Fees

Training taken to maintain or improve your professional skills is usually tax deductible as an ordinary and necessary business expense. Consult with your tax advisor for applicability.

Registration Package Pricing	Member Advance	Member On-Site	Non-Member Advance	Non-Member On-Site
Expo and FSCT Annual Meeting Presentations	$75	$90	$100	$125
Full Technology Conference & Expo	$495	$545	$595	$645
Coatings Technology Conference Two-Day Course	$395	$445	$495	$545
Executive Forum	$395	$445	$495	$545
Pre-Convention Training Seminar	$195	$245	$295	$345
Social Guest Program	$60	$70	$60	$70
Retired FSCT Member and Spouse (each)	$30	—	—	—
Student (Valid Student ID Required)	$15	$25	$15	$25

No advance registrations will be accepted after 12:00 Midnight on September 11. All credit card transactions are processed in U.S. Dollars and are subject to current exchange rates. International checks must be submitted in U.S. Dollars, paid in U.S. Banks. Badges will be mailed in advance to pre-registered ICE and Conference attendees and their pre-registered Social Guests.

Badge holders will be distributed at the ICE registration verification areas located at McCormick Place North and at the Chicago Hilton and Towers.

Conference attendees registration credentials including badges will be distributed in Chicago at the ICE Conference Registration area located in the Chicago Hilton Hotel.

FSCT's refund policy

Cancellations received on or before October 9 will be charged $15. Cancellations received after that date will be charged $50. No refunds will be issued for cancellations received after October 16. All refunds will be processed after November 1.

Registration Hours

McCormick Place North

Tues., Oct. 22	7:30 am - 5:00 pm
Wed., Oct. 23	7:30 am - 5:00 pm
Thurs., Oct. 24	7:30 am - 5:00 pm
Fri., Oct. 25	7:30 am - 12 Noon

Chicago Hilton and Towers

Mon., Oct. 21	5:00 pm - 7:00 pm
Tues., Oct. 22	7:30 am - 5:00 pm
Wed., Oct. 23	7:30 am - 10:00 am

Special Airfare Discounts

Special arrangements have been made with United and Delta Airlines for reduced airfares for ICE attendees. To participate, call the FSCT Travel Desk or the airlines directly.

Contact the FSCT Travel Desk and mention "ICE96"

Phone	800-448-FSCT
Int'l callers	215-628-2549
Fax	215-628-0310

Contact the airlines directly by calling

United 800-521-4041	mention code: **563UA**
Delta 800-241-6760	mention code: **I 3633**

1996 PRE-REGISTRATION FORM

FSCT International Coatings Expo & Technology Conference

• Chicago, IL •

October 22 • 23 • 24 • 25, 1996

- **Fax** completed form to **(805) 654-1676**
- **Mail** completed form with payment to: ICE Registration, c/o RCS, 2368 Eastman Ave., Ste. 11, Ventura, CA 93003-7797
- *Registration Helpline:* (610) 940-0777, 8:30 - 4:30 ET

Deadline: September 11, 1996. Register Today!

To pre-register, this form must be postmarked no later than September 11, 1996. Forms received after then will be returned with a notice advising you to register on-site. Form must be filled out completely for processing. A confirmation of your registration will be sent to you. Badges will be sent in advance to U.S. registrants. International registrants may obtain their badges at the international registration desk in Chicago. ICE badges must be worn for admission to the convention programs and Expo.

1. Industry Attendee Badge Information:

CP

FIRST NAME (Nickname)

FIRST NAME LAST NAME

COMPANY

MAILING ADDRESS (or P.O. Box)

CITY STATE/PROV.

COUNTRY (other than U.S.) POSTAL CODE

TELEPHONE NO. FAX NO.

2. Social Guest Badge Information:

CP

FIRST NAME (Nickname)

FIRST NAME LAST NAME

CITY STATE/PROV.

COUNTRY (other than U.S.) POSTAL CODE

3. Registrant Profile:

FSCT Member? 1 ❑ Yes 2 ❑ No

Society Affiliation ____________________

Information below must be completed for registration to be processed

Your Company (Check one only)

31 ❑ Manufacturers of Paints, Varnishes, Lacquers
32 ❑ Manufacturers of Printing Inks
33 ❑ Manufacturers of Sealants, Caulks, Adhesives
34 ❑ Manufacturers of Powder Coatings
35 ❑ Manufacturers of Raw Materials
36 ❑ Manufacturers of Equipment and Containers
37 ❑ Sales Agents for Raw Materials and Equipment
38 ❑ Government Agency
39 ❑ Research/Testing/Consulting
40 ❑ Educational Institution
41 ❑ Paint Consumer
42 ❑ Environmental Services
43 ❑ Other______________

Your Position (Check one only)

51 ❑ Management/Administration
52 ❑ Mfg. & Engineering
53 ❑ Quality Control
54 ❑ Research & Development
55 ❑ Technical Sales Service
56 ❑ Sales & Marketing
57 ❑ Consultant
58 ❑ Educator/Student
59 ❑ Other ______________

4. Registration Information:

Enter your selected options below. (See accompanying page for description of each registration option) ***NOTE: Seminar and course attendance is limited.*** *If checking a conference seminar or course, provide second choice.*

	Member	Nonmember	AMOUNT
❑ **Expo & Annual Meeting Papers Only** ***(Oct. 23-25)***	$ 75 (A)	$ 100 (B)	$________
❑ **Retired Member** (Expo & Annual Meeting Only)	$ 30 (C)	—	$________
❑ **Social Guest of Retired Member**	$ 30 (D)	—	$________
❑ **Student** (Expo & Annual Meeting Only)	$ 15 (E)	$ 15 (E)	$________
❑ **Full Conference & Expo** ***(Oct. 22-25)*** *Check one training seminar and one conference course below*	**$495** (I)	**$ 595** (J)	$________
❑ **Conference Two-Day Course** ***(Oct. 23-24)*** *Check below*	$395 (K)	$ 495 (L)	$________
❑ **Executive Forum** ***(Oct. 22)***	$395 (G)	$ 495 (H)	$________
❑ **Pre-Convention Training Seminar** ***(Oct. 22)*** *Check below*	$195 (M)	$ 295 (N)	$________
❑ **Social Guest Program** ***(Oct. 23-25)***	$ 60 (F)	—	$________
❑ **FSCT Industry Luncheon Ticket** ***(Oct. 24)*** *No. of tickets* ____	$ 30 (X)	$ 30 (X)	$________

Oct. 22 Training Seminars

T1 ❑ Surfactant Chemistry
T2 ❑ Technical Presentations
T3 ❑ Technical & Scientific Writing
T4 ❑ Design of Experiments
T5 ❑ Spray Application
____________ (second choice)

Oct. 23-24 Conference Courses

C1 ❑ Substrates & Coatings
C2 ❑ Coatings Characterization
C3 ❑ Polymer Chemistry
C4 ❑ Back to Basics
______________ (second choice)

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TOTAL DUE $________

5. Method of Payment:

Total Amount Due $__________

(circle method of payment):

CK Check
MO Money Order
MC MasterCard
VS Visa
AE American Express

Card # ____________________

Expiration Date ______________

Cardholder's Name (please print):

____

Cardholder's Signature:

____

*Make checks payable in U.S. Funds to **FSCT***

Cancellation Policy:

Cancellations received on or before October 9 will be charged a $15 cancellation fee. Conference cancellations received after that date will be charged a fee of $50. NO REFUNDS FOR CANCELLATIONS RECEIVED AFTER OCTOBER 16.

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Available Programs

FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY

ice INTERNATIONAL COATINGS EXPO AND TECHNOLOGY CONFERENCE

	INTERNATIONAL COATINGS EXPO	FSCT ANNUAL MEETING & TECHNICAL PRESENTATIONS	OPENING SESSION	MATTIELLO LECTURE	ONE PRE-CONVENTION TRAINING SEMINAR	EXECUTIVE FORUM DINNER	ONE CONFERENCE COURSE	MANAGING RESEARCH & DEVELOMENT	WELCOME SOCIAL	CONTINENTAL BREAKFAST
International Coatings Expo (ICE)	✔	✔	✔	✔						
Full Coatings Technology Conference & Expo	✔	✔		✔	✔		✔			
Coatings Technology Conference Course	✔	✔		✔			✔			
Executive Forum	✔	✔	✔	✔		✔		✔		
Pre-Convention Training Seminar	✔	✔	✔	✔	✔					
Social Guest Program	✔		✔						✔	✔

Federation of Societies for Coatings Technology
492 Norristown Road
Blue Bell, PA 19422-2350

Circle No. 9 on the Reader Service Card

JOURNAL OF COATINGS TECHNOLOGY

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Technical Articles

Formulation and Production Forum

Federation News

Spotlight

Departments

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Guide for Authors

JCT JOURNAL OF COATINGS TECHNOLOGY

GENERAL

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

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

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

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

SUBMISSION OF MANUSCRIPTS...

...for the Journal

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

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

...by Constituent Societies For International Coatings Technology Conference Presentation

Ten complete copies of the manuscript are required for committee review. The set of copies should be addressed to Mike Bell, Director of Educational Services, FSCT, 492 Norristown Rd., Blue Bell, PA 19422.

...for Roon Foundation Award Competition

Ten complete copies of the manuscript are required, and should be submitted to Mike Bell at the address previously listed.(For complete details, see "Roon Awards" section of the JOURNAL in the January 1995 issue.)

MANUSCRIPT PREPARATION

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

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

Original Research Papers: The main technical content of the JOURNAL OF COATINGS TECHNOLOGY will continue to be original research papers. Editors support the trend in scientific writing to a direct, less formal style that permits limited use of personal pronouns to avoid repititious or awkward use of passive voice.

Review Papers: Papers that organize and compare data from numerous sources to provide new insights and unified concepts are solicted. Reviews that show how advances from other fields can beneficially be applied to coatings are also desired. Reviews that consist mainly of computer searches with little attempt to integrate or critically evaluate are not solicited.

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

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

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

Manuscripts should be typed with double spacing on one side of $8^1/2$ x 11 inch (22 x 28 cm) paper, with at least one-inch (2.5 cm) margins on all four sides. All paragraphs should be indented five spaces, and all pages should be numbered at the top center, or upper right corner.

Title

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

Authors' Biographies and Photographs

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

Abstracts

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

Text

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

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

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

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

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

Metric System

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

Tables, Graphs, and Drawings

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

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

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

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

Photographs

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

Color prints and slides are unacceptable.

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

Nomenclature

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

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

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

Equations

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

Summary

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

Acknowledgment

If used, it should follow the summary.

References

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

(1) Pascal, R.H. and Reig, F.L., "Pigment Colors and Surfactant Selection," *Official* DIGEST, 36, No. 475 (Part 1), 839 (1964).
(2) Davidson, H.R., "Use and Misuse of Computers in Color Control," JOURNAL OF COATINGS TECHNOLOGY, 54, No. 691, 55 (1982).
(3) Stephen, H.G., "Hydrogen Bonding—Key to Dispersion?," *J. Oil & Colour Chemists' Assoc.*, 65, No. 5, 191 (1982).
(4) Patton, T. (Ed.), *Pigment Handbook*, Vol. 1, John Wiley & Sons, Inc., New York, 1973.
(5) Henderson, W.A. Jr. and Singh, B. (to American Cyanamid Co.), U.S. Patent 4,361,518 (Nov. 30, 1982).

OTHER INFORMATION

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

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

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JCT JOURNAL OF COATINGS TECHNOLOGY

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The JOURNAL OF COATINGS TECHNOLOGY is available on microfilm from University Microfilms, a Xerox Co., Ann Arbor, MI 48106.

FSCT Board of Directors—1995-96

COMMENT

Offering a Golden Opportunity

In July, athletes from around the world will strive for that most desirable of treasures—Olympic gold. Despite their diverse origins, these athletes are united by a common goal—to stretch beyond their individual limitations and achieve their personal (and, they hope, the world's) best.

Overcoming barriers is also a focus of FSCT this summer. At the same time its Board of Directors is developing strategic proposals that may dramatically affect its structure and operating procedures, the Federation is strengthening international ties and furthering its educational mission globally.

Nowhere will this be more evident than at the Sheraton Maria Isabel Hotel & Towers, in Mexico City on August 15-17. There, FSCT will join with the Asociacion Nacional de Fabricantes de Pinturas y Tintas, A.C. (ANAFAPYT) and Instituto Mexicano de Tecnicos en Pinturas y Tintas (IMTPYT) to co-sponsor the Pan-American Coatings Expo. For the first time, FSCT will move beyond its traditional North American borders to sponsor a trade show. Building on 60 years of experience gained from running the largest exposition for the coatings industry, the FSCT has attracted over 75 exhibitors to Mexico City. They will focus on the manufacturing, environmental, and formulating needs of the Latin American coatings market, including Mexico, Central and South America.

Equally significant is the partnership in this venture between ANAFAPYT, the Mexico Technical Institute, and FSCT. There are common issues that face the paint and printing ink industries on a global level and this partnership offers a means for improving communication between the three groups. In addition, the Annual Convention of ANAFAPYT and the Technical Conference of the Mexico Technical Institute, held in conjunction with the Pan-American Coatings Expo, provide attendees with additional opportunities to further their own educational goals.

FSCT, ANAFAPYT and IMTPYT invite you to Mexico City to "go for the gold" and move towards achieving your professional best!

Patricia D. Viola
Editor

Technical Abstracts

Spanish translations provided by Jesús Camacho, of Instituto Mexicano de Tecnicos en Pinturas y Tintas.

Impedance Study of the Effect of *a Thin Rust Layer at the Steel-*Paint Interface on Coating Deterioration—S. Feliu, Jr., M. Morcillo, and S. Feliu

JCT, Vol. 68, No. 858, 33 (1996)

Impedance measurements were used to study the effect of the presence of a lightly prerusted substrate on coating deterioration during exposure to a saline solution. For this purpose, a chlorinated rubber coating was applied over clean and prerusted low carbon steel plates. An important number of replicate specimens were tested to establish the reality of small differences in the impedance behavior of the paint coating.

Although individual data were poorly reproducible across the different replicate specimens, statistically significant differences between the average values of paint capacitance and paint resistance for clean and rusted substrates were shown.

Estudio de Impedancia del Efecto de un Lecho de Oxido Delgado en la Interfase de Pintura-Acero en la Deteriorizacion del Recubrimiento—S. Feliu, Jr., M. Morcillo, y S. Feliu

Fueron usadas mediciones de impedancia para estudiar el efecto de la presencia de un substrato ligeramente preóxidado en la deteriorización de un recubrimiento durante la exposición a una solución salina. Para este proposito, fué aplicado un recubrimiento de goma clorada sobre platos de bajo acero al carbón preóxidado. Fueron probados un número importante de especimenes *replegados para establecer la realidad de las pequeñas diferencias* en el comportamiento del recubrimiento.

Sin embargo, datos individuales fueron reproducidos pobremente a través de los diferentes especimenes replegados, se encontraron diferencias estadísticamente significativas entre los valores promedio de la capacitancia y la resistencia de la pintura para los substratos óxidados y limpios.

Emulsification of Alkyds for *Industrial Coatings*—G. Östberg and B. Bergenståhl

JCT, Vol. 68, No. 858, 39 (1996)

So far, alkyd emulsions have mostly been used in consumer paints. These are relatively easy to emulsify due to their low viscosity. Lately, alkyd emulsions for industrial paint have gained increasing attention. Alkyds for industrial paints have a much higher viscosity than alkyds for consumer paints which require other emulsification techniques. In this work an alkyd with 40% oil length has been emulsified by the inversion technique. Inversion emulsification accomplished by adding water to an alkyd/surfactant mixture at constant temperature affords emulsions with droplet sizes below 1 μm at a concentration of three percent *on the alkyd phase. Small droplets* are necessary for colloidal stability of the emulsion. The solubility of surfactant in the alkyd and the water phase determines at which water concentration the emulsion inverts. High molecular weight ethoxylated anionic surfactants are effective as emulsifiers. Using these surfactants, the *emulsification becomes less dependent on emulsification temperature than when nonionic* surfactants are used.

Emulsificación de Alquidálicos para Recubrimientos Industriales—G. Ösberg y B. Bergenstahal

Las emulsiones alquidálicas comunmente no han sido usadas en pinturas de consumo. *Estas son* relativamente faciles de emulsificar debido a baja viscocidad. Tardiamente las emulsiones alquidálicas para pintura industrial han ganado atención. Las alquidálicas para pinturas industriales tienen mucho mayor viscocidad que las alquidálicas para pinturas de consumo la *cual requiere otro tipo de emulsificación. En este trabajo un alquidálico con 40%* de largo de aceíte ha sido modificado por la técnica de inversión. La emulsificación por inversión se llevó a cabo por adición de agua a una mezcla de surfactante/alquidálico a una temperatura constante nos obteniendose emulsiones con gotas de tamaño menor a 1 μm a una concentración de 3% en la fase alquidálica. Las gotas pequeñas son necesarias para la estabilidad coloidal de la emulsión. La solubilidad del surfactante en la fase agua y alquidálica determina a que concentración de agua la emulsión se invierte. Los surfactantes anionicos etoxilados de alto peso molécular son efectivos como emulsificadores. Usando estos surfactantes la emulsificación llega a ser menos dependiente de la temperatura de emulsificación que cuando se usan surfactantes no-ionicos.

Correlation of Accelerated *Exposure Testing and Exterior* Exposure Sites Part II: One Year Results—The Cleveland Society for Coatings Technology Technical Committee

JCT, Vol. 68, No. 858, 47 (1996)

Results in the Cleveland Society's long-term project to correlate accelerated test methods to several exterior exposure sites are presented. Included is a brief review of the methodology and the six month results. Recently completed one-year data are presented and discussed in regards to changes which have occurred with this additional exposure.

Spearman rank correlation analysis was initially used to investigate the weathering data from nine exterior exposure sites. Site to site correlations were found for several of these sites. Similar analysis was then used to investigate the degree of correlation present between each site and five accelerated test methods. The Spearman rank correlation was also used in the present study to analyze the results of six months additional exposure.

The nine sites chosen attempted to encompass several different types of climates with varying *degrees of harshness. They included several coastal sites, both east and west, as well as several*

non-marine, mild to moderate industrial exposures. The accelerated test methods included both old and new techniques, i.e., salt fog, cyclic salt fog, Prohesion cabinet, cyclic Prohesion/QUV, and cyclic immersion/UV weathering (KTA-Envirotest).

As Part I of this study concluded, correlations were present with the cyclic Prohesion/QUV accelerated test and four of nine exterior sites when rust creep at scribe was used as the measuring criteria. At 12 months, the cyclic Prohesion/QUV test continues to show statistical correlations for rust creep data, but sites which previously showed no correlation now correlate, and some sites which previously correlated, now do not. These results suggest that stronger irradiance may be necessary during accelerated testing to push correlations with exterior exposures to longer time frames.

Other test criteria, including blistering, surface rusting and gloss, have also been monitored throughout this study. While some correlations are now present, the lack of system to system differentiation within some of the exposure series, makes some of these correlations suspect. Additional exposure should broaden the range of results such that meaningful correlation analysis is possible. At least two additional years of exposure is planned.

Correlacion de Pruebas de Exposición Aceleradas y Zonas de Exposicion Exterior Part II: Resultados de un Año—Cleveland Society for Coatings Technology

Son presentados los resultados de un proyecto de largo plazo de la Sociedad de Cleveland para correlacionar métodos de prueba aceleradas para varios zonas de exposición exterior. Esto incluye una breve revisión de la metodolgía y los resultados de seis meses. Recientemente se completaron los datos de un año los cuales han sido presentados y discutidos teniendo en cuenta cambios que han ocurrido con esta exposición adicional.

Fué inicialmente usado el análisis de correlación de rango de Spearman para investigar los datos de intemperismo a partir de nueve sitios de exposición exterior. Se encontraron correlaciones sitio a sitio para varios de estos lugares. Entonces se usaron análisis similares para investigar el grado de correlación presente entre cada sitio y cinco métodos de prueba acelerada. La correlación de rango de Spearman también fué usada en el presente estudio para analizar los resultados de seis meses de exposición adicional.

Los nueve sitios escogidos intentaron contener diferentes tipos de clima con varios grados de aspereza. Incluyendo varios sitios costeros, tanto del este como del oeste, así como various no-marinos, exposiciones industriales medianas a moderadas. Los métodos de prueba acelerados incluyeron tanto las técnicas viejas como las nuevas, por ejemplo, niebla de sal, niebla de sal ciclica, gabinete de prohesión, prohesión ciclica/QUV e intemperismo de imersión ciclica/UV (KTA Envirotest).

Como parte I de este estudio concluido, se presentaron correlaciones con la prueba acelerada de prohesión ciclica/QUV y cuatro de nueve sitios exteriores cuando fué usado como criterio de medición el método de arrastre de moho en marca. En 12 meses, la prueba de prohesión/QUV cíclica contínua para mostrar correlaciones estadísticas para los datos de arrastre de moho, pero los sitios que previamente no correlacionaban ahora correlacionan, y algunos sitios que anteriormente correlacionaron ahora no lo hacen. Estos resultados sugieren que puede ser necesaria irradanción más intensa durante la prueba acelerada para empujar correlaciones con exposiciones exteriores a escenarios de prueba más prolongados.

También han sido monitoreados a lo largo de este estudio otros criterios de prueba, incluyendo abultamiento, oxidación superficial y brillo. Mientras algunas correlaciones son presentadas, las diferentes fallas de sistema a sistema a partir de algunas series de exposición, hace sospechosas a algunas de estas correlaciones. La exposición adicional debería ampliar el rango de resultados de tal forma que es posible obtener el significado del análisis de la correlación. Finalmente, se están planeando dos años adicionales de exposición.

Synthesis, Characterization, and Application of Lesquerella Oil and Its Derivative in Water-Reducible Coatings—S.F. Thames and H. Yu

JCT, Vol. 68, No. 858, 63 (1996)

Lesquerella oil (LO), a domestically produced vegetable oil of hydroxy fatty acid composition, has been used as a raw material for the synthesis of novel, water-reducible polyester coatings. The properties of these and castor oil derived polymers have been compared. Accordingly, polyesters of acid values approaching 50 were synthesized from LO, dehydrated lesquerella oil (DLO), castor oil (CO), and dehydrated castor oil (DCO). Aqueous solutions of the polyesters were prepared and used as ingredients in the formulation of industrial melamine-polyester baked coatings and air-dry polyester coatings. They were applied, cured, and their properties evaluated. The LO and CO derived coatings were comparable in pencil hardness, adhesion, gloss, and gloss retention properties. However, coatings from LO were superior in flexibility and ultraviolet stability.

Sintésis, Caracterización y Aplicación del Aceite de Lesquerela y su Derivado en Recubrimientos Reducibles en Agua—S.F. Thames y H. Yu

El aceite de Lesquerela (LO), un aceite vegetal producido domestícamente y con composición de ácido hidroxí graso, ha sido usado como materia prima para la sintesis de nuevos recubrimientos poliéster reducibles en agua. Han sido comparadas las propiedades de estos y los polímeros derivados del aceite de ricino. Conforme a esto, fueron sintetizados poliésteres de aproximadamente 50 valores de ácido a partir de LO, aceite de lesquerela dihidratado (DLO), aceite de ricino (CO) y aceite de ricino dihidratado (DCO). Las soluciones acuosas de los poliésteres fueron preparadas y usadas como ingredientes en la formulación de recubrimientos horneados de poliéster-melamina y recubrimientos de poliéster aire-seco. Todos fueron aplicados y curados, posteriormente se llevó a cabo la evaluación de sus propiedades. Los recubrimientos derivados de CO y LO fueron comparables en dureza, adhesión, brillo y propiedades de retención de brillo. Sin embargo, los recubrimientos formulados a partir de LO fueron superiores en estabilidad ultravioleta y flexibilidad.

George R. Pilcher, of Akzo Nobel Coatings, is Named Recipient of FSCT 1996 George Baugh Heckel Award

The Federation of Societies for Coatings Technology is pleased to announce that George R. Pilcher, Technical Director, Coil and Extrusion Business Unit, for Akzo Nobel Coatings Inc., Columbus, OH, will be the recipient of the organization's highest honor, the George Baugh Heckel Award, for 1996.

Mr. Pilcher, a member of the CDIC Society for Coatings Technology, will receive the award at the Opening Session of the Federation's Annual Meeting in Chicago, IL, on October 22.

The Heckel Award recognizes the outstanding contributions that Mr. Pilcher has made to the Federation's interest and prestige. Established in 1951, the Award is dedicated to the memory of George Baugh Heckel—author, poet, editor, and historian—who served as temporary Chairman when the Federation was organized in 1922 and as Secretary for many years thereafter.

Federation Accomplishments

A member of the Federation since 1976, Mr. Pilcher has been nominated to serve as a Member-at-Large on its Board of Directors for 1996-97. He previously served in this capacity from 1988-90.

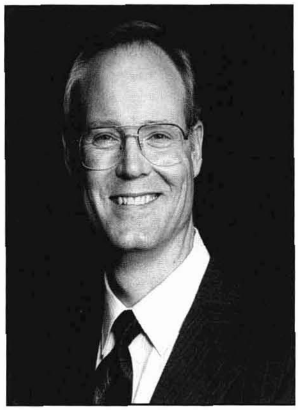
Mr. Pilcher's considerable contributions to the organization include active involvement on many FSCT committees, including the Professional Development Committee (1985-89) for which he was Chair from 1987-88. A member of the Annual Meeting Program Committee in 1986 and 1988-91, he chaired that group in 1989. He chaired the Roon Awards Committee in 1991 and served as a member from 1991-96. Mr. Pilcher has been a member of the Mattiello Memorial Lecture Committee (1991-1996) and serves as the 1996 Chair.

He was a member of the APJ/Voss Award Committee (1984-91); Finance Committee (1989-90), and Nominating Committee (1989-90). At the Federation's Annual Meeting, he has chaired sessions for five years.

A member of the Editorial Review Board of the JOURNAL OF COATINGS TECHNOLOGY from 1993 to the present, Mr. Pilcher also currently serves as a member of the Publications Committee.

Society Activities

Currently a member of the CDIC Society, Mr. Pilcher began his involvement with the FSCT as a member of the Cleveland Society. He acted as Chair for the Society's Educational Committee in 1979-81 and as a member of that group from 1976-81. As a member of the Technical Committee (1978-79), he presented the Cleveland Society's technical paper, "Study of Organotitanates as Adhesion Promoters" at the 1978 FSCT Annual Meeting in Chicago. Mr. Pilcher was very involved in the Cleveland Society Conference on "Advances in Coating Technology" for which he served as Chairman in 1979 and 1980, Session Chair in 1983, Judge in 1982, and Judging Chair in 1986. The Cleveland Society honored him with their prestigious "Certificate of Award" for "outstanding contributions" to that group.



Career Highlights

Mr. Pilcher has been involved in the coatings industry for 26 years and has been employed with Akzo Nobel for 15 years. His areas of expertise include the chemistry of saturated polyester and silicone polyester polymers; the chemistry and use of pigments in coatings; degradation mechanisms of poly(vinyl)chloride polymers; the dispersion of pigments in fluid media; the durability of coatings; and coatings for use in the coil application process.

Mr. Pilcher was graduated from College of Wooster, in 1970 with a B.A. in Chemistry.

Industry-Related Activities

Mr. Pilcher has contributed significantly to the activities of the Coatings Industry Education Foundation, having served on its Board of Trustees from 1987 to the present and as President from 1989-95.

An active member of the American Chemical Society, Division of Polymeric Materials: Science and Engineering (PMSE), he acted as Founding Chairman of the group's Roy W. Tess Award in Coatings, 1984-1996, and was Chairman of PMSE in 1993.

Mr. Pilcher presented the Keynote Address for the Washington Paint Technical Group in 1988, and the Paint and Pigment Division, Gesellschaft Deutscher Chemiker, 1993.

In 1995, he became the first American to be elected Honorary "Corresponding Member," for the Paint and Pigment Division, Gesellschaft Deutscher Chemiker. In 1988, he was elected Fellow, American Institute of Chemists.

Mr. Pilcher served on the Advisory Board for the National Science Foundation Coatings Center (1993-96), and is First Vice-Chairman of ASTM D-1 (1995-present). He was Chairman of ASTM Subcommittee D01.55, "Factory-Applied Coatings on Preformed Products," from 1991 to 1993. He was also Chair of the Gordon Research Conference on the Chemistry and Physics of Coatings and Films in 1991.

The author of numerous journal articles, he also contributed the chapter on "Saturated Polyester Coatings," in *Organic Coatings: Their Origin and Development*, edited by Herman F. Mark and Raymond B. Seymour (Elsevier).

Mr. Pilcher's involvement extends into community service as well. A Trustee of the Westerville Public Library (1992-present), he served as Vice President in 1995-96. He was President of the Kiwanis Club of Strongsville, Ohio in 1976.

* * *

The Federation is proud to include Mr. Pilcher in the distinguished list of recipients of the prestigious George Baugh Heckel Award.

COMPUTER USES IN THE COATINGS INDUSTRY

August 20-21, 1996
Hyatt Regency O'Hare, Chicago, IL
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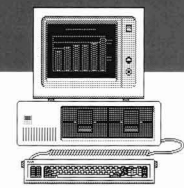

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FSCT Presents Seminar on "Computer Uses in the Coatings Industry"

Tuesday - Wednesday, August 20-21, 1996
Hyatt Regency O'Hare, Chicago, IL

Many challenges face the coatings industry as it strives to deliver consistently better products for more demanding customers. In addition to understanding the latest materials which are used to develop coatings and understanding the complex regulatory issues, the industry must make the best and most effective use of the newest available tools and technologies to produce top quality products.

FSCT's new course, "Computer Uses in the Coatings Industry," scheduled for August 20-21, 1996 at the Hyatt Regency O'Hare, in Chicago, IL, is designed to provide the latest information to assist those responsible for the development and production of coatings. The objectives of the two day course are as follows:

- Provide attendees with a general overview of the various uses of computers in the coatings industry
- Give attendees a basic understanding of specific coatings related applications for computers, such as: Design of Experiments; Formulation, including regulatory compliance; and Manufacturing/Production.

The program has been designed for the following practitioners: R&D staff; coatings formulators; lab personnel; technical directors; group leaders and project managers; manufacturing personnel; and regulatory specialists with coatings development responsibility.

REGISTRATION INFORMATION

To register, simply complete the registration form on the facing page in detail, attach your check or money order or provide credit card information, and return to: Federation of Societies for Coatings Technology, 492 Norristown Rd., Blue Bell, PA 19422-2350.

Registration Fees

$295 for FSCT members
$395 for Nonmembers

Included in the registration is the following:

- Luncheons
- Refreshment Breaks
- Reference Materials

Payment by check must be made in U.S. Funds, payable to U.S. Banks

Cancellation Policy

All cancellations made within five (5) business days of the event will be assessed a $60 charge.

Attendance is limited and registrations will be accomodated on a first come first served basis.

HOUSING

FSCT has arranged for a block of rooms at the Hyatt Regency O'Hare at the rate of $115 single or $135 double occupancy. To receive this special room rate, contact the Hyatt directly at:

800-233-1234 or 847-696-1234

Be sure to have the following information available prior to calling:

- Meeting code: **FSCT Seminar**
- Arrival and departure dates
- Room type desired
- Name(s) of room occupants
- Credit card for guaranteeing the reservation
- Mailing address to which confirmation will be mailed

Reservations must be placed with the hotel by July 30, 1996, to receive the special rate. After July 30, reservations will be placed on a space available basis only.

The Hyatt Regency O'Hare is located at River Road and the Kennedy Expressway, three miles from O'Hare International Airport and is 20 minutes from downtown Chicago. The hotel offers complimentary transportation to and from the Airport.

TRAVEL ARRANGEMENTS

Contact the FSCT Travel Desk at **1-800-448-FSCT** and mention the code FSCT-SEM-896 for air transportation needs. Special discounts are available on United.

Tentative Program

Tuesday, August 20, 1996

8:30 AM - 10:30 AM .... *General Overview of Computer Uses*
Charles Rooney, Orr & Boss

10:30 AM - 10:45 AM .... Refreshment Break

10:45 AM - 12:15 PM .... *Design of Experiments*
Charles Rooney, Orr & Boss

12:15 PM - 1:15 PM .... Lunch

1:15 PM - 2:45 PM .... *Formulation*
Edward Wilson, AI Ware

2:45 PM - 3:00 PM .... Refreshment Break

3:00 PM - 4:00 PM .... *Solvents*
Tom Larson, Exxon

Wednesday, August 21, 1996

8:15 AM - 9:45 AM .... *Formulation*
DT Wu, DTW Associates

9:45 AM - 10:00 AM .... Refreshment Break

10:00 AM - 11:30 AM .... *Manufacturing Software*
Paul Silvani, Lakeshore Consulting Inc.

11:30 PM - 12:30 PM .... Lunch

12:30 PM - 2:00 PM .... *Manufacturing*
to be determined, Oliver Wight Companies

2:00 PM - 3:00 PM .... Open Forum

1996 PAN-AMERICAN COATINGS EXPO

SHOW INFORMATION

AUGUST 15-17, 1996
SHERATON MARIA ISABEL HOTEL
MEXICO CITY, MEXICO

ANAFAPYT

Federation of Societies for Coatings Technology

Instituto Mexicano de Técnicos en Pinturas y Tintas

Welcome . . .

Dear Colleagues

It is my pleasure, as President of the FSCT, to extend a warm welcome to all of you attending the first Pan-American coatings show co-sponsored by the FSCT, ANAFAPYT, and Instituto Mexicano de Tecnicos en Pinturas y Tintas. As the coatings industry has become a global industry, it is fitting that we are gathering for our first international exposition opportunity. In today's environment, the sharing of information and new technology is critical for everyone in the industry. We can meet the challenges of the future by participating in events such as this. I would like to thank the supplier community for their participation and all attendees whose participation is extremely important. Enjoy the show and the warmth and hospitality of Mexico.

Dr. Darlene Brezinski
FSCT President, 1995-96

Welcome Friends!

The Pan-American Coatings Expo means a lot more to the Mexican Society than just the first big event that the FSCT is organizing in our country. It shows confidence and trust in a country that has been struggling with a lot of barriers to try to be at the same technological level as the rest of the world. I am sure that I do not speak alone when I say that the Mexican Technicians are convinced that the only way to be competitive in this growing industry is to be aware of all the new products and technologies that are being developed. Issues like aggressive training programs as well as accurate and updated information are essential for any company that wants to remain as an option to the customers.

For this reason and many others, I am confident you will find that Mexico is fertile land for your products and systems as well as a friendly country.

Marcelo E. Herrera Diaz, President
Mexican Society of Technicians in Paints and Inks

Estimados Amigos Industriales:

Es para ANAFAPYT un gran honor el ser copatrocinador del Panamerican Show, presentado por la Asociación de Sociedades para la Tecnología de Recubrimientos y al mismo tiempo llevar a cabo La Convención Anual y el desarrollo de las Jornadas Técnicas de nuestro Instituto Mexicano de Técnicos en Pinturas y Tintas.

A juzgar por el número de participantes en este evento, se podrán revisar y apreciar nuevos materiales, equipos y tecnologías para el sector de Pinturas y Tintas.

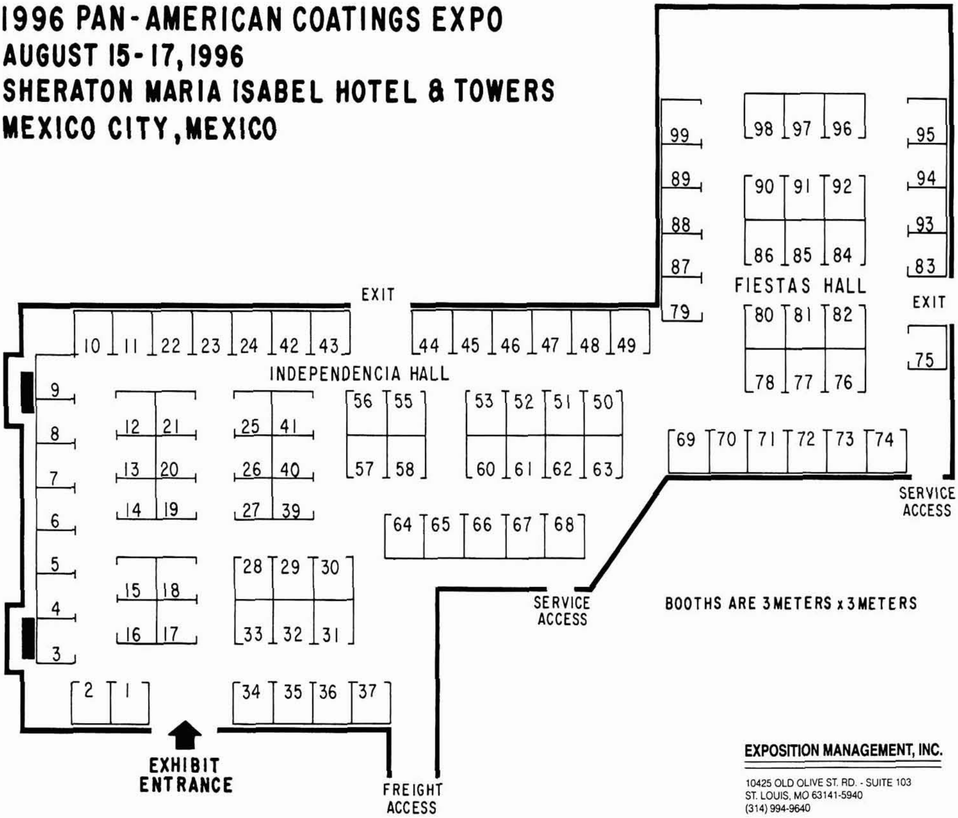
Es la primera vez que en la Convención Anual, que es la número XXII, ya participan como socios gran número de nuestros proveedores y diferentes empresas relacionadas con el ramo, por lo cual nuestra Asociación ha tomado un nuevo impulso y ha sorprendido a otros grupos industriales y Comerciales, que se haga este tipo de eventos donde participan también empresas de Centro y Sudamérica, en un tiempo donde el país no acaba de salir de sus problemas que comenzaron en diciembre de 1994.

La ANAFAPYT fortalecida tiene nuevos servicios, como lo es el "Centro de Cómputo."

Desde luego agradecemos a la Federación y a nuestra entusiasta Instituto de Técnicos, así como a las empresas asociadas por el gran impulso que le han dado a este evento Panamericano. Que no dudamos tendrá un gran éxito y será de beneficio para el mejor desarrollo de nuestra Industria de Pinturas y Tintas.

Ing. Rafael Del Rio Huidobro
Presidente
ANAFAPYT (Mexico)

1996 PAN-AMERICAN COATINGS EXPO
AUGUST 15-17, 1996
SHERATON MARIA ISABEL HOTEL & TOWERS
MEXICO CITY, MEXICO



EXPOSITION MANAGEMENT, INC.

10425 OLD OLIVE ST. RD. - SUITE 103
ST. LOUIS, MO 63141-5940
(314) 994-9640

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1996 PAN-AMERICAN COATINGS EXPO

DESCRIPTIONS OF EXHIBITS

AIR PRODUCTS AND CHEMICALS, INC. 3, 4, 5, 6
7201 Hamilton Blvd.
Allentown, PA 18195
Phone: 610-481-7290
FAX: 610-481-5817

Air Products features the benefits of Surfynol® multi-functional surfactants in water-based coatings systems. Specifically highlighted are our products for architectural coatings. Also on display are epoxy curatives for high-solids and waterborne coatings. Water-based polymer emulsions for a wide variety of interior/exterior paints are being promoted.

ANAFAPYT, A.C. 65
Gabriel Mancera No. 309
Col. Del Valle
Mexico, D.F. 03100
Mexico
Phone: 525-682-7794
FAX: 525-543-6488

Mexican Association of Manufacturers of Paints and Inks. Co-organizer of the Pan-American Coatings Expo.

ANGUS CHEMICAL CO. 50
1500 E. Lake Cook Rd.
Buffalo Grove, IL 60089
Phone: 847-215-8600
FAX: 847-215-8626

ANGUS features additives for coatings including AMP-95 multifunctional additive, NiPar wetting additive, Zoldine MS-plus moisture scavenger, and Bioban CT preservative.

ARCO CHEMICAL PAN AMERICA, INC. 42
Reforma 390
Decimo Piso-06600
Mexico, D.F. 06600
Mexico
Phone: 525-525-1036
FAX: 525-207-0859

Arco highlights the following: ARCOSOLV® P-Series glycol ethers; MP Diol® glycol; NMP (n-methyl-pyrroledone); ARCOL® polyols; TBHP (tertiary-butyl hydroperoxide); ARCAL™SAA-100 (styrene-allyl alcohol copolymer); ARCAL™DAP (diallyl phthalate); and ARCAL™AP-1375 (allyl propoxylate).

ASHLAND CHEMICAL, IND. CHEM. & SOLVENTS DIV. 76
Box 2219
Columbus, OH 43216
Phone: 614-790-3475
FAX: 614-790-3426

ATLAS 85
4114 North Ravenswood Ave.
Chicago, IL 60613
Phone: 312-327-4520
FAX: 312-327-5787

Atlas provides environmental and materials testing instrumentation that simulates radiant energy, temperature, salt fog, moisture, and other components of the environment. Our outdoor sites offer both natural and accelerated exposure testing.

BAYER DE MEXICO, S.A. DE C.V. 55,56,57,58
M. Cervantes Saavedra 259
Col. Granada
Mexico, D.F. 11520
Mexico
Phone: 525-728-3000
FAX: 525-728-3155

Bayer de Mexico features raw materials for the coatings industry including: polyesters, polyisocyanates, acrylics, polyethers, and additives.

BAYER DE MEXICO, PIGMENTS S.A. 81,82
M. Cervantes Saavedra 259
Col. Granada
Mexico, D.F. 11520
Mexico
Phone: 525-728-3091
FAX: 525-728-3099

Bayer de Mexico—Pigments highlights organic and inorganic pigments; additives for coatings; and microbiocides for paints and lacquers.

BYK-CHEMIE USA 29
524 South Cherry St.
Wallingford, CT 06492
Phone: 203-265-2086
FAX: 203-284-9158

BYK-Chemie highlights BYK®-410, the new liquid rheological additive for solvent-based and solvent-free systems. This line of additives includes wetting and dispersing agents, defoamers, surface leveling agents, and acid blocked catalysts. Our distributor Intertrade S.A. de C.V. is joining us at the adjacent booth.

CB MILLS 44
1225 Busch Parkway
Buffalo Grove, IL 60089-4504
Phone: 847-459-0007
FAX: 847-459-0598

CB Mills is a manufacturer of vertical and horizontal mills as well as solvent recovery systems and tank washers. The horizontal mill, solvent recovery system, and tank washer are microprocessor controlled.

CHARLOTTE CHEMICAL INC. 77
Homero 432-PH, Col. Polanco
Mexico, D.F. 11570
Mexico
Phone: 525-203-6226
FAX: 525-203-6434

Charlotte Chemical highlights raw materials for the manufacture of traffic, swimming pool, and anticorrosive paints. Chlorinated rubber, chlorinated paraffins, polymerics plasticizers, plasticizer for nitrocellulose lacquer, tricresyl phosphate castor oil, acrylamide, methacrylic acid, organic fungicide, and paint additives are also highlighted.

CIBA-GEIGY MEXICANA S.A. DE C.V. 75
Calz. Tlalpan #3058
Col. Santa Ursula Coapa
Mexico, D.F. 04850
Mexico
Phone: 525-549-3000
FAX: 525-544-1135

Ciba-Geigy Mexicana exhibits organic pigments for inks & paints, epoxy resins, and additives for paints (UV absorbers, anticorrosives).

COATINGS WORLD/INK WORLD 92
17 S. Franklin Tpk.
Ramsey, NJ 07446
Phone: 201-825-2552
FAX: 201-825-0553

Coatings World is a new publication covering the global paints, coatings, adhesives and sealants industry. *Ink World* is a monthly publication with a circulation of over 7,000 readers in the printing inks and allied industries.

CONNOR COMERCIAL, S.A. 47
Prol. Canal de Miramontes No. 60
Col. Ejidos de Huipulco
Tlalpan 14840
Mexico
Phone: 525-673-0222
FAX: 525-594-2507

Connor Comercial is a technical distributor and agent of manufacturers for the following: (1) Process Machinery—agitators, dispersers, filters, premillers, bead mills (horizontal and vertical), continuous, sieves, solvent recycling tank washers, grinding media, viscosity control; and (2) Laboratory Testing Equipment—adhesion, color, cyclic corrosion, formulation, film thickness (dry, wet), fineness of grind, gloss, impact, air humidity, printability testers, tack, viscosimeters, weathering and salt spray testers, mixers/dispersers for the laboratory.

DANIEL PRODUCTS CO., INC. 49
400 Claremont Ave.
Jersey City, NJ 07304
Phone: 201-432-0800
FAX: 201-432-0266

Daniel Products Company, Inc. features additives and colorants for high performance environmentally friendly coatings and inks. Slip-Ayd® wax dispersion, micronized wax and wax emulsions; Dapro® foam suppressors and interfacial tension modifiers; Disperse-Ayd® multifunctional pigment wetting and dispersing agents; and water- and solvent-based Tint-Ayd® pigment dispersions are also offered.

DEGUSSA CORP. 52,53
Calz. Mexico-Xochimilco 5149
Mexico, D.F. 14610
Mexico
Phone: 525-673-1370
FAX: 525-673-1016

Numerous products for the paint and coatings industry are on display, including Aerosil® fumed silicas, Acematt® flatting agents, specialty carbon blacks, and IPDA isophorone diamine.

DISTI-KLEEN, INC. 35
358 Nye Ave.
Irvington, NJ 07111-4713
Phone: 201-372-1500
FAX: 201-372-8311

Disti-Kleen features solvent recovery equipment, washing equipment, pails, drums, openhead containers, stationary tanks, and tote tanks as well as automated color dispensing equipment.

DJB S.A. DE C.V. 41
Blvd. Queretaro #2449
Tlalnepantla, Edo de Mexico 54060
Mexico
Phone: 525-362-2506
FAX: 525-362-5571

DJB distributes hollow glass and ceramic microspheres and glass beads as grinding media for PQ Corporation and Potters Industries Inc.

DOW CORNING DE MEXICO, S.A. DE C.V. 51
Campos Eliseos 345-5
Col. Polanco
Mexico City, D.F. 11550
Mexico
Phone: 525-327-1300
FAX: 525-327-1327

Dow Corning provides silicone technologies to the coatings industry. Dow's product lines include: silicone resins—high temperature and weather resistant applications; paint additives; and water repellents for concrete, wood, limestone, sandstone, bricks, etc.

DRAISWERKE GMBH 36,37
Speckweg 43-51
Mannheim, D-68305
Germany
Phone: 621-750-400
FAX: 621-750-4322

Draiswerke, Germany, manufacturer of dispersing equipment and newly developed complete plants for the coatings and ink industries, exhibit the Drais DCP-SUPERFLOW 170 C agitated media mill. This addition to the SUPERFLOW family is designed for large-scale production. It features pass operation and recirculation options, high level dispersion for thermo-sensitive formulations, cooling performance, ease of cleaning, and is economical to run.

DRAISWERKE, INC. 23,24
40 Whitney Rd.
Mahwah, NJ 07430
Phone: 201-847-0600
FAX: 201-847-0606

Draiswerke, Inc. is exhibiting: (1) DCP-Megaflow 170-C, (double cylinder design, with double surfaces of rotor & stator pegs. Mill system for re-circulation & single pass grinding); (2) PM-DDA direct dispersion mill (continuous feed, premix unit eliminates large premix tanks & dispersers); and (3) PM-1 H/V laboratory media mill (for laboratory & development work).

DUPONT, S.A. DE C.V. 48
Av. Homero No. 206
Col. Chapultepec, Morales 11570
Mexico
Phone: 525-722-1285
FAX: 525-722-1373

DuPont displays a titanium dioxide of 100% chloride process. Also featured is Ti-Pure®.

EASTMAN CHEMICAL CO. 62,63
Insurgentes SUR 1106
Piso 7, Col. Nochebuena
Mexico City, DF 03720
Mexico
Phone: 525-559-7511
FAX: 525-559-4007

Eastman is promoting its line of solvents, specialty cellulosic resins, polyester resin intermediates, and adhesion promoters for the paint and coatings industry. Eastman's expanding presence in Mexico is also highlighted.

EGON MEYER, S.A. DE C.V. 90
Av. Henry Ford No. 38
Fraccionamiento Industrial,
San Javier, C.P. 54030
Tlalnepantla, Edo. de Mexico
Mexico
Phone: 525-310-5766
FAX:525-310-4649

EIGER MACHINERY INC. 7
888-214 E. Belvidere Rd.
Grayslake, IL 60030
Phone: 800-25-EIGER
FAX: 847-970-9804

Eiger is displaying a line of laboratory and production horizontal bead mills. Also highlighted are: patented laboratory "Mini-Mill" for research, development, and quality control work; new "Maxi-Mill" self-pumping, laboratory pilot mill for small batch production and larger R&D projects; MKII production horizontal bead mill with a cartridge seal and cylinder designs; and beltless laboratory mixer/disperser/batch bead mill.

EPWORTH/MOREHOUSE COWLES .. 93
1600 W. Commonwealth Ave.
Fullerton, CA 92633
Phone: 714-738-5000
FAX: 714-738-5960

Now that the merger of Epworth and Morehouse-Cowles is complete, they now offer more than 130 years of experience. The booth will display the newest design in horizontal mills and newly designed Cowles Dissolver.

FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY 67
492 Norristown Rd.
Blue Bell, PA 19422
Phone: 610-940-0777
FAX: 610-940-0292

FSCT offers a comprehensive line of industry publications, educational materials, and membership information. Publications include the newly published *Coatings Encyclopedic Dictionary*, the Federation's *Series on Coatings Technology*, and Sci*Quest*, a CD-ROM tutorial for new and seasoned industry professionals. Details on the FSCT's International Coatings Expo and Technology Conference (October 22-25) in Chicago, IL, are also available.

FLUID MANAGEMENT 15,18
1023 S. Wheeling Rd.
Wheeling, IL 60090
Phone: 708-459-2174
FAX: 708-537-5530

BFGOODRICH SPECIALTY CHEMICALS 1
9911 Brecksville Rd.
Cleveland, OH 44141
Phone: 216-447-5000
FAX: 216-447-5770

BFGoodrich features its line of waterborne polymers for paint, coatings, and graphic arts. Product offerings include Carboset® acrylic emulsions and resins, Sancure® polyurethane dispersions, and Permax™ vinylidene chloride acrylate copolymer emulsions.
Coatings polymers offered are designed for industrial maintenance and specialty architectural applications. Emphasis is on factory-applied, do-it-yourself and contractor clear wood lacquers, corrosion-resistant metal coatings finishes for plastics, and temporary coatings. Graphic arts polymers are highlighted by glycol-ether free pigment grinding vehicles and a variety of specialty emulsions for packaging and overprint varnishes.

GRUPO PROVEQUIM 70,71
Alamo Plateado No. 1
1 Piso Los Alamos Lomas Verdes
Naucalpan, Edo. de Mexico
Mexico
Phone: 525-393-0300
FAX: 525-393-7795

Grupo Provequim is a distributor of chemical products in Mexico, with 19 branches nationwide. Companies represented include: Cabot Corp., Cab-O-Sil Division; Silberline Mfg., Co., Inc.—aluminum pigments; RIMSA Waste & Disposal Management Services; and CCPQ (ChemCentral-Provequim).

HALOX 32,33
1326 Summer St.
Hammond, IN 46321
Phone: 219-933-1560
FAX: 219-933-1570

Halox focuses on the concept of SQP and is bringing this concept to the Pan

American Expo. Halox presents information on their inhibitive pigments. Replacements for lead and chromates are offered.

HÜLS AMERICA INC. 16, 17
220 Davidson Ave.
Somerset, NJ 08873
Phone: 908-560-6879
FAX: 908-560-6901

Hüls America features its Colortrend® universal machine colorants, Colortrend color systems, Chroma-Chem® 844 industrial colorants, Chroma-Chem 844 industrial color systems and a comprehensive line of biocides. Colortrend color systems can be used to make custom colors in latex, acrylic, PVA, and alkyd paints. Chroma-Chem® 844 industrial colorants are designed for in-plant and machine tinting of high performance, non-aqueous industrial and maintenance coatings. The biocides—fungicides and preservatives—protect paint from the time the coating goes into the can until long after the coating has been applied.

HUNTERLAB 12
11491 Sunset Hills Rd.
Reston, VA 22090
Phone: 703-471-6870
FAX: 703-471-4237

HunterLab exhibits their MiniScan portable and ColorQuest benchtop spectrophotometers for color management of coatings and pigments. The EasyMatch Windows '95 based, Color Matching System will be demonstrated. In addition, the new PRO II glossmeter will be shown.

ICIS-LOR 88
3730 Kirby Dr., Ste. 1030
Houston, TX 77098
Phone: 713-525-2600
FAX:713-525-2659

IMTPYT 66
Gabriel Mancera No. 309
Col. Del Valle
Mexico, D.F. 03100
Mexico
Phone: 525-682-7794
FAX: 525-543-6488

Mexican Society of Technicians in Paints and Inks. Co-organizer of the Pan-American Coatings Expo, IMTPYT highlights all the multiple services it offers to its members.

INPRA-LATINA 72
1680 SW Bayshore Blvd.
Port Saint Lucie, FL 34984
Phone: 407-879-6666
FAX: 407-879-7388

INPRA LATINA is a quarterly magazine, written in Spanish and Portuguese for the manufacturers of paints, coatings, adhesives, and printing inks in Latin America. It is produced by Latin Coast LCC—a joint venture between Latin Press, Inc. of Medillín, Colombia, South American and CoastCom Corporation of Port St. Lucie, FL, USA. The Mexicana Paint and Printing Ink Association (ANAFAPYT) supports INPRA LATINA as an honorary member on the magazine's editorial board.

INTERTRADE S.A. DE C.V. 28
Luz Saviñon 513 - ler. Piso
Col. Del Valle, Mexico 03100
Mexico
Phone: 525-523-5704
FAX: 525-523-8056

Pigments, titanium dioxide-Kemira; color pigments-Heubach; acrylic resins-CCP Emulsion Systems; and aluminum paste-Alcan Toyo.

SC JOHNSON POLYMER 21
1525 Howe St.
Racine, WI 53403-2236
Phone: 414-631-4353
FAX: 414-631-3608

SC Johnson Polymer supplies acrylic polymers and additives to the paint and coatings industry. On display is patented SGO technology for highly pure solution polymers and their RC water-based technology for ultrafine particle size emulsions. Products based on these technologies are positioned as differentiable performers for horizontal concrete, high performance 2-pack urethanes, decorative and industrial metal and wood applications.

KADY INTERNATIONAL 46
127 Pleasanthill Rd.
P.O. Box 847
Scarborough, ME 04074
Phone: 207-883-4141
FAX: 207-883-8241

Kady International displays a top entry lab mill, the KADY L2000—a high speed, rotor stator dispersion mill with rotor tip speeds of 9,000 ft. per min. The KADY quickly reduces agglomerates to their original particle size. KADY Mills are available in ranges from one pint to three gallons vs. batch or continuous operation.

KENRICH PETROCHEMICALS, INC. . 61
140 East 22nd St.
Bayonne, NJ 07002
Phone: 201-823-9000
FAX: 201-823-0691

Kenrich Petrochemicals highlights Ken-React titanate, zirconate, and aluminate coupling agents for high-solids and water-based anti-corrosive coatings. Ken-Stat KS MZ100, a non-blooming, non-moisture dependent, permanent and transparent antistat based on combined neoalkoxy zirconates to give volume and surface conductivity to clear films is also featured. Kenplast diluents for epoxy are on display.

KING INDUSTRIES, INC. 14
Science Rd.
Norwalk, CT 06852
Phone: 203-866-5551
FAX: 203-866-1268

King features product and application information on their 10 major product lines used in the formulation of high-solids, waterborne, and powder coatings and inks. Products on display are: Nacure® and K-Cure® catalysts for thermoset coatings, K-Kat® catalysts for 2K urethanes, K-Flex® polyester polyols, urethane diols and polyester/urethane dispersions, K-Sperse® dispersing agents, Nacorr® rust and corrosion inhibitors, Disparlon® surface control agents and thixotropes, Agitan™ foam control agents, Tafigel™ polyurethane associative thickeners, Metolat™ and Edaplan™ leveling and wetting agents.

THE LUBRIZOL CORP. 10
29400 Lakeland Blvd.
Wickliffe, OH 44092-2298
Phone: 216-943-4200
FAX: 216-943-9076

Lubrizol provides innovative additive products, technical support and distribution throughout Mexico and Latin America. Key products exhibited include Lanco™ additives for surface modification and protection, IRCOGEL® rheology control additives for mid-to-high solid coatings, Ircosperse® dispersions for color development and consistency, and corrosion inhibitors.

MEARL DE MEXICO, S.A. DE C.V. 73
Avenida Gustavo Baz, No. 176-2
Col. San Jerónimo Tepetlacalco
Tlalnepantla,
CP 54090, Edo. de Mexico
Mexico
Phone: 525-361-7091
FAX: 525-361-7409

METAMORFOSIS PUBLICIDAD,
S.A. DE C.V. 91
Guido Reau 56
Col. Alfonso XIII
Mexico, D.F. 01460
Mexico
Phone: 525-660-1175
FAX: 525-660-1450

3M MÉXICO S.A. DE C.V. 86
Calz. San Juan de Aragón
516 Col. Carrera Lardizabal
Mexico, D.F. 07070
Mexico
Phone: 525-728-2028
FAX: 525-728-2270

3M and Zeelan Industries offer engineered microspheres in different sizes, strength, density, and composition. These products are designed to offer improved flow to lower resin demand and reduce shrinkage.

METAPOL, S.A. DE C.V. 25
Azahares No. 26-203
Col. Sta. Ma. Insurgentes
Mexico, D.F. 06430
Mexico
Phone: 525-583-8770
FAX: 525-583-0557

Metapol features metallic pigments (bronze powders "gold" shades) and aluminum pastes and powders for the coatings industry.

MICRO POWDERS, INC. 2
580 White Plains Rd.
Tarrytown, NY 10591
Phone: 914-793-4058
FAX: 914-472-7098

Micro Powders, Inc., an ISO 9002 certified company, is exhibiting its full line of micronized waxes for use in paints, printing inks, and coatings. New additions to the product range are also being introduced, including: Superslip waxes—stir-in micronized waxes for all types of paints and coatings; Synfluo waxes—micronized modified PTFE wax additives; Aquabead® waxes and emulsions—wax powders and emulsions for exterior stains and coatings; and Aqua Poly 235—a new micronized polyethylene wax.

MING-ZU CHEMICAL INDUSTRIES ... 31
1578 Barclay Blvd.
Buffalo Grove, IL 60089
Phone: 708-419-1083
FAX: 708-419-1082

MOCAYCO 35
Reforma Norte No. 604-1802
Col. Nondalco Tlaltelolco
Mexico, D.F. 06900
Phone: 525-583-8226
FAX: 525-597-1392

Mocayco highlights additives, extenders, fillers, resins, solvents, flatting agents, and milling media.

MONSANTO CO. 13
800 N. Lindbergh Blvd.
St. Louis, MO 63367
Phone: 314-694-5100
FAX: 314-694-4128

Amino crosslinkers, flow modifiers and solvents for high-solids, waterborne, and radiation-cured coatings.

MULOX DE MEXICO, S.A. DE C.V. 43
Cuauhtemoc No. 509
Matehuala, S.L.P., Mexico
Phone: 91-488-2-40-32
FAX: 91-488-2-40-67

Mulox features flexible intermediate bulk containers (FIBC). The groundable "Electra" (FIBC) can be used in areas where an electrostatic spark could cause fire or explosion. All FIBC's designs meet or exceed a 5:1 safety ratio. Mulox's FIBC's transport and handle dry flowable products.

NATIONAL STARCH & CHEMICAL, S.A. DE C.V. 11,22
Miguel de Cervantes
Saavedra 71
Col. Granada
Mexico, D.F. 11520
Mexico
Phone: 525-545-4274
FAX: 525-531-0417

National Starch features: emulsion resins (vinyl acrylics, styrene-acrylics, acrylics); rheology modifiers (thickeners, dispersant); and Elotex™ redispersible polymers.

NEW WAY PACKAGING MACHINERY, INC. 8,9
210 Blettner Ave.
Hanover, PA 17331
Phone: 717-637-2133
FAX: 717-637-2966

New Way exhibits its Model E-5 labeler for quart cans and smaller, as well as aerosol cans up to 4 1/2" in diameter. New Way also manufactures labelers for gallon cans and smaller and all round plastic containers.

NYCO-SIERRA-REPTEC 74
Lerdo de Tejada #272 amp. Petrolera
Azcapotzalco, D.F. 02720
Mexico
Phone: 525-561-4516
FAX: 525-561-3661

PAAR PHYSICA 39
1090 King George Post Rd.
Edison, NJ 08837
Phone: 908-738-6640
FAX: 908-738-7025

PINTURAS SEÑALMEX S.A. DE C.V. 79,87
Bosques de Cidros
#173-5 Piso
Col. Bosques de Las Lomas
Cuajimalpa, D.F. 05120
Mexico
Phone: 5-229-7477/78
FAX: 5-229-7430

On display are paints for traffic signalling, vinyl emulsified paints, and bright alkyd enamel.

PLUESS-STAUFER MEXICANA, S.A. DE C.V. 84
Lomas Verdes 750-205
Naucalpan, Mexico, D.F. 53120
Mexico
Phone: 525-343-9442
FAX: 525-343-2623

Pluess-Staufer displays ultrafine ground calcium carbonates in dry and slurry form. Trademarks: Omyacarb and Hydrocarb. Also highlighted are calcined and hydrous clays featuring Optiwhite grades. Trademark: Burgess.

PREMIER MILL 64
One Birchmont Dr.
Reading, PA 19606-3298
Phone: 610-779-9500
FAX: 610-779-9666

Premier Mill Corp., a manufacturer of wet processing equipment, is exhibiting the production size Supermill 2.

Q-PANEL LAB PRODUCTS INC. 45
26200 First St.
Cleveland, OH 44145
Phone: 216-835-8700
FAX: 216-835-8738

Q-Panel is exhibiting the QUV accelerated weathering tester and the Q-fog cyclic corrosion tester. In addition, Q-Panel is introducing their new division called Q-Lab Weathering Research Service. Q-Lab is a contract test facility specializing in environmental exposure tests to determine materials' durability when subject to the forces of weathering and corrosion. Q-Lab features Florida weathering exposures, cyclic corrosion testing, and accelerated weathering.

QUIMICA SAN DIEGO, S.A. DE C.V... 34
Av. Uno No. 498-5
Parque Industrial Cartagena
Tultitlan, Edo de Mexico, D.F. 54918
Mexico
Phone: 525-888-0804
FAX: 525-888-0820

Quimica San Diego features fumed silicas (Aerosil), blacks (channel and furnace), and flatting agents. Also highlighted are silicone and organic additives. Other features include vinyl resins (VMCH, VAGH, VYNS, etc.) and silicon resins (high temperature).

REACCIONES QUIMICAS, S.A. DE C.V. 69
Carretera Monterrey A. Saltillo KM 7
Santa Catarina, N.L., 66350
Mexico
Phone: 8-316-8316
FAX: 8-316-8330

Reacciones Quimicas is a manufacturer of synthetic resins located in Santa Catorina, N.L., Mexico. Our main products are alkyd resins, solubilized acrylics and additives for coatings; as well as non-saturated polyesters, gel coats and cleaners for reinforced plastics. In November 1995 we signed a joint venture with CCP (Cook Composites & Polymers) which will increase our capability.

REICHHOLD QUIMICA DE MEXICO, S.A. DE C.V. 26,27
Norte 45 No. 731
Col. Ind. Vallejo, Mexico, D.F.
Mexico
Phone: 525-729-8600
FAX: 525-368-4524

Reichhold Química, is a subsidiary of Reichhold Chemicals, with headquarters in Mexico City and production facilities in Mexico City and Toluca City. A producer of coatings and ink resins, displays acrylic alkyd systems for auto refinishing, water emulsified alkyds, medium oil resins, acrylic emulsions for environmental traffic paints, and other solutions for industrial and trade sale enamels.

REYNOLDS METALS CO. 89
4101 Campground Rd.
Louisville, KY 40211
Phone: 502-775-4280
FAX: 502-775-4249

Reynolds Metals Company features an extensive line of aluminum pigment, flake and atomized powders for diverse applications. Paste products are available for OEM and automotive refinish, industrial maintenance and roof coatings. Atomized Powders are manufactured to meet exacting specifications of the chemical, metallurgical and aerospace industries. New this year is a special group of products developed specificially for OEM automotive applications.

ROHM AND HAAS MEXICO S.A. DE C.V. **94, 95**
Av. Insurgentes Sur No. 1106 10° Piso
Col. Nochebuena
Mexico, D.F. 03720
Mexico
Phone: 525-728-6615
FAX: 525-728-6618

SHAMROCK TECHNOLOGIES INC. .. **30**
Foot of Pacific St.
Newark, NJ 07114
Phone: 201-242-2999
FAX: 201-242-8074

Shamrock Technologies' technical and sales associates are available to discuss micronized wax products and PTFE additives for solvent and waterborne coatings. Newly featured for powder coatings are Powertex 61 for low gloss texture finish and Flouro C359 for abrasion resistance in high gloss finishes. Also exhibited are products designed to achieve slip, mar, and abrasion resistance, matting, textured appearance, and hydrophobicity.

SHELL MEXICO, S.A. DE C.V. **40**
Av. Insurgentes Sur.
No. 954-5-5 Piso
Mexico, D.F. 03100
Mexico
Phone: 525-687-4088
FAX: 525-536-7920

Shell Mexico features epoxy resins, curing agents, waterborne epoxy resins, epoxy acrylic resins, reactive diluents, and solvents.

SUN CHEMICAL COLORES S.A. DE C.V. **68**
5020 Spring Grove Ave.
Cincinnati, OH 45232-1999
Phone: 513-681-5950
FAX: 513-632-1537

Sun Chemical Colores S.A. de C.V. is introducing the Predisol PC line for powder coatings. This pigments preparation is designed to facilitate, and economize the production of powder coatings. Also presented are high performance organic pigments for automotive OEM and refinish use, plus lead-replacement products.

TEGO CHEMIE SERVICE **83**
Leibnitz #270 Col. Anzures
Mexico, D.F. 11590
Mexico
Phone: 525-227-7450
FAX: 525-227-7452

Tego Chemie Service is a supplier/manufacturer of additives for the coating and ink industry. Its line includes defoamers, deaereators, surface control and wetting agents. Additionally, there is a wide range of heat resistant and hydrophobing agents.

TRANSMISIONES Y EQUIPOS IND. S.A. DE C.V. **80**
Dakota #157, Col. Napoles
Mexico, D.F. 03810
Mexico
Phone: 525-687-7554
FAX: 525-682-7793

Versa-Matic highlights Elima-Matic anti-stalling, non-icing, lubrication free air valve system. The company's line of air operated, double diaphragm pumps and replacement parts are also featured.

UCB QUIMICA DE MEXICO S.A. DE C.V. **78**
Antonio M. Rivera No. 1-E
Centro Ind. Tlalnepantla
Tlalnepantla, Mexico 54030
Mexico
Phone: 525-565-6798
FAX: 525-565-5665

U.S. POLYMERS, INC./ ACCUREZ CORP. **60**
300 E. Primm St.
St. Louis, MO 63111
Phone: 314-638-1632
FAX: 314-638-2322

U.S. Polymers, Inc. manufactures specialty resins and custom formulations for the paint, coatings, and packaging industries. Featured this year are new lines of water-reducibles and high-solids resins. Accurez Corp. offers the Epi-Tex® line of epoxy esters. Also, find out about Epi-Tex®611Q epoxy ester emulsion.

VERSA-MATIC **80**
6017 Enterprise Dr.
Export, PA 15632
Phone: 412-327-7867
FAX: 412-327-5234

Versa-Matic highlights its Elima-Matic anti-stalling, non-icing, lubrication free air valve system. The company's line of air operated, double diaphragm pumps and replacement parts is also featured.

WATSON PHILLIPS Y CIA SUCS. S.A. DE C.V. **20**
San Francisco-Cuautalpan 101
Naucalpan, Edo de Mexico 53370
Mexico
Phone: 525-357-1612
FAX: 525-576-0627

Watson Phillips is a distributor for the following: Dry Branch-kaolin clays; Crosfield-flatting agents; Floridin-attapulgites; U.S. Silica-silica sands; Shellac resins; Magnesium Elektron-zirconates; and desiccants.

ZENECA RESINS MEXICO **19**
Prolongación González Ortega No. 1737
Zona Industrial Tuluca, Edo de Mexico
Mexico
Phone: 527-216-5444
FAX: 527-216-7848

Zeneca Resins is exhibiting existing and new resin technologies for industrial, specialty, and domestic paints. Zeneca produces both waterborne and solvent-borne acrylics and urethanes in Latin America and the United States. These resins can be used to formulate paints and coatings for many substrates including wood, metal, masonry, and plastic. Currently, the technologies are utilized in automotive, maintenance, construction, flooring, consumer, and assembly line applications. The company also offers starting point formulations and technical support.

A Return to Natural Colors Predicted for Automobile Colors in the Next Century

Based on emerging fashion and home furnishing trends, DuPont Automotive, Troy, MI, forecasted vehicle color trends and fabric concepts for the next millennium. DuPont's report sees the color trend heading towards a palette of natural colors that are reminiscent of the natural beauty of southern Italy, the Grand Canyon, and the Arizona desert.

According to Bob Daily, of DuPont Automotive Finishes, "... we will see shades of beige, gold, coral, copper, and purple that are reminiscent of the '70s interest in earth tones, only interpreted in lighter and brighter hues and shades." Furthermore, "They are starting to show up on our vehicles, based on the influence of fashion, fabric, and home furnishings. Even the new brighter shades of green, or 'verde,' will bring new interest to the color as it peaks in popularity."

"Our research shows that natural colors will dominate the fast-growing upscale luxury, midsize, and sport utility/light truck markets, making them the most popular colors of the future. We also see the high tech trend influencing silver and gold with metallic and pearlescent effects, as well as pigment technology that creates hue shifts based on different viewing angles. Also, there will be a new interest among subcompact, sports car, and sports utility (SUV) buyers in yellows and oranges, among other bright color shades."

The color and fabrics people choose also make a statement about personalities and lifestyles, said Kendy Ball Kutchek, DuPont Marketing Manager—Automotive Textiles. Kutchek cited a new fashion interest in man-made fabrics that stretch or drape well and can include metallic effects as an influence for future vehicle interior fabrics, not only in seats, but for other interior components.

DuPont's styling trends, which come out of the apparel offices in New York, are categorized into four color trends that drive both the interior fabric and exterior colors in the automotive market. They are:

(1) Classical—colors that are timeless and represent a look that never fades.

(2) E-Mail—modern colors that reflect the efficient choice for a person who lives for today, but is ready to step into tomorrow, with every minute along the way accounted for.

(3) Replay—Just as it sounds, everything old is new again with updates.

(4) Fast Forward—time never stands still and the clock moves on.

DuPont has tracked and reported color popularity for vehicles for more than 40 years.

The Futures Group and D/L Labs To Develop Coatings Industry Study

According to Saul Spindel of D/L Laboratories, "The coatings industry has experienced massive changes in recent years in technology, government regulations, and the mania regarding mergers and acquisitions." To address the everchanging coatings industry, the Futures Group, Glastonbury, CT, in conjunction with D/L Laboratories, New York, NY, will develop an in-depth study on the future of the coatings industry.

The study will use scenario-based analysis to address a variety of issues important to the industry. In addition, the study will enable firms in the industrial manufacturing community to develop and stress test current and *de novo* strategies such as: effects of NAFTA, changes in government regulations, improvements in powder paint technology, decrease in availability of basic polymers due to shortages, and waste disposal management.

Scenario-based analysis is an enriched basis for strategy development and will identify an array of possible future manufacturing environments.

Heubach Restructures Three Business Units

A two-year restructuring program of Heubach, Langelsheim, Germany, has been completed. The three units affected by this program are pigment colors, metal chemicals, and non-ferrous metals. The headquarters of all three units had traditionally been located near Goslar, Germany.

The metal chemical business, the first restructured unit, has been transferred to Penarroya S.A., Rieux, France, a 50% holding of Heubach & Lindgens.

In another move, non-ferrous metals were spun off and their activities will be based in Harlingerode, Germany.

Finally, the colored pigment activities were combined and are now the core business group of the Heubach Group. This business produces organic and inorganic pigment colors and pigment preparations in Europe, North America, Latin America, and Asia. The European activities are headquartered in Goslar and those for North American in Fairless Hills, PA. Latin American headquarters are based in Sao Paulo, Brazil, while Bombay, India and Hong Kong also control regional activities.

The restructuring is supported by the opening of several new Heubach facilities throughout the world including: a new 1,000 ton phthalocyanine green factory was commissioned in Ankleshwar, India, in the fall of 1995. In addition, a new 20,000 ton iron oxide plant began operation in November 1995 followed by the start up of a 2,000 ton European pigment paste operation in January 1996.

Seegot Inc. Wins Shell's Gold Level Award

Seegott Inc., Streetsboro, OH, has been awarded Shell Chemical's Gold Level Performer of the Year award for distribution of resins and related products.

Founded in 1972, Seegott maintains regional offices in Illinois, New Jersey, Texas, and Ohio.

Sartomer Receives Quality Leadership Award; Reveals Plans to Buy Degussa's Cationic Product Line

Sartomer Company, Exton, PA, was the recipient of the 1996 Pennsylvania Quality Leadership Award for quality managment and achievement. Sartomer's President Nick Trainer accepted the award from Pennsylvania's Lieutenant Governor Mark S. Schweiker on behalf of all Sartomer employees.

Sartomer was one of two companies across the state selected for the Cornerstone Award; and the only chemical company among the recipients. Sartomer was judged statewide in an intensive, seven-month evaluation process modeled after the Malcolm Baldridge National Quality Award.

Sartomer's commitment to teamwork was particularly noted by the Pennsylvania Quality Leadership Awards Council. Sartomer has over 70 teams including: Commercial Development, Responsible Care, ISO 9002 Certification, Customer Satisfaction, and Performance Improvement.

In other news, Sartomer Company, along with her sister company Cray Valley have announced the intent to purchase the Degacure® cationic product line from Degussa AG, Frankfurt am Rhein, Germany.

Schenectady Int'l to Acquire Howell's Texas Facility

Schenectady International, Inc., Schenectady, NY, has revealed plans to purchase the Howell Hydrocarbons and Chemicals facility in Channelview, TX. The acquisition is expected to be completed before the end of the third quarter of 1996.

Mikron Instrument Co. Relocates Headquarters

Mikron Instrument Co., Inc., has relocated it world headquarters to a new larger facility at 16 Thorton Rd., Oakland, NJ 07436. The new 47,000 square foot facility includes Mikron's engineering, manufacturing, marketing and sales departments, as well as their corporate administration.

Witco Opens Bulk Storage Facility on Chicago, IL, Plant Site; Announces the Purchase of Ferro's Plastic Lubricants Business

The Resins Group of Witco Corp., Greenwich, CT, has opened a new bulk storage facility at the site of its Chicago, IL, manufacturing plant, which produces Witcobond® aqueous polyurethane dispersions.

The new storage facility allows for expanded production capacity through debottlenecking of the plant. The facility distributes product via tank wagons (capacity 5,000 gallons) to customers in the East, Southeast, and Southwest regions of the United States.

Elsewhere, Witco has purchased the products of the plastic lubricants business from Ferro Corp., Cleveland, OH, while selling its oil additives business to Ferro. The terms of the transactions were not disclosed.

The sale of Witco's oil additives business was expected after the company announced a global plant consolidation program in January 1996, which included the planned closing of its Brainards, NJ, facility.

Silikal Resins Opens Offices

Silikal Resins Systems, Westlake, OH, has opened three new regional offices in Cincinnati, OH, Austin, TX, and Seattle, WA. This brings the number of regional offices to 11.

Silikal Resins Systems markets resin systems for new construction and the renovation and restoration of interior and exterior floor surfaces and other building projects.

The Paint Stone

The PAINT STONE is the official newsletter of the Federation of Societies for Coatings Technology.

Serving its members and the Coatings Industry, *The PAINT STONE* is published at 492 Norristown Rd., Blue Bell, PA 19422. Tele: 610-940-0777; FAX: 610-940-0292.

Submissions for consideration should be forwarded to *The PAINT STONE* at the above address.

ISSN 1073-693X

Route to:

FSCT Series Monograph Addresses Service Life Prediction for Coatings

The FSCT is pleased to announce the publication of "Methodologies for Predicting the Service Lives of Coating Systems," the much anticipated addition to its continuing *Series on Coatings Technology*. The 36-page monograph is authored by Jonathan W. Martin, National Institute of Standards; Sam C. Saunders, Washington State University; F. Louis Floyd, Duron Paints & Wallcoverings; and John P. Wineburg, Marshall R&D Laboratory, E.I. du Pont de Nemours & Co., Inc.

In the monograph, the authors acknowledge the rapid technological and structural changes which have impacted the organic coatings industry over the last two decades. These changes have been induced by legislative actions such as restrictions pertaining to hazardous chemicals, toxic effluents and volatile organic compounds. The consequence of these changes has been the displacement of almost all commercially-important, well-established coatings (largely high solvent coatings) by newer systems, the formulation and application of which are based on different chemistries and technologies. Unlike the displaced coatings, however, the new coatings do not have performance histories and the only accepted method for generating performance data is through an extensive outdoor exposure program. Since outdoor exposure results typically take five years to obtain, a desperate need exists for a methodology which is capable of generating timely, accurate and reliable service life estimates of a coating system.

The monograph reviews the attributes of the service life prediction problem which are common to all materials, components, and systems in an effort to establish a set of criteria for assessing the adequacy of existing or proposed service life prediction methodology for coating systems. The current durability methodology and the reliability-

(Continued on page 4.)

Strategies for Success When Attending 1996 FSCT International Coatings Expo

Time management . . . optimization of resources . . . managing multiple objectives— these concepts are not just buzzwords for the 90s. These terms reflect the changing corporate environment that employees face as they must adapt to "doing more with less." These changes are no less evident in the coatings industry as it continues to experience consolidations, restructuring, and downsizing.

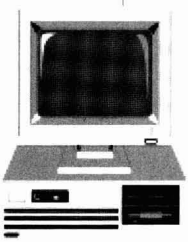
What impact do these constraints have on attendance at events such as the International Coatings Expo, to be held in Chicago on October 23-25? In the words of one self-confessed "veteran" of the industry, these considerations play a major role in developing a "strategy" for attending the Expo.

(Continued on page 3.)

Inside This Issue

iMIS Increases Member Service and Productivity at FSCT Headquarters

The goal of most associations is member service. In that respect the Federation of Societies for Coatings Technology is no different that any other organization. With over 7,200 members, the task of maintaining accurate member records has become increasingly difficult. Fortunately for FSCT and its 26 Constituent Societies, a new software product, iMIS, is enabling the headquarters' staff to better serve its members.



For years, FSCT worked from Macintosh computers, which were primarily used for desktop publishing, maintained the records to produce the *Year Book*. In addition, the FSCT's original computer system, a TI mini computer system, maintained the subscriber records, accounting files, trade show records, and some other functions. The problem with this record keeping format was that the information on the two different systems could not be networked. Therefore, there was a lot of duplication of effort.

After assessing the problems of this system, Director of Membership Services Tori Graves, explored possible solutions. Through the assistance of the American Society of Association Executives, Ms. Graves was introduced to iMIS, an association management software system that enables the maintenance and organization of information about any number of members, prospects, and other contacts. Ms. Graves says that "This software system runs on a mixed network here at the office, so we can integrate a lot of the different functions that are performed.

iMIS was installed in the spring of 1995 and in a short period of time, it was used to manage the registration for the Annual Meeting and Paint Industries' Show in St. Louis, MO. In addition, membership rosters received by each Society were integrated into the system and enabled the production of more useful listings for the 1996 *Year Book*. Currently iMIS is tracking the membership status and dues payment, exhibition management, subscriptions, publications, order processing, and registration for some educational programs. In the near future, all accounting functions will be integrated into this system as well.

The main focus of iMIS, however, is member information. Ms. Graves says, "Presently, the system is able to track all address information, the type of company the member works for, and his/her position, as well as member type and areas of FSCT and Society service. Additional demographic fields are being planned for the future including degree earned and areas of interest." iMIS provides much more detailed membership information than the staff has had access to in the past. According to Ms. Graves, "This information will allow us to better serve our members' interests. For example, if we conduct an educational program focused on manufacturing, iMIS can generate a report of our manufacturing members. This new system enables us to target these programs to a specific interest group."

iMIS has proven invaluable in helping FSCT staff perform their jobs. For example, Membership Assistant Marie Wikiera notes that her work efficiency is aided tremendously by iMIS. In the past Ms. Wikiera would spend much time processing membership inquiries. Now, iMIS enables her to respond to member requests within minutes. In addition, this system provides better management of all requests that come in. An activity record is generated for each inquiry so the date that an action has been performed is available. This enables headquarters to track the activities of members, such as what educational programs are attended and what publications have been purchased. Now all of

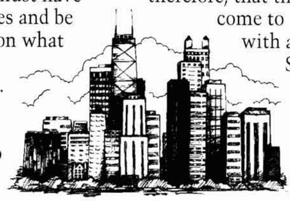
(Continued on page 4.)

Secrets for Success When Attending the International Coatings Expo

(continued from page 1.)

Mort Spiegel, President of Spiegel & Associates, has been attending the "Paint Show" for more than 30 years. He notes that since companies may be reluctant to send as many employees to the Expo as in days past, it is imperative for those who do attend to be able to maximize their investment. A targeted strategy for attendance can enable employees to accomplish much towards meeting their company's short- and long-term goals.

According to Mr. Spiegel, the attendee must have clear objectives and be able to focus on what is to be accomplished. "Some attendees go to the Expo to renew old acquaintances, some want to show support for the industry, and some may be seeking employment opportunities. But most are working on short-term projects and they are looking for answers. This is where the attendee (buyer) needs to focus on realizing that, okay, here are my projects, now that I'm going to the Expo, which of the exhibitors can help me?"



Participation at the Expo can satisfy a number of objectives, such as:

- finding solutions to known problems,
- finalizing selection of a supplier for post-Expo purchases,
- identifying new technologies which will be of interest in your business,
- meeting with technical experts,
- and assessing the technical direction of the industry.

Past studies have indicated that a Paint Show attendee spent approximately two days visiting suppliers at their exhibits. This averages out to about eight hours over the course of the two days. If attendees spend an average of 20 minutes at each booth, they can only have in-depth discussions with about 20 suppliers.

For the 1996 International Coatings Expo, nearly 300 exhibitors have contracted for booth space. As Mr. Spiegel points out, "Realistically speaking, there is a possibility of visiting only 20 or 30 booths for in-depth discussion within the time frame available. It is critical, therefore, that the attendee come to the Expo with a plan." Since there is only so much time, the attendee must try to achieve maximum impact in minimal time.

So, what's the secret for success at the Expo? "The prospective attendees need to do their homework before they even come to Chicago," encourages Mr. Spiegel. It is critical to learn what is being offered at the booths. This can be done in advance by paying attention to the advertisements placed by exhibitors in industry journals, by carefully noting any pre-Expo mailings by exhibitors, and by searching the Internet for a particular supplier's Web page. More and more companies are using the Internet to promote their products and services and a visit to a supplier's Web page may provide a quick answer on whether a more in-depth visit at the Expo would be beneficial.

Another successful strategy is to sort your priorities and plan your time accordingly. Scheduling an appointment with the technical experts at the booths in which you are interested can help insure a more effective use of your time. Pre-planning must also take into account any additional activities which must be scheduled, such as participation in a conference course or attending a technical paper.

Obviously, attendance at the International Coatings Expo can provide a valuable service for your company, yet as Mr. Spiegel notes, "in this era of downsizing and restructuring, it is imperative for the buyer to be able to justify the investment." A targeted strategy is the key!

Mort Spiegel is President of Spiegel & Associates, Inc., located in Morristown, NJ. He has more than 30 years of selling experience in the chemical industry. Mr. Spiegel holds a B.S. Degree in Chemistry and an MBA in Marketing.

He began his career with D.H. Litter in New York. Subsequently, he was employed in sales and marketing management positions with such raw materials firms as Ciba, Diamond Shamrock, J.M. Huber, and Troy Chemical.

Mr. Spiegel has supervised both direct and manufacturers representative sales organizations. The company he founded more than five years ago offers a wide range of services including sales representation, key account selling, sales training, market definition surveys, technical assessment, regulatory assistance, and sales promotion.

Tips For Visiting The Expo

Federation of Societies for Coatings Technology
ice International Coatings Expo and Technology Conference

What to see

✓ Visit your current suppliers
✓ Visit your suppliers' competition
✓ Visit potential suppliers
✓ Make discoveries

How to save time

✓ Take a moment to read the Expo *Program Book*
✓ Don't hesitate to ask for a demonstration of anything being shown
✓ Make your visits to exhibits brief (about five minutes) and to the point
✓ Take notes during conversations with exhibitors
✓ Collect relevant literature, but don't burden yourself by taking everything

FSCT Series Monograph Addresses Service Life Prediction for Coatings

(Continued from Page 1.)

based methodology are then evaluated against these criteria.

The criteria reported by the authors include the ability to (1) handle high variability in the time-to-failure data for nominally identical coated panels exposed in the same service environment, (2) analyze multivariate and censored time-to-failure data, (3) establish a connection between laboratory and field exposure results, and (4) quantitatively predict the service life of a coating system exposed in its intended service environment.

The current durability methodology was developed prior to the recognition of the proposed criteria and, as such, was not designed to satisfy these criteria. Efforts to correct its deficiencies have been made over the last 80 years, but success has been elusive. The failure of the current methodology has generally been ascribed to inadequacies in laboratory-based aging tests, specifically, the inability to simulate weathering conditions in the laboratory. However, the authors suggest that the failure of the current methodology can be attributed to its being based on faulty premises, inadequacies in experimental design, and the lack of reproducibility of the weather over any time scale.

As an alternative, reliability-based methodology is reviewed and assessed. The authors relate that this methodology has a strong theoretical basis plus a history of successful applications in the electronics, medical, aeronautical, and nuclear industries. A number of experiments with coatings has already been conducted using this methodology. The results indicate that this methodology can be applied in predicting the service life of coating systems and that it satisfies the proposed service life prediction criteria.

Implementation of a reliability-based methodology will require substantial changes in the current experimental procedures. These changes result from the quantitative nature of the service life data and will include: (1) more systematic characterization of the initial properties of a coating system, (2) quantitative characterization of each of the weathering variables comprising the in-service environment, (3) quantification of macroscopic degradation and relating submacroscopic to macroscopic measures of degradation, (4) utilization of experimental design techniques in planning and executing short-term laboratory-based experiments, and (5) development of computerized techniques for storing, retrieving, and analyzing collected data. The authors attest that these changes will be justified in view of the greater reliability of the results.

* * *

The *Federation Series on Coatings Technology* is a well recognized educational resource for the industry. The Series booklets, prepared in an 8 1/2 x 11 format, sell for $25 each. The FSCT member discounted prices is $15. Additional discounts are available with the purchase of the entire Series.

Orders for monographs may be placed by contacting Meryl Simon, FSCT, 492 Norristown Rd., Blue Bell, PA 19422-2350. Phone: (610) 940-0777; FAX: (610) 940-0292.

Calendar of Events

1996

August

- **15-17** Pan American Coatings Expo. Co-sponsored by FSCT, ANAFAPYT, and Instituto Mexicano de Tecnicos en Pinturas y Tintas. Sheraton Maria Isabel Hotel, Mexico City, Mexico. (FSCT, 492 Norristown Rd., Blue Bell, PA 19422. [(610) 940-0777]).

October

- **23-25** International Coatings Expo and International Coatings Technology Conference. McCormick Place North, Chicago, IL. (FSCT, 492 Norristown Rd., Blue Bell, PA 19422. [(610) 940-0777]).

1997

February

- **18-20** Western Coatings Societies' 23rd Biennial Symposium and Show. Sponsored by the Golden Gate, Los Angeles, Pacific Northwest, and Rocky Mountain Societies. Disneyland Hotel and Convention Center, Anaheim, CA (Bruce Cotton, Pluess-Staufer (California) Inc. P.O. Box 825, Lucerne Valley, CA 92356;[(610) 248-7306]; or Ron Elliott, J.R. Eliott Enterprises, Inc., 300 Thor Pl., Brea, CA 92621; [(714) 529-0711]).

iMIS Aids in Member Service at FSCT

(Continued from Page 1.)

this information can be retrieved automatically.

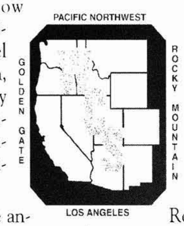
You have seen how iMIS benefits both headquarters' functions and individual members. But what can it do for your Society? Ms. Graves states "At this point, a Society can contact us if they are doing a program and ask for members and/or nonmembers in a specific geographic region or industry area. Then we can provide them with a disk that contains this information for mailing labels. A promotional mailing can then be performed." In fact the Los Angeles Society requested such information for their first promotional mailing for the 23rd Biennial Western Coatings Societies' Symposium and Show.

In addition, iMIS can help each Society with member recruitment. "We can provide a report on inquiries that pertain to each Society from the nonmember requests that we receive. The Societies are then able to pursue these potential candidates," says Ms. Graves. "The best thing about this system is that in the past we only ever tracked members, now we even have some information about nonmembers and we can provide Societies with some strong recruitment tools.

With iMIS, FSCT has taken a giant step in better serving the needs of the members and operating efficiently. iMIS is enabling FSCT to reach its goals.

Western Coatings Societies' Symposium & Show Slated for Feb. 18-20, 1997 in Anaheim, CA

Planning is underway for the Western Coatings Society's 23rd Biennial Symposium and Show (WCSSS) slated for February 18-20, 1997, at the Disneyland Hotel and Convention Center, Anaheim, CA. The event is cosponsored by the Golden Gate, Los Angeles, Pacific Northwest, and Rocky Mountain Societies for Coatings Technology.



The Symposium and Show are anticipated to attract more than 150 exhibitors and over 3,000 registrants. A full technical program is also on the event's agenda. Other social activities scheduled include a banquet and entertainment.

Society members organizing the event include the following: Symposium Chair—Robert Skarvan, of Engineered Polymer Solutions, Inc.; Entertainment—Dave Muggee, of E.T. Horn and Melinda Rutledge, of Rheox, Inc.; Exhibits—John Long, of Smiland Paint and Roberta Garcia, of ICI-Sinclair; Technical Papers—Gil Mislang, of Dunn Edwards; Registration—Keith Venia, of Tavco Chemicals; Publicity—Roxanne Echevarria, of Davis Colors; and Advisor—Dick Sutherland, of E.T. Horn.

For more information, contact Roxanne K. Echevarria, LASCT, 11278 Los Alimitos Blvd., #104, Los Alimitos, CA 90720; (310) 594-5739.

Institute of Materials Science and ACS: PMSE To Cosponsor North American Research Conference

The Institute of Materials Science, New Paltz, NY, in conjunction with the American Chemical Society's Division of Polymeric Materials: Science and Engineering, Washington, D.C., will sponsor the Fourth North American Research Conference on Organic Coatings: Science and Technology. The event is scheduled for November 10-13, 1996 in Hilton Head Island, SC.

The topics to be discussed include the following:

"Structure-Performance Relationships in Polyalkylene Oxide-Modified Epoxy Coatings"—Kenneth W. Anderson, The Dow Chemical Co.;

"Protective Coatings on Aluminum Formed by Spontaneous Polymerization"—James P. Bell, University of Connecticut;

"Roughness and Pattern Measure Appearance: Using Profilometer Data to Quantify Appearance"—Donald W. Boyd, of PPG Industries Inc.;

"Preparation of Coatings with Tailored Anti-Adhesive Properties"—Robert F. Brady, Jr., Department of the United States Navy;

"Polyoxyethylene Di-Phosphonates as Dispersing Agents"—Yves Chevalier, LMOPS-CNRS;

"The Formation, Structure, and Properties of Latex Film"—Jianrong Feng, University of Toronto;

"Two-Component Water-Reducible Polyurethane Coatings"—Denise E. Fiori, Cytec Industries, Inc.;

"Analysis of the Viscoelastic and Mechanical Behavior of Films from Polymer Latices"—Catherine Gauthier, INSA de Lyon, France;

"Investigation of Latex Particle Morphology and Surface Structure of Different Films, Layers, and Coatings"—Bettina Gerharz, Hoechst AG;

"Latices with Intrinsic Crosslink Activity"—John Geurts, Eindhoven University of Technology;

"In-situ Sensing of Molecular and Physical Property Changes in Coatings During Cure and Aging"—David E. Kranbuehl, The College of William and Mary;

"Advanced Coatings Appearance Measurement"—Jonathan W. Martin, NIST;

"Effect of Thermal and Hydroscopic History on Physical Aging of Organic Coatings"—Dan Y. Perera, CoRI;

"Novel N-Vinylformamide Derived Products and Applications in Radiation Cure Coatings"—Robert K. Pinschmidt, Jr., Air Products and Chemicals;

"Mechanical Degradation of Painted Plastics: Surface Coating Effects"—Rose A. Ryntz, Ford Motor Co.;

"Latex Particle Morphology Control via Crosslinking and Controlled Feeding of Monomer"—Donald C. Sundberg, University of New Hampshire; and

"Spectroscopic Analysis of Surfaces and Interfaces of Coatings"—Marek W. Urban, North Dakota State University.

For additional information, contact Dr. Angelos V. Patsis, Institute of Materials Science, SUNY at New Paltz, New Paltz, NY 12561.

Advanced Polymer Course To Focus on Conductive Polymers

Advanced Polymer Courses, Falmouth, MA, will conduct a course on "Inherently Conductive Polymers: An Emerging Technology," on September 8-9, 1996 at the Hotel Sofitel, Brugge, Belgium.

The seminar, which consists of technical presentations and demonstrations, will cover the various aspects of inherently conductive polymers including: processing into films and coatings, and applications, such as ESD, shielding, electronic, and electrochemical devices.

The course is designed for engineers and scientists involved in the R&D as well as design of a variety of electrical and electronic devices incorporating semiconducting and high conductivity coatings and films.

To obtain additional information, contact Matt Aldissi, Advanced Polymer Courses, 536 Main St., Unit #1, Falmouth, MA 02540.

Report of the Activities of ASTM D01.57, Artists Paints and Related Materials, of ASTM Committee D01 Meeting held May 8

SUBCOMMITTEE D01.57 ARTISTS' PAINTS AND RELATED MATERIALS

M. D. Gottsegen, Chair

D01.57.02—Lightfastness of Pigments—T. Vonderbrink, Chair. Extensive revisions of D 4303 have been prepared by T. Vonderbrink. The revisions incorporate a fourth test method, exposure to irradiance from cool white fluorescent lamps and filtered fluorescent UV sunlamps, and add artists' gouache paints as a test vehicle. Many of the calculations in section 7 on procedure have been changed, new reporting procedures in section 9 have been written, and a new Appendix XI on Radiant Exposure Calculation has been proposed. The revisions and comments by N. Searle were discussed and approved by the W1.57. A ballot is being prepared.

D01.57.04—Specification for Artists' Paints—B. Gavett, Chair. Corrections to several pigment names in Tables 1, Suitable Pigments List, of D 4302, D 5067, D 5098, and D 5724 were discussed, so as to bring them into conformity with each other across all the specifications. Many of the changes will be editorial, but some will need balloting. G. Stegmeir is preparing a list.

D01.57.07—Physical Properties—R. Gamblin, Chair, reported on a survey on artists' uses of substrates, sizes, and grounds. (The survey will be run again in the *National Artists Equity Newsletter*.) Based on the results of the survey, it seems clear that these materials should be considered systems for painting with artists' acrylic emulsion, alkyd, and oil paints. Mr. Gamblin proposed writing a practice for the preparation, application, and use of these systems, and a specification, and possibly a test method, regarding the relative performance characteristics of sizes and grounds on canvas with artists' oil, alkyd, and acrylic emulsion paints. Both the National Gallery of Art in Washington, D.C., and the Molart project in The Netherlands will be approached and asked to take part in research looking into these systems. R. Gamblin agreed to begin work on a practice.

A list of definitions of terms relating to substrates, primers, grounds, sizes, and gessoes has been prepared, and the D01.57 membership was asked to send written comments to R. Gamblin.

L. Adlerstein expressed a continuing interest in a specification for surfactants and paint thinners. He believes that some thinners contain too much surfactant, which may cause long-term stability problems for paint films, and that this may be a particular problem for some of the new nontoxic thinners. R. Gamblin agreed to bring to the next meeting a report on solvents and their evaporation rates.

D01.57.08—Toxicity Labeling—W. Stopford, Chair. No business.

D01.57.09—Watercolors—W. Upchurch, Chair. There was discussion about how to go about expanding the list of suitable pigments for watercolor and gouache paints without having single companies bear the entire cost of lightfastness testing in these vehicles. W. Upchurch agreed to write a letter to manufacturers soliciting money for a W1.57 Test Fund, to be held at ASTM under the same system used for the other D01.57 Fund, which is used to assist user members with travel expenses. It was agreed that the program will be set up so that small companies could contribute according to their ability. It was also reported that the Canadian Conservation Institute has the appropriate equipment and would be interested in performing tests on a paid basis. M. Golden commented that it would be valuable for artists to label their paintings as to the materials used.

T. Takigawa presented the final results of the xenon arc lightfastness tests and preliminary results of the Verilux test on new pigments in watercolor and gouache vehicles. Final results on the Verilux tests will be available soon, and D01.57 will vote on the new pigments at its next meeting.

D01.57.10—Consumer Evaluation—J.T. Luke, Chair. Proposed revisions to D 5383 and D 5398 were presented for discussion. In both test methods the description of the specimen covers will be changed to alert users that the covers should be chemically inert, and how to detect appearance changes in specimens that do not contain oil if interaction with the specimen cover is suspected. Further discussion of some other changes will be conducted at the next W1.57 meeting.

D01.57.11—Gouache Paints—T. Takigawa, Chair. D 5724, Standard Specification for Gouache Paints, has been published.

D01.57.12—Determination of Toxicity—W. Stopford, Chair. Dr. Stopford presented the results of a workshop held in March 1996 at a meeting of the Society of Toxicologists, on appropriate ways of validating D 5517, Standard Test Method for Determining Extractability of Metals from Art Materials. Participants reviewed recent studies comparing D 5517 extraction results with other bioavailability studies and the wax matrix effect of wax. The workshop also considered the effect of carboxylic acid/pepsin in the stomach, and recommended that a further test of D 5517 be conducted using an actual art material. Dr. Stopford reported that he would conduct this test on a copper pigment and on an artists' oil paint containing the same pigment, would send these results to the SOT workshop attendees, and report on their reactions at the next D01.57 meeting. Dr. Stopford reported that the SOT did not recommend revision of D 5517 to concur with EN71.3-92 until the discrepancy between results and the wax matrix effect are further investigated.

Several other changes in D 5517 were suggested regarding pH, solvents, and sample stabilization, and Dr. Stopford agreed to look into them and report to W1.57 at its next meeting.

There was considerable discussion about the possibility of developing a test method for the autocombustibility of linseed oils with and without driers, and other oil-containing art materials. This is in response to a new Connecticut labeling law, and Swedish recommendations on the labeling of such products for combustibility. It was agreed to perform testing at four to six laboratories on products supplied by manufacturers and to write a provisional test method, to enlist the cooperation of the CPSC, and to urge Connecticut to change its law based on this test method to adopt more appropriate warning language in its labeling requirements. The draft test method will use an absorbent rag that is standardized and mass produced. At the next meeting, W1.57 will consider the emergency nature of this provisional test method.

D01.57.14—Colored Pencils—L. Armstrong, Chair. Progress on developing a specification for colored pencils was reviewed. Ms. Armstrong reported on some problems that have developed. Most serious is that the specification has been based on the methods in D 5383 using the Blue Wools, and that now concern is being expressed that the specification would be too different from those applying to the other colored materials, which are based on longer exposures. A specification based on different exposure requirements would cause

(Continued on next page)

ASTM *(continued from previous page)*

confusion among users and possibly mislead them regarding the quality of pigments used in colored pencils. Ms. Armstrong agreed to extend testing to 1260 MJ/m2 provided she can arrange to continue to use the Heraeus tabletop xenon arc instrument she had been using, to better correlate with the methods applied to the other art materials. She will also do interlaboratory repeatability tests, and then rate the results in five broad categories. It was agreed that an ad hoc meeting would be held following the D01.57 meeting, to review visually determined ratings given colored pencil specimens so far.

D01.57—M. Gottsegen, Chair. The Minutes of the January 22, 1996 meeting were approved, and the revised and amended Minutes of the June 4, 1995 meeting were approved.

A motion to make changes in D 5383 and D 5398 was approved.

A motion to accept the revisions in D 4303 was approved.

A motion to authorize the Chair to write to Molart in The Netherlands, requesting study of the interface between synthetic and natural materials such as between acrylic emulsion grounds and linseed oil paints, was approved.

M. Gottsegen reported that the need for funding for consumer representatives to help them attend D01.57 meetings had increased 100% in the past two years, but that the level of contribution D01.57 requests of manufacturers had not increased in at least 10 years. D01.57 approved a request that manufacturers increase their contribution.

The next D01.57 meeting will be January 26-27, 1997, at the Embassy Suites Hotel in Ft. Lauderdale, FL.

NDSU Short Course to Focus on Environmentally Compliant Coatings

Due to the increasing environmental concerns and current EPA regulations facing the coatings industry today, North Dakota State University, Fargo, ND, will conduct an intensive short course on "Environmentally Compliant Coatings" on January 21-24, 1997 at the Crown Plaza Resort, Hilton Head Island, SC.

This course will focus on all aspects of environmentally compliant chemicals used in coatings technology. Topics to be discussed include the following:

Modern Aspects of Waterborne and Latex Coatings—polymers and oligomers, synthesis, rheology, film formation, and surface defects in formulation and application.

Powder Coatings—new technologies, rheological behavior, approaches, applications, uses, and performances.

Radiation Curing—Selection of curing agents and catalysts, kinetic limitations, and possible ways to circumvent them.

High-Solids—polymers and oligomers, synthesis, effect of oligomer structures on film properties; optimizing coatings performance and synthesis.

Rheology of Clear and Pigmented Coatings—fundamental considerations and their effect on applications

Analysis of Coatings—thermal, mechanical, and spectroscopic analysis of coatings; structure-property relationships in coatings

Crosslink Density—Properties of coating films, thermomechanical behavior of coatings; dynamic mechanical analysis; weathering; structural analysis.

PVC/CPVC—environmentally compliant coatings, corrosion resistance of environmentally compliant coatings.

For additional information, contact Debbie Shasky, Program Coordinator, NDSU, Department of Polymers and Coatings, 54 Dunbar Hall, Fargo, ND 58105.

DuPont Releases Schedule for Public Seminars on Statistics

The Quality Management and Technology business of DuPont, Wilmington, DE, has released its 1996 schedule for public seminars on "Statistics and Experimental Design."

"Strategy of Experimentation" will be held on the following dates: August 20-22, Wilmington; September 17-19—Nashville, TN; October 15-17—Boston, MA; November 12-14—San Antonio, TX; and December 3-5—Wilmington.

"Strategy of Formulations Development" is scheduled for October 22-24—Boston.

"Statistical Process Control" will be conducted on September 17-20 in Wilmington.

"Statistical Process Control Basics" will be held on November 19-20 in Wilmington.

"Focus on Data" is scheduled for November 12-14 in Wilmington.

Contact DuPont Quality Management & Technology, 1007 Market St., Nemours Bldg. 6498, Wilmington, DE 19898, for additional information.

Literature Review

Polymer Durability: Degradation, Stabilization, and Lifetime Prediction

Published by:
American Chemical Society, 1155 16th St., N.W., Washington, D.C. 20036, 1995, 712 pages, $139.95

Reviewed by: David R. Bauer, Ford Motor Co.

Polymer Durability: Degradation, Stabilization, and Lifetime Prediction is a collection of 39 chapters based on a major symposium on polymer durability presented at the 1993 Chicago ACS meeting. The book focuses on polymer degradation and stabilization with a smaller section on lifetime prediction.

Despite the fact that the book was published some two years after the symposium, the work well represents the state-of-the-art in this important field. The editors did an excellent job of attracting the leaders in the field. For example, the section on degradation includes papers by Starnes, Jr. et al. on PVC, Factor on polycarbonate; Lemaire et al. on silicones; Hoyle et al. on polyurethanes and ureas; and Billingham on polypropylene. The sections on stabilization and lifetime prediction include chapters by Pospisil, Pickett, and Moore, Gerlock et al., Decker, Zweifel, Gillen et al., and Gijsman et al. Of particular importance for coating scientists are the chapters by Pickett and Moore, Decker, and Gerlock et al. on measurements of stabilizer lifetimes in polymers and coatings. Loss of ultraviolet light absorber is critical to the long-term performance of many coatings and these three chapters describe both measurement techniques and mechanistic understanding of UVA loss.

Other chapters of interest to coating scientists include several chapters on the use of luminescence to follow polymer oxidation and chapters on the measurement of diffusion of additives in polymers. The book is well organized and presented. It would make a fine addition to the library of anyone working in the area of coating and polymer durability.

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	❒ Hard Cover	❒ $105	❒ $135	___
Glossary of Color Terms		❒ $6 (one price)		___
Infrared Spectroscopy Atlas		❒ $150	❒ $200	___
Pictorial Standards		❒ $100 (one price)		___
Panorama	❒ 1 Yr.	❒ $900	❒ $1200	___
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Federation of Societies for Coatings Technology

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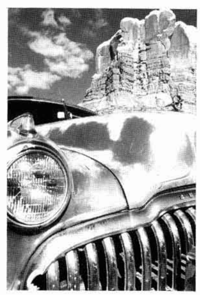
The U.K. Birmingham Paint, Varnish & Lacquer Club, c/o Robert McD. Barrett, B.I.P. Chemical Ltd., P.O. Box 6, Warley, West Midlands, England

Jesus Camacho, ANAFAPYT, Gabriel Mancera 309, Col. Del Valle, 03100 Mexico, D.F., Mexico

Impedance Study of the Effect of a Thin Rust Layer at the Steel-Paint Interface on Coating Deterioration

S. Feliu, Jr., M. Morcillo, and S. Feliu—CSIC*



Impedance measurements were used to study the effect of the presence of a lightly prerusted substrate on coating deterioration during exposure to a saline solution. For this purpose, a chlorinated rubber coating was applied over clean and prerusted low carbon steel plates. An important number of replicate specimens were tested to establish the reality of small differences in the impedance behavior of the paint coating.

Although individual data were poorly reproducible across the different replicate specimens, statistically significant differences between the average values of paint capacitance and paint resistance for clean and rusted substrates were shown.

INTRODUCTION

In a previous work,[1] the need for a statistical approach for studying painted metals on the basis of impedance measurements was pointed out. The results showed that the high dispersion in the parameter values obtained from impedance diagrams hinders the ability to draw quantitative conclusions on the effect of some variables. Data scatter is particularly troublesome for establishing the reality of small differences in the system response to the electrical signal applied during measurements. In fact, poorly reproducible data may cause the effect of a variable to go unnoticed if such an effect is only moderate. In that case, it is mandatory to use a statistical approach involving many replicates in order to draw reliable conclusions.

In practice, the hazardous effect of painting over a rusted steel substrate is well known.[2] Also, accelerated laboratory tests have shown coatings applied to rusted steel deteriorate very rapidly relative to those applied to clean steel, especially if the rust layer is salt contaminated.[3] Both under real service conditions and in laboratory tests, the detrimental effect of rust usually appears after a fairly long time, resulting in the loss of adhesion of the coating that leads to blistering and delamination. The sequence of events that take place at the early stages of exposure to the aggressive medium is poorly documented, however. Two immediate questions in this respect are: (1) When does the presence of rust in the steel substrate start to affect the stability of the metal/paint system? and (2) What is the effect of rust on system parameters determined from impedance measurements? The purpose of this work was to answer these two particular questions in the case of a lightly prerusted steel substrate. At the same time, investigations were conducted to determine if a very thin non-contaminated rust layer is enough to introduce a differential effect on the behavior of the metal/paint system. A large number of replicate specimens were used in order to ensure statistically significant results.

EXPERIMENTAL

Low-carbon steel specimens were prerusted in a chamber at room temperature and 100% relative humidity for 30 days in order to allow a thin rust layer to be formed. The amount of rust was controlled by weight gain. From the series of specimens prepared, those exhibiting a rust layer of 2.1 ± 0.4 mg per cm^2 were selected.

A chlorinated rubber-based paint was then air-sprayed on the specimens. The specimens with an average dry film thickness within the range 20 ± 5 μm were tested. For this investigation, a chlorinated rubber resin pigmented with red lead according to the Spanish Standard INTA 164705 was specifically formulated. After one week's curing in the laboratory atmosphere, the painted specimens were subjected to the experiments described in the following.

Tests were conducted by using the classical three-electrode technique. Following a well-established procedure,[4,5] the painted steel surface area (viz., the working electrode) was confined by using a short piece of glass tubing placed on the specimen. Both the electrodes and the electrolyte (a three percent w/w NaCl solution) were accommodated inside the

*Centro Nacional de Investigaciones Metalúrgicas, Av. Gregorio del Amo, 8. (28040) Madrid, Spain.

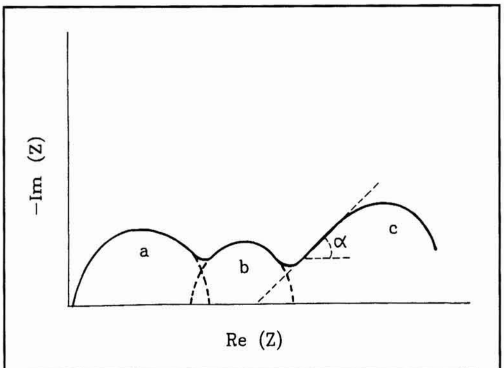


Figure 1—Typical impedance plot for the painted steel after some time of exposure to three percent NaCl solution.

tube. The specimen surface area exposed to the electrolyte was 3.1 cm^2. The reference electrode was a saturated calomel electrode and the counterelectrode was a sheet of platinized titanium.

Overall, 13 replicate specimens were examined for each exposure period to the electrolyte.

Faradaic impedance measurements were made at the rest potential by using a Solartron 1250 frequency response analyzer coupled to a 1286 potentiostat interface from the same manufacturer. A sinusoidal signal of 10 mV (rms) was applied over the frequency range from 55 kHz to 1 mHz.

Figure 1 shows a typical Nyquist diagram obtained for the painted steel specimens.[1] The graph includes a high-frequency (HF) semicircle, a mid-frequency (MF) semicircle, and a low-frequency (LF) tail. HF semicircle labeled a in *Figure* 1 was used to determine C_1 and R_1. In fact R_1 was obtained from the semicircle diameter and C_1 from the expression[6]:

$$C_1 = \frac{1}{2\pi f_{max} R_1}$$

where f_{max} is the frequency at which the impedance reactive component was maximal. In practice, the semicircles were more or less depressed, so we chose to approximate the semicircle diameter to the arc chord.

MF semicircle, labeled b in *Figure* 1, was used to obtain C_2 and R_2 by a similar procedure. The results were less reliable than those derived from HF semicircle because the MF semicircle was not as well defined.

Finally, the initial slope (in degrees) of the rising portion of LF tail, labeled c in *Figure* 1, was also measured.

RESULTS AND DISCUSSION

First consider the effect of a rusted substrate on parameters C_1 and R_1 and their temporal changes on exposure of the painted steel to the saline solution. These two parameters are widely accepted as measures of the coating capacitance and resistance, respectively.[6] As can be seen in *Figures* 2 and 3, the C_1 and R_1 values obtained from the replicate series (represented by dots) were poorly reproducible. Although this fact agrees with the already mentioned wide variability of EIS data, the broad range of values obtained could also point to a nonreproducible specimen preparation. Regarding this point, precautions were taken to secure similar initial conditions in all the specimens, especially regarding the rust layer and paint coating thickness. Exaggerated as the range of variation values might seem, it should be stressed that quite a similar behavior had already been reported by these and other authors in papers where statistical approaches were also used to study a variety of coated metal systems.[1,7-10] This strongly suggests that coating inhomogeneity is hard to avoid in practice, and that a high scatter of EIS data is a rather common

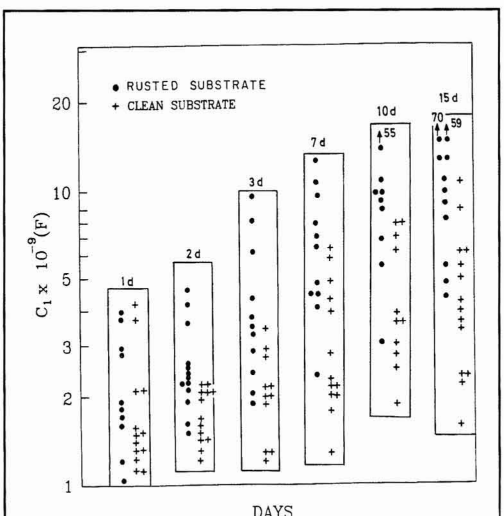


Figure 2—Scatter of C_1 data obtained from the series of replicate specimens after the indicated periods of exposure to three percent NaCl solution (d = days).

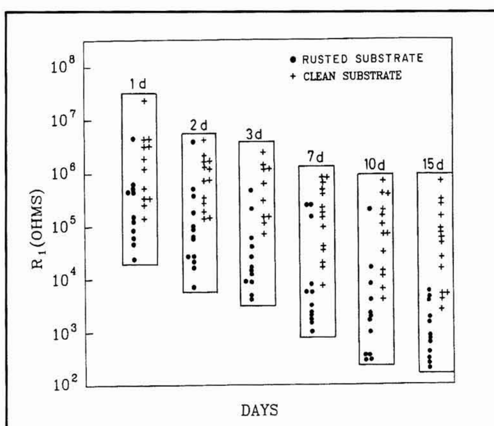


Figure 3—Scatter of R_1 data obtained from the series of replicate specimens after the indicated periods of exposure to three percent NaCl solution (d = days).

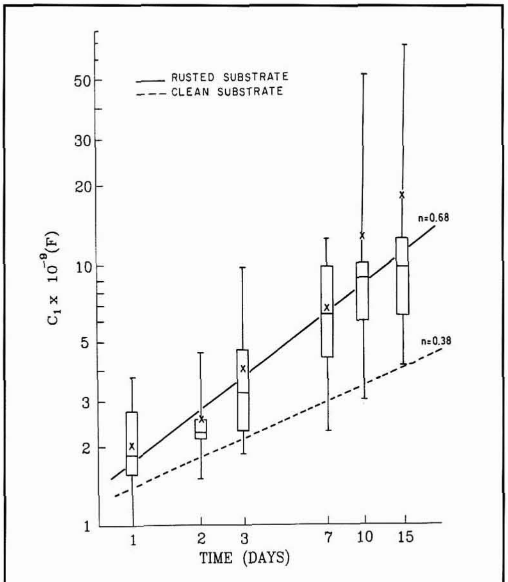


Figure 4—Box and whisker plot of C_1 groups of data.

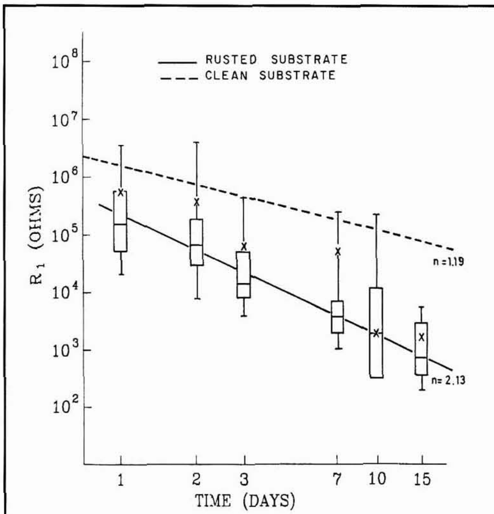


Figure 5—Box and whisker plot for R_1 groups of data.

fact in painted specimens prepared and tested using the conventional laboratory procedures.

Figures 2 and 3 also show the results (represented by crosses) obtained in a previous work[1] where paint was applied over a clean substrate. The strong overlap of the ranges of values for the C_1 and R_1 parameters under the two sets of surface conditions precludes a direct comparison and leads to a statistical approach.

One method of treating the problem statistically is to determine whether it is highly probable that real differences exist between the means of the two sets of replicate observations for the rusted and clean substrates. To this end, the two sets of experimental data were compared by using the method described by Freeman.[11,12] To apply normal statistics, the values have been expressed in terms of the logarithm of the parameters, since in this way an approximately normal distribution of values is obtained.[13] As can be seen in *Table* 1, it seems quite certain that the two substrate conditions differ in quality as far as log C_1 and log R_1 means are concerned. The two conditions resulted in significant differences in the observed behavior of log C_1 from the second day of specimen exposure to the saline solution, and so were log R_1 means from the first day of exposure. The rust film on the substrate therefore affects the electrochemical behavior of the system after 1-2 days' exposure to the saline medium.

Figures 4 and 5 show the variation of C_1 and R_1, respectively, with the exposure time. Box and whisker plots[14] represent grouped data. The box encloses the interquartile range, with the lower line identifying the 25th percentile and the upper the 75th; also a line sectioning the box displays the

Table 1—Comparison Between the Means of Two Sets of Observations for Prerusted and Clean Steel Substrates. Values of C_1 and R_1 Parameters

Exposure Days	Substrate Condition	Mean of LOG C_1 in F cm^{-2}	Mean of LOG R_1 in ohms cm^2	Confidence Level at Which the Difference Between Means is Significant (percent): For LOG C_1 Values	For LOG R_1 Values
1	Rusted	−8.708	5.313	85	99
	Clean	−8.806	6.097		
2	Rusted	−8.608	4.916	99	99
	Clean	−8.764	5.811		
3	Rusted	−8.446	4.360	99	99
	Clean	−8.699	5.624		
7	Rusted	−8.209	3.872	99	99
	Clean	−8.543	5.115		
10	Rusted	−8.023	3.313	99	99
	Clean	−8.372	4.790		
15	Rusted	−7.928	2.971	99	99
	Clean	−8.385	4.597		

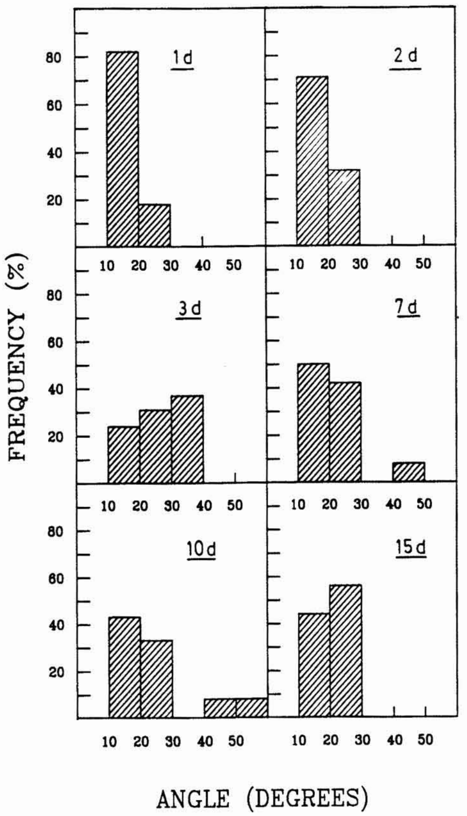


Figure 6—Slope (angle) values of the initial part of the LF tail for the series of replicate specimens. Frequencies of each value after the indicated periods of exposure (d = days).

median and a cross shows the mean value. The mean has the disadvantage of being affected by extreme values. When these occur, as in our case, the median is preferred as a more accurate measure of a centrality. As can be seen from *Figures* 4 and 5, the median (and also the mean) for the C_1 and R_1 values tended to increase and decrease, respectively, with the exposure time. This trend is reflected in a roughly linear segment in the log-log plot (solid line) during the first 15 days of exposure where impedance measurements were made.

In addition to the plots for the rusted substrate, *Figures* 4 and 5 include the curves for the clean substrate (broken lines) obtained elsewhere.[1] It is interesting to note that the slopes (n) of the plots of C_1 and R_1 against time for the coating applied to the rusted substrate are roughly double those for the coating applied over clean steel. Thus, the effect of time on coating decay is seemingly squared by the presence of rust in the substrate.

The influence of the substrate condition on C_2 and R_2 parameters which are usually related to the double-layer capacitance and the charge transfer resistance of the corrosion process, respectively,[6] is also of interest. However, determining these two parameters is often impossible because the MF semicircle from which they are derived is frequently ill-defined (overlapped with the end of HF semicircle or the initial portion of LF tail or does not even appear in the Nyquist diagram). Thus, C_2 could only be estimated from 32% of the Nyquist diagrams obtained, and R_2 from 47%. Therefore, the number of replicates used proved inadequate for drawing statistically significant conclusions on the effect of a rusted substrate on these parameters. Roughly, the C_2 values obtained for the rusted substrate were similar to those previously estimated for paint applied over a clean substrate,[1] whereas R_2 values were smaller by one order of magnitude than those for paint over clean steel.

The angle between the initial rising portion of LF tail in the Nyquist diagram and the real axis was also measured. In previous work,[1] paint over a clean steel substrate provided angles in the range 30-50° that tended to decrease after 10 and 15 days exposure. On the other hand, the coating on the rusted substrate gave rise to angles of 10-30° from the first few days of exposure (*Figure* 6).

The fact that the coating on the rusted substrate gives rise to LF tails that are flatter than the typical 45° tails for the Warburg impedance suggests a non-uniform current distribution effect, which could be modeled by a transmission line.[15,16] An ideal transmission line theory predicts a phase angle of the impedance vector equal to one-half that for a uniform current distribution.[17] In our case, the transmission line effect should be associated with adhesive failure of the metal/paint bonds and the possible formation of a thin aqueous film at the metal/paint interface. Armstrong and Wright[16] found that the aqueous solution penetrating down a fine pore in the coating may spread out over a finite distance (wetted area) from the bottom of the defect in a thin layer between the coating and the metal. From a study of the degradation mechanism of a coated system, Geenen et al.[18] concluded that water may accumulate at the metal/coating interface at places where the coating is adhered poorly to the metal. In our case, the presence of rust may account for the increased water uptake in the coating/rusted substrate interface relative to this phenomenon in a clean substrate. Because the flattened tails obtained for the rusted substrate appear from the first day of exposure, the coating probably allows the aqueous solution to rapidly reach the underlying metal.

It is widely known that the HF semicircle contains paint film information but no substrate information.[6,19] However, in this paper, the C_1 and R_1 values derived from this semicircle depend as well on the substrate condition ("rusted" or "clean"). It is seemingly plausible that the influence of the substrate in this case may be exerted indirectly through its effect on coating degradation. As noted earlier, changes in those two parameters during exposure of the specimens to the saline solution were, from the beginning, substantially faster in the coating applied to the rusted substrate than to a clean one. One may, therefore, wonder what the reason for the accelerated degradation of the coating on the rusted substrate is. In a study of the degradation of paint films, Walter[20] obtained failure times that were considerably shorter for free films than for attached films. Two of the reasons proposed by Walter to account for this finding are that a rigid substrate provides mechanical strength to the attached film and that free films are exposed to the aggressive solution from both sides. Perhaps a similar explanation could be applicable to our results, since the rusted substrate is not a firm substrate and water at the coating/substrate interface may contribute to coating deterioration from this side as well.

CONCLUSIONS

For a chlorinated rubber-coated rusted steel, the parameters derived from the impedance diagrams resulting from multiple replicates show a very large scatter, so a statistical approach is required to analyze the effect of the rusted substrate condition on coating degradation.

The mean values (for 13 replicate specimens) of capacitance (C_1) and resistance (R_1) of paint film changed markedly from the first day of exposure of the metal/paint system to a three percent NaCl solution. A comparison of the results obtained for the coating applied over the rusted substrate with those for the same coating over clean steel reveals significant differences between their respective C_1 and R_1 mean values. The rate of change of C_1 and R_1 with time is also much higher for the rusted steel substrate than for the clean one.

The LF tails in Nyquist diagrams obtained for the coating applied over a rusted substrate frequently have substantially smaller slopes than those for the coating applied over a clean substrate. This is consistent with the view that a liquid phase is formed at the rusted substrate/paint interface, in which case the system response to the electrical signal applied in tests can be roughly modeled by a transmission line. The presence of such an interfacial liquid phase may boost the temporal changes in parameters C_1 and R_1.

ACKNOWLEDGMENT

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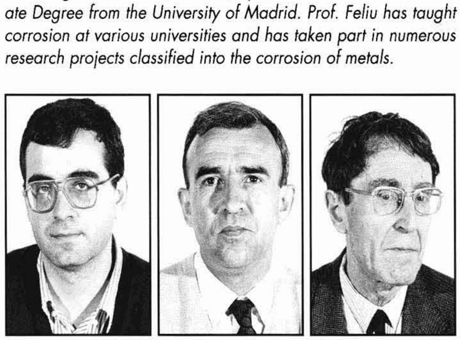

S. Feliu, Jr. **M. Morcillo** **S. Feliu**

Emulsification of Alkyds for Industrial Coatings

Gunilla Östberg and Björn Bergenståhl—Institute for Surface Chemistry*

INTRODUCTION

During recent years, the interest in using waterborne alkyd paints has increased.[1,2] Emulsified alkyds have been used primarily in the decorative and protective field. In most cases they are used as co-binders, especially in stains and primers for exterior use. Although alkyd emulsions cannot match the performance of a solvent-borne alkyd so far, they are an attractive alternative since they contain no volatile organic compounds. For health and environmental reasons, alkyd emulsions for industrial coatings have gained increasing attention. Alkyds for industrial coatings are often dissolved in toxic aromatic organic solvents such as xylene. The volume of organic solvents used in industrial paints is also considerably larger than the volume used in consumer paints.

In alkyd emulsions, in comparison to latex dispersions, the resin is post emulsified as fine droplets in water. A crucial factor for acquiring good colloidal stability is that small droplets are obtained in the emulsification process.[3] The choice of surfactants here is critical. The surfactant should simplify the formation of the droplets during emulsification and afterwards stabilize them against flocculation and coalescence.[4,5] The right surfactant should fulfill these requirements at low concentrations since high amounts of surfactants often give soft and water-sensitive paint films. In a previous study, the influence of surfactants on emulsification and shear stability of alkyd emulsions for consumer paints has been investigated.[6-8]

Alkyds for industrial coatings have a much higher viscosity than alkyds used in consumer paints, which demand a special emulsification technique to create finely dispersed emulsions. In the present work, the possibilities of emulsifying high viscosity alkyds by the inversion technique have been investigated. The influence of type and concentration of surfactant on the inversion properties and droplet size has been studied. An increased knowledge of the inversion technique, although it is applied on alkyds in this study, is also of interest for emulsification of other resins with high viscosity, for example, polyesters, wax, epoxy, and tackifiers.

To date, alkyd emulsions have mostly been used in consumer paints. These are relatively easy to emulsify due to their low viscosity. Lately, alkyd emulsions for industrial paints have gained increasing attention. Alkyds for industrial paints have a much higher viscosity than alkyds for consumer paints which require other emulsification techniques. In this work an alkyd with 40% oil length has been emulsified by the inversion technique. Inversion emulsification accomplished by adding water to an alkyd/surfactant mixture at constant temperature affords emulsions with droplet sizes below 1 μm at a concentration of three percent on the alkyd phase. Small droplets are necessary for colloidal stability of the emulsion. The solubility of surfactant in the alkyd and the water phase determines at which water concentration the emulsion inverts. High molecular weight ethoxylated anionic surfactants are effective as emulsifiers. Using these surfactants, the emulsification becomes less dependent on emulsification temperature than when nonionic surfactants are used.

EMULSIFICATION TECHNIQUES

In principle, emulsification can be made by two different techniques, direct emulsification or emulsification through inversion.

In direct emulsification the resin is dispersed directly into water by using high shear agitation or high pressure homogenization. The resulting droplet size depends to a large extent on the intensity of the agitation and on the self-emulsifying contribution from the surfactant. However, with increasing mixing, a more effective process is obtained, which is less dependent of the type of surfactant. To emulsify resins that are solid at room temperature by the direct method, the temperature must be increased to lower the viscosity. An alternative is to dilute the resin in a solvent. The solvent can be removed after emulsification to obtain a solvent-free emulsion.[9]

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Table 1—Surfactants Used for Emulsification

Surfactant	Symbol	HLB	Commercial Name	Supplier
Anionic				
Fatty alcohol ether sulphate, sodium salt	C_{12}EO5-S-Na	—	FES 32	Henkel KGaA Plastics & Coatings Technology
Fatty alcohol ether sulphate, sodium salt	C_{12}EO10-S-Na	—	FES 993	Henkel KGaA Plastics & Coatings Technology
Fatty alcohol ether sulphate, sodium salt	C_{12}EO30-S-Na	—	FES 77	Henkel KGaA Plastics & Coatings Technology
Fatty alcohol either sulphate, sodium salt	C_{12}EO50-S-Na	—	FES 61	Henkel KGaA Plastics & Coatings Technology
Nonionic				
Fatty alcohol ethoxylate	C_{16}/C_{18}EO80	18.5	Berol 08	Akzo Nobel Surface Chemistry AB

In inversion emulsification, the water phase is first emulsified into the resin forming a water-in-oil (W/O) emulsion. By changing the temperature or the water concentration, the W/O emulsion can invert into an oil-in-water (O/W) emulsion. The surfactant, and also to some degree the concentration of resin in water, determines which emulsion type is formed[10-13] at a certain temperature. A hydrophobic surfactant, with a low hydrophilic lipophilic balance (HLB), is most soluble in the resin phase and gives a W/O emulsion according to Bancroft's rule.[14] A hydrophilic surfactant (with a high HLB) is most soluble in the water phase and favors the formation of an O/W emulsion.

In principle there are two different techniques to induce inversion:

(1) In the phase inversion temperature (PIT) method (or thermal inversion), the oil, water, and a nonionic surfactant are mixed at a high temperature. The high temperature increases the hydrophobicity of a nonionic surfactant which results in a W/O emulsion. By decreasing the temperature, the surfactant becomes more hydrophilic and diffuses from the oil across the phase boundary over to the water phase. The diffusion causes an inversion to an O/W emulsion. The temperature at which the emulsion inverts is called the phase inversion temperature. This concept is well described by Shinoda and co-workers[10-12,15-17] and some others[18,19] for oils of low viscosity. PIT is specific for every system and depends on type and concentration of surfactant, type of oil and additives, for example, salt. By proceeding through a microemulsion region (with low interfacial tension) at inversions, very finely dispersed emulsions can be obtained.[20-22]

(2) In the other technique, the emulsifier is first mixed with the resin. Water is then added to the mixture at constant temperature to obtain a W/O emulsion. At a certain ratio of water to resin, the emulsion inverts. This concentration is called the emulsion inversion point, EIP.[23-26] This technique is often used in industrial applications.

The inversion technique is especially advantageous for oils of high viscosity since emulsification can be made in a simple laminar shear field. The emulsification is strongly enhanced by a high viscosity of the continuous phase, which is the resin before inversion. The droplet size, d, in a laminar shear depends on the viscosity ratio of the phases as:[3]

$$d \propto \eta_{\text{continuous phase}}^{-0.6} \text{ if } \frac{\eta_{\text{dispersed phase}}}{\eta_{\text{continuous phase}}} < 4 \quad (1)$$

In inversion emulsification, however, the choice of surfactant is more critical than in direct emulsification.

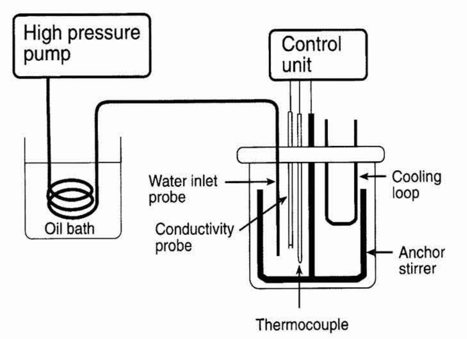

Figure 1—A schematic picture of the laboratory reactor for the inversion experiments. The reactor can operate above atmospheric pressure, over 100°C. The reactor is equipped with a thermocouple, an anchor stirrer, a water inlet probe, and a conductivity probe. The reactor is heated by an external heater. The water is pumped into the reactor by a high pressure pump.

MATERIALS

The alkyd used is a chain-stopped alkyd, based on linoleic rich fatty acids. The oil length is 40%, the acid value is 10 mg KOH/g alkyd, and the hydroxyl number is 85 mg KOH/g alkyd. The viscosity is 18,300 mPas at 100°C. The surfactants used are listed in *Table* 1.

The fatty alcohol ether sulphates are supplied as solutions in water. The solutions were freeze dried and the surfactants were used as solids. The nonionic surfactant is solid.

The alkyd was neutralized with dimethylethanolamine or potassium hydroxide (in water solution) before emulsification.

METHODS

Inversion Experiments

Inversion experiments were performed in a laboratory reactor (Parr Instrument Company, USA). A schematic of the reactor is shown in *Figure* 1. The reactor allows experiments above atmospheric pressure. The reactor volume is 300 ml and it is equipped with an anchor stirrer, a thermocouple, and inlet

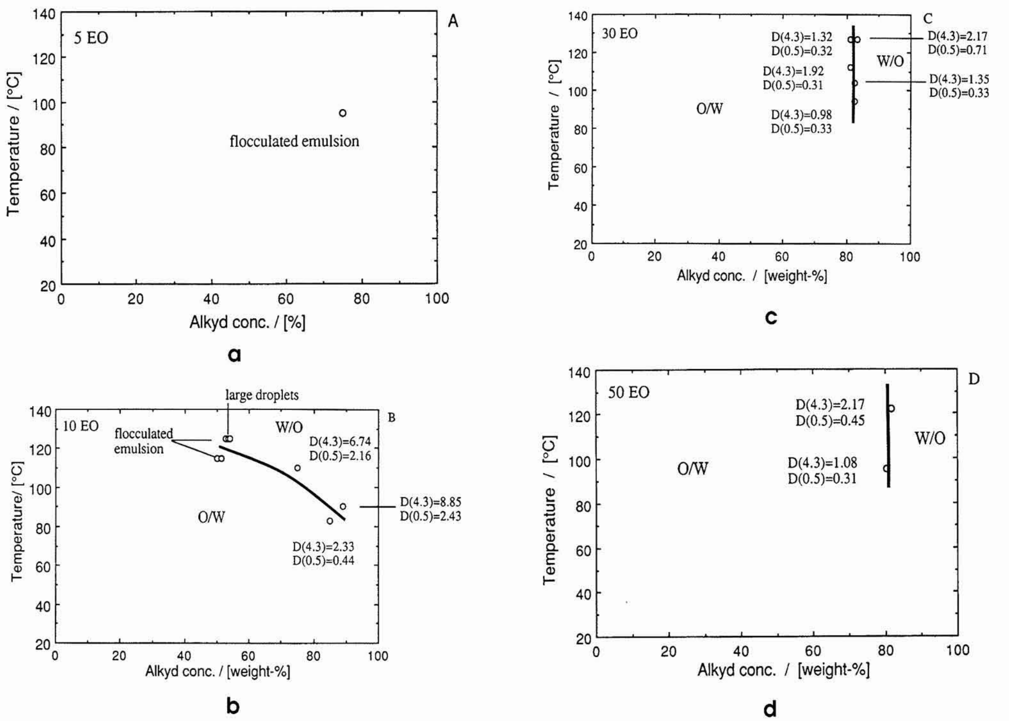

Figure 2a-d—Emulsion inversion point for the anionic surfactants, C_{12}EOn-S-Na with different length of the ethylene chain (n=5, 10, 30, and 50 EO). Emulsification is made by adding water to the alkyd/surfactant mixture at constant temperature. The alkyd has an oil length of 40% and it neutralized with DMEA. The concentration of surfactants are 10% on the alkyd weight. D(4.3) is the volume-weighted mean drop diameter and D(0.5) is the volume-weighted median.

probe for adding the water, a cooling coil for a proper control of temperature, and a conductivity probe for detecting inversion. The water phase contains 1 mM sodium chloride to obtain conductivity. A distinct increase in conductivity is observed when the emulsion inverts from a W/O to an O/W emulsion. The reactor is heated by an external electrical heater connected to a control unit. Water is pumped into the reactor by a high pressure pump which allows pumping above 100°C. The water is preheated to the emulsification temperature by dipping the water tube into an oil bath before it enters the reactor.

Emulsification is made by the EIP technique. The alkyd and emulsifier is mixed and neutralized in the reactor. When the emulsification temperature is reached, the preheated water is pumped into the reactor at constant temperature.

After inversion the emulsions are diluted to 50% during cooling to room temperature.

Droplet Size

Droplet sizes were measured with a laser diffraction instrument, Mastersizer (Malvern Instruments, England). The instrument uses an approximation of the Mie scattering theory, which utilizes the refractive index of the dispersed phase and its absorption. The relative refractive index $n_{alkyd}/n_{water} = 1.15$ for the alkyd used. The absorption value was estimated to be 0.1. The results are recorded as a volume distribution. The initial droplet size is expressed as D(4.3) which is the volume-weighted mean diameter or as D(0.5) which is the volume-weighted median. Surfactant layer thicknesses (see the following) are estimated from the D(3.2) value which is the area weighted mean drop diameter. The emulsions were also examined by microscopy.

Calculations of an Apparent Surfactant Layer Thickness

If it is assumed that all surfactant is located at the surface of the alkyd droplets (which is an overestimation), an apparent surfactant layer thickness, Δ, can be calculated[6] from the known volume fraction of surfactant with respect to the oil phase, $\phi_{surfactant}$, and from the area weighted drop radius, r. For small values of $\phi_{surfactant}$ the layer thickness becomes:

$$\Delta = \frac{\phi_{surfactant} \cdot r}{3} \qquad (2)$$

If the calculated thickness is compared to the length of the extended surfactant molecule, one can estimate the surface

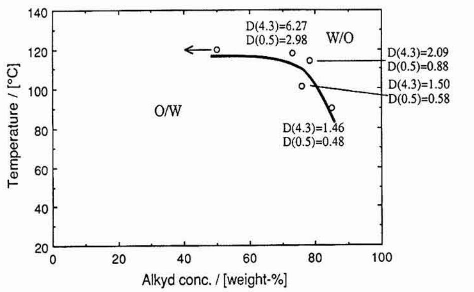

Figure 3—Emulsion inversion points for the nonionic surfactant, $C_{16}/C_{18}EO80$. Emulsification is made by adding water to the alkyd/surfactant mixture at constant temperature. The arrow indicates that no inversion is obtained down to the measured concentration. The alkyd has an oil length of 40% and is neutralized with sodium hydroxide. The concentration of surfactants are 10% on the alkyd weight. D(4.3) is the volume-weighted mean drop diameter and D(0.5) is the volume-weighted median.

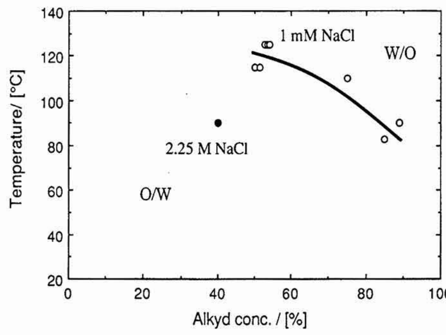

Figure 4—The change of emulsion inversion point for emulsions of alkyd with 40% oil length and $C_{12}EO10$-S-Na when salt (2.25 M NaCl) is added to the water phase. The emulsifier becomes more hydrophobic when the salt is added which favors the w/o emulsion and inversion at higher water concentrations.

coverage. In the calculation the densities were estimated to 1.0 for both the alkyd and the surfactants.

Cloud Point

Cloud point was measured by dissolving one percent surfactant in sodium chloride. The solutions were introduced in glass ampoules that were sealed. The ampoules were placed in an oil bath at different temperatures and cloud points determined visually.

RESULTS AND DISCUSSION

Influence of Surfactant on the Emulsion Inversion Point

The results from the inversion emulsification using the anionic surfactants are presented in *Figures* 2a-d. The results are presented in phase inversion diagrams. Using the EIP technique, we are going from the right side in the diagram at 100% alkyd, at constant temperature, to the left when water is added. The lines (only one point in *Figure* 2a) indicate when inversion is obtained. Above the inversion line, the emulsions are W/O and below O/W. Droplet sizes of the emulsions after inversion are included in the diagrams.

With the anionic surfactant with 5 EO at 95°C (*Figure* 2a), inversion was obtained but the emulsion was crude and flocculated. The anionic surfactant with 10 EO (*Figure* 2b), gave better emulsions. Especially at lower temperatures relatively small droplets were obtained. At temperatures above 110°C, the emulsions were crude and flocculated immediately after inversion. It can be seen that emulsion inversion point (EIP) changes with temperature using this surfactant. The higher the emulsification temperature, the more water was required before the emulsion inverts. For the more hydrophilic surfactant with longer EO chains, 30 and 50 EO, the EIP is independent of the temperature. Also, for these emulsions the droplet size of the emulsions is independent of the emulsification temperature.

The emulsification results when a pure nonionic surfactant is used (see *Figure* 3). Also with this surfactant, the emulsion inversion point depends on the emulsification temperature and the droplets are smaller at lower temperatures.

It has been found that the phase inversion lines are different for different oils using the same type of surfactants. For a non-polar paraffin oil, the phase inversion temperature is completely independent of the oil-in-water concentration (i.e., the inversion line is horizontal) when ethoxylated nonylphenol was used. With a more polar oil, xylene, the

Table 2—Critical Surfactant Concentration and Layer Thicknesses

Emulsifier	Critical[a] Surfactant Concentration (weight-% on alkyd)	Droplet Size D(3,2)[b] (μm)	Critical Surfactant Layer Thickness[c] (Å)	Calculated Length of the Emulsifier[d] Molecule (Å)	Ratio[e]
$C_{12}EO10$-S-Na	3	0.90	44	56	0.78
$C_{12}EO30$-S-Na	3	0.41	20	128	0.16
$C_{16}/C_{18}EO80$	3	0.48	56	315	0.18

(a) Lowest concentration when the droplet size D(0.5) are below 1μm.
(b) Area weighted mean diameter.
(c) Critical surfactant layer thickness is taken from Figure 7.
(d) Calculated from the bond lengths for an extended molecule, C-C 1,54 Å, C-O 1,44 Å, O-H 0.97 Å. All bond angles.
(e) Critical surfactant layer thickness divided by calculated molecular length.

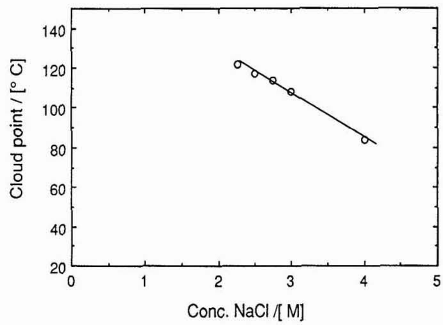

Figure 5—The change of cloud point of C_{12}EO10-S-Na with salt concentration. Below 2.25 M NaCl there is no cloud point under 150°C.

phase inversion temperature varies with temperature.[17] The solubility of the surfactant changes more gradually in a polar oil compared to a non-polar oil. This indicates that it is the temperature dependent solubility of the surfactant in the oil and water phase respectively that determines the emulsion inversion point, i.e., the slope of the inversion line.

The different temperature dependency seen in our experiments can also be explained by the solubility of the emulsifier in the alkyd and the water phase. The solubility properties of nonionic surfactant display a different temperature dependence compared to anionic surfactants. Ethoxylated nonionic surfactants become more hydrophobic with increasing temperature due to the water structure around the ethylene oxide chain. Anionic surfactants do not display such a temperature dependency. The anionic surfactants used in this study, however, contain ethylene oxide chains of different length which gives them a somewhat similar character to a nonionic surfactant.

When the emulsification temperature is increased with the anionic surfactant, the 10 EO (in *Figure* 2b), and with the nonionic surfactant (in *Figure* 3), they become more hydrophobic. This makes them good stabilizers for the W/O emulsions so more water has to be added before inversion occurs. The amount of water needed to obtain inversion is likely determined by the amount of surfactant necessary to stabilize the water droplets. Because of the hydrophobic character of these emulsifiers at higher temperatures, they are poor stabilizers for the O/W emulsions, and crude emulsions are obtained after inversion. At lower temperatures the emulsifiers are more hydrophilic and dissolve in the water phase, which favors an O/W emulsion. This results in an earlier inversion and smaller droplets. An experiment supporting this theory is that the emulsion inversion point is changed from 85-89% alkyd in water to about 40% when the salt concentration was increased in the water phase (see *Figure* 4). Addition of salt decreases the cloud point and the water solubility of the ethoxylated surfactant, according to *Figure* 5.

The emulsifiers with 30 and 50 EO, however, seem to retain their hydrophilicity within this temperature interval resulting in an early inversion and finely dispersed emulsions at all temperatures.

Similar changes of inversion lines for an oil of low viscosity has also been reported when an ethoxylated nonionic surfactant was gradually replaced by a pure anionic surfactant.[27] The viscosity has also been reported to influence the inversion line[28] which indicates that diffusion of the surfactant is an important factor.

Influence of Surfactant Concentration on the Droplet Size

In the previous section, we could see that hydrophilic anionic surfactants with long EO chains gave emulsions with the smallest droplets. The influence of concentrations of surfactants on the droplet sizes is shown in *Figure* 6. The results for both the anionic surfactants with 10 and 30 EO and for the nonionic surfactant are included. Emulsification was made at 90°C. The sample at one percent concentration of nonionic surfactant did not invert after addition of 50% water but inverted during cooling. The emulsion flocculated directly after inversion. At 0.5% concentration of the anionic surfactant with 30 EO, the emulsion also flocculated directly after inversion.

From the results with the weight concentration in *Figure* 6, it seems as if the nonionic surfactant should be less effective than the anionic ones. The nonionic surfactant, however, has a much higher molecular weight than the anionic ones so if molar concentrations are considered instead, the nonionic surfactant is as effective as the anionics.

For a further understanding of the difference between the effectiveness of the surfactants, a more detailed discussion of the surfactant layer around the droplets is needed.

If it is assumed that all of the surfactant is located at the surface of the droplets (which is an overestimation since it is also soluble in the alkyd and in the water phase), an apparent thickness of the surfactant layer can be estimated using equation (2). If this thickness is compared to the length of the surfactant molecule, an estimation of the packing density of the surfactant on the droplet surface is obtained. The calcula-

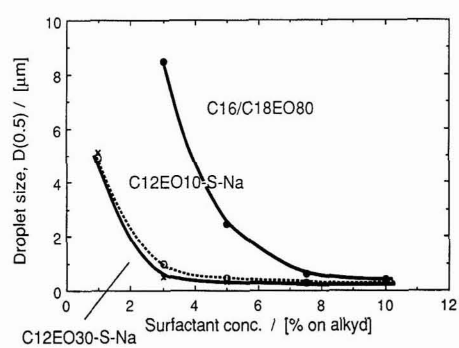

Figure 6—The droplet sizes after inversion emulsification at different surfactant concentrations. D(0.5) is the volume-weighted median of the drop diameter. The data from both the anionic surfactants and for the nonionic surfactants are included in the figure. The emulsions are neutralized with sodium hydroxide.

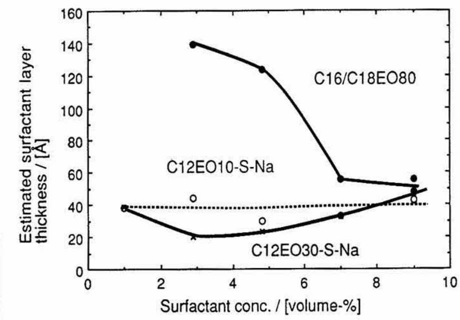

Figure 7—Estimated surfactant layer thicknesses on the emulsion droplet surfaces at different surfactant concentrations.

tions of the surfactant layer thicknesses are shown in *Figure* 7. From *Figure* 6 it can be seen that the critical concentrations for both the anionic surfactants are about three percent. Below this concentration the droplet size starts to increase over 1µm. Since the surfactant layer thicknesses remain constant below three percent (see *Figure* 7), it can be concluded that it is the supply of surfactants that determine the droplet sizes obtained during emulsification. For the nonionic surfactant, the layer thickness increases below the critical concentration, 7.5%, indicating that these surfactants act differently than the anionics. Below the critical concentration effects, others than the supply of surfactants seem to determine the droplet size.

If the surfactant layer thicknesses are compared to the length of the molecules (see *Table* 2), it can be seen that both the nonionic surfactant and the more hydrophilic anionic surfactant with 30 EOs give stable emulsions at very thin surfactant layers around the droplets. The ratio between the critical layer thicknesses and the calculated molecular length are 0.16 and 0.18, indicating a very low packing density of surfactants at the droplet surfaces. The low packing density proposes a non-extended configuration of the surfactant molecule on the droplet surfaces. For the anionic surfactant with 10 EOs the ratio is higher, 0.78, showing a higher packing density.

If these results are compared to emulsification of alkyds by high pressure homogenization,[6] it seems as if inversion emulsification is a more effective emulsification method, at least when the high molecular weight surfactants are used. In high pressure homogenization, the ratio between the critical layer thickness and the calculated molecular length were 0.37-0.63 for some nonionic surfactants showing a somewhat higher packing density. With a pure anionic surfactant, however, extremely low packing density were obtained in high pressure homogenization.

CONCLUSION

Alkyds of high viscosity can be emulsified by the inversion technique using simple hydrophilic nonionic and anionic surfactants. Fine dispersed, stable emulsions are obtained by using the EIP technique, i.e., by adding water to the alkyd/emulsifier mixture at constant temperature. There is no need to make the inversion by going through a microemulsion region as proposed in the PIT technique to obtain small droplets.

The emulsion inversion point and the droplet size seem to depend on the solubility of the surfactant in alkyd and the water phases.

By using hydrophilic anionic surfactants with long ethylene oxide chains, the droplet sizes become less dependent on the emulsification temperature than when nonionic and more hydrophobic anionic surfactants are used.

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Constituent Society Paper

Correlation of Accelerated Exposure Testing and Exterior Exposure Sites Part II: One-Year Results

Cleveland Society for Coatings Technology Technical Committee—
Ben J. Carlozzo,* Jeff Andrews, Freidun Anwari, Mark DiLorenzo, Roy Glover, Steven Grossman, Chris Harding, Joseph McCarthy, Brian Mysza, Russell Raymond, Brian Skerry, Phillip M. Slifko, Walter Stipkovich, John C. Weaver, and Guy Wilson

Results in the Cleveland Society's long-term project to correlate accelerated test methods to several exterior exposure sites are presented. A brief review of the methodology and the six-month results are included, as well as the one-year data.

At six months (see Part I), correlations were presented only with the cyclic Prohesion®/QUV accelerated test and four of nine exterior sites when rust creep at scribe was the measuring criteria. At one year, the cyclic Prohesion/QUV test continues to show statistical correlation for rust creep data, but sites which previously showed no correlation now correlate, and some of the sites which previously correlated, now do not. This result suggests that stronger UV irradiance may be necessary during accelerated testing.

Other test criteria, including blistering, surface rusting, and gloss, have also been monitored throughout this study. Additional exposure time is needed to broaden the range of results to yield meaningful correlations. At least two additional years of exposure are planned.

INTRODUCTION AND REVIEW

Test methods which can accurately predict the durability of coatings have been sought since the beginning of the modern coatings era. For the industrial maintenance market, where the corrosion resistance for these protective coatings is extremely important, this need is even more urgent.

Fifteen years ago, the annual cost due to corrosion of metals was estimated at a staggering $70 billion.[1] Today, the amount is undoubtedly much higher. The special requirements of these systems make rapid testing of these coatings critical, but also much more difficult. The first attempt to use artificial weathering was cited in a paper by Nelson written in 1922.[2] A useful history of the development of artificial weathering is also available by Garlock and Sward.[3]

When researchers in corrosion science have performed accelerated testing, the most cited method has been the salt fog spray cabinet.[4] Even so, major complaints have been voiced due to the artificial results generated by this method, especially when compared to natural weathering.[5] In particular, the unnatural chemistries of the corrosion products present have been cited by several researchers,[6-8] as well as the exclusion of other commonly found chemical species; for example, the presence of sulphates in industrial atmospheres was known to Nelson, who tried to incorporate them into his early weathering chambers.

In the chemistry of steel corrosion, the presence of sulphate in the form of soluble iron salts has been known for years.[9] Today, the occurrence of acid rain is blamed on the sulphur and nitrogen by-products of an industrialized society. Tests for durability in this type of environment would be appropriate and, in fact, are available in the form of moist sulphur dioxide cabinets (i.e., the Kesternich cabinet). However, this cabinet is also subject to criticism about realistic weathering, as other gases and electrolytes are usually not present.

In the past 15 years, additional literature and round-table discussions have focused on the problems associated with the currently prescribed tests. Timmins pointed out that salt fog testing was qualifying coatings in the lab; yet, these same coatings were failing in the field.[10]

In 1981, Leidheiser, speaking at a symposium sponsored by the National Association of Corrosion Engineers, concluded his talk by listing several unsolved problems related to coat-

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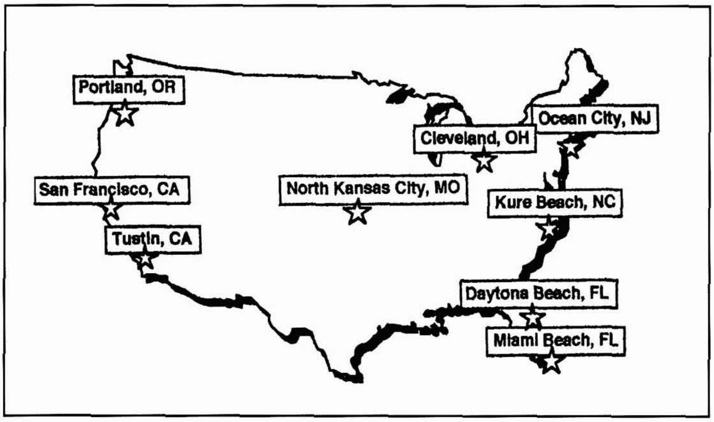

Figure 1—Geographic representation of sites.

ings and the corrosion protection of steel.[11] The number one problem, as he saw it, was the "... development of an accelerated atmospheric corrosion test, the results of which correlate well with service experience."

In the trade sales and automotive markets, UV-condensation testing had been used to simulate Florida exposure for fading and loss of gloss. This test method is best embodied by American Society for Testing and Materials (ASTM) Methods G 26-92 and G 53-91[12]: specifically, Xenon Arc and QUV®, respectively. Several studies have correlated these instruments to exterior exposures,[13-15] with good results, especially when corrosion was not a factor.

Skerry and co-workers used a method developed by Timmins, called the Prohesion® test, to correlate accelerated results with exterior exposures.[16] In that work, the additional use of a UV weathering cycle with the Prohesion test was first proposed. The early successes of this particular cyclic method spawned a renewed interest and belief that true correlations to exterior exposures are possible.[17-24]

In 1990, the Cleveland Technical Committee first proposed a project which would look at some of the factors which affect correlations in accelerated exposures. The protocol of this study would be similar to that proposed by ASTM subcommittee D01.27.31 on accelerated testing in corrosive environments, which was about to undertake a series of round-robin test programs to characterize several exterior corrosive sites as well as investigate newer test instruments and procedures. The ASTM study would be using specification coatings available through the Steel Structures Painting Council (SSPC). Although the rationale for their use included the long history and information available on these coatings, some types contained many ingredients that states were now questioning, or legislatively banning.

In order to broaden the usefulness of our study, the Cleveland Technical Committee decided to investigate newer compliant coatings. Choosing coatings which met new regulatory requirements, like low toxicity inhibitive pigments, lower volatile organic content (VOC), and new, higher performance binders, would make these data more timely. Investigating the newer technologies, of interest to our members, would generate a broader base of data for future studies and developments.

The Technical Committee initiated a program which would investigate eight compliant coatings, (either high-solids, waterborne, or both) and one specification alkyd. Five test methods would be used and the coatings would be placed on exposure

Table 1—Systems and Manufacturers Recommended Application and Coverage

System #	Description	Application Method	Recoat Time (Hr)	Wt% Solids	Vol% Solids	Wet Film	Dry Film
1 ...	DTM self priming acrylic latex	Airless spray	2.0	—	37.5	4.0	1.5
	Topcoated with a DTM acrylic latex	Airless spray	2.0	—	37.5	4.0	1.5
2 ...	Acrylic latex primer	Airless spray	2.0	—	37.5	4.0	1.5
	Topcoated with an acrylic latex semi-gloss	Airless spray	2.0	—	37.5	4.0	1.5
3 ...	2-Component high-solids urethane basecoat	Conventional spray	4.0	66.7	52.3	1.9	1.0
	2-Component high-solids urethane topcoat	Conventional spray	5.0	66.9	66.9	1.5	1.0
4 ...	High-solids solvent epoxy aluminum mastic	Airless spray	18.0	80.0	72.0	6.5	4.5
	Elastomeric styrene-acrylic latex topcoat	Airless spray	18.0	59.0	53.0	16.0	8.5
5 ...	Waterborne acrylic-crosslinked epoxy basecoat	Airless spray	2.0	—	37.5	8.0	3.0
	Waterborne acrylic-crosslinked epoxy topcoat	Airless spray	2.0	—	37.5	8.0	3.0
6 ...	Water-reducible alkyd—self priming	Conventional spray	0.5	48.6	34.5	2.9	1.0
	Water-reducible alkyd—self priming	Conventional spray	0.5	48.6	34.5	2.9	1.0
7 ...	Styrene acrylic maintenance coating—self primed	Conventional spray	—	54.6	39.6	6.3	2.5
	Styrene acrylic maintenance coating—self primed	Conventional spray	—	54.6	39.6	6.3	2.5
8 ...	Water-reducible epoxy ester primer	Conventional spray	18.0	44.0	30.7	3.7	1.1
	Semi-gloss acrylic latex topcoat	Airless spray	2.0	—	37.5	4.0	1.5
9 ...	Specification alkyd primer—TTE-266	Conventional spray	24.0	59.7	37.5	4.7	1.8
	Specification alkyd—TTE-266	Conventional spray	24.0	55.8	38.0	4.6	1.8

for at least three years. It is important to stress that the test protocol was designed to use coatings which were expected to give results with a wide difference in performance; which coating system was better than another was not the purpose of this investigation. In fact, some coatings were not necessarily meant for corrosive environments, but designed for mild, non-corrosive industrial, and even trade sales and consumer use.

Part I of the project included the first six months results of exterior exposure, as well as descriptions of our tests and procedures. That study was presented to the FSCT at the Annual Meeting in Atlanta in 1993 and appeared in the October 1994 issue of the JOURNAL OF COATINGS TECHNOLOGY (JCT).[25] The present study evaluates the one-year exposure results and discusses plans for further study.

Test Methods and Exposure Sites

The accelerated methods originally used included: (1) standard salt fog (5.0 wt% NaCl); (2) cyclic salt fog (5.0 wt% NaCl, run in a wet/dry cycling cabinet); (3) wet/dry cycling cabinet with 0.05 wt% NaCl and 0.35 wt% $(NH_4)_2SO_4$ as the electrolyte (recommended Prohesion cabinet cycle); (4) UV condensation cabinet cycled with the wet/dry Prohesion type cycle [QUV®/cyclic Prohesion with 0.05 wt% NaCl and 0.35 wt% $(NH_4)_2SO_4$], and (5) cyclic immersion/UV weathering using the KTA-Envirotest® [0.05 wt% NaCl and 0.35 wt% $(NH_4)_2SO_4$]. See Part I for more details.[26]

Five commercial and four private sites are being used for exterior exposure testing. *Figure* 1 shows the geographic distribution of these sites. They are Ocean City Research Corporation, Ocean City, NJ; LaQue Center for Corrosion Technology, Inc., Kure Beach, NC; Battelle, Daytona Beach, FL; Sub-Tropical Testing Service, Miami, FL; Truesdail Laboratories, Inc., Tustin, CA; Coatings Research Group, Inc., Cleveland, OH; Tnemec, Inc., North Kansas City, MO; the Golden Gate Bridge Authority, San Francisco, CA; and the Rodda Paint Company, Portland, OR.

The goal of this study is to determine if the currently proposed accelerated methods statistically correlate with exterior exposures. Although the current results are based on a full-year exposure, these results should still be viewed as preliminary. Even so, some conclusions can be drawn from the degree of correlation currently present, especially when compared to the correlations found for the six-month results.

EXPERIMENTAL

Test Paints

Eight systems were chosen based on the criteria that all coatings would be VOC compliant under California law. In addition, a ninth system was selected because it was used in the ASTM study. All systems are commercially available. *Table* 1 lists the systems, application methods, and some physical properties.

Panel Preparation, Sites, and Test Methods

The experimental design for this study is given in detail in Part I[27] and only a brief description is presented here:

Sufficient panels were prepared which allowed us to expose five replicates of each system at nine different exterior exposure sites as well as five accelerated tests. A sufficient excess was prepared such that panels with only very minor application variations in film build and gloss would be sent to each site.

One slight variation was introduced to the panels after the six-month evaluation. In the original study, a high melting point paraffin wax was used to edge dip the panels, but proved unable to withstand the cold weather cycling and had poor adhesion to the water-reducible alkyd enamel. A formula modification, by the addition of approximately 50% by weight of an ethylene/vinyl acetate copolymer (Elvan 205W, Dupont), raised the melting point and increased flexibility. After the one-year analysis, the exterior panels were again re-dipped with this mixture before being returned for continued exposure. While this edge treatment appears to have performed somewhat better than the original wax, some delamination was still seen. The use of a high-solids epoxy, or a more flexible, yet corrosion resistant, material will be considered for future work.

As before, all panels were rated by ASTM procedures which included ASTM D 1654,[28] Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments; ASTM D 610,[29] Evaluating Degree of Rusting on Painted Steel Surfaces ; ASTM D 714,[30] Evaluating Degree of Blistering of Paints; ASTM D 2803,[31] Filiform Resistance of Organic Coatings on Metal; and ASTM D 523,[32] Standard Practice for Specular Gloss.

The original accelerated exposure study from Part I has been used throughout the course of exterior exposure testing for comparison. Changes in correlation, either improvements or reductions, will be monitored and results will be used to guide future work.

Given the scope of the undertaking, and the need to schedule instrument time, it was decided to delay the accelerated tests until all testing could be performed simultaneously. In this way systematic errors between the intra-lab results would be decreased. Relative to exterior exposure, this increased the storage time by 90 days. There has been some question as to the ability to compare results and derive correlations between panels exposed after two different storage cycles (two months for exterior exposure and five months for accelerated testing). However, the fact that correlations were seen for one test method and several sites, indicates this may not be a critical concern.

This premise and whether the two months between preparation and exposure was realistic, will be investigated in an upcoming study. Coatings may fail in different ways, depending on their cure time before exposure. We will attempt to follow one or two systems under various conditions, to determine if changes in this early history affect the correlations.

The UV Light Source

In order to correlate all the artificial light exposure series, the decision was made to use one type of light source. The pros and cons of UVA-340 type bulbs versus UVB-313 bulbs have been debated in literature.[33-40] UVA-340 bulbs were used in our study, not only due to their reputation as the most similar to natural exposure, but mainly because most of the existing work on cycled Prohesion describes experiments us-

Table 2—Results of Exterior Exposure Testing by ASTM D 1654: Rust Creep

Ocean City, NJ: 12 Months

SYS	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	4	3	4	3	3	3.4	0.55	4	7.5
2	6	6	6	6	6	6.0	0.00	2	3.5
3	1	2	3	1	0	1.4	1.14	5	9.0
4	2	2	2	6	4	3.2	1.79	4	7.5
5	6	4	6	5	5	5.2	0.84	3	5.5
6	6	6	6	6	7	6.2	0.45	2	3.5
7	7	7	8	7	7	7.2	0.45	1	1.5
8	4	6	5	4	4	4.6	0.89	2	5.5
9	7*	7*	7*	7*	7*	7.0	0.00	1	1.5

Stand. dev. of means = 1.9419
Mean of stand. dev.'s = 0.6789

Kure Beach, NC: 12 Months

1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
3	3	3	3	3	3.0	0.00	4	8.0
7	7	8	7	7	7.2	0.55	1	1.0
1	0	2	1	1	1.0	0.71	5	9.0
3	4	8	4	3	4.4	2.07	3	5.5
6	6	5	6	5	5.6	0.55	3	5.5
5	6	5	6	6	5.6	0.55	3	5.5
6	6	7	7	7	6.6	0.55	2	2.5
6	6	6	6*	6*	6.0	0.00	3	5.5
7*	6*	6*	7*	6*	6.4	0.55	2	2.5

1.9802
0.16144

Daytona Beach, FL: 12 Months

1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
4	5*	4*	4	3*	4.0	0.71	4	8.0
8	8*	8	7	8*	7.8	0.45	2	2.5
1	2	2	2	1	1.6	0.55	5	9.0
9	9	9	9	8	8.8	0.45	1	1.0
6	6	5	6	5	5.6	0.55	3	5.5
6	6	6*	6	6	6.0	0.00	3	5.5
6*	6*	5*	6*	7*	6.0	0.71	3	5.5
6	6	6	6	6	6.0	0.00	3	5.5
7*	7*	8*	7*	8*	7.6	0.55	2	2.5

2.1541
0.4411

Cleveland, OH: 12 Months

SYS	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	7	7	7	7	7	7.0	0.00	3	6.5
2	8	8	8	8	8	8.0	0.00	2	3.0
3	5*	4*	5*	4*	4*	4.4	0.54	4	9.0
4	4	6	5	6	10	6.2	2.28	3	6.5
5	7	8	6	6	7	6.8	0.83	3	6.5
6	6	7	7	8	7	7.0	0.70	3	6.5
7	9	9	9	9	9	9.0	0.00	1	1.0
8	8	8	8	8	8	8.0	0.00	2	3.0
9	8	8	8	8	8	8.0	0.00	2	3.0

Stand. dev. of means = 1.333
Mean of stand. dev.'s = 0.4833

N. Kansas City, MO: 12 Months

1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
8	9	8	8	9	8.4	0.54	2	6.5
9	9	9	9	9	9.0	0.00	1	3.0
5*	6*	6*	5*	5*	5.4	0.54	4	9.0
9	9	7	8	9	8.4	0.89	1	3.0
6	6	8	7	7	6.8	0.83	3	8.0
8	8	8	9	9	8.4	0.54	2	6.5
9	9	9	9	9	9.0	0.00	1	3.0
9	9	9	9	9	9.0	0.00	1	3.0
9	9	9	9	9	9.0	0.00	1	3.0

1.2481
0.3711

Miami Beach, FL: 12 Months

1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
8	8	7	8	7	7.4	0.54	2	7.0
9	9	9	9	9	9.0	0.00	1	3.0
4	5	5	5	5	4.8	0.44	3	9.0
9	9	9	9	9	9.0	0.00	1	3.0
9	9	9	9	8	8.8	0.44	1	3.0
8	7	8	8	7	7.6	0.54	2	7.0
9	9	9	9	9	9.0	0.00	1	3.0
8	8	8	7	7	7.6	0.54	2	7.0
8	9	9	8	9	8.6	0.54	1	3.0

1.3654
0.3378

Portland, OR: 12 Months

SYS	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	7	8	7	7	8	7.4	0.54	2	7.0
2	9	8	8	9	8	8.4	0.54	1	3.0
3	5*	5*	5*	4*	5*	4.8	0.44	3	9.0
4	8	8	8	8	9	8.2	0.44	1	3.0
5	8	8	6	8	7	7.4	0.89	2	7.0
6	7	7	8	7	8	7.4	0.54	2	7.0
7	9	8	8	8	8	8.2	0.44	1	3.0
8	8	8	8	8	8	8.0	0.00	1	3.0
9	7	8	8	8	8	7.8	0.44	1	3.0

Stand. dev. of means = 1.0868
Mean of stand. dev.'s = 0.4744

San Francisco, CA: 12 Months

1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
6*	6	6*	7*	6	6.2	0.44	3	7.0
7	7	8	8	7	7.4	0.54	2	4.5
1*	2*	2*	3*	1*	1.8	0.83	4	9.0
9	8	9	8	6	8.0	1.22	1	2.0
7	6	7	6	7	6.6	0.54	3	7.0
8	8	7	7	7	7.4	0.54	2	4.5
7	7	8*	8*	8*	7.6	0.54	1	2.0
7	7	6	6	7	6.6	0.54	3	7.0
8*	7*	8*	8*	8*	7.8	0.44	1	2.0

1.9000
0.6256

Tustin, CA:12 Months

1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
9	9	8	9	8	8.6	0.54	1	3.0
9	9	9	9	9	9.0	0.00	1	3.0
7	7	7	8	7	7.2	0.44	3	7.5
9	9	9	8	9	8.8	0.44	1	3.0
8	9	9	8	8	8.4	0.54	2	6.0
7	8	8	8	7	7.6	0.54	3	7.5
9	9	9	9	9	9.0	0.00	1	3.0
7	7	7	7	6	6.8	0.44	4	9.0
9	9	8	9	9	8.8	0.44	1	3.0

0.8293
0.3756

ing these types of bulbs. Some recent literature,[41,42] as well as the results which follow, suggest that a stronger light source is necessary, especially to correlate to non-corrosive but high UV sites.

Statistical Methods

In order to attempt correlations between different sites, different instruments, and the results between each, five replicates of each paint system were exposed at each site and in each instrument. The Spearman rank correlation technique was then used to analyze the data. The Spearman technique requires that the different systems are ranked in order of performance, then this rank is compared with ranking from other sites and instruments. Differences in rank are then used to generate a sum squared rank difference $\Sigma(RD)^2$. From this, correlation coefficients are then calculated and compared to a critical value for statistical significance.

The following equations were used to evaluate our exposure results and determine ranking. Each was taken from a standard college text on statistics[43]:

(1) Mean ($\bar{x}$):

$$\bar{x} = \frac{\Sigma x}{n} = \frac{x_1 + x_2 + \ldots x_n}{n}$$

x = variable of interest; n = sample size.

(2) Sample standard deviation (σ):

$$\sigma = \sqrt{\frac{\Sigma (x - \bar{x})^2}{n - 1}}$$

x = variable of interest; $\bar{x}$ = mean; n = sample size.

(3) t Test Statistic:

$$t = \frac{\bar{x} - \bar{x}'}{s / \sqrt{N}}$$

$\bar{x}$ and $\bar{x}'$ = the means being compared. s = Standard deviation. Number of samples, N = 5; degrees of freedom, (N-1) = 4; critical value at the 90% confidence level = 2.132.

(4) Spearman rank correlation coefficient (ρ)

$$\rho = 1 - \frac{6\Sigma (x - y)^2}{N (N^2 - 1)}$$

x = rank of first experiment; y = rank of second experiment; critical value at the 90% confidence level = 0.600.

For each test site, the standard deviation of all the means was calculated to give an indication of how well each test differentiated the coatings. Also calculated was the mean of all standard deviations of each test method as a first approximation of the reproducibility for that method. These values are given in each of the data tables.

Each system was ranked first by using the "t" statistic to determine if any statistical differences were present in the means. (That is, was the mean of one system calculated to be 6.0, statistically the same or different from a value calculated as 6.4 in a different system). Statistically different means were given the next lowest rank. That rank determination is labeled tau (τ) in the tables. From this ranking, a Spearman rank, labeled rho (ρ) in the data tables, was derived. This rank was then used to calculate the Spearman correlation coefficients.

In some cases, two different systems with the same mean might have different rankings by the t test, which uses the standard deviation to test whether one average is statistically different from another. Only those which were statistically significantly different were given the next rank. In some of the systems, especially for gloss determinations, several of the panels were rusted beyond the ability to make the measurement meaningful. Where an entire series was not used, it was rated as worst and included. For some series, outlying numbers were discarded, especially where those numbers differed by greater than three sigmas. The ranking was then based on a "z" statistic:

$$Z = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{s_1 / N_1 + s_2 / N_2}} \quad (5)$$

Spearman rank correlation requires that a rank be assigned for each data point in a series of results. The statistics also require that all the rank positions be additive and equal the sum of the sample being investigated. That is, for a population of nine systems, the sum of the ranks must equal 45 (9+8+7+6+5+4+3+2+1). When ties occur, the sum of the ranks must still equal 45, as if no ties were present. That is why a rank order might be 1.5, 1.5, 4, 4, 4, 6, 7, 8.5, 8.5 (sum = 45) instead of 1, 1, 2, 2, 2, 3, 4, 5, 5, (sum = 25) as suggested by the t statistic ranking. Once all the ranks are in this format, it is possible to compare the results by calculating correlation coefficients. The value of the correlation coefficient would then determine whether the correlation is statistically significant. For values which are greater than the critical correlation coefficient, the absolute value of the correlation coefficient is a good approximation of how good the correlation is. The smaller the $\Sigma(RD)^2$, the more similar the rank order. This would indicate a better correlation.

Using the Spearman rho ranking, a table of correlation coefficients was constructed comparing each site to every other and each site to each accelerated test method. From a standard set of correlation data available for this purpose,[44] the critical value of the Spearman correlation coefficient corresponding to the 90% confidence level was determined by use of formula #4. The critical value of the correlation coefficient which would give a 90% confidence level in the results would be 0.600 or greater.

Exterior and Accelerated Exposure Testing

Each panel was evaluated according to the ASTM criteria previously discussed. The presence of filiform type corrosion was noted by an asterisk on the rust creep results. Differentiation of blisters occurring at the scribe, and blisters on the face of the panel were also made.

At the 60% failure level, panels had to be exposed for 1278 hr in the salt fog testing, 1768 hr in the cycled salt fog, 1176 hr in the Prohesion cabinet, 2000 total hr in the cyclic Prohesion (1000 hr QUV and 1000 hr salt spray), and a total 2000 hr in the KTA-Envirotest.

Table 3—Results of Exterior Exposure Testing by ASTM D 610: Degree of Surface Rust

Ocean City, NJ: 12 Months

SYS	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	10	9	10	9	9	9.4	0.55	1	3.5
2	9	10	6	10	8	9.6	1.67	1	3.5
3	9	9	9	9	10	9.2	0.45	1	3.5
4	9	9	9	10	9	9.2	0.45	1	3.5
5	9	9	7	9	8	8.4	0.89	2	7.0
6	5	2	7	3	3	4.0	2.00	4	9.0
7	10	10	9	9	10	9.6	0.55	1	3.5
8	6	7	6	6	8	6.6	0.89	3	8.0
9	10	9	9	9	9	9.2	0.45	1	3.5

Stand. dev. of means = 1.8297
Mean of stand. dev.'s = 0.8778

Kure Beach, NC: 12 Months

SYS	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	10	9	10	9	9	9.4	0.55	1	2.0
2	5	6	10	9	8	7.6	2.07	2	5.5
3	9	10	9	8	9	9.0	0.71	1	2.0
4	10	10	9	9	10	9.6	0.55	1	2.0
5	8	9	9	9	9	8.8	0.45	2	5.5
6	3	2	6	5	4	4.0	1.58	4	9.0
7	9	9	8	9	9	8.8	0.45	2	5.5
8	7	8	5	8	6	6.8	1.30	3	8.0
9	9	8	8	10	8	8.6	0.89	2	5.5

Stand. dev. of means = 1.7578
Mean of stand. dev.'s = 0.9500

Daytona Beach, FL: 12 Months

SYS	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	10	8	10	9	9	9.2	0.84	2	3.5
2	9	10	9	8	10	9.2	0.84	2	3.5
3	10	9	10	8	9	9.2	0.84	2	3.5
4	10	10	10	10	10	10.0	0.00	1	1.0
5	6	7	9	6	9	7.4	1.52	3	6.5
6	5	4	5	5	5	4.8	0.45	5	9.0
7	9	7	9	7	8	8.0	1.00	3	6.5
8	6	7	7	7	8	7.0	0.71	4	8.0
9	9	9	10	9	10	9.4	0.55	2	3.5

Stand. dev. of means = 1.6333
Mean of stand. dev.'s = 0.7500

Cleveland, OH: 12 Months

SYS	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	10	10	10	10	10	10.0	0.00	1	
2	10	10	10	10	10	10.0	0.00	1	
3	10	10	10	10	10	10.0	0.00	1	
4	10	10	10	9	10	9.8	0.45	1	
5	10	10	10	10	10	10.0	0.00	1	
6	10	10	10	10	10	10.0	0.00	1	
7	10	10	10	10	10	10.0	0.00	1	
8	10	10	10	10	10	10.0	0.00	1	
9	10	10	10	10	10	10.0	0.00	1	

Stand. dev. of means = 0.0677
Mean of stand. dev.'s = 0.0500

N. Kansas City, MO: 12 Months

SYS	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	10	10	10	10	10	10.0	0.00	1	
2	10	10	10	10	10	10.0	0.00	1	
3	10	10	10	10	10	10.0	0.00	1	
4	10	10	10	10	10	10.0	0.00	1	
5	10	10	10	10	10	10.0	0.00	1	
6	10	10	10	10	10	10.0	0.00	1	
7	10	10	10	10	10	10.0	0.00	1	
8	10	10	10	10	10	10.0	0.00	1	
9	10	10	10	10	10	10.0	0.00	1	

Stand. dev. of means = 0.0000
Mean of stand. dev.'s = 0.0000

Miami Beach, FL: 12 Months

SYS	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	10	10	10	10	10	10.0	0.00	1	
2	10	10	9	10	10	9.8	0.45	1	
3	10	10	10	10	10	10.0	0.00	1	
4	10	10	10	10	10	10.0	0.00	1	
5	10	10	10	10	9	9.8	0.45	1	
6	9	10	10	10	10	9.8	0.45	1	
7	10	10	10	10	10	10.0	0.00	1	
8	10	10	10	10	10	10.0	0.00	1	
9	10	10	10	10	10	10.0	0.00	1	

Stand. dev. of means = 0.1000
Mean of stand. dev.'s = 0.15

Portland, OR: 12 Months

SYS	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	10	10	10	10	10	10.0	0.00	1	
2	10	10	10	10	10	10.0	0.00	1	
3	10	10	10	10	10	10.0	0.00	1	
4	10	10	10	10	10	10.0	0.00	1	
5	10	10	10	10	9	9.8	0.45	1	
6	10	10	10	10	10	10.0	0.00	1	
7	10	10	10	10	10	10.0	0.00	1	
8	10	10	10	10	10	10.0	0.00	1	
9	10	10	10	10	10	10.0	0.00	1	

Stand. dev. of means = 0.0667
Mean of stand. dev.'s = 0.0500

San Francisco, CA: 12 Months

SYS	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	10	10	10	10	10	10.0	0.00	1	1.5
2	7	7	9	9	6	7.6	1.34	3	7.0
3	9	9	8	8	9	8.6	0.55	2	4.0
4	9	8	10	9	10	9.2	0.84	1	1.5
5	9	9	8	8	9	8.6	0.55	2	4.0
6	1	1	4	3	2	2.2	1.30	4	9.0
7	9	9	9	9	9	9.0	0.00	2	4.0
8	8	8	8	7	9	8.0	0.71	3	7.0
9	9	7	7	7	9	7.8	1.10	3	7.0

Stand. dev. of means = 2.2608
Mean of stand. dev.'s = 0.7100

Tustin, CA:12 Months

SYS	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	6	5	6	6	6	5.8	0.45	3	7.5
2	7	7	7	7	7	7.0	0.00	2	3.5
3	6	6	6	7	6	6.2	0.45	3	7.5
4	7	7	6	7	8	7.0	0.71	2	3.5
5	7	7	6	6	7	6.6	0.55	2	3.5
6	9	10	10	10	10	9.8	0.45	1	1.0
7	5	7	7	7	6	6.4	0.89	2	3.5
8	7	6	6	5	5	5.8	0.84	3	7.5
9	6	6	6	6	6	6.0	0.00	3	7.5

Stand. dev. of means = 1.2369
Mean of stand. dev.'s = 0.4822

Table 4—Results of Exterior Exposure Testing by ASTM D 714: Degree of Blistering

Ocean City, NJ: 12 Months

SYS	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	10	10	10	8VF	8F	9.2	1.10	1	3.5
2	10	10	10	10	10	10.0	0.00	1	3.5
3	10	10	10	10	10	10.0	0.00	1	3.5
4	10	10	10	10	10	10.0	0.00	1	3.5
5	10	10	6F	10	8F	8.8	1.79	1	3.5
6	8D	8D	8M	8D	8D	8.0	0.00	3	8.5
7	10	10	10	10	10	10.0	0.00	1	3.5
8	8F	8F	8F	8M	8VF	8.0	0.00	3	8.5
9	10	8VF	8VF	8F	10	8.8	1.10	2	7.0

Stand. dev. of means = 0.8485
Mean of stand. dev.'s = 0.4433

Kure Beach, NC: 12 Months

SYS	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	10	10	10	10	10	10.0	0.00	1	4.5
2	10	10	10	10	10	10.0	0.00	1	4.5
3	10	10	10	10	10	10.0	0.00	1	4.5
4	10	10	10	10	10	10.0	0.00	1	4.5
5	10	10	10	10	10	10.0	0.00	1	4.5
6	8D	8D	8D	8D	8D	8.0	0.00	2	9.0
7	10	10	10	10	10	10.0	0.00	1	4.5
8	10	10	10	10	10	10.0	0.00	1	4.5
9	10	10	10	10	10	10.0	0.00	1	4.5

Stand. dev. of means = 0.6667
Mean of stand. dev.'s = 0.0000

Daytona Beach, FL: 12 Months

SYS	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	10	10	10	10	10	10.0	0.00	1	3.5
2	8VF	8VF	8VF	8VF	8VF	8.0	0.00	3	8.5
3	9F	9F	9F	9F	9F	9.0	0.00	2	7.0
4	10	10	10	10	10	10.0	0.00	1	3.5
5	10	10	10	10	10	10.0	0.00	1	3.5
6	8D	8D	7D	8D	8D	7.8	0.45	1	8.5
7	10	10	10	10	10	10.0	0.00	1	3.5
8	10	10	10	10	10	10.0	0.00	1	3.5
9	10	10	10	10	10	10.0	0.00	1	3.5

Stand. dev. of means = 0.9244
Mean of stand. dev.'s = 0.0500

Cleveland, OH: 12 Months

SYS	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	10	10	10	10	10	10.0	0.00	1	
2	10	10	10	10	10	10.0	0.00	1	
3	10	10	10	10	10	10.0	0.00	1	
4	10	10	10	10	10	10.0	0.00	1	
5	10	10	10	10	10	10.0	0.00	1	
6	10	10	10	10	10	10.0	0.00	1	
7	10	10	10	10	10	10.0	0.00	1	
8	10	10	10	10	10	10.0	0.00	1	
9	10	10	10	10	10	10.0	0.00	1	

Stand. dev. of means = 0.0000
Mean of stand. dev.'s = 0.0000

N. Kansas City, MO: 12 Months

SYS	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	10	10	10	10	10	10.0	0.00	1	
2	10	10	10	10	10	10.0	0.00	1	
3	10	10	10	10	10	10.0	0.00	1	
4	10	10	10	10	10	10.0	0.00	1	
5	10	10	10	10	10	10.0	0.00	1	
6	10	10	10	10	10	10.0	0.00	1	
7	10	10	10	10	10	10.0	0.00	1	
8	10	10	10	10	10	10.0	0.00	1	
9	10	10	10	10	10	10.0	0.00	1	

Stand. dev. of means = 0.0000
Mean of stand. dev.'s = 0.0000

Miami Beach, FL: 12 Months

SYS	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	10	10	10	10	10	10.0	0.00	1	
2	10	10	10	10	10	10.0	0.00	1	
3	10	10	10	10	10	10.0	0.00	1	
4	10	10	10	10	10	10.0	0.00	1	
5	10	10	10	10	10	10.0	0.00	1	
6	10	10	10	10	10	10.0	0.00	1	
7	10	10	10	10	10	10.0	0.00	1	
8	10	10	10	10	10	10.0	0.00	1	
9	10	10	10	10	10	10.0	0.00	1	

Stand. dev. of means = 0.0000
Mean of stand. dev.'s = 0.0000

Portland, OR: 12 Months

SYS	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	10	10	10	10	10	10.0	0.00	1	
2	10	10	10	10	10	10.0	0.00	1	
3	10	10	10	10	10	10.0	0.00	1	
4	10	10	10	10	10	10.0	0.00	1	
5	10	10	10	10	10	10.0	0.00	1	
6	10	10	10	10	10	10.0	0.00	1	
7	10	10	10	10	10	10.0	0.00	1	
8	10	10	10	10	10	10.0	0.00	1	
9	10	10	10	10	10	10.0	0.00	1	

Stand. dev. of means = 0.0000
Mean of stand. dev.'s = 0.0000

San Francisco, CA: 12 Months

SYS	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	10	10	10	10	10	10.0	0.00	1	3.0
2	8VF	8VF	8VF	10	6M	8.0	1.41	2	7.0
3	10	10	10	8VF	10	9.6	0.89	1	3.0
4	10	10	10	10	10	10.0	0.00	1	3.0
5	10	10	10	10	10	10.0	0.00	1	3.0
6	8D	8D	8F	8MD	8MD	8.0	0.00	2	7.0
7	10	10	10	10	10	10.0	0.00	1	3.0
8	6F	8F	8F	6F	8F	7.2	1.10	2	7.0
9	8VF	10	8VF	6F	8VF	8.0	1.41	3	9.0

Stand. dev. of means = 1.1508
Mean of stand. dev.'s = 0.5344

Tustin, CA: 12 Months

SYS	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	10	10	10	10	10	10.0	0.00	1	
2	10	10	10	10	10	10.0	0.00	1	
3	10	10	10	10	10	10.0	0.00	1	
4	10	10	10	10	10	10.0	0.00	1	
5	10	10	10	10	10	10.0	0.00	1	
6	10	10	10	10	10	10.0	0.00	1	
7	10	10	10	10	10	10.0	0.00	1	
8	10	10	10	10	10	10.0	0.00	1	
9	10	10	10	10	10	10.0	0.00	1	

Stand. dev. of means = 0.0000
Mean of stand. dev.'s = 0.0000

Table 5—Correlation Table: Exterior Site Versus Exterior Site

	Results of 12 Month Testing—ASTM D 1654: Rust Creepage								
(a)	E1	E2	E3	E4	E5	E6	E7	E8	E9
E1	—	.463	.643	.825	.604	.617	.617	.688	.367
E2		—	.738	.850	.779	.813	.813	.738	.546
E3			—	.488	.779	.813	.813	.800	.571
E4				—	.846	.625	.858	.625	.433
E5					—	.654	.988	.779	.538
E6						—	.733	.771	.738
E7							—	.771	.538
E8								—	.679
E9									—

(a) E1 = Ocean City, NJ.
E2 = Kure Beach, NC.
E3 = Daytona Beach, FL.
E4 = Cleveland, OH.
E5 = N. Kansas City, MO.
E6 = Miami Beach, FL.
E7 = Portland, OR.
E8 = San Francisco, CA.
E9 = Tustin, CA.

RESULTS AND DISCUSSION

Spearman rank correlation coefficients have proven useful in earlier attempts to correlate natural exposures to accelerated weathering.[4,5,18,19] The use of t tests allowed us to assign a rank based on the statistical significance of the mean and standard deviations of our data.

Five replicates for each system at each test site were used in order to give good statistical agreement to the data. While generally true, some test results had outlying numbers which greatly increased the standard deviation. Most texts in statistics caution that a good rule of thumb with outlying data is to include it, unless some other rationale is known for its exclusion. For our data, there were only one or two cases where the result was so obviously different from the other replicates, that the data was excluded. In the cases where this happened, the statistics were calculated with one less sample and resulted in fewer degrees of freedom, but the standard deviation was vastly improved.

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It is important to stress that the test protocol was designed to use coatings which are expected to give results with a wide difference in performance. The purpose of the testing was not to determine which coating system was better than another but to have a broad range of performance results such that ranking and site-to-site comparisons would be meaningful.

The most important data was the ranking of one system versus another from exposure site to exposure site and from accelerated method to accelerated method. This made the choice of coatings systems purely arbitrary.

Compared to six-month exposure data, correlations again appear to be present. These correlations may continue or not, as additional exterior exposure data become available. With this in mind, the following discusses the one-year data.

Exterior Exposures

The standard deviation of the means was again used as a quick determination of how well different sites differentiated the nine systems under consideration. As before, greater differentiation was present at the more severe exposure sites.

The mean of the standard deviations was used to determine the consistency of the results within a system. Smaller numbers would indicate that the panels at a particular site were weathering uniformly within each system. Inspection of individual systems showed this was very much the case for most of the tests investigated.

Gloss Retention (ASTM D 523): Although gloss data were measured before and after accelerated testing, and was measured before our exterior panels were placed on exposure, insufficient change was seen at the six-month investigation to try to correlate this data. At the 12-month evaluation, substantial changes in gloss were present and an attempt was made to correlate this data. The results were somewhat ambiguous and are not presented due to the finding that the data was tainted by the presence of large amounts of dirt, which gave misleading gloss values. In order to track changes in gloss, future analyses will record gloss on a small portion of the panel, which is washed to remove dirt. While this one value is not enough for statistical purposes, failure rates can be monitored. At the completion of this study, when panels are retired from exterior exposure, a complete analysis will be performed.

RUST CREEPAGE (ASTM D 1654): After one-year exterior exposure, rust creepage continues to be the predominant failure mode for most of the corrosive environments. Samples which had substantial levels of creep have progressively worsened. Those with little creepage have finally begun to show more creepage (particularly the northern and mid-continent environments). This has led to some interesting shifts in the correlation tables. *Table* 2 lists the 12-month exposure testing for rust creepage.

SURFACE RUST AND BLISTERING (ASTM D 610 AND ASTM D 714): Surface rust was virtually non-existent at the six-month investigation. After one year, sufficient data is present to attempt correlations. The most surface rust is seen on panels from high corrosive exposure sites. A large amount was also present on the Los Angeles basin panels (Tustin, CA). The results for surface rust are listed in *Table* 3.

Blistering was even less evident than surface rusting at six months and, to date, only minimal amounts were seen in the highly corrosive environments. Even for these four sites, most of the blistering appears to be in the early stages. All of the non-corrosive sites continue to show little or no blistering at 12 months. *Table* 4 contains the results for blistering.

Correlation Data: Exterior Exposures

RUST CREEP TESTING: In our last study, rust creep was the only test which had enough variation to allow correlations to be run. Comparing the exterior site-to-site correlations for six months versus one year, some interesting changes have occurred. Several of the weak correlations have strengthened considerably, and in general, most of the sites show some degree of correlation with each other (*Table* 5).

The mild industrial Florida site (Miami) shows correlations with at least a 90% degree of confidence for all other sites. The Kure Beach site shows excellent correlation regardless of the site, with all correlating at the 90% confidence level except for the Tustin site. The San Francisco site shows similar correlation as the Kure Beach site. The Daytona Beach site does not correlate well with northern sites, except for the Portland site, to which it shows the strongest correlation.

In general, northern exposures tend to correlate best with other northern exposures, dropping off rapidly in significance when compared to southern exposures. The New Jersey site correlates well with all except the Daytona Beach site and the Tustin site. The Cleveland site shows strong correlations for all except the Daytona Beach and the Tustin site. Portland also correlates well with all except the Tustin site.

The poorest degree of correlation appears to be the Tustin site, most likely due to the actual degree of weathering the panels have received at this site. Longer exposure may make this site improve in correlation to the other sites. If the two- and three-year results all continue with this trend, it may be possible to offer a time weighted index for extent of weathering at all our exposure sites.

SURFACE RUSTING: At 12 months, Tustin, CA, with its pitting rust spots and stain, was the only site besides the corrosive environments, which had enough differentiation for correlations to be valid. The type of surface rust at this site, however, is not similar to the type seen at the other sites. As a result, this site shows an inverse degree of correlation to the other sites. The other sites all correlate to each other at a 90% level of confidence (*Table* 6).

Table 6—Correlation Table: Exterior Site Versus Exterior Site

Results of 12 Month Testing—ASTM D 610: Surface Rusting

(a)	E1	E2	E3	E8	E9
E1	—	.825	.871	.642	–.038
E2		—	.871	.879	–.192
E3			—	.646	–.138
E8				—	–.079

(a) E1 = Ocean City, NJ.
E2 = Kure Beach, NC.
E3 = Daytona Beach, FL.
E4 = Cleveland, OH.
E5 = N. Kansas City, MO.
E6 = Miami Beach, FL.
E7 = Portland, OR.
E8 = San Francisco, CA.
E9 = Tustin, CA.

DEGREE OF BLISTERING: Only the east coast corrosive environments and the Golden Gate bridge exposures have shown enough differentiation, i.e., blister formation, to allow site-to-site correlations. Site-to-site correlations for these areas show that most of the correlations rely on similar coatings systems showing similar types and amounts of blistering. Amongst these sites, only the Ocean City to Daytona Beach correlation and the Golden Gate Bridge–Daytona Beach correlation do not correlate at a 90% confidence level (*Table* 7).

Correlation Data: Accelerated Testing

RUST CREEPAGE: *Table* 8 is reproduced from the six-month study and contains the results of accelerated testing as measured according to ASTM D 1654. This table was also used in correlations to exterior exposures for the six-month study.

SURFACE RUSTING AND BLISTERING: *Tables* 9 and 10 list the results for surface rusting and blistering from the accelerated testing run for the six-month study. It should be noted that there was very little surface rusting on the cyclic salt fog, Prohesion, cyclic Prohesion/weathering ,and KTA-Envirotest panels. The standard salt fog testing (ASTM B 117) was the only accelerated test which showed any degree of differentiation of results when evaluated for surface rusting.

Table 7—Correlation Table: Exterior Site Versus Exterior Site

Results of 12 Month Testing—ASTM D 714: Blistering

(a)	E1	E2	E3	E8
E1	—	.763	.379	.838
E2		—	.763	.600
E3			—	.467

No other sites with blistering.

(a) E1 = Ocean City, NJ.
E2 = Kure Beach, NC.
E3 = Daytona Beach, FL.
E4 = Cleveland, OH.
E5 = N. Kansas City, MO.
E6 = Miami Beach, FL.
E7 = Portland, OR.
E8 = San Francisco, CA.
E9 = Tustin, CA.

Table 8—Results of Accelerated Testing for ASTM 1654: Rust Creep

Salt Fog: 5% NaCl - 1258 hr

System #	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	8	7	8	8	8	7.8	0.4472	3	6.5
2	9	9	8	8	6	8.0	1.2274	2	4.0
3	9	10	9	9	10	9.4	0.5477	1	1.5
4	9	9	9	9	9	9.0	0.0000	1	1.5
5	8	9	9	9	8	8.6	0.5477	2	4.0
6	7	6	7	4	7	6.2	1.3038	4	8.0
7	7	9	5	5	9	7.0	2.0000	3	6.5
8	8	8	9	8	7	8.0	0.7071	2	4.0
9	5	5	5	5	5	5.0	0.0000	5	9.0
Stand. dev. of means =							1.3964		
Mean of stand. dev's =							0.7534		

Cyclic Salt Fog: 5% NaCl - 1834 hr

System #	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	8	9	8	4	9	7.6	2.0736	1	3.0
2	6	5	8	9	9	7.4	1.8166	1	3.0
3	9	9	9	8	2[a]	8.75	0.5000	1	3.0
4	9	9	9	9	9	9.0	0.0000	1	3.0
5	9	9	9	9	9	9.0	0.0000	1	3.0
6	3	4	4	4	4	3.8	0.4472	4	9.0
7	8	8	7	7	8	7.8	0.5477	2	6.5
8	6	8	8	5	5	6.4	1.5166	2	6.5
9	4	4	5	5	5	4.6	0.5477	3	8.0
Stand. dev. of means =						1.8835			
Mean of stand. dev's =							0.8277		

Prohesion Cabinet - 1176 hr

System #	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	3	3	3	3	2	2.8	0.4472	5	9.0
2	4	4	4	4	4	4.0	0.0000	3	5.5
3	6	7	3	6	6	5.6	1.5166	1	1.5
4	6	5	5	4	6	5.2	0.8367	2	3.0
5	4	4	5	4	5	4.4	0.5477	3	5.5
6	4	5	5	4	4	4.4	0.5477	3	5.5
7	4	4	4	5	4	4.2	0.4472	3	5.5
8	4	7	7	6	6	6.0	1.2247	1	1.5
9	4	3	4	4	4	3.8	0.4472	4	8.0
Stand. dev. of means =							0.9804		
Mean of stand. dev's =							0.6683		

Cyclic Prohesion Cabinet - 2000 hr

System #	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	6	6	6	7	6	6.2	0.4472	3	8.0
2	8	4	6	7	5	6.0	1.5811	2	4.5
3	9	5	4	6	7	6.2	1.9235	2	4.5
4	7	8	5	6	6	6.4	1.1402	2	4.5
5	3	5	5	6	5	4.8	1.0954	4	9.0
6	8	6	7	4	5	6.0	1.5811	2	4.5
7	10	7	10	8	10	9.0	1.4142	1	1.0
8	7	6	8	8	8	7.4	0.8944	2	4.5
9	8	5	8	8	6	7.0	1.4142	2	4.5
Stand. dev. of means =							1.1652		
Mean of stand. dev's =							1.2768		

KTA-Tator Envirotest - 2000 hr

System #	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	6	6	7	4	5	5.6	1.1402	2	6.0
2	6	7	5	7	6	6.2	0.8367	2	6.0
3	6	5	8	7	6	6.4	1.1402	1	1.5
4	7	6	6	6	7	6.4	0.5477	2	6.0
5	7	7	6	6	6	6.4	0.5477	2	6.0
6	6	6	6	6	6	6.0	0.0000	2	6.0
7	7	7	6	7	6	6.6	0.5477	2	6.0
8	6	6	7	7	7	6.6	0.5477	2	6.0
9	7	7	7	8	7	7.2	0.4472	1	1.5
Stand. dev. of means =						0.4410			
Mean of stand. dev's =							0.6395		

(a) Value for panel #5 omitted from calculation of mean and standard deviation.

Table 9—Results of Testing for ASTM D 610: Degree of Surface Rust

Salt Fog: 5% NaCl - 1258 hr

System #	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	4	5	4	2	4	3.8	1.10	5	9.0
2	8	6	9	6	8	7.4	1.34	3	5.0
3	10	10	10	9	10	9.8	0.45	1	1.5
4	8	8	9	9	9	8.6	0.55	3	5.0
5	10	10	9	10	9	9.6	0.55	1	1.5
6	7	7	7	7	8	7.2	0.45	4	7.5
7	7	7	1[a]	5	6	6.3	0.96	4	7.5
8	9	8	9	8	7	8.2	0.84	3	5.0
9	9	9	9	10	9	9.2	0.45	2	3.0

Stand. dev. of means = 1.8963
Mean of stand. dev's = 0.7409

Cyclic Salt Fog: 5% NaCl - 1834 hr

System #	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	10	9	9	9	9	9.2	0.45	2.	5.0
2	6	9	8	9	9	8.2	1.30	2	5.0
3	10	9	10	10	10	9.8	0.45	1	2.0
4	8	8	9	9	8	8.4	0.55	3	7.5
5	8	10	9	9	10	9.2	0.84	1	2.0
6	8	7	8	8	8	7.8	0.45	4	9.0
7	8	10	9	9	8	8.8	0.84	2	5.0
8	8	9	8	9	8	8.4	0.55	3	7.5
9	10	10	8	9	9	9.2	0.84	1	2.0

Stand. dev. of means = 0.6280
Mean of stand. dev's = 0.6945

Prohesion Cabinet - 1176 hr

System #	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	10	9	8	10	9	9.2	0.84	2	4.0
2	9	10	10	10	8	9.4	0.89	1	1.5
3	10	10	10	10	10	10.0	0.00	1	1.5
4	10	8	9	8	8	8.6	0.89	2	4.0
5	8	7	7	8	9	7.8	0.84	3	7.0
6	4	6	7	7	7	6.2	1.30	4	9.0
7	10	6	6	6	8	7.2	1.79	3	7.0
8	9	8	7	7	9	8.0	1.00	3	7.0
9	9	9	9	9	9	9.0	0.00	2	4.0

Stand. dev. of means = 1.1935
Mean of stand. dev's = 0.8394

Cyclic Prohesion Cabinet - 2000 hr

System #	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	10	10	10	10	10	10.0	0.00	1	4.0
2	9	8	9	9	9	8.8	0.45	2	8.5
3	10	10	9	10	10	9.8	0.45	1	4.0
4	10	10	10	9	10	9.8	0.45	1	4.0
5	10	10	10	10	9	9.8	0.45	1	4.0
6	10	7	8	6	9	8.0	1.58	2	8.5
7	10	10	10	10	10	10.0	0.00	1	4.0
8	10	9	10	10	9	9.6	0.55	1	4.0
9	10	10	10	10	10	10.0	0.00	1	4.0

Stand. dev. of means = 0.6856
Mean of stand. dev's = 0.4353

KTA-Tator Envirotest - 2000 hr

System #	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	10	6	10	10	10	9.2	1.79	1	4.5
2	10	10	10	10	10	10.0	0.00	1	4.5
3	10	10	10	9	10	9.8	0.45	1	4.5
4	10	10	10	10	10	10.0	0.00	1	4.5
5	9	9	10	10	10	9.6	0.55	1	4.5
6	9	9	8	8	9	8.6	0.55	2	9.0
7	9	10	9	10	10	9.6	0.55	1	4.5
8	10	10	10	10	9	9.8	0.45	1	4.5
9	10	10	10	10	10	10.0	0.00	1	4.5

Stand. dev. of means = 0.4631
Mean of stand. dev's = 0.4807

(a) Value for panel #3 omitted from calculation of mean and standard Deviation

Table 10—Results of Testing for ASTM D 714: Degree of Blistering

Salt Fog: 5% NaCl - 1258 hr

System #	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	2D	2D	2D	2D	2D	2.0D	0.00	3	8.5
2	8F	4M	8F	4M	8F	6.4F	2.19	1	2.5
3	6F	6F	6F	6F	6F	6.0F	0.00	2	6.0
4	8F	8F	8F	10	6F	8.0F	1.41	1	2.5
5	8F	6F	6F	6F	6M	6.4	0.89	2	6.0
6	6M	6F	6M	4M	6M	5.6M	0.89	2	6.0
7	2D	2D	2D	2D	4F	2.4D	0.89	3	8.5
8	8F	4M	8F	8F	4F	6.4F	2.19	1	2.5
9	8F	8F	8F	8F	6F	7.6F	0.89	1	2.5

Stand. dev. of means = 2.0923
Mean of stand. dev's = 1.0415

Cyclic Salt Fog: 5% NaCl - 1834 hr

System #	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	8F	8F	2F	8F	6F	6.4F	2.61	1	4.5
2	6M	8F	8F	8F	6F	7.2F	1.10	1	4.5
3	8F	6F	8F	8F	8F	7.6F	0.89	1	4.5
4	8F	8F	8F	8F	8F	8.0F	0.00	1	4.5
5	8F	8F	8F	8F	8F	8.0F	0.00	1	4.5
6	6F	6F	6F	6F	6F	6.0F	0.00	2	9.0
7	8F	8M	8M	8F	8M	8.0M	0.00	1	4.5
8	8F	8F	6F	6F	8F	7.2F	1.10	1	4.5
9	8F	8F	8F	8F	8F	8.0F	0.00	1	4.5

Stand. dev. of means = 0.7513
Mean of stand. dev's = 0.6325

Prohesion Cabinet - 1176 hr

System #	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	10	10	10	10	10	10.0	0.00	1	5.0
2	10	10	10	10	10	10.0	0.00	1	5.0
3	10	10	10	10	10	10.0	0.00	1	5.0
4	10	10	10	10	10	10.0	0.00	1	5.0
5	10	10	10	10	10	10.0	0.00	1	5.0
6	10	10	10	10	10	10.0	0.00	1	5.0
7	10	10	10	10	10	10.0	0.00	1	5.0
8	10	10	10	10	10	10.0	0.00	1	5.0
9	10	10	10	10	10	10.0	0.00	1	5.0

Stand. dev. of means = 0.0000
Mean of stand. dev's = 0.0000

Cyclic Prohesion Cabinet - 2000 hr

System #	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	10	10	10	10	10	10.0	0.00	1	4.5
2	10	10	10	10	10	10.0	0.00	1	4.5
3	10	10	10	10	10	10.0	0.00	1	4.5
4	10	10	10	10	10	10.0	0.00	1	4.5
5	10	10	10	10	10	10.0	0.00	1	4.5
6	10	8MD	8F	8M	10	8.8M	1.10	2	9.0
7	10	10	10	10	10	10.0	0.00	1	4.5
8	10	10	10	10	10	10.0	0.00	1	4.5
9	10	10	10	10	10	10.0	0.00	1	4.5

Stand. dev. of means = 0.4000
Mean of stand. dev's = 0.1217

KTA-Tator Envirotest - 2000 hr

System #	1	2	3	4	5	Mean	S/D	Rank tau	Rank rho
1	10	10	10	10	10	10.0	0.00	1	5.0
2	10	10	10	10	10	10.0	0.00	1	5.0
3	10	10	10	10	10	10.0	0.00	1	5.0
4	10	10	10	10	10	10.0	0.00	1	5.0
5	10	10	10	10	10	10.0	0.00	1	5.0
6	10	10	10	10	10	10.0	0.00	1	5.0
7	10	10	10	10	10	10.0	0.00	1	5.0
8	10	10	10	10	10	10.0	0.00	1	5.0
9	10	10	10	10	10	10.0	0.00	1	5.0

Stand. dev. of means = 0.0000
Mean of stand. dev's = 0.0000

Table 11—Correlation Table: Exterior Sites Versus Accelerated Testing

Results of 12 Month Testing—ASTM D1654: Rust Creepage

Instrument	Exterior Sites[a] E1	E2	E3	E4	E5	E6	E7	E8	E9
Salt fog ASTM B-117	-0.588	-0.271	0.075	-0.350	-0.058	0.042	-0.008	-0.304	-0.092
Cyclic salt fog	-0.513	-0.142	0.033	-0.221	-0.075	0.204	-0.013	-0.100	0.375
Prohesion cabinet	-0.342	-0.158	0.029	-0.088	0.088	-0.138	0.129	-0.200	-0.417
Prohesion/QUV	0.550	0.550	0.375	0.638	0.663	0.329	0.629	0.625	0.308
KTA-Envirotest	.0.150	0.271	0.171	0.146	0.175	0.188	0.188	0.200	0.288

(a) Key to exterior sites:
E1 = Ocean City, NJ. E6 = Miami Beach, FL.
E2 = Kure Beach, NC. E7 = Portland, OR.
E3 = Daytona Beach, FL. E8 = San Francisco, CA.
E4 = Cleveland, OH. E9 = Tustin, CA.
E5 = N. Kansas City, MO.

Table 12—Correlation Results: 6 Months Versus 1 Year

Prohesion/Weathering Cycle vs Exterior Exposure Rust Creep Testing (ASTM D 1654)

Spearman Rank Correlation Coefficients (p)

Exposure Site	6 Months	1 Year
Ocean City, NJ	0.710	0.550
Kure Beach, NC	0.592	0.550
Daytona Beach, FL	0.608	0.375
Cleveland, OH	0.567	0.638
N. Kansas City, MO	0.646	0.663
Miami Beach, FL	-0.175	0.329
Portland, OR	0.604	0.629
San Francisco, CA	0.250	0.625
Tustin, CA	0.329	0.308

Salt fog and cyclic salt fog were the only accelerated tests which showed any blistering. It has been a contention that blistering is one of the unnatural modes of failure in standard salt fog testing. In the accelerated test study, most of these blisters were no longer present when the panels were photographed, indicating they were mostly fluid filled and receded on drying. The cyclic Prohesion/weathering test did have one series of panels with some small hard rust blisters which are more typical of corrosive environments.

Correlation of Exterior Exposures with Accelerated Tests

RUST CREEPAGE: *Table* 11 is a correlation of rust creepage for accelerated testing versus exterior exposure. *Table* 12 compares the correlation factors for each exterior site compared to Prohesion/QUV accelerated testing at the different time intervals studied. Correlations seen in the six-month data between cyclic Prohesion/QUV, and several sites do not appear to be getting stronger. The only site which showed correlation at six months and has larger correlation coefficients after one year, is the Portland site, and although the North Kansas City site continues to correlate, the strength of that correlation has weakened.

One favorable result is that several sites which did not correlate with cyclic Prohesion/QUV after six months, now do. At the six-month evaluation, it was obvious that the major reason for lack of correlation was primarily the absence of sufficient degradation to differentiate the coatings. The additional six months exposure helped differentiate the coatings to the point that correlations could be made.

After 12 months, no other accelerated test shows correlation as strong as the cycled Prohesion/QUV. However, the correlation between the Ocean City site and standard salt fog did strengthen considerably. This will be monitored closely after two years of exposure to determine if

Table 13—Correlation Table: Exterior Sites Versus Accelerated Testing

Results of 12 Month Testing—ASTM D 610: Surface Rusting

Instrument	Exterior Sites[a] E1	E2	E3	E4	E5	E6	E7	E8	E9
Salt fog ASTM B-117	-0.300	0.200	0.250	—	—	—	—	0.004	0.071
Cyclic salt fog	0.546	0.546	0.383	—	—	—	—	0.363	-0.263
Prohesion cabinet	0.825	0.850	0.842	—	—	—	—	0.367	-0.179
Prohesion/QUV	0.571	0.708	0.438	—	—	—	—	0.725	-0.038
KTA-Envirotest	0.796	0.708	0.696	—	—	—	—	0.688	0.133

(a) Key to exterior sites:
E1 = Ocean City, NJ. E6 = Miami Beach, FL.
E2 = Kure Beach, NC. E7 = Portland, OR.
E3 = Daytona Beach, FL. E8 = San Francisco, CA.
E4 = Cleveland, OH. E9 = Tustin, CA.
E5 = N. Kansas City, MO.

Table 14—Correlation Table: Exterior Sites Versus Accelerated Testing

	Results of 12 Month Testing—ASTM D 714: Blistering								
	Exterior Sites[a]								
Instrument	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**	**E8**	**E9**
Salt fog ASTM B-117	-0.058	0.488	0.146	—	—	—	—	-0.346	—
Cyclic salt fog	0.763	1.000	0.713	—	—	—	—	0.600	—
Prohesion cabinet	0.650	0.850	0.650	—	—	—	—	0.600	—
Prohesion/QUV	0.763	1.000	0.763	—	—	—	—	0.600	—
KTA-Envirotest	0.763	1.000	0.713	—	—	—	—	0.600	—

(a) Key to exterior sites:

E1 = Ocean City, NJ.
E2 = Kure Beach, NC.
E3 = Daytona Beach, FL.
E4 = Cleveland, OH; Panels are not differentiated enough to report.
E5 = N. Kansas City, MO; Panels are not differentiated enough to report.
E6 = Miami Beach, FL; Panels are not differentiated enough to report.
E7 = Portland, OR; Panels are not differentiated enough to report.
E8 = San Francisco, CA.
E9 = Tustin, CA; Panels are not differentiated enough to report.

this correlation continues to strengthen to the point of significance.

SURFACE RUST AND BLISTERING: Now that some exterior results are more pronounced, the accelerated test data can be analyzed for correlation. *Tables* 13 and 14 show correlations for surface rust and blistering, respectively, between accelerated and exterior exposure series. Although substantial correlations appear to be present, the results are actually an indictment of the unnatural conditions found in high salt concentration electrolytes. The panels, which correlate the best to those from accelerated tests, are those which show the least amount of surface rust and blistering.

SUMMARY

The Cleveland Technical Committee has undertaken a long-term project to investigate several accelerated methods, including some shown to provide better correlation to exterior corrosive sites. Through the use of currently compliant and high-solids coatings systems, a rank order is being established for each system. This will allow us to continue to monitor site-to-site and instrument to instrument correlations. Site-to-instrument correlations appear to be present for several of the tests. Using this information will allow researchers to shorten the development time between conception to introduction of coatings systems.

Five accelerated methods have been investigated, including salt fog, cyclic salt fog, Prohesion, cyclic Prohesion/weathering, and immersion/weathering, and compared to nine exterior exposure sites. To determine statistically significant orders of rank, the test results were analyzed using a "t" statistic and ranked from best to worst at a 95% confidence level for statistically significant differences. These rankings were then converted to a suitable Spearman ranking and the Spearman coefficient, rho, was calculated and tabulated for site-to-site and site-to-accelerated test method comparisons. Values greater than the critical value for rho (0.600 at the 90% confidence level) were considered to show correlation.

The nine coating systems tested in accelerated tests were also placed on exterior exposure at nine different sites across the United States. Those panels were rated at six months and 12 months for gloss retention, rust creepage, surface rust, and blistering. The results of this testing were also subjected to statistical methods and correlation coefficients calculated to determine the presence of site-to-site correlations. These did exist at the six-month and 12-month intervals for several sites.

At 12 months, instrument-to-site correlations have strengthened from some sites, but weakened for others compared to the six-month data. This trend may indicate that as a certain level of weathering is achieved, correlations are maximized. As weathering continues, these correlations weaken. Stronger irradiance may be necessary to correlate results to longer time scales. The use of either EMMAQUA type testers (which concentrate natural sunlight) or with higher irradiance UV light sources which duplicate the sun's energy output (higher intensity UVA 340 bulbs) may be necessary. Both areas will be pursued in the future.

The gloss results need to be monitored for additional exposure data. However, the results to date may also indicate that insufficient irradiance was received to differentiate the systems investigated. The use of gloss retention as a means to rank coatings may also be suspect. It is possible that comparisons are only valid for similar systems, for example, comparing chemically equivalent latex systems, or similar epoxy/polyamide coatings, etc. Additional exposure time may shed some light on this question.

Future accelerated work will also investigate the practice of using aged panels for these tests (stored in a neutral non-weathering environment) versus fresher yet fully cured specimens. The belief is that an under cured sample will show less correlation than one stored for several months, but unexposed to harsh environments.

As exposure data is made available, correlations will be updated and reported.

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Synthesis, Characterization, and Application of Lesquerella Oil and Its Derivative in Water-Reducible Coatings

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Lesquerella oil (LO), a domestically produced vegetable oil of hydroxy fatty acid composition, has been used as a raw material for the synthesis of novel, water-reducible polyester coatings. The properties of these and castor oil derived polymers have been compared. Accordingly, polyesters of acid values approaching 50 were synthesized from LO, dehydrated lesquerella oil (DLO), castor oil (CO), and dehydrated castor oil (DCO). Aqueous solutions of the polyesters were prepared and used as ingredients in the formulation of industrial melamine-polyester baked coatings and air-dry polyester coatings. They were applied, cured, and their properties evaluated. The LO and CO derived coatings were comparable in pencil hardness, adhesion, gloss, and gloss retention properties. However, coatings from LO were superior in flexibility and ultraviolet stability.

INTRODUCTION

Castor oil (CO) and its ricinoleic acid derivatives are widely used for the manufacture of lubricants, plastics, coatings, and pharmaceutical supplies.[1] The annual consumption by U.S. industries is nearly 90 million pounds or nearly one-seventh of the total world export of castor oil. All CO consumed by the U.S. is imported and its price is generally higher than common domestic vegetable oils. Therefore, there is sufficient reason to consider dependable domestic alternatives that can deliver cost and/or performance comparable to those provided by CO.

The relatively high concentration of hydroxy fatty acids in the seed oils of *Lesquerella* makes it an attractive candidate for a castor oil replacement.[2] The seed of *L. fendleri*, the species under breeding and agronomic development in Phoenix, AZ, contains in excess of 25% oil by weight of which approximately 55% is lesquerolic (14-hydroxy-11-eicosenoic) acid, the C_{20} homologue of ricinoleic acid.[2] Thus, this higher carbon content fatty acid is an ideal reactant for polymer synthesis and modification to a value-added, industrial raw material.[3]

Accordingly, our study focuses on the commercialization of lesquerella oil (LO) as a raw material for novel surface coating products. Initial efforts resulted in the synthesis of dehydrated lesquerella oil (DLO) which we have found to be a good drying oil. The polyesters from LO provided attractive coatings demonstrating comparable pencil hardness, gloss, and gloss retention properties, but the flexibility was superior to CO counterparts. In summary, we have prepared and tested novel water-reducible LO derived polyesters as candidate industrial coatings.

EXPERIMENTAL

Materials

Lesquerella oil (refined *Lesquerella fendleri*) was purchased from International Flora Technology, Ltd. Sodium bisulfate, phthalic anhydride (PA), maleic anhydride (MA), trimethyolpropane (TMP), pentaerythritol (PE), diethanolmethylamine (DEMA), 2-butoxyethanol (BE), and xylenes were purchased from Aldrich Chemical Company. Ammonium hydroxide was purchased from Fisher Chemical Company. The esterification catalyst, lithium ricinoleate, was purchased from Pfaltz & Bauer. Dehydrated castor oil was supplied by Welch, Holme & Clark Company. Resimene 747, a melamine crosslinking agent, was supplied by Monsanto Chemical Company. The driers, 5% cobalt Hydro-Cure II, 12% zirconium Hydro-Cure, and 5% calcium Hydro-Cure were supplied by Mooney Chemicals. Nacure 155 (dinonylnaphthalene disulfonic acid) was supplied by King Industries. All chemicals were used as received.

Preparation of Dehydrated Lesquerella Oil

In a 500 mL four-necked, round-bottom flask equipped with a nitrogen inlet, mechanical stirrer, and thermometer

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was charged 300 g (0.31 mol) LO and 3 g (0.025 mol) sodium bisulfate. The flask contents were heated to 240°C and was held at this temperature for 90 min to complete the dehydration process. Filtration was affected to remove residual solids, and the acid value, iodine value, and hydroxyl value were determined to be 3.68 mg KOH/g, 146 g of I_2/100 g, and 6.9 mg KOH/g of oil, respectively.

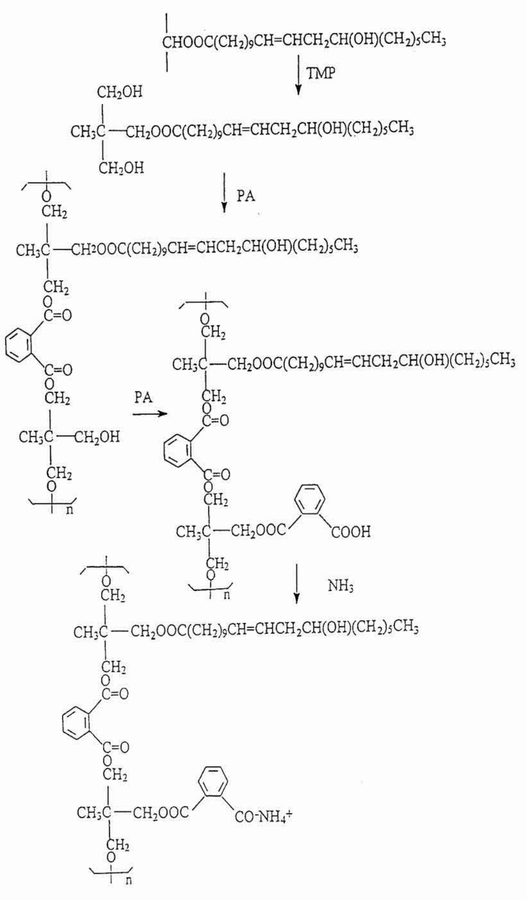
Preparation of Polyester Resins

Two polyester types were synthesized, short-oil polyesters (36% oil length), and long-oil polyesters (56% oil length). In the former case, both LO and CO polyesters were prepared for heat cure melamine-polyester coatings. Similarly, the latter long-oil polyesters utilized DLO and DCO for the chemical reactivity required of polyesters designed for air-dried coatings. The formulations and properties of the polyesters are presented in *Table* 1. The water-reducible polyesters were prepared in two steps (*Scheme* 1). The conventional, solvent-borne polyesters were first synthesized by the monoglyceride process. Subsequently, they were reacted with PA or MA in order to graft hydrophilic carboxylic acid groups into the polymer structure. Neutralization of the acid functionalities was effected with a volatile amine (*Scheme* 1)[4] and gave water-reducible polymers.

Table 1—Properties of Water-Reducible Polyesters

	WPC36[c]	WPL36[d]	WPDC56[e]	WPDL56[f]
Oil type	CO	LO	DCO	DLO
Oil, g	60.00	60.00	90.00	90.00
Trimethylol propane	51.57	51.57	15.02	15.02
Pentaerythritol, g	—	—	15.25	15.25
Phthalic anhydride, g	62.73	62.73	46.04	46.04
Alkyd constant	1.02	1.02	1.01	1.01
AH type[a]	PA	PA	MA	MA
AH, g	20.06	20.06	12.64	12.64
Non volatiles, %	98.56	98.87	97.52	93.50
Acid value, mg KOH/g	50	52	52	51
Gardner color grade	7	9	9	11
η,[b] cps	1100	450	334	240

(a) Anhydride used to graft extra acid groups to the polyester.
(b) Viscosity of 60% polyester solution in xylenes.
(c) Castor oil based melamine-polyester coating.
(d) Lesquerella oil based melamine-polyester coating.
(e) Dehydrated castor oil based air-drying polyester coating.
(f) Dehydrated lesquerella oil based air-drying polyester coating.



Scheme 1—Synthesis of water-reducible polyester.

Polyester Characterization

Acid values were determined according to ASTM D 1639. Viscosities were measured with a Brookfield viscometer, model DV-II at 3 rpm with 60% solids in xylenes at 23°C.

Formulation of Melamine-Polyester Coatings

The LO and CO based short-oil polyesters, WPL36 and WPC36 respectively, and the methylated melamine resin, Resimene 747, were used to formulate melamine-polyester heat cured coatings. The formulations are described in *Table* 2. The polyesters were dissolved in BE to an 80% (w/w) solution. After neutralization with DEMA, dissolution in water was affected (pH=8.3). The remaining reagents were added to the clear solution and agitated with a high-speed mixer. No pigments were employed, and the coatings were evaluated as clear films. Four mil (100 μ) wet films were applied with a draw-down bar onto iron phosphated test panels (type R). The films were heat cured at 170°C for 15 min and equilibrated at ambient for seven days before testing.

Formulation of Air-Dry Polyester Primers

Air-dry polyesters were formulated with DLO and DCO polyester resins, WPDL56 and WPDC56, respectively. The formulation techniques were similar for each ester. For instance, a polyester was dissolved in BE to form a 70% (w/w) solids solution after which 28% ammonium hydroxide solution neutralized the acid groups to pH 8.3. Metal driers were added to accelerate oxidative polymerization. The remaining ingredients were added and agitated with a high-speed mixer (*Table* 2). No pigments were employed, and the coatings were evaluated as clear films. Four mil (100 μ) wet films were applied onto iron phosphated test panels (type R) and were tested after seven days at ambient.

Table 2—Formation of Water Reducible Coatings

	WPC36[f]	WPL36[g]	WPDC56[h]	WPDL56[i]
Polyester, g	53.43	50.05	67.65	67.15
Xylenes, g	0.78	0.57	4.70	4.67
Butoxyethanol, g	12.58	11.94	24.29	24.11
Diethanolmethylamine, g	4.30	4.02	—	—
28% Ammonia, g	—	—	3.81	3.71
Melamine,[a] g	13.64	12.67	—	—
Nacure 155, g	0.75	0.67	—	—
Water, g	48.13	45.06	78.02	71.20
Cobalt drier,[b] g	—	—	1.08	1.07
Zirconium drier,[c] g	—	—	0.84	0.83
Calcium drier,[d] g	—	—	3.38	3.36
pH	8.3	8.3	8.3	8.3
Viscosity,[e] s	68.0	58.0	70.0	68.0
Dry-through time, h	—	—	4.0	3.5
Solids, %	51	51	38	39
VOC, g/L	226	226	326	326

(a) Resimene 747.
(b) 5% Cobalt Hydro-Cure II.
(c) 12% Zirconium Hydro-Cure.
(d) 5% Calcium Hydro-Cure.
(e) Recorded by EZ™ Equivalent "ZAHN" Viscosity Cup #4.
(f) Castor oil-based melamine-polyester coating.
(g) Lesquerella oil-based melamine-polyester coating.
(h) Dehydrated castor oil-based air-dry polyester coating.
(i) Dehydrated lesquerella oil-based air-dry polyester coating.

Coating Characterization

Drying times of air-dry polyester coatings were determined on 3 mil (75 μ) wet films by a Gardner circular drying time recorder. Pencil hardness tests were performed with a Gardco pencil scratch hardness kit according to ASTM D 3363. Adhesion was determined by the cross-hatch tape test, ASTM D 3359. Impact tests were measured with a BYK-Gardner heavy duty impact tester, model #IG-1120, with 1.8 Kg (4 lb) mass and 1.27 cm (0.5 in.) diameter round nose punch. The conical mandrel flexibility was performed according to ASTM D 522. Yellowness indexes were measured by Applied Color System CS-5 chroma-sensor. Ultraviolet (UV) resistance was determined by exposing the coating films in Atlas ultra-violet/condensation screening device equipped with F40 UVB lamps under procedure B specified by ASTM D 4587. Specular gloss was measured by Gardco statistical novoglass. Salt spray testing (ASTM B 117) was performed at 34°C using 5% NaCl in D.I. water solution via a salt spray chamber. Dry film thicknesses were measured by a Gardco mini-test 4000 microprocessor coating thickness gauge.

Glass transition temperature (T_g) measurements were performed with a Mettler DSC 30 differential scanning calorimeter (DSC). An indium metal standard was used to calculate the temperature correction factor. Correction factors were used in the software for all samples. Samples were encapsulated in standard 150 μm aluminum DSC pans and heated from −50° to 300°C under a nitrogen atmosphere at 10°C/min. The T_gs were calculated using the alternate T_g method of Mettler Graphware version 7.1. This method defines the midpoint of the total change in the heat capacity at the T_g.

Infrared (IR) specular reflectance data were collected before and after 500 hr UV exposure test with a Bio-Rad FTS-25 spectrometer resolved to 4 cm^{-1}.

RESULTS AND DISCUSSION

Properties of the polyesters are presented in *Table* 1. The polyesters of LO and CO were designed with similar alkyd constants and acid values. However, the polyesters differed in color grades and viscosities (*Table* 1). For instance, the polyesters of LO and DLO are higher in Gardner color grade, and lower in solution viscosity than their CO counterparts. The darker color is attributed to the higher Gardner color grades of the starting materials, LO and DLO, i.e., 8 and 11, respectively, as contrasted to those for CO and DCO, i.e., 5 and 6, respectively.

Viscosity variations, on the other hand, are likely associated with structural differences of the oils. For instance, LO is composed of approximately 55% lesquerolic acid, while ricinoleic acid makes up 90% of CO. The higher concentration of ricinoleic acid by weight of CO allows extensive hydroxyl hydrogen bonding potential, and consequently higher viscosity.[5] Moreover, LO polyesters may be more effectively "plasticized" by the longer C_{20} fatty acid groups thereby lowering viscosity.

Coating formulations are tendered in *Table* 2. Reagents included BE as co-solvent, DEMA, and ammonium hydroxide for pH adjustments to 8.3.[4]

The curing process of water-reducible, melamine-polyester coatings is complex.[6] For instance, in addition to the traditional crosslinking reactions, e.g., the reaction between hydroxyl (–OH) of polyester resin and methylol ($-NCH_2OH$) of melamine resin, waterborne polymers offer additional crosslinking sites via the carboxyl group (–COOH), i.e., the melamine $-NCH_2OH$ moiety can crosslink with the polyester –COOH groups. Moreover, this latter reaction requires higher curing temperatures than the $-NCH_2OH$ and –OH reaction.[6] In order to determine the appropriate curing profile, the WPL36 melamine-polyester coating was cured at temperatures ranging from 150° to 180°C with variations in cure time of 10 to 20 min. The resulting films were studied via DSC for T_g determinations (*Figure* 1). Films cured at 150°C displayed no major change in T_g when the baking time was increased from 10 to 20 min (167.8° to 168.1°C). When curing was affected at 180°C for 10 min, a final T_g of 175.2°C was

Table 3—Properties of Water-Reducible Coatings

	WPC36[a]	WPL36[b]	WPDC56[c]	WPDL56[d]
Thickness, (μm)	12.77	12.77	12.77	12.77
Crosshatch tape adhesion, D 3359	5B	5B	5B	5B
Pencil hardness, D 3363, scatch/gouge	HB/8H	HB/8H	2B/F	2B/F
Impact resistance, D 2794, direct/reverse, J	18.1/15.8	18.1/18.1	18.1/18.1	18.1/18.1
Conical mandrel, D 522, (0.125 cm)	Pass	Pass	Pass	Pass
MEK double rub resistance	> 400	> 400	10	8
Yellowness index, D 4587	9.00	11.15	6.81	7.91
Gloss (20°), B 523	63	62	85	86
Gloss retention, %	94	97	71	69
Salt fog, B 117	300 hr	300 hr	100hr	100hr
Scribe creep, mm	1	1	< 1	< 1
Scribe blister	No. 2, medium	No. 2, medium	No. 8, medium	No. 8, dense
Surface blister	No. 8, few	No. 8, few	No. 8, medium	No. 8, dense

(a) Castor oil-based melamine-polyester coating.
(b) Lesquerella oil-based melamine-polyester coating.
(c) Dehydrated castor oil-based air-drying polyester coating.
(d) Dehydrated lesquerella oil-based air-drying polyester coating.

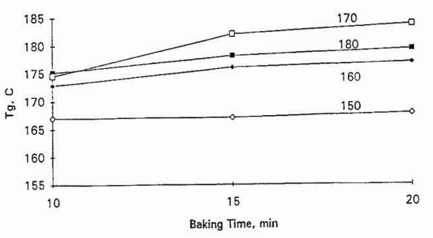


Figure 1—T_g versus baking time for lesquerella oil-based melamine-polyester coatings (WPL36), at different temperatures.

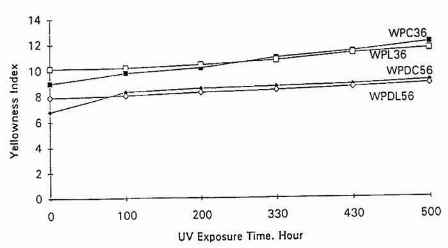


Figure 2—Yellowness index of coating films versus UV exposure time.
WPL36 = Lesquerella oil-based melamine-polyester coating; WPC36 = castor oil-based melamine-polyester coating; WPDL56 = lesquerella oil-based air-drying polyester coating; and WPDC56 = castor oil-based air-drying polyester coating.

recorded. However, at such high temperatures, overbaking can occur resulting in polymer degradation. For instance, *Figure* 1 shows the influence of overbaking at 180°C for greater than 10 min. The resulting films have lower T_g than if they were cured at 170°C for equal time. Accordingly, a cure schedule of 170°C for 15 min was chosen.

Drying properties for the DLO and DCO air-dry polyester coatings are comparable. The dry-through times were recorded as 3.5 and 4 hr for WPDL56 and WPDC56 coatings, respectively.

The physical properties of LO melamine-polyester coatings and DLO air-dry polyester are compared with their CO counterparts in *Table* 3. The LO and CO polyester films exhibited similar pencil hardness and adhesion properties. All coating films possessed excellent adhesion (5B) to the steel substrate. The scratch/gouge cross-cut pencil hardness was HB/8H for heat-cured melamine-polyester coating synthesized from WPL36 and WPC36, respectively, and 2B/F for air-dry polyester coatings made from WPDL56 and WPDC56, respectively. It is not surprising that the long-oil, air-dry polyester coatings were softer than the heat-cured types. The LO short-oil coatings withstood 20 in.-lb (2.3 J) higher impact than the compositionally analogous CO coatings, and all coatings passed the one-eighth inch conical mandrel test.

The heat cured LO and CO polyester-melamine coatings gave excellent MEK double rub data (>400) while the air-dry polyester coatings were less resistant to MEK.

Coatings of LO and CO are comparable in gloss development and gloss retention properties. The thermally cured melamine-polyester coatings retained >95% initial gloss values after 500 hr in the UV condensation cabinet (*Table* 3). The ambient air-cured polyesters retained 70% initial gloss (*Table* 3).

LO polyester coatings were comparable to CO counterparts in the salt spray corrosion evaluations. For instance, the heat-cured LO and CO coatings exhibited 1 mm scribe creep, No. 2 medium scribe blister, and few No. 8 surface blisters after 300 hr salt spray testing. In testing of the air-dry systems, the CO polyester was slightly superior to the LO coating. After 100 hr in salt spray, the CO air-dry coating gave No. 8 medium surface blister while the LO coating exhibited No. 8 dense surface blisters.

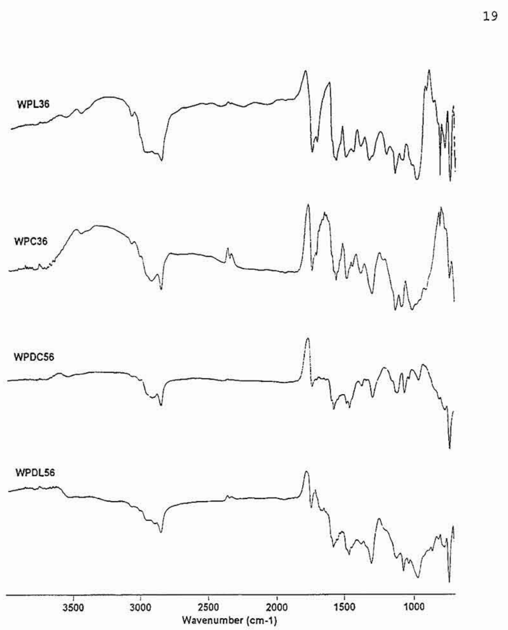


Figure 3—Subtracted IR specular reflectance spectra obtained by subtracting the spectra recorded after 500 hr UV exposure test with their corresponding spectra before UV exposure test.

WPL36 = Lesquerella oil-based melamine-polyester coating; WPC36 = castor oil-based melamine-polyester coating; WPDL56 = lesquerella oil-based air-drying polyester; and WPDC56 = castor oil-based air-drying polyester coating.

The yellowness index (YI), *Figure* 2, of the air-dried polyester coatings was lower than the heat-cured coatings. Both LO and DLO coatings have higher YI values than CO and DCO coatings. Nevertheless, LO seems superior to CO in influencing the YI. For instance, *Figure* 2 confirms a faster increase in YI for CO polyesters than LO coatings tested under identical conditions. Moreover, the CO coatings reached a higher YI than the LO polyesters after 500 hr UV exposure, although the initial YI of the CO polyesters was lower.

Improved UV resistance of LO based coatings was also confirmed via IR specular reflectance analysis (*Figure* 3). IR specular reflectance spectra were recorded for coating films before and after 500 hr UV exposure testing. The former spectrum was subtracted from the latter spectrum in order to determine the absorption differences and highlight changes caused by UV exposure. It is generally known that exposure to UV initiates polymer degradation by oxidation of $-CH_n$ producing various alcohol, carboxyl acid, and aldehyde functionalities.[7] The spectra in *Figure* 3 indicate that compared to WPL36 and WPDL56, WPC36 and WPDC56 possess stronger absorption frequencies at 3000 to 3500 cm^{-1} wavenumber range, which is consistent with –OH and –COOH absorption, and at 1600 and 1780 cm^{-1} corresponding to carbonyl absorption. Further, stronger negative absorbance in the 2800 to 3000 cm^{-1} wavenumber range correspond to decrease in $-CH_n$ absorption. Thus, UV exposure has a greater effect on CO polyesters than the LO analogs.

CONCLUSION

Novel, air-dry, and heat-cure water-reducible polyester polymers were synthesized from LO and DLO. Their physical properties were compared to similar compositions derived from CO and DCO. The comparative study confirmed that LO polyesters were lower in viscosity, but darker in color than their CO counterparts. Waterborne, methylated melamine polyester coatings were studied and a cure schedule of 170°C for 15 min was optimum. The LO and CO polyester coatings were comparable in pencil hardness, adhesion, gloss, and gloss retention properties, however, the LO derived coatings were superior in flexibility and UV stability.

ACKNOWLEDGMENT

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Regulatory Update July 1996

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

Department of Transportation Research and Special Programs Administration
May 17, 1996—61 FR 24904
Hazardous Materials In Intrastate Transportation; Extension of Comment Period
Action: Supplemental notice of proposed rulemaking; extension of comment period

The Research and Special Programs Administration (RSPA) extended its deadline for submitting comments on its March 20, 1996 supplemental notice of proposed rulemaking on intrastate transportation of hazardous materials. Under that regulation, RSPA proposed certain exceptions from requirements in the Hazardous Materials Regulations that would otherwise apply to the transportation of small quantities of specific hazardous materials; smaller cargo tank motor vehicles used in intrastate transportation of flammable liquid petroleum products; and registered inspections of these smaller cargo tank motor vehicles.

The deadline has been extended until August 16. Comments should be addressed to Dockets Unit, Room 8421, RSPA, Department of Transportation, Washington, D.C. 20590-0001. Please identify the comments as Docket (HM-200), and submit five copies.

For additional information, contact RSPA's Jackie Smith or Diane LaValle, (202) 366-8553.

Environmental Protection Agency
May 20, 1996—61 FR 25223
Control Techniques Guidelines Document; Wood Furniture Manufacturing Operations
Action: Notice of release of final control techniques guidelines document

In this notice, the Environmental Protection Agency (EPA) announces the availability of a final control techniques guidelines (CTG) document for control of volatile organic compounds (VOC) emissions from wood furniture finishing and cleaning operations. This document is designed to assist states in analyzing and determining reasonably available control technology (RACT) for stationary sources of VOC emissions located within ozone nonattainment areas.

Copies of the CTG can be obtained from the U.S. EPA Library (MD-35), Research Triangle Park, NC 27711, (919) 541-2777. Electronic copies are also available on EPA's Technology Transfer Network bulletin board system, (919) 541-5742.

For further information, contact Paul Almodovar, EPA, (919) 541-0283.

Environmental Protection Agency
June 4, 1996—61 FR 28197
National Emission Standards for Hazardous Air Pollutants; Revision of Initial List of Categories of Sources and Schedule for Standards Under Sections 112(c) and (e) of the Clean Air Act Amendments of 1990
Action: Notice of revisions to initial list of categories of major and area sources, and revisions to promulgation schedule for standards

EPA has published a list of revisions made or which have been proposed to the initial list of categories of hazardous air pollutants, which was originally issued in the July 16, 1992 *Federal Register* (57 FR 10461). Several of the revisions identified in this notice have already been published in actions associated with listing and promulgating emission standards for individual source categories. Some of the revisions have not been reflected in any previous notice and are being taken without public comment. This list was effective June 4, 1996.

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

Environmental Protection Agency
May 30, 1996—61 FR 27038
Hazardous Waste Combustors; Revised Standards; Proposed Rule—Notice of Extension of Comment Period

Due to the length and complexity of the proposed rule for hazardous waste incinerators, cement kilns, and aggregate kilns (61 FR 17358), EPA has extended the comment deadline from June 18 to August 19, 1996. Under this proposal, emission standards for specific types of air pollution from hazardous waste facilities would be established. These requirements are being proposed jointly under the Clean Air Act and the Resource Conservation and Recovery Act (RCRA).

Commenters must send an original and two copies of their comments, by August 19, to RCRA Docket Information Center, Office of Solid Waste (5305W), EPA, 401 M Street, S.W., Washington, D.C. 20460. Please reference docket number F-96-RCSP-FFFFF on all copies.

For general information on this rulemaking, contact the RCRA Hotline (800) 424-9346. For additional information, contact Larry Denyer, EPA, (703) 308-8770.

Environmental Protection Agency
June 5, 1996—61 FR 28508
Hazardous Waste Treatment, Storage, and Disposal Facilities and Hazardous Waste Generators; Organic Air Emission Standards for Tanks, Surface Impoundments and Containers
Action: Amendment of final rule to postpone requirements

EPA announced an extension to the effective date for the rulemaking on Hazardous Waste Treatment, Storage and Disposal Facilities and Hazardous Waste Generators; Organic Air Emission Standards for Tanks, Surface Impoundments and Containers, first published on December 6, 1994 (59 FR 62896). EPA has granted a four month extension to the compliance date, from June 6, 1996 to October 6, 1996.

Under the authority of the RCRA, the rule establishes additional air standards for hazardous waste treatment, storage and disposal facility owners and operators, and requires hazardous waste generators accumulating waste on-site in RCRA permit-exempt tanks and containers to implement air emission control criteria.

For additional information, contact the RCRA Hotline at (800) 424-9346.

Notice—The EPA is sponsoring a national, interactive teleconference on September 18, 1996 in order to help manufacturers of wood furniture products understand the requirements for compliance with the Clean Air Act. The teleconference will include interviews and case studies, as well as an opportunity for questions. Topics will cover whether facilities must comply with the Clean Air Act, the regulation of emissions, and reporting and recordkeeping requirements. For more information on the teleconference, contact your state environmental office.

Regulatory Agenda—In the May 13 *Federal Register* (61 FR 23610), the Environmental Protection Agency published its semi-annual regulatory agenda, highlighting the agency's future goals concerning proposed rulemakings, final regulations and notices. Please note that the scheduled dates for action may be subject to change. The rules scheduled for action include:

Toxic Substances: Toxic Substances Control Act (TSCA) chemical use inventory project—notice of proposed rulemaking in June 1996.

Lead: Lead hazards—notice of proposed rulemaking in November 1996;

Lead-based paint activities rules—final action in June 1996; and

Requirements for the disposal of lead-based paint abatement waste—final action in September 1996

Solid and Hazardous Waste: Paint manufacturing wastes listing—notice of proposed rulemaking in September 1997.

Air Quality: National VOC emission standards for automotive refinish coatings—final action in December 1996;

VOC regulation for architectural coatings—final action in October 1996;

Aerosol spray paints VOC rule—notice of proposed rulemaking in September 1996; and

Reduction of VOC emissions from coatings used in the aerospace, wood furniture, and shipbuilding industries—notice of proposed rulemaking in July 1996.

Bill To Amend The Clean Air Act Introduced—Representative Joe Barton (R-TX) introduced legislation (H.R. 3519) on May 23 to amend the Clean Air Act by allowing, among other things, sources of pollution to trade emission credits. As currently written, the measure would permit state emission trading programs as long as they do not cause a region to miss an attainment deadline or a rise in emissions. In addition, the bill allows facilities to make minor changes in their operations without first obtaining EPA approval.

Other provisions of the bill include excluding minor new source review from the operating permit program, providing for facility-wide emission caps instead of subsections of facilities, and extending operating permits from five years to up to ten.

Although there are few remaining legislative days in the congressional calendar for action on the measure, the bill may be considered on a House corrections day, which is set aside for non-controversial measures. Supporters of the measure believe that, even if it doesn't advance from committee, the issue has been brought to the attention of both Congress and the public, which may lead to changes in the next session.

Superfund Update—As the remaining days on the Congressional calendar dwindle, the possibility of passage of Superfund reform legislation in both the House and Senate is becoming less likely. In the House, GOP leaders have scheduled H.R. 2500 for floor debate on July 17, but at press time, the bill had not yet even been scheduled for markup by the House Commerce Committee. Currently, intra-party negotiations over the bill's content are still continuing, with no end in sight. Disagreement still centers around the issues of liability and natural resources damages.

And in the Senate, negotiators from both parties have proposed a series of different Superfund reform plans in their ongoing effort to reach a bipartisan compromise. Although meetings between Democratic and Republican representatives and EPA Administrator Carol Browner have been described as "positive," little actual progress in developing an agreement has been made. Senate leaders had hoped to mark up a bipartisan bill in the Environment and Public Works Committee by the Memorial Day recess, but that deadline passed with no action. Robert Smith (R-NH), chairman of the Senate Subcommittee on Superfund, Waste Control, and Risk Assessment, has stated that he believes a bill can be passed this year, but only if it finishes committee mark up by July 4. The House and Senate are both apparently waiting for the other side to move forward with their respective Superfund measures.

To further complicate reauthorization efforts, a federal district judge has struck down portions of the Superfund liability scheme. In *U.S. v. Olin Corporation*, the judge ruled that there is no specific provision in the Comprehensive Environmental Response, Compensation & Liability Act (CERCLA) for retroactive liability. Although legal experts expect this ruling to face a number of courtroom challenges and that it is too soon for opponents to celebrate the end of the Superfund program, the decision has only added to the controversy over reauthorization.

Florida Solvent Mixtures Tax Repealed—Florida's excise tax on solvent mixtures has been repealed, effective July 1, 1996. The repeal came about as a result of the enactment of a bill, S.B. 1148, developed by the Florida Paint Council and NPCA.

In 1983, Florida established a trust fund to help pay for the cleanup of hazardous waste sites, emergency response operations, and the rehabilitation of contaminated drinking water systems. In 1989, the tax base was broadened to include solvent mixtures, levied when the product was first produced or imported into the state.

The repeal of the excise tax on solvent mixtures is prospective; the tax will not be imposed on products manufactured or imported into the state after July 1, 1996.

States Proposed Legislation and Regulations

ALASKA

Environmental Audits—AK S. 199 (Leman and Pearce) relates to environmental audits and health and safety audits to determine compliance with certain laws. On May 2, the bill was withdrawn from consideration by the House Committee on Labor and Commerce.

ARIZONA

Water Quality—AZ S. 1401 (Buster) provides, among other things, for issuance of a single area-wide permit for discharges and for new exemptions from permit requirements. The governor signed the bill on April 16.

CALIFORNIA

Air Quality (Proposed Regulation)—The California Air Resources Board (CARB) proposed a regulation (96 CARR 864) which would incorporate by reference federal criteria for the precertification of commonly used air pollution equipment. Contact Mike Tollstrup, CARB, (916) 323-8473.

Environmental Audits—CA S. 1752 (Sher) provides that no civil or administrative sanction shall be assessed against any person who, as a result of an environmental audit, fully discloses a minor violation of an environmental regulation. On June 11, the Senate Committee on Natural Resources and Wildlife amended and released the legislation.

Graffiti—CA A. 2295 (Sweeney) authorizes the court to order, upon conviction for a graffiti offense, that the defendant keep the damaged property or another property free of graffiti for a specified period of time. The bill was approved by the assembly and sent to the Senate Committee on Criminal Procedure on May 30.

CA A. 2331 (Goldsmith) makes it a felony, punishable by prison and suspension of driving privileges, for any person to deface with graffiti property not his own where the amount of defacement is more than $400 but less than $5,000. The assembly approved the legislation on May 24; it was referred to the Senate Committee on Criminal Procedure.

CA A. 2433 (Harvey) provides that, with respect to the first and second violations relating to graffiti, the maximum fine and community service time be doubled. Any subsequent violations would impose a fine of up to $3,000. On May 20, the bill passed the assembly and was sent to the Senate Committee on Criminal Procedure for consideration.

Hazardous Waste—CA S. 1757 (Calderon) exempts a surface impoundment that was constructed before July 1, 1996 from the land disposal prohibitions for hazardous waste pursuant to the federal Resource Conservation and Recovery Act (RCRA), and from the federal minimum treatment standards. On May 30, the bill passed the Senate and referred it to the Assembly Committee on Environmental Safety and Toxic Materials.

Hazardous Waste (Proposed Regulation)—The California Department of Toxic Substances Control (DTSC) proposed a regulation (22 CCR) which would allow large volumes of non-RCRA hazardous waste to be eligible for the statutory exemptions and exclusions for recyclable materials. Contact Joan Ferber, DTSC, (916) 322-1003.

Hazardous Waste (Regulation)—A regulation (96 CARR 813) adopted by the California DTSC repeals specific requirements concerning treatment standards for non-RCRA waste categories. The rule became effective March 29. Contact Joan Ferber, DTSC, (916) 322-6409.

Hazardous Materials Transportation—CA A. 2201 (House) repeals the provisions requiring the inspection of vehicles used to transport hazardous waste and the adoption of regulations for containers used to transport hazardous waste. The assembly approved the measure on May 30; it is currently under consideration by the Senate Committee on Transportation.

Lead—CA S. 2080 (O'Connell) enacts the Comprehensive Childhood Lead Poisoning Prevention Act, which finds that the state lacks an approach to lead hazard evaluation and control. On May 29, the bill failed to pass out of the Senate Appropriations Committee.

Packaging—CA A. 2508 (House) requires every rigid plastic container sold or offered for sale in the state to generally meet specified criteria, including that the container is subsequently reused by a particular user industry for at least two years. The legislation was passed by the assembly on May 23 and sent to the Senate Committee on Governmental Organization.

Spray Paint Restrictions—CA S. 1696 (Kopp) prohibits any person, firm, or corporation from selling, offering to sell, giving, or in any way furnishing to another person any "portable" aerosol container of paint, and would prohibit any person, unless he possesses a specific exemption, from possessing any aerosol container of paint while on the private property of another or in any public place. On May 23, the Senate Appropriations Committee held the bill without recommendation. It is considered dead for this session.

Toxic Substances—Proposition 65—CA A. 3160 (Olberg) allows the state attorney general to certify that a private attorney's action to enforce Proposition 65 would not be in the public interest. On May 31, the bill failed to pass the assembly.

Toxic Substances—Proposition 65 (Notice)—The California Office of Environmental Health Hazard Assessment (OEHHA) has issued a revised list of chemicals (96 CARR 930) that are known to the state to cause cancer or reproductive toxicity, as required by Proposition 65. The amendments were effective May 1. Contact OEHHA, (916) 445-6900.

Water Quality—CA A. 2620 (Morrissey) provides that dischargers shall not be required to meet water quality standards that exceed standards prescribed under the federal Safe Drinking Water Act, unless otherwise required to do so by federal law or those water quality standards that are prescribed for the purpose of regulating newly discovered contaminants determined to be hazardous. The bill passed the assembly and was sent to the Senate Committee on Toxics and Public Safety Management.

COLORADO

Air Quality (Proposed Regulation)—The Colorado Air Quality Control Commission (AQCC) proposed a regulation (5 CCR 1001) which would adopt new source performance standards for the determination of volatile matter content, water content, density, volume solids, and weight solids of surface coatings. Contact Technical Secretary, AQCC, (303) 692-2000.

A proposed rule (20 COR 3) of the Colorado AQCC would specify that permits issued by the U.S. EPA under Parts C or D of the Clean Air

Act are considered to be applicable criteria of the state operating permit program. In addition, the rule expands references to major sources obtaining operating permits. Contact AQCC, (303) 692-3100.

Hazardous Waste (Regulation)—A rule (6 CCR 1007) adopted by the Colorado Department of Public Health and Environment (DPHE) allows public access to information throughout the permitting process and operational lives of facilities that store, treat, or dispose of hazardous wastes. The rule went into effect on May 30. Contact Karen Osthus, DPHE, (303) 692-3300.

Lead—CO S. 131 (Alexander) concerns a comprehensive plan to reduce lead poisoning. On April 23, consideration of the bill was indefinitely postponed.

CONNECTICUT

Air Quality—CT S. 267 (Committee on the Environment) provides loans to small businesses and manufacturers to meet Clean Air Act requirements. On May 29, the governor signed the legislation.

FLORIDA

Air Quality (Proposed Regulation)—The Florida Department of Environmental Protection (DEP) has announced changes to a proposal (22 FLAR 2697) to amend requirements for operating permits for major sources of air pollution. The revisions include specifying that reports on all deviations from permit conditions must be submitted on a semi-annual basis; deleting sections governing excess emissions resulting from facility startup, shutdown, or malfunction; and modifying provisions for local air programs. Contact Beth Hardin, DEP, (904) 488-0114.

Water Quality—FL S. 1148 (McKay) excludes solvent mixtures from the substances that are subject to the tax on pollutants for water quality. The legislation became law without the governor's signature on June 1.

IDAHO

Water Quality (Proposed Regulation)—The Idaho Department of Health and Welfare (DHW) has proposed a rule (96 IDAB 11) which would amend water quality regulations according to the federal Clean Water Act. Under the proposal, a process to incorporate federal maximum daily load requirements within current water quality programs would be established, among other things. Contact Mark Shumar, DHW, (208) 373-0502.

ILLINOIS

Air Quality—IL S. 1408 (Luechtefeld and Rea) provides for legislative review of any proposed memorandum of understanding which may require the state to undertake emissions reductions in addition to those specified by the Clean Air Act Amendments. On May 29, the bill was sent to the governor for signature.

Hazardous Materials Transportation (Regulation)—A regulation (20 ILR 6535) adopted by the Illinois Department of Transportation (DOT) incorporates federal requirements for the manufacture and maintenance of cargo tank motor carriers, amends design loading standards for certain cargo tank motor carriers, and updates provisions for the transportation of hazardous materials in tank cars. The rule went into effect April 30. Contact Cathy Allen, DOT, (217) 785-1181.

Final rules of the Illinois DOT adopts federal standards by reference for, among other things, cargo tank motor vehicles, the transportation of portable tanks, lists of reportable hazardous substance, and the construction and maintenance of intermediate bulk containers used for the transportation of hazardous materials. The regulation went into effect April 30. Contact Cathy Allen, DOT, (217) 785-1181.

Water Quality (Proposed Regulation)—A proposal of the Illinois Pollution Control Board (PCB) would require the state to adopt regulations which are identical in substance with federal Clean Water Act standards for pretreatment requirements. Contact Dorothy Gunn, PCB, 100 W. Randolph Street, Suite 11-500, Chicago, IL 60601.

INDIANA

Air Quality (Proposed Regulation)—A proposal (19 INR 2099) of the Indiana Department of Environmental Management (DEM) concerning a program of permit-by-rule for sources with very small emissions would set criteria for exempting such sources from Title V requirements, establish regulations for demonstrating compliance, and define recordkeeping requirements. Contact Mike Brooks, DEM, (317) 233-5686.

Air Quality (Hearing Notice)—The Indiana Pollution Control Board (PCB) has rescheduled a hearing on a proposed rule which would establish requirements for continuous emissions monitoring systems on certain types of facilities. The hearing will now be held on July 11 in Indianapolis. Contact John Broyles, PCB, (317) 233-0118.

Hazardous Waste (Regulation)—A final regulation (19 INR 1970) of the Indiana Department of Environmental Management (DEM) incorporates by reference federal financial responsibility standards for owners and operators of hazardous waste treatment, storage and disposal facilities. The rule went into effect May 1. Contact Elaine Roemer, DEM, (317) 232-8883.

IOWA

Air Quality (Regulation)—A final rule (18 IAAB 1766) of the Iowa Environmental Protection Commission (EPC) amends current provisions concerning air pollutants to, among other things, exempt acetone from the list of volatile organic compounds (VOCs), establish a voluntary operating permit rule for small sources, specify that visible emission standards of less than 40% may be set up in construction permits, and alter the requirements for qualification in visual determination of the opacity for emissions. The regulation was effective June 12. Contact Catharine Fitzsimmons, EPC, (515) 281-8941.

KANSAS

Water Quality (Proposed Regulation)—A proposal of the Kansas Department of Health and Environment (DHE) would establish new wastewater permit fee categories and would specify fees for general permits and for storm water. Contact Christine Seeds, DHE, (913) 296-5506.

LOUISIANA

Regulatory Agenda (Notice)—The Louisiana Department of Environmental Quality (DEQ) has issued its spring 1996 edition of the semi-annual regulatory agenda, including information on current proposed rules and other proposals that are scheduled for release in 1996. Contact Lana Guidry, DEQ, (504) 765-0399.

MAINE

Air Quality (Proposed Regulation)—A proposal of the Maine Department of Environmental Protection (DEP) would amend the maximum allowable ambient air quality increases for particulate matter to incorporate federal standards for the prevention of significant deterioration. Contact Carolyn Wheeler, DEP, (207) 287-2437.

Solid Waste (Proposed Regulation)—The Maine DEP proposed a rule which would amend provisions for the registration, installation, operation and removal of underground storage tanks to make them consistent with federal standards. Contact George Seel, DEP, (207) 287-2651.

MARYLAND

Lead—MD H. 23 (Hubbard) requires the establishment of programs for lead poisoning screening and education. On April 6, the conference committee report on the measure was adopted by the House.

Lead (Regulation)—A rule adopted by the Maryland Department of the Environment (DOE) establishes standards and procedures for the accreditation of persons who conduct inspections or risk assessments for lead paint, or who are involved in lead paint abatement. The regulation was effective May 20. Contact Deanna Miles-Brown, DOE, (410) 631-3173.

Lead (Proposed Regulation)—The Maryland DOE has proposed a regulation which would establish standards and procedures for the conduct of lead paint abatement activities. Contact Deanna Miles-Brown, DOE, (410) 631-3173.

MICHIGAN

Air Quality (Regulation)—A regulation (96 MIR 9) adopted by the Michigan Department of Natural Resources (DNR) would set up a voluntary statewide emission averaging and reduction credit program. The rule, which became effective March 15, specifies the criteria for program eligibility, lists the instances in which the use of averaging and reduction credits is prohibited, establishes required methods for emission monitoring and reduction credit quantification, and sets up recordkeeping and registration procedures. Contact DNR, (517) 373-7069.

A proposal issued (96 MIR 105) by the Michigan Department of Environmental Quality (DEQ) would amend the definition of VOC; modify permit exemptions; establish new standards for general permits to install and for limiting potential to emit; incorporate federal standards for controlling hazardous air pollutants; and update requirements for the renewable operating permit program. Contact DEQ, (517) 373-7069.

Solid Waste—MI S. 941 (McManus) provides for solid waste permit and license application fees. The bill has passed both the House and Senate; on June 5, the Senate concurred with the House amendments.

MINNESOTA

Air Quality (Regulation)—A final regulation (20 MNSR 2254) of the Minnesota Pollution Control Agency (PCA) incorporates federal requirements governing national emission standards for hazardous air pollutants for source categories into state law. The regulation went into effect April 22. Contact Sherryl Livingston, PCA, (612) 296-7832.

MONTANA

Air Quality (Proposed Regulation)—Regulations (96 MTAR 1019, 1024) proposed by the Montana Board of Environmental Review (BER) would amend the current definition of VOCs in order to be consistent with federal standards and would incorporate federal guidelines for the administration of maximum achievable control technology requirements of hazardous air pollutants. Contact BER, (406) 444-2544.

NEVADA

Air Quality (Regulation)—A final rule of the Nevada State Environmental Commission (SEC) revises state hazardous air pollutants standards to conform with federal requirements by repealing certain redundant provisions concerning the adoption of emission standards, best available control technology, and minimum available control technology. The regulation was effective May 3. Contact David Cowperthwaite, SEC, (702) 687-4670.

A regulation adopted by the Nevada SEC increases Class I and II air quality stationary source permitting fees; decreases Class II general permit fees; increases the annual emissions fees; exempts sources emitting less than 25 tons per year from such fees; and eliminates specific general fees. The rule became effective May 3. Contact David Cowperthwaite, SEC, (702) 687-4670.

NEW HAMPSHIRE

Air Quality (Regulation)—A final rule (16 NHRR 11) of the New Hampshire Department of Environmental Services (DES) amends and readopts requirements to implement air quality standards for difference types of pollutants emitted in or transported into the state. The regulation went into effect April 25, 1996 and will expire April 25, 2004. Contact Susan Jones, DES, (603) 271-7874.

Water Quality (Proposed Regulation)—The New Hampshire DES proposed a regulation (16 NHRR 5) which would amend standards for surface water quality, including provisions to ensure compliance with federal EPA requirements. Contact George Berlandi, DES, (603) 271-2457.

A proposed rule of the New Hampshire DES would establish pretreatment standards for industrial wastewater which must be conformed to before discharge into a sewer system or treatment facility can occur. Contact George Carlson, DES, (603) 271-2052.

NEW JERSEY

Solid Waste (Proposed Regulation)—A proposal of the New Jersey Department of Environmental Protection (DEP) would, among other things, introduce new requirements for surface impoundments and for solid waste treatment, storage and disposal facilities; detail recordkeeping and reporting requirements for solid waste facilities and transporters; and specify registration requirements for transporters of both solid and hazardous waste. Comments must be received by July 5. Contact Janis Hoagland, DEP, (609) 292-0716.

NEW MEXICO

Air Quality (Proposed Regulation)—A proposed regulation (7 NMR 181) of the New Mexico Environmental Improvement Board (EIB) would incorporate U.S. EPA air emissions requirements, and would amend requirements for construction permits, new source performance standards, and emission criteria for hazardous air pollutants. Contact Dave Wunker, EIB, (505) 827-1032.

NEW YORK

Air Quality—NY A. 10818 (Committee on Rules) clarifies that fugitive emissions are included in determining whether a source of hazardous air pollutants is subject to Title V permits. Introduced on May 30, the bill is under consideration by the Assembly Committee on Rules.

Graffiti—NY S. 4578 (Tully) delays the issuance of a driver's license to any person under age 21 for one year for each conviction or adjudication as a youthful offender for making graffiti. The measure repassed the Senate on June 4 and was sent to the Assembly Committee on Transportation.

NY S. 7636 (Maltese) creates a new crime of making graffiti in the first degree when a person commits another graffiti crime on the same or religious property within a period of ten years. Introduced on May 30, the bill was referred to the Senate Committee on Rules.

Hazardous Materials Transportation—NY S. 391 (Levy) establishes a task force to develop and implement a statewide system for recording incidents involving railroad carriers transporting hazardous materials. On June 4, the bill passed the Senate and was referred to the Assembly Committee on Transportation.

Lead—NY S. 1262 (Volker) establishes a lead abatement licensing and certification program to reduce the health and safety hazards associated with lead abatement. On June 10, the measure was amended on the Senate floor.

Water Quality (Notice)—The New York Department of Environmental Conservation (DEC) has issued a series of fact sheets (18 NYSR 81), available to the public, which lists the upcoming proposed amendments to the state's water quality standards. Contact Scott Stoner, DEC, (518) 485-5824.

OHIO

Hazardous Waste—OH H. 435 (White) revises the requirements and procedures governing modifications of hazardous waste facility installation and operation permits. The governor signed the bill on May 20.

OKLAHOMA

Water Quality (Proposed Regulation)—A proposal (13 OKR 1287) issued by the Oklahoma Department of Environmental Quality (DEQ) would incorporate by reference the final national pollutant discharge elimination system storm water multi-sector general permit for industrial activities into the state water quality program. Contact Cary Pirrong, DEQ, (405) 271-5205.

OREGON

Air Quality (Proposed Regulation)—The Oregon Department of Environmental Quality (DEQ) proposed a rule (35 ORRB 7) which would revise the definition of VOC to reflect the U.S. EPA's delisting of acetone. The rule went into effect March 29. Contact Susan Greco, DEQ, (503) 229-5213.

A proposal (35 ORRB 18) of the Oregon DEQ would establish fees for the administration of a pilot pollution prevention tax credit program, designed to use fiscal incentives to encourage businesses regulated under certain national emission standards for hazardous air pollutants to install equipment to prevent pollution. Contact Susan Greco, DEQ, (503) 229-5213.

Hazardous Materials Transportation (Regulation)—A regulation (35 ORRB 10) adopted by the Oregon Department of Transportation (DOT) incorporates federal standards for hazardous materials; motor carrier safety; and driver, vehicle and hazardous materials out-of-service equipment. The rule went into effect April 1. Contact Brenda Trump, DOT, (503) 945-5278.

RHODE ISLAND

Air Quality (Regulation)—A final regulation (96 RIGR 104) of the Rhode Island Department of Environmental Management (DEM) limits the VOC content of coatings used in wood product manufacturing operations and from solvent cleaning operations. In addition, the sale of automotive refinishing products that do not meet VOC limits is banned, and the VOC content of coatings and other surface preparation products must be listed on certified product data sheets. The rule went into effect April 8. Contact Barbara Morin, DEM, (401) 277-2808.

Spray Paint Restrictions—RI S. 2837 (Palazzo) bans the sale of "portable" cans of spray paint. On May 21, the legislation was amended and released from the Senate Judiciary Committee.

SOUTH CAROLINA

Air Quality (Regulation)—A regulation adopted by the South Carolina Department of Health and Environmental Control (DHEC) incorporates federal revisions of air quality model guidelines for the prevention of significant deterioration in order to improve the technical basis for impact assessment of sources of air pollution. The rule was effective April 26. Contact DHEC, (803) 734-4750.

VERMONT

Lead—VT H. 778 (Committee on Health and Welfare) creates a program to prevent lead paint poisoning in children in rental housing and child care facilities. The governor signed the legislation on May 15.

WEST VIRGINIA

Hazardous Waste (Regulation)—The West Virginia Division of Environmental Protection (DEP) adopted a regulation, effective June 1, which amends current hazardous waste management requirements by incorporating specific federal standards, including provisions for (1) small quantity generators; (2) interim status for owners and operators of hazardous waste treatment and disposal facilities; and (3) land disposal restrictions. Contact H. Michael Dorsey, DEP, (304) 558-2505.

WISCONSIN

Hazardous Materials Transportation (Regulation)—The Wisconsin Emergency Response Board (ERB) issued an emergency regulation (ERB 4), effective February 23, which will allow the continuation of the Wisconsin Hazardous Materials Transportation Registration program, including the fees for transporting hazardous materials. Contact Jan Grunewald, ERB, 2400 Wright Street, Madison, WI 53707-7865.

Lead (Regulation)—The Wisconsin Department of Health and Social Services has permanently adopted an emergency rule which establishes criteria for grants to support educational programs on the dangers of lead paint and funds lead poisoning screening and inspections. The regulation was effective July 1. Contact Bill Otto, Bureau of Public Health, (608) 266-9337.

Optimization of Paint Formulations Made Easy with Computer-Aided Design of Experiments for Mixtures

Mark J. Anderson and Patrick J. Whitcomb—Stat-Ease, Inc.*

Introduction

Powerful desk-top software tools now make it easy to optimize paint formulations. Coatings researchers can use the computer to apply statistically based design of experiments (DOE) for mixtures—a proven method for making breakthrough improvements in cost and performance. This paper shows the application of the latest technology of computer-aided mixture design to data from Hesler and Lofstrom's 1981 article "Application of Simplex Lattice Design Experimentation to Coatings Research."[1] In the process the essential aspects of mixture methodology are illustrated.

Experimental

Hesler and Lofstrom reformulated a coating composed of a prime pigment (titanium dioxide), a vehicle (latex emulsion), and two extender pigments. They hoped to meet or exceed existing hiding power and scrub loss performance while lowering material cost. Their study focused on non-volatile materials, of which seven percent represented additives that remained at fixed levels. The remainder, re-coded to 100%, varied as follows: 5-45% prime pigment, 20-60% vehicle, 30-70% extender 1, 5-45% extender 2. These four components are labeled A, B, C, and D respectively.

Because each of these constraints covers an identical range (40%), the design space forms a simplex (the tetrahedron in *Figure* 1). The points shown on this figure come from a statistically based mixture design called a simplex centroid.[2] (Hesler and Lofstrom's designation of their design as a simplex lattice is a misnomer). In general, a simplex centroid design provides purest blends to estimate main effects, binary blends for interactions, ternary blends for third-order effects, and so on to the overall centroid. In this case, the simplex centroid gave four purest blends, six binary blends, four ternary blends, and one blend of all four components. Hesler and Lofstrom added four check blends along the axes from the centroid to the extreme vertices. They also replicated each of the 19 experimental blends to provide estimation of pure error.

For convenience of computing, the 38 resulting blends were re-coded to 0 at minimum concentration and 1 at maximum concentration. These values are labeled "pseudocomponent." *Table* 1 shows the coding for the four purest blends represented by the extreme vertices in *Figure* 1. The complex mixture design with actual results is reproduced in *Table* 2.

Table 1—Pseudocomponent Coding for Purest Blends: The Extreme Vertices. (Actual component values shown in parentheses.)

Blend	Component (TiO_2)	Component (Vehicle)	Component C (Pigment)	Component D (Pigment)
1	1 (45%)	0 (20%)	0 (30%)	0 (5%)
2	0 (5%)	1 (60%)	0 (30%)	0 (5%)
3	0 (5%)	0 (20%)	1 (70%)	0 (5%)
4	0 (5%)	0 (20%)	0 (30%)	1 (45%)

Analysis

Predictive Models

With the aid of software,[3] the resulting response data for hiding power and scrub loss were fitted via least squares regression to canonical mixture models.[4] These polynomial models can be recognized by lack of an intercept. *Appendix* 1 shows the derivation of the canonical mixture model for linear blending of two components. The model includes all the components while accounting for the restriction that all must add to unity. This restriction could also be satisfied by sacrificing one of the terms from the original polynomial, but this obscures the interpretation. (See footnote in *Appendix* 1 for the alternate model—also known as a "slack variable" mixture model.)

If expanded to a sufficient order, canonical mixture models provide a good approximation of the true response surface. *Table* 3 shows the results of the model fitting along with key statistics. Second order terms were needed to model the interactions between components. Also, analysis revealed that taking logarithms of the responses gave a better

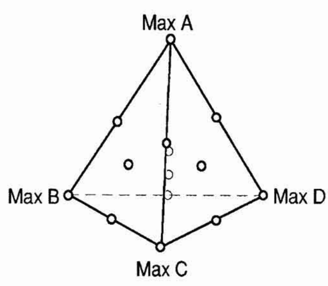


Figure 1—Simplex centroid for four components.

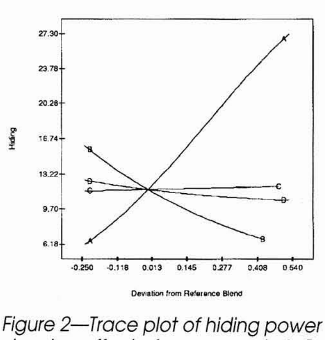


Figure 2—Trace plot of hiding power showing effect of components A, B, C, and D.

*2021 E. Hennepin Ave., Ste. 191, Minneapolis, MN 55413.

Table 2—Experimental Data

Blend	A (TiO_2)	B (Vehicle)	C (Pigment)	D (Pigment)	Hiding Power	Scrub Loss[a]
1A	0.45	0.20	0.30	0.05	35.93	942.50
1B	0.45	0.20	0.30	0.05	29.80	686.50
2A	0.05	0.60	0.30	0.05	3.65	37.00
2B	0.05	0.60	0.30	0.05	3.80	42.00
3A	0.05	0.20	0.70	0.05	9.19	253.50
3B	0.05	0.20	0.70	0.05	9.36	153.00
4A	0.05	0.20	0.30	0.45	7.84	862.00
4B	0.05	0.20	0.30	0.45	7.95	516.00
5A	0.25	0.40	0.30	0.05	15.23	67.50
5B	0.25	0.40	0.30	0.05	17.26	102.00
6A	0.25	0.20	0.50	0.05	23.59	370.50
6B	0.25	0.20	0.50	0.05	21.69	351.00
7A	0.25	0.20	0.30	0.25	19.79	486.50
7B	0.25	0.20	0.30	0.25	20.47	624.00
8A	0.05	0.40	0.50	0.05	5.45	42.50
8B	0.05	0.40	0.50	0.05	5.47	53.50
9A	0.05	0.40	0.30	0.25	4.53	42.50
9B	0.05	0.40	0.30	0.25	4.90	61.00
10A	0.05	0.20	0.50	0.25	8.43	386.50
10B	0.05	0.20	0.50	0.25	8.33	299.00
11A	0.18	0.33	0.43	0.05	14.12	73.00
11B	0.18	0.33	0.43	0.05	14.88	78.00
12A	0.18	0.33	0.30	0.18	12.18	138.50
12B	0.18	0.33	0.30	0.18	12.52	133.50
13A	0.18	0.20	0.43	0.18	16.17	408.50
13B	0.18	0.20	0.43	0.18	18.43	364.00
14A	0.05	0.33	0.43	0.18	5.87	70.50
14B	0.05	0.33	0.43	0.18	5.91	81.50
15A	0.15	0.30	0.40	0.15	11.58	113.50
15B	0.15	0.30	0.40	0.15	11.97	114.50
16A	0.30	0.25	0.35	0.10	22.77	371.50
16B	0.30	0.25	0.35	0.10	21.43	346.50
17A	0.10	0.45	0.35	0.10	6.22	52.50
17B	0.10	0.45	0.35	0.10	6.35	29.00
18A	0.10	0.25	0.55	0.10	10.45	106.50
18B	0.10	0.25	0.55	0.10	10.81	129.50
19A	0.10	0.25	0.35	0.30	9.97	405.00
19B	0.10	0.25	0.35	0.30	11.13	246.50

(a) Average from two measurements made on each blend.

Table 3—Computer-Generated Predictive Models[a]

Hiding Power:

$$\text{Log } Y_1 = 1.505\,A + 0.563\,B + 0.965\,C + 0.908\,D + 0.707\,AB + 0.515\,AC + 0.424\,AD - 0.086\,BC - 0.229\,BD - 0.001\,CD$$

(Overall F=402 with $p < 0.001$ and no significant lack of fit ($p=0.136$))

Scrub Loss:

$$\text{Log } Y_2 = 2.927\,A + 1.581\,B + 2.279\,C + 2.840\,D - 1.305\,AB - 0.328\,AC - 0.298\,AD - 1.243\,BC - 1.837\,BD - 0.126\,CD$$

(Overall F=77 with $p < 0.001$ and no significant lack of fit ($p=0.334$))

(a) Responses transformed with log base ten and fit by least squares regression to Scheffé mixture polynomials

fit. The log transformation typically helps when the response range approaches or exceeds an order of magnitude. In this case, hiding power ranged from 3.6 to 36 and scrub loss ranged from 24 to 1155.

Canonical mixture models provide a great deal of utility to formulators. Main effects indicate response at maximum level of a particular component. For example, from *Table* 2 you see that the coefficient for component A (titanium dioxide) reached a relatively high level of 1.505 in the model for hiding power. Responses were transformed by log base ten, so to return to original units you must use the antilog. This results in predicted hiding power of 32 at the blend which was rich in titanium dioxide. (Hesler and Lofstrom report actual results of 35.9 and 29.8.)

The second order terms, such as AB, reveal interactions. For responses where higher is better, such as hiding power, positive interaction coefficients indicate synergism. Negative interaction coefficients indicate antagonism. For responses where lower is better, such as scrub loss, the inverse is true: positive coefficients on interactions indicate antagonism and negative coefficients show synergism.

In some cases it becomes necessary to add a third-order term, creating a "special cubic" polynomial model. In a four-component blend, these terms will be: ABC, ABD, ACD, and BCD. They estimate three-component interactions.

Interpretation Graphs

Rather than belabor interpretation of coefficients, it is best to look at response graphs to gain insights about your mixture system. Trace plots can be very helpful, particularly with more than three components. The plots reveal how the response changes when changing the concentration of each component while keeping all others in constant proportion. The overall centroid makes a good starting point. *Figure* 2 shows the trace plot for hiding power. Not surprisingly, it

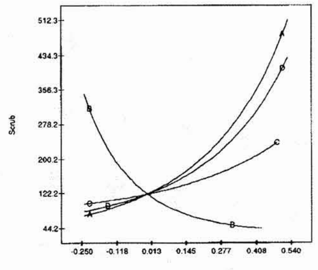


Figure 3—Trace plot of scrub loss showing effect of components A, B. C, and D.

Table 4—Optimization Objectives

Hiding Power ≥ 9.93
Scrub Loss ≤ 108 mg/100 cycles
Raw Material Cost ≤ $2.06/gallon
where:
RMC = 3.2651 A + 1.5604 B + 1.6269 C + 1.2741 D
based on pseudocomponent coding.

Table 5—Numerical Optimization via Desirability Analysis

	Goal	Low	High	Result	Desirability
Hiding power	max	9.93[c]	35.00[m]	11.02	0.08
Scrub loss	min	30.00[m]	108.00[c]	77.44	0.26
Cost	min	1.20[m]	2.06[c]	1.96	0.12

(c) Control Value
(m) Arbitrarily set near experimental minimum or maximum.

Overall Desirability = $\sqrt[3]{0.08 \times 0.26 \times 0.12} = 0.135$
At optimum component levels of:

13.67% A—Prime pigment (titanium dioxide)
33.71% B—Vehicle (latex emulsion)
48.62% C—Extender pigment 1
5.00% D—Extender pigment 2

Table 6—Confirmation of Hesler and Lofstrom's (H&L) Predicted Optimum

	Control	Predicted (by H&L)	Observed	Predicted (by A&W)
Hiding power	9.93	11.35	10.15	10.40
Scrub loss	108	16	52	58.6
Cost	$2.06	$2.01	$2.01	$2.01

H&L's "optimum formula" formula*:

15% A—Prime pigment (titanium dioxide)
39% B—Vehicle (latex emulsion)
41% C—Extender pigment 1
5% D—Extender pigment 2

*Note that this differs somewhat from Anderson and Whitcomb's (A&W) optimum formula (shown in *Table* 5).

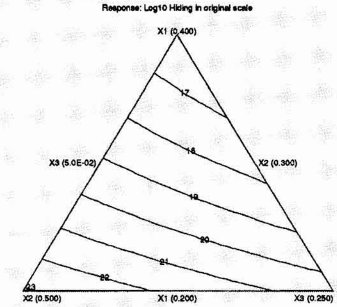


Figure 4—Contour plot of hiding power at 25% TiO_2.

DESIGN-EXPERT Plot—Model: Quadratic

Actual Components: X1 = Vehicle; X2 = Extender A; X3 = Extender B

Actual Constants: TiO2 = 0.2500

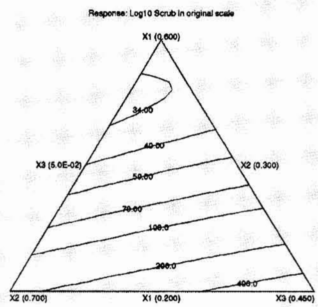


Figure 5—Contour plot of hiding power at scrub loss at 5% TiO_2.

DESIGN-EXPERT Plot—Model: Reduced Quadratic

Actual Components: X1 = Vehicle; X2 = Extender A; X3 = Extender B

Actual Constants: TiO_2 = 5.00E-02

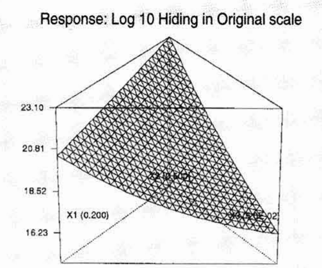


Figure 6—3-D view of hiding power at 25% TiO_2.

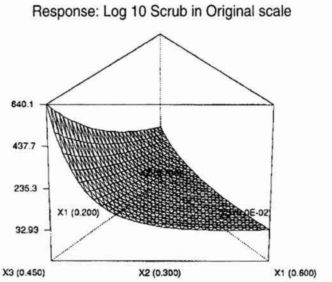


Figure 7—3-D view of scrub loss at 5%.

indicates that titanium dioxide makes a large positive impact. *Figure* 3 shows the trace plot for scrub loss. Titanium dioxide again makes an impact but in this case lower is better. The other three components show more effect on scrub loss than on hiding power.

Two-dimensional contour plots provide numerical predictions as a function of the component levels. Only three components can be displayed at once. Extra components must be "sliced." *Figure* 4 illustrates the 2D contour plot for hiding power sliced on titanium dioxide at 25%. Normally the choice of component for slicing should be based on the trace plots. It is best to plot the components that exhibit larger, non-linear effects and slice on the others. However, to maintain consistency with the plots originally produced by Hesler and Lofstrom, the plots in this paper are based on titanium dioxide as the constant. *Figure* 5 shows the contour plot for scrub loss with titanium dioxide held at a low level of five percent. Note that both plots provide predictions in the original scale, but they are based on the log mode shown in *Table* 3.

Three-dimensional views of these "slices," shown in *Figures* 6 and 7, provide valuable perspectives on the shape of the surfaces.

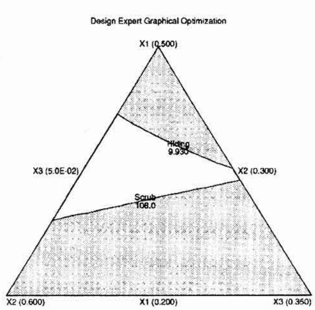


Figure 8—Graphical overlay contour plot (slice at titanium dioxide level of 15%).

Actual Components: X1 = Vehicle; X2 = Extender A; X3 = Extender B

Actual Constants: TiO_2 = 0.1500

They help the experimenter visualize the responses.

Multiple Response Optimization

The objective for optimization is to make a coating at least as good as the control (see *Table* 4) while minimizing cost. The cost equation indicates that the biggest savings will come from reduction of component A, the titanium dioxide. However, from the response plots, it appears that a compromise level of this component must be found. At low levels of titanium dioxide, the hiding power will be adversely affected, while at high levels the scrub loss becomes excessive. By overlaying the response plots for both measurements and shading out unsatisfactory regions, a "sweet spot" often emerges where all specifications are met. In this case a search of overlay plots for different levels of titanium dioxide reveals a slice at 15% with just such a sweet spot (see *Figure* 8). The operating window disappears at the lower level of five percent or higher level of 25% titanium dioxide.

As the number of components increases, it becomes more and more difficult to find the sweet spot, assuming one even exists. It becomes handy to use a numerical optimization approach with the aid of software. One popular method involves assigning desirability ratings on a scale from zero to one.[5,6] The procedure is fairly simple:

(1) Establish goals: minimize, maximize, or hit a target;

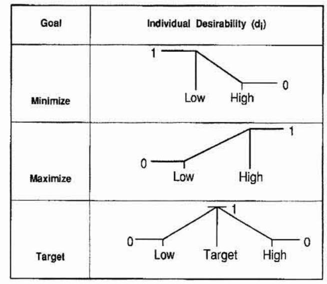
(2) Set threshold specifications, low and high;

(3) Use the criteria from steps one and two to rate desirability of each response from zero to one; and

(4) Search through experimental region for a set of predicted responses that gives maximum geometric mean desirability.

Figure 9 shows how to assign desirability ratings depending on the objective for any given response—minimize, maximize, or hit a target. The ramp functions need not be linear. They can be weighted so that desirability exhibits an exponential dependence on distance of the response from target. Note that using a geometric mean causes overall desirability (D) to be zero if any individual desirability (d) is zero, so all responses must conform to requirements.

The key to multiple response optimization is the development of a single objective function such as desirability. Then a search algorithm can be applied to find the optimum. A hill-climbing approach called variable-size simplex method works very well.[7] As illustrated in *Figure* 10, this method converges fairly quickly on the maximum desirability. The size of the simplex varies. It gets bigger when going uphill and contracts



$$D = (d_1 \otimes d_2 \otimes \ldots d_n)^{1/n} = (\prod d_i)^{1/n}$$

where D = Overall desirability

d = Individual desirability.

Figure 9—Desirability functions.

whenever it overshoots the mark.

Table 5 summarizes the result of a simplex optimization on the experiment by Hesler and Lofstrom. The resulting level of titanium dioxide falls relatively close to the 15% level found by the "hit or miss" approach using contour graphs. Overall desirability is not high, but this is not important. What matters is that the recommended component levels give the best predicted outcome relative to the specified goals. In this case one must make compromises because of the conflicting relations between responses.

Table 6 shows what Hesler and Lofstrom recommended for the optimal formulation. It is reasonably close to the recommendation given in *Table* 5. However, their predicted response agrees relatively poorly with the observed response. They did not take advantage of a response transformation, which enabled creation of a more accurate predictive model.

Summary

The use of statistical design principles of mixture experiments is now commonplace. For example, an article randomly selected

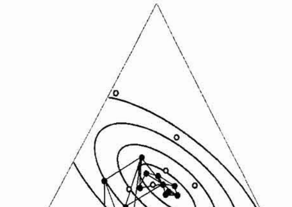


Figure 10—Optimization via variable-size simplex—open circles represent steps that were abandoned in favor of expanded or contracted vertices for the variable size simplex.

from a recent issue of this Journal included contour plots identical in nature to those illustrated.[8] State-of-the-art statistical methods, made easy with computer software, can yield an optimized coating formulation that meets specific performance criteria at minimum cost.

Acknowledgments

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Appendix 1—Derivation of Canonical Model* for Linear Blending with Two Components for Mixture Constraint: $X_1 + X_2 = 1$

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2$$

Replacing β_0 by $\beta_0 (x_1 + x_2)$ we get

$$Y = \beta_0 (x_1 + x_2) + \beta_1 x_1 + \beta_2 x_2$$

$$Y = (\beta_0 + \beta_1) x_1 + (\beta_0 + \beta_2) x_2$$

$$Y = \beta_1' x_1 + \beta_2' x_2$$

*The alternative is a slack mixture model:

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2$$

Replacing x_2 by $(1-x_1)$ we get

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 (1-x_1)$$

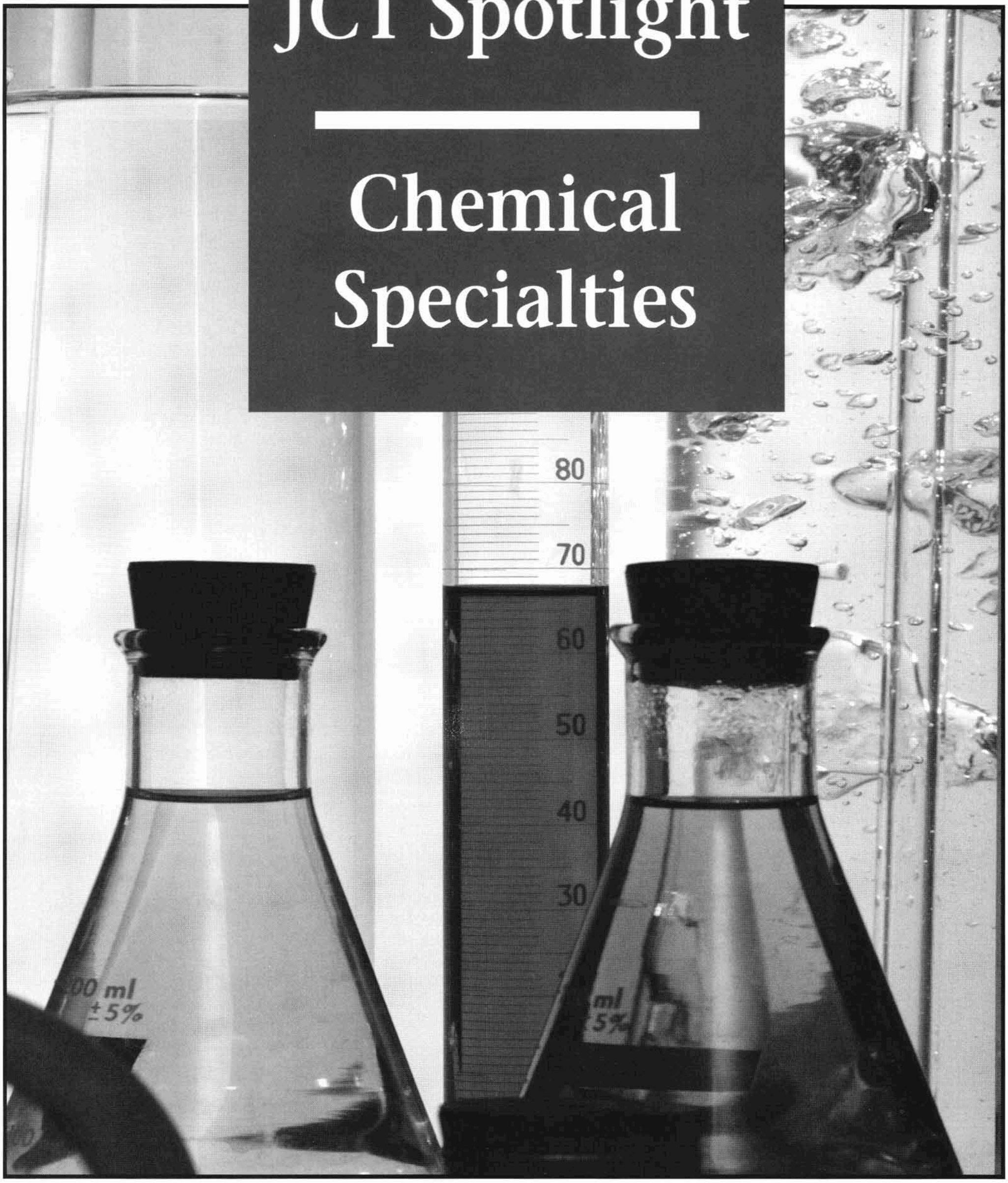
$$Y = \beta_0 + \beta x_1 + \beta_2 - \beta_2 x_1$$

$$Y = (\beta_0 + \beta_2) + (\beta_1 - \beta_2) x_1$$

$$Y = \beta_0' + \beta_1' x_1$$

JCT Spotlight

Chemical Specialties



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Additives—An Introduction

*There are many raw materials that are used to enhance final coating properties or aid in the successful manufacturing or application of the coating. The proper selection of additives and knowledge of their interaction with other materials is critical to the final coating. This Spotlight focuses on these diverse materials and provides a brief introduction to some of the additives used today.**

There are a multitude of additives on the market today from which a formulator may choose. Although they are key components in a coating, additives are difficult to define. Their functions vary from being very specific and somewhat independent of the other ingredients in the "can" to being multifunctional. Some additives, such as dispersing agents and defoamers, can be proprietary products with highly specific functions that work well in some systems but cannot be used in all systems. This makes general recommendations very difficult. Even more problematic are formulation substitutions. Often areas of function overlap and clear lines between functionality and the category of additive cannot be drawn. Occasionally, the use of one additive will demand the use of others to counter the effect of the first.

The key to formulating is to understand the function of an additive and its chemical or physical behavior in the presence of other components in the coating. This is not easy or simple.

Sometimes very minor amounts of some additives can have major effects on the coating and final film performance. The complexity of the coating raw materials—and what happens at the interfaces of each—is of critical importance.

Additive functions can generically be categorized into four main areas:

(1) *Preventative*—Prevents a potential problem such as mildew growth.

(2) *Corrective*—Corrects a problem in a coating e.g., use of a defoamer.

(3) *Quality aid*—Improves performance, such as with slip or mar aid.

(4) *Production aid*—Aids in manufacturing, e.g., dispersants to aid pigment dispersion.

Water-based additives are growing at a faster rate than solvent-based materials. This is not surprising because the regulatory climate has encouraged many people to change their operations based on compliant materials. Raw material suppliers are constantly responding to increased regulatory demands and providing materials, such as flatting agents, which are modified and improved for use in aqueous and high solids systems.

Latex systems are also difficult to formulate because of the wide variety of additives being used today. It is very difficult for formulators to keep up with the changing technologies and raw materials.

ABRASIVES & FILLERS

There are abrasives and fillers, which do not contain crystalline silica, that are especially designed for waterborne and standard solvent-borne coatings. These additives are ideal for areas needing anti-slip abrasives, such as floor coatings, or texturizer technology. Particle sizes can range from 0.8 mm to 45 microns (0.044 mm).

ADHESION PROMOTERS

Adhesion promoters are compounds that improve the adhesion of a polymeric film to an inorganic substrate. For metals in particular this is important because metals, as a class, are unstable. The pure metal is always oxidizing to the metal oxide on the surface of the metal substrate. Exposure to moisture, oxygen, and salts accelerate the process. Almost all coatings contain microvoids through which oxygen, small molecules like water, and ionic materials can diffuse. If the coating can remain bonded to the metal, then the damage done by these diffuse agents will be non-existent and corrosion can be prevented. It is, therefore, very important to do all that is possible to maximize adhesion.

For some materials this involves a mechanical roughening of the substrate surface to increase the surface area for physical absorption. Chemical pretreatments such as zinc/iron phosphate and various other materials have also been used because tightly bound phosphated surfaces will retard access to the metal and, therefore, impede corrosion.

Typically, organofunctional silanes have been used in coatings as adhesion promoters because they provide a polar functional group to contribute to increased bonding to a mineral substrate. They also are hydrolyzable and provide wetting ability and surface activity. The silanes react with the polymer and the substrate to form covalent bonds across the interface. Silane adhesion promoters are used in urethane, epoxy, acrylic, and latex systems.

Other adhesion promoters that are in the marketplace are titanates, zircoaluminates, zirconates, alkyl/aryl phosphate esters, and proprietary metal organic compounds. The silanes are moisture sensitive and will hydrolyze over time to silanols. Although this is not a problem in solvent-borne coatings systems, for waterborne systems this can cause difficulties.

The titanates and zirconates suffer from moisture sensitivity as well, so caution is necessary when using them with waterborne systems. Neo-alkoxy products are claimed to not have this problem. Alkyl/aryl phosphate esters, zircoaluminates, and the metal organic promoters are stable in waterborne coatings. The are quite different in chemical nature and, therefore, the formulator needs to evaluate them separately.

ANTI-SAG AND SETTLING

Anti-sag and settling agents are compounds that are used to increase the viscosity of paints, prevent sagging once applied, and retard pigment settling. Most of these materials impart a thixotropic rheology to the paint.

Treated clays are the main type of thixotropic agent used in alkyd systems. These are Bentonite clays which have been treated so that they build a gel structure by hydrogen bonding in the paint. They are either added into the mill base where the dispersion shear breaks the agglomerates, or added as a pre-gel. These clays of two types depending on whether or not they need a polar activator. The activators are usually alcohols. The choice of a clay is dependent on the system.

In many latex systems, structure is formulated into the coating and settling is not as much of a problem as in solvent systems. For some aqueous systems the choice of colloid is very important. A wide variety of thickeners are available for waterborne systems. Assistance should be sought from the supplier of these materials.

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* This introduction is exerpted from Sci*Quest*, a CD-ROM multimedia coatings tutorial, released by FSCT in 1995.

Sometimes various anti-settling agents are used in combination with others to achieve better results and properties. These types of additives affect viscosity at low shear rates and are also beneficial for flow control, anti-sagging, and pigment suspension.

ANTI-SKINNING

Alkyds dry through interaction with atmospheric oxygen, and the same reaction will take place on the surface of the paint in the can to form a skin. Anti-skinning agents are added to all alkyd paints to prevent this occurrence. These agents are oximes which complex the active driers in the formula so that the driers cannot function. Once the paint has been applied, the volatile oximes evaporate, allowing the drying process to begin. The standard anti-skinning agent is methyl ethyl ketoxime (MEKO); butyraldoxime and cyclohexanone oxime are also used. Cyclohexanone oxime has a special place in paints which require a very low odor. Phenol based antioxidants are also used in paints, but they can seriously retard the drying process. They are used in situations where the volatility of oximes would cause a problem such as in dip tanks.

Anti-skinning agents are used at about 10 times the cobalt or manganese level on resin solids. Thus, a paint containing 0.06% cobalt metal drier would use 0.6% MEKO on resin solids. This is approximately 0.2-0.3% on weight of paint.

ANTI-STATS

Anti-stats are static dissipative materials that can be blended internally with powder coatings to enhance the electrostatic spray characteristics of the coating and minimize dust attraction. This increases the transfer efficiency which improves penetration into corners and recesses. The anti-stats seem to have no adverse affect on the physical characteristics of the final powder coating such as: impact resistance, pencil hardness, gloss, gel time, color adhesion, cure time, salt spray, and condensing humidity. These agents are able to control gassing and minimize pinholing in the coating.

BIOCIDES

Because paints are largely organic in nature, they provide a source of food for microbial agents. Emulsifiers, thickeners, and other additives provide nutrients for support of microbial growth. As such, paints need to be protected from microbe attack. There are a number of microorganisms that the formulator needs to be conscious of when formulating paints. Sometimes the terminology of available is confusing: biocide, mildewcide, fungicide, algaecide (also spelled algicide), and so forth. Product literature and the suppliers will certainly assist in this regard. Many of these additives are multi-purpose and can curtail the growth of a number of organisms.

Biocidal agents are available to work both "in-the-can or batch" and in the dried film. For this reason, many manufacturers include a biocide (anti-microbial) agent in the formulation of the paint so that it can kill both bacteria and yeasts which can be present. If not corrected before they start, microorganisms can lead to the production of gases. This can occur in the container and result in can lids popping and cans distending, offensive odors, and loss of film and application properties.

In-Can Antimicrobial Agents

Bacteria and yeast organisms are often introduced to the paint during the manufacturing process. They can come from the raw material or from in-plant poor housekeeping practices. The solution is to add a biocide during manufacture to prevent in-can growth of undesirable organisms. The problem is more serious in the case of waterborne systems than it is for solvent systems as the presence of solvent tends to act as a deterrent for microorganism growth.

In-can preservatives for waterborne systems are used to protect latex coatings. Such coatings are susceptible to microbial attack because of the presence of biodegradable emulsifiers, stabilizers, and cellulosic thickeners, all of which can support of microbial growth.

In-can microbial growth is caused by bacteria, yeast, and contaminants in raw materials. The use of a biocide is necessary to kill bacteria and yeast that can cause problems in the can and in production. In-can preservative chemistries include: isothiazolinones, oxazolidines, formaldehyde donors, and metal pyridinethioloxide. These preservatives are bactericides and their dosage is typically ~ 0.1% or higher.

For an interior aqueous coating, usually only a preservative is needed. Exceptions are often made for bathrooms, kitchens, and laundry areas which tend to be more humid. Exterior coatings, however, need preservatives for in-can and the cured film.

Dry Film Antimicrobial Agents

The growth of organisms, such as mold, mildew, and algae is very undesirable from an appearance point of view. These organisms also cause the physical breakdown of the paint film which can lead to an increase in porosity of the surface of the film and a subsequent loss of adhesion to the substrate. Moisture also may contribute to the growth of fungus which can decay a wood substrate. Dry film preservatives that protect from mold, mildew, fungus, and algae are fungicides. Some of these agents serve as fungicide and mildewicide and have a broad range of biocidal properties against fungi, algae and wood destroying fungi. Typical agents are chlorothalonil, iodopropynybutyl carbamate, octyl isothiazolinone, zinc pyrithione (also known as zinc 2-pyridinethiol-1-oxide), and diiodomethyl-p-toylsulfonate.

Zinc oxide is used in combination with some of these agents and has been shown to have improved resistance to mildew growth.

Many commercial products are available as both dry powders and as aqueous dispersions. The dispersions are usually provided in regular or fine particle size grades; the finer grades tend to be more resistant to settling.

For use in architectural coatings, it is important that the fungicidal material have a low solubility in water so that it is not readily leached out of the paint film. It should also not cause any weathering effect such as fading, chalking, or discoloration.

DEFOAMERS

Although the terms defoamer and anti-foaming agent are often used interchangeably, they are not the same. A defoamer is a bubble breaker—it stops the foam and breaks the bubble once it has been formed. An anti-foaming agent prevents the formation of foam. Usually a good defoamer is a poor antifoaming agent; the reverse is also true.

Foam Formation

Pure water—or any pure liquid—does not foam. It is the additives (surfactants, dispersants, etc.) that enable foam to form.

Entrapped air, or foam, is introduced into the manufacture of most paints as part of the process. Manufacturing care must be taken to avoid entrapping air during production by choosing the correct stirring equipment and stir conditions. Letting the product stand for as long as possible is also helpful in preventing air entrapment.

There is a problem with high levels of foam that occur during the milling stage. Due to the activity of some surfactants at the air/water interface, foam is often created and stabilized in both the pre-mixing and milling chambers of dispersing equipment. Foam slows down the process of dispersion and adversely affects moisture resistance. Using silicone anti-foam agents presents additional potential for surface defects.

Foaming occurs during application of some degree depending on the method of application. For example, curtain coating carries entrapped air continuously around the system. Entrapped air also occurs with airless spray systems. Spray application in relatively low humidity conditions or in high temperatures can increase the tendency for foam entrapment.

Latex paints are stabilized with surfactants which easily generate foam under agitation. Elimination of this foam is essential for the manufacturing process, for storage, and for good application properties.

Bubble creation and retention is very common for waterborne systems because of the high levels of surfactants. Bubble release agents are available for aqueous and nonaqueous coating systems. They are very effective in water reducible and high solids systems.

A bubble, as a sphere, requires the least amount of surface energy. Large bubbles rise faster than small ones and collect on the surface. They are often covered by a surface film of surfactant or other additive in the coatings system. On the surface, the bubbles pack side by side as densely as possible. In some systems densely packed microfoam can form on the surface and remain there even after the film has cured.

In a waterborne formulations, the bubbles are surrounded with a microcoating of surfactant. As they attempt to rise to the surface of the film, the surfactant coated bubbles encounter resistance from doing so by a thin layer of resin that is between surfactant treated surfaces.

Gases are soluble in liquid media to different extents and are influenced by temperature. As the paint film starts to dry, the dissolved gases try to escape in the form of bubbles. In the process of escape, tiny pores may be formed in the film. This is extremely important in the case of applicators that are applying paint direct-to-metal surfaces where the possibility of corrosion may occur. For this reason deaeraters, used in combination with defoamers, should be used to produce a pore free film.

These types of foam bubbles must be eliminated to minimize surface defects and optimize the coating performance. Additives can destroy the foam produced, prevent its formation, or accelerate the ascent of isolated foam bubbles. Which type is chosen depends on the problem.

DISPERSANTS

A dispersant is used to help the suspension of fine particles of a solid in a liquid phase. It must be able to totally wet the solid particle and also be able to interact with the dispersing medium. Dispersants act by being absorbed on the surface of the pigment particles with the other end of the molecule exposed and usually charged. Since like charges repel, the individually coated pigment particles repel each other and stay uniformly dispersed. Because the individual pigments are all so chemically different—some are attracted to water and some are not—the dispersants have to be chemically different. When changing pigmentation in a formula, the dispersant needs to be checked quite carefully to see if it is stable in the particular formulation.

Pigment dispersants are necessary to improve the wetting of the pigment and enhance its suspension. The choice of dispersant depends on the nature of the pigments and if the coating is a waterborne or solvent-borne system. Dispersants are available for organic and inorganic pigment systems.

Because of their hydrophobic nature, organic pigments are difficult to disperse in aqueous media. Surface active compounds which are amphoteric in nature are usually effective for both organic and inorganic pigments that are particularly hydrophobic.

For aqueous systems, these agents (dispersants) must disperse the pigment and form an affiliation between the pigment and the dispersing medium which is water. There are several types of dispersants commonly used in latex paints. For example:

- Phosphates: Potassium tripolyphosphate and several sodium phosphates. The potassium salt is preferred because it is less soluble.
- Ionic types: The ones most commonly used are the sodium salts of water soluble polymers known as Tamol 731 or Colloid III.

Other ionic hydrophilic and lipophilic types are available on the market. The hydrophobic part of the molecule is attracted to the pigment particle and surrounds the particle with an ionic layer. Pigment separation by mutual repulsion takes place. These cannot be relied on for in-can stability and need to be used then with nonionic surfactants.

Ionic and anionic surfactants are also essential for good dispersion and contribute to the latex paint system by helping to optimize hiding power, flow, and leveling. The amount of dispersant used is very small and is directly related to the total surface area of the pigment used.

Pigments are usually easier to disperse in solvent-borne resin systems, however, higher solids systems will sometimes show pigment flocculation problems. Amphoteric diluents have been developed that are effective for preventing flocculation of carbon black and other organic and inorganic pigments in higher solids systems. These diluents have also been able to keep viscosity from increasing in some coatings where the polymer's solubility is causing rheology problems.

The most widely used wetting agents are primarily alcohol and alkyl phenol ethoxylates used alone or blended with anionic surfactants. Acetylenic diols are also sometimes added. The newest class of dispersing agents is known as the aromatic ethoxylates. This type of molecule contains a relatively larger anchor group that is a polycyclic aromatic structure. No amine or acidic groups are present, so the compound is pH neutral. Aromatic ethoxylates allow high pigment loading and do not tend to foam. Water resistance and gloss retention are both good.

Dispersing and wetting agents have a strong effect on the performance of the topcoat and primer. This is particularly true as formulators start to substitute components in a paint because of environmental regulations. Certain additives (e.g., nonionic surfactants) are not often used in a primer because of their decreased humidity and salt spray resistance.

For coatings intended for metal application, the formulator needs to be additionally concerned because most of the wetting/dispersing agents will have some effect on the anti-corrosive properties of the primer.

DRIERS

Driers are not the same as curing agents which chemically react with functional groups in the polymer. Driers are catalytic in nature and do not chemically react with the polymeric material. Driers promote or accelerate the drying, curing, or hardening of oxidizable coatings vehicles. The most common driers used in paints are metallic soaps of monocarboxylic acids.

Driers are metal carboxylates used as catalysts in the curing of coatings at ambient and elevated temperatures. The metal in all cases is the cation and has the capability of more than one oxidation state.

The drying of oil based paints occurs through a process which is characterized by oxygen absorption, followed by the formation of peroxide, and subsequent peroxide decomposition. The presence of driers in the paint accelerates the oxygen absorption and the resultant drying of the film.

Alkyds absorb oxygen into their double bonds, breaking those bonds to form free radicals which can undergo polymerization to give a dry film. Alkyds would dry to a soft film without driers over several days. Using driers we can have tack free times of a few hours and hard dry overnight.

Driers are the salts of organic acids (i.e., metal carboxylates), usually C_8-C_{10} branched acids, such as naphthenic acid and neo-decanoic acid. The choice of acid does not seem to have an effect on the drying. It primarily affects solubility, stability, and efficacy. The acid makes the metal soluble in the resin system. Insoluble salts, such as acetates or chlorides, do not function as driers. Drier levels are always expressed as percent metal on resin solids and are generally in the ranges of 0.01-0.6%.

Classification of Driers: Driers are classified as oxidation, polymerization or auxiliary catalysts. The oxidative driers (also known as primary driers or active driers) promote the absorption of oxygen by the film as well as catalyzing the formation and decomposition of peroxides. These driers promote the surface drying of a coating.

Active metals are those which promote the oxidation reaction. They are also referred to as "surface" or "top" driers. The auxiliary driers promote the polymerization reaction and are known as through-driers. It is common to use at least one active drier and one or more auxiliary driers. The proper balance of driers in an oxidation curing system is essential to stability, rate of cure, and development of film properties.

The main drier metals are:

Active— cobalt, manganese, iron, cerium, rare earths, vanadium, and accelerators

Auxiliary—lead, calcium, zirconium, zinc, barium, bismuth, and lithium.

EMULSIFIERS

Emulsifiers fall into the category of surface active materials—or surfactants. In general they are used to produce stable mixtures of two partially immiscible liquids. They promote the ease of mixing or dispersibility by lowering the surface tension of the liquid, much as a wetting agent lowers the surface tension of the liquid for application to a solid substrate.

Emulsifiers allow us to make water-in-oil (W/O) emulsions and oil-in-water (O/W) emulsions.

FLAME RETARDANTS

Combustion occurs when a substrate is heated to its flammable temperature in the presence of oxygen. As it is being heated, it starts to decompose, and, as it does so, it produces flames. Over the years we have become increasingly conscious of safety and concerned about the materials used in construction and finishing of buildings. This includes coatings.

The application of a flame retardant coating can help to reduce the combustibility of that coated surface. Usually coatings are made flame retardant by blending in additives. Many of the retardant additives are bromine containing, i.e., brominated diphenyl or diphenyl oxide compounds together with antimony trioxide. Also chlorinated paraffins have been added to latices to impart flame retardancy.

Zinc borate is used in many fire retardant and intumescent coatings usually in combination with chlorowax or some other halogenated source. Other fire retardant additives, such as antimony oxide and/or alumia trihydrate, are also used to provide synergism leading to a high degree of fire retardancy.

Certain monomers—copolymers of vinyl chloride and vinylidene chloride—tend to be less flammable then non-chlorinated monomers polymers, but because chlorine is less effective than bromine or phosphorous, additive flame retardants are still needed.

Work has also been done in the area using dibromostyrene-based latices. These are copolymers of dibromostyrene with various monomers depending on the desired T_g of the final coating. Dibromostyrene-based butadiene and acrylic latices have the desired physical properties for use in coatings, adhesives, and sealants.

FLASH RUST INHIBITORS

Flash rusting can sometimes be a problem in water based systems. To prevent flash rusting, proper control of pH is very important. In addition to pH control, the use of flash rust inhibitors such as sodium nitrate, sodium benzoate, barium metaborate, etc., in small quantities will eliminate and prevent a problem from occurring.

FLATTING AGENTS

A wide variety of natural and synthetic materials that are added to coatings to primarily affect gloss are called flatting agents. When light is reflected from a smooth surface, the surface appears to be glossy. When light is scattered as it hits the surface, instead of being reflected, a matte appearance will be created. Any tiny irregularities in a coating film will cause light to scatter. Flatting agents reduce gloss by imparting micro-roughness to the paint surface as it driers and cures. The rough surface diffuses light rather than reflecting it. The result to the eye is a matte surface. To add irregularity in the surface of the film and yet maintain smoothness, flatting agents are used.

Highly pigmented coatings often have low gloss because pigment particles protrude through the surface causing roughness. Gloss is usually measured at an angle of 60° from the horizontal. Many formulators use extender pigments for this purpose. Sometimes quite different agents—such as wood flour—are used to impart irregularity in the surface of the film rather inexpensively. Some flatting agents are sold with the direct intent of lowering gloss.

Formulation Considerations: Prior to determining which type of flatting agent to use, the surface smoothness, film clarity, and general appearance for the end user must be determined. Also the choice of flatting agent can make a significant difference in application characteristics such as visocisity, re-dispersion, and gloss stability.

Silicas: Silicas have typically been used as the flatting agents in the industry. Silicas can be used in solvent and aqueous systems and in virtually all types of resin systems: acrylics, vinyls, polyesters, nitrocellulosics, urethanes, and alkyds. The reduction of gloss can have a significant corresponding effect on increasing viscosity which makes the job of formulation sometimes difficult.

The synthetic silica flatting agents are used to produce low gloss finishes in organic solvent-borne systems, waterborne, and high solids coatings. Typically, waterborne finishes cannot withstand high shear which can destroy the emulsion and does cause foaming. So the flatting agent must be easy to wet out and incorporate into the coating under low shear conditions. Silicas are available as precipitated silica, fumed silica, diatomaceous silica and silica gels.

APPLICATIONS: Silicas are used in architectural coatings and varnishes, coil coatings and general industrial finishes, industrial wood finishes, topcoats and primers for corrosion resistance, and textured and suede effect finishes. Some coatings segments need very high quality synthetic silicas—coil coatings in particular.

Clear coatings for fine furniture and other wood products are flatted to obtain a satin finish. The satin finish is a desirable aesthetic feature, obtained by lowering the 60° gloss while maintaining a relatively high 85° gloss, or sheen. Clarity is a very important criteria for wood finishes and cannot be obtained with naturally occurring flatting agents, due to their high index of refraction compared to the resin system in the coating. This difference in refractive index creates internal haze. Therefore flatting agents must be used that have a similar refractive index to the resin system for both solvent and waterborne system. The silica gel technology enables these flatting agents to be used in waterborne clear wood satin finishes.

The clarity of the coating can be achieved by matching the refractive index of silica and the resin system and controlling the particle size. Surface treatments, or lack thereof, can influence this property significantly.

In waterborne coatings, settling is a bigger problem then for conventional solvent-borne systems. As such, wax treated silicas may sometimes be used because they provide better suspension properties. But great care has to be taken during the dispersion because if the wax is separated from the silica, it will tend to cause craters in the final film. For solvent-borne systems, silica dispersion is always post additive. Hydrous silica has water-filled pores and does not cause coagulation problems.

To incorporate porous silicas into waterborne systems, the silica should be prewet by dispersing in water, coalescents, cosolvents and thickeners prior to addition to the polymer dispersion.

For low energy cure systems (such as UV or EB) flatting is more difficult because it does not depend on solvent evaporation and film shrinkage. As a general rule, slow curing systems and slow response at the film surface will lead to a situation where flatting is easier.

FLOW MODIFIERS

Flow is a resistance to movement by a liquid material. Leveling is a measure of the ability of a coating to flow out after application so as to obliterate any surface irregularities such as brush marks, orange peel, craters and so forth.

Surface tension holds a liquid together and causes it to take the smallest possible volume. A drop of liquid on a solid surface will cover a larger or smaller area depending on both the surface tension of the liquid and the surface tension of the substrate. For example, a drop of water, which has high surface tension, will bead up as small as possible on a clean and waxed automobile. The same drop of water will tend to completely spread out and "wet" another portion of the automobile that is not so clean or waxed. A liquid will "wet" a substrate when the substrate has an equal or higher surface tension than the liquid itself. Sufficient wet film thickness is also important for a smooth surface.

Because of the recent advances in technology within the industry in areas of powder and waterborne systems, good flow is more important than ever. Many of the resins that are being introduced exhibit poor wetting and flow characteristics. This is such an important area because good flow is necessary to eliminate possible surface defects such as craters, fisheyes, orange peel, and pinholes.

Most surface defects develop during the application of the coating. Application methods can influence leveling. For instance, some brushes, rollers, and direct roller coaters can produce uneven surface films that require leveling for a smooth finish. Other methods that produce a smooth surface—spraying, curtain coatings, reverse roller coating—need to maintain that smoothness during the baking and curing process.

Leveling agents function by influencing the viscosity throughout the film. Solvents with good solvating power and a gradual evaporation rate influence the "open" time necessary for leveling. Leveling agents can also be pigment dispersants which function by preventing the flocculation of pigments.

Flow modifiers can differ greatly in their chemical structure and in their ability to affect surface tension and promote leveling within any given coating system. As such, they need to be evaluated in a formula at several different usage levels to determine the optimum level needed in any given formulation. Even more importantly, a given low agent's effectiveness will vary from system to system. The nature of the resin, other additives, and application technique will all affect the flow agent. For this reason great care must be taken when selection is made and laboratory work must be conducted to check on effectiveness and surface defects.

Flow agents are available for powder systems, solvent, and waterborne applications. The most commonly used flow agents are silicones, surfactants, fluorinated alkyl esters, solvents, and polyacrylates.

FREEZE-THAW STABILIZERS

Ethylene and propylene glycols are the most widely used. Propylene is preferred because of regulations. In specific formulations some of the glycol ethers (carbitols) can also act as freeze-thaw stabilizers. These are used where ethylene and propylene glycols have detrimental effects on rheology and/or gloss.

HINDERED AMINE LIGHT STABILIZERS

The UV absorbers are not able to absorb all of the UV light that a coating is exposed to. Some ultraviolet light will penetrate the coating surface. Because of this, UV stabilizers called hindered amine light stabilizers, or HALS, are incorporated into the coating. These molecules work by scavenging any free radicals that do form—this is different from UV absorbers which prevent their formation in the first place. HALS function by removing radicals from the system and subsequently regenerating themselves. Most formulators will use a combination of absorbers and HALS for this reason.

When selecting a HALS, the formulator must be very careful regarding the basicity of the compound. A basic HALS is capable of interacting with acid catalysts, metal catalysts, and even some organic pigments. In an acid catalyzed paint system the use of a basic HALS will have the effect of retarding the cure. For coatings systems like this, nonbasic hindered amines (such as a hindered amino ether) can be used.

Certain pigments, such as carbon black and titanium dioxide, absorb UV light and can increase the stability of the coating. But TiO_2 can also eject electrons and undergo a number of reactions to form free radicals. Again, this illustrates the wisdom of incorporating HALS into a formulation desired to withstand weathering and provide a quality coating.

HALS do not depend on the thickness of the sample for effectiveness. For this reason they are useful for substrates that have a high surface-to-volume ratio: thin coatings, multifilament and thin thermoplastic films. These additives are outstanding in their effectiveness of protecting and prolonging the coating in exterior exposures—particularly for polyolefins, polyurethanes and acrylics.

MAR AND SLIP AIDS

Waxes can provide a protective thin film and they can offer excellent slip and surface feel. There are many such additives available to the formulator today. We call them slip aids. Slip aids are available as solids or liquids. Solid additives are conventionally used in both dry, dispersed, and emulsion form.

WAXES: Solid slip aids are known as waxes. Some of these are naturally occurring products of animals such as beeswax. Some come from plants, for example, carnauba wax from the leaves of Brazilian palm trees is used as a polish for automobiles and floors. These waxes are "esters" of long chain fatty acids and alcohols. Specialty waxes are also available.

As a general rule, wax emulsions are added last in the coating formulation, although in each formula this should always be tested and not assumed because order of addition is always important in a formulation. Normally, levels of 3-5% was solids on a vehicle solids basis is used in coatings.

Modified names are used for other substances that have waxy properties. Paraffin wax is really a mixture of long chain hydrocarbons. It is one of the higher molecular weight petroleum distillates having 25-50 carbons; as such they are quite soluble in non-polar hydrocarbon solvents. The paraffin waxes are often used in solvent-borne wood coatings and stains.

Polyethylene waxes are unsaturated (containing carbon-carbon double bonds); paraffin waxes are saturated (having no double bonds). Polyethylene waxes are high molecular weight—generally between 1000 and 3000. These waxes are frequently used as anti-slip aids and mar aids because of their general insolubility. The polyethylene waxes can be used for most applications in both waterborne and solvent-borne systems. They are available as dispersions and emulsions in micronized or unground forms. The micronized have a very fine particle size and can easily be incorporated into the coating and applied by a spray gun.

Waxes are widely used in the coatings industry in a variety of systems, including inks, coatings, flexible packaging, stains, and lacquers.

Waxes decrease blocking so unwanted transfer or adhesion to a contacted surface is prevented. This can be very important for materials that are coated, dried and stacked for storage and shipping.

SILICONE ADDITIVES: Silicone additives show strong growth in paint and coatings formulations. There are silicone additives for both solvent and aqueous systems. Normally these are poly-dimethyl siloxanes. In general, silicone fluids exhibit the following properties:

- low surface tension
- water repellent behavior
- thermal resistance
- inhibit floating
- serve as flow aids
- improved gloss and surface smoothness
- an almost unchanged viscosity over a wide range of temperatures

Care must be taken in formulation not to cause instability problems.

Some reactive silicones can be incorporated into the resin to enhance gloss, adhesion, and mar resistance. These types of products are di-functional silicone polymers; both ends of each silicone chain are modified with an organic functional group capable of undergoing further reactions. For example, various polyalkyleneoxide-modified silicones allow the modified thickener to be water soluble, lower in surface tension and hydrophilic.

In summary, slip agents are available as solids or liquids. The liquid slip aids are usually either polydimethylsiloxane—either diluted with solvent, or in the form of an emulsion for use in waterborne systems. These silicones will migrate to the surface of the coating and impart excellent slip resistance and lubricity. If not properly used, they can also be the source of surface defects such as cratering. Loss of adhesion is also possible if other interfaces are affected.

MOISTURE SCAVENGERS

Moisture that gets trapped in a coating can have devastating effects on the appearance and performance of the film. Exterior coatings, in general, can have problems with moisture but certain coating applications are more sensitive to this than others. Applicators who are painting bridges, boats, offshore platforms, etc. are all concerned with moisture related problems if they are using moisture sensitive materials.

Moisture is introduced to the coating in the form of dissolved water in solvents and other raw materials. Often it is adsorbed water in fillers and pigments. For high solids coatings that can have a serious effect because these coatings systems are higher in solids content. Humidity is a big factor in creating problems for the applicator using two-component moisture sensitive urethanes.

For urethane coatings this is particularly important because the slightest trace of moisture can react with isocyanates to form carbon dioxide and amines. The amines in turn react with more isocyanate to form ureas.

Ureas affect different coatings in different ways. For one-component urethanes, the carbon dioxide that forms can cause the can to bulge or blow its lid. The formation of high molecular weight ureas will increase the in-can viscosity dramatically. Usually gelation occurs.

Low solids two-component systems are generally more forgiving to moisture contamination. Higher solids systems are not because the formed carbon dioxide gas cannot readily escape from the curing product. As a result, entrapped bubbles or pinholes appear which detract from system performance as well as appearance. This is especially true for higher build films that are usually found in industrial maintenance coatings.

The trend toward thicker films and faster curing polyurethane systems makes it more important that moisture be controlled. As solids increase it is difficult for carbon dioxide bubbles to reach the coating surface before the film cures.

For two-component high solids systems, carbon dioxide is not easily removed. Entrapped bubbles appear and pinholing becomes a problem. The reaction of isocyanate and condensed humidity forms microbubbles on the coating surface that reduces gloss.

For this reason, it is desirable to remove or eliminate water from the coating, and raw materials or substrate surface. This is usually accomplished by one of the following:

(1) *Molecular sieves*—they provide a physical trapping mechanism to isolate water in the formulation. The sieves are made from aluminum silicate spheres and have been successfully used

in many applications. They are not effective for high solids coatings.

(2) *Isocyanates*—also used with one component systems, but they create bubbles and, in general, can be safety hazards.Para-toluene sulfonylisocyanate has been used for this purpose.

(3) *Oxazolidines*—these ketone based compounds chemically react to eliminate water, thus bubble formation and subsequent down-glossing and hazing can be eliminated in two-component polyurethane coatings.

pH CONTROL AGENTS

The pH of a latex must be controlled within a certain range of stability. Organic amines are most commonly used, in particular: AMP-95 2-amino-2-methyl-1-propanol.

AMP is a multifunctional additive used as a pigment codispersant, a buffer, an emulsifying amine, and corrosion inhibitor. AMP-95 is often added to the letdown in paint manufacture for efficient low odor pH control. When used in the grind, it reduces dispersant demand; when used in conjunction with conventional dispersants, it improves color development and reduces foam.

Care must be exercised using slowly volatilizing amines such as AMP-95, because they can cause blocking, early water sensitivity, or after tack problems under poor drying conditions. In some circumstances, ammonia, TEA, or DEA are more suitable.

PLASTICIZERS

A plasticizer is a material which is used in the coatings industry to increase the flexibility or distensibility (elongation) of a polymer or coating. This can often be recognized in films as offering greater impact resistance, toughness, and adhesion. The organic plasticizers are usually moderately high molecular weight materials (liquids) or low melting solids. By imparting some degree of flexibility to the resin, film cracking can usually be minimized.

The mechanism(s) by which plasticizers actually work has been theorized by many. There is general belief that smaller molecules have a higher proportion of "free volume" surrounding them than larger polymeric structures which tend to be rather resistant to movement. By adding smaller, plasticizer molecules into the resin blend the free volume within the blend is increased and, thereby, permits easier internal motion of macromolecules—resulting in a more flexible film. The action of the plasticizer is such that it appears to actually solvate various points along the polymer chain. It is also felt that this is a very dynamic condition—the plasticizer molecules are attached to a given group and then are displaced and replaced by other groups and so forth.

The addition of a plasticizer lowers the softening point—T_g—of the resin. This can give elongation properties to the resin and subsequent coating, such that the film can withstand shock or impact resistance. Some emulsions are very hard and a plasticizer is required to assure proper film formation.

Primary plasticizers are those which are highly compatible with a given resin system. Secondary plasticizers are those which, upon aging, tend to form droplets or give internal cloudiness or bloom as a crystalline surface.

In general, the phthalic anhydride esters—or phthalates—have been used widely throughout the coatings industry as general purpose plasticizers. The most commonly known are the dibutyl phthalates and dioctyl phthalate. Obviously, a whole array of plasticizers exist and are chosen for use based on specific performance and/or price considerations.

In addition to cost and specific use performance, there should be some environmental consideration given when choosing a plasticizer.

In selecting the proper plasticizer for a given resin system, keep in mind that the following factors will influence the effectiveness of the plasticizer:

- presence or absence of specific functional groups in the resin
- polarity and hydrogen bonding ability of functional groups
- stearic hindrance
- molecular weight.

RHEOLOGY MODIFIERS

Rheology modifiers are often difficult for a formulator to appreciate and work with. They are necessary additives to prevent excessive sag during the application process, but they cannot add such a significant viscosity increase to the product that it affects the package viscosity.

Rheology control is particularly important in products that are sold to the do-it-yourself market. It is not uncommon for cans of house paint to stay on the shelf in smaller market areas for one or more years. Therefore, it becomes imperative that the formulation be such that the can will be free from pigment settling and will still apply properly.

Emulsion paints usually require the addition of thickeners so that the paint has the right application viscosity and so that the pigments and other particulates do not settle to the bottom.

These additives are carefully designed to promote high viscosity at low shear rates (i.e., in the can) and low viscosity at higher shear rates (during application). Very small amounts of additive are required to affect the rheological properties of a coating—generally we are looking at amounts from 0.1-1.5% by weight.

Rheological additives used to be easy to categorize into solvent and water based systems. With recent technological advances in waterborne additives, these categories are no longer logical as many of the thickeners are applicable to both water and solvent systems. Six types of thickener additives that are used to control rheological properties in coatings include cellulosics, associative thickeners, clays, fumed silica, acrylates, and Kevlar®.

SURFACTANTS

The term 'surfactant' is often used to include dispersants, emulsifiers, detergents, wetting agents, and defoaming agents. These categories have been treated individually within this Additive Section, but in each case we are really talking about "surface active materials."

Their use in waterborne coatings is widespread. Surfactants have long been used throughout the chemical industry to emulsify oil and water systems, as wetting agents, and for dispersion and defoaming applications.

It becomes difficult to define or categorize certain materials at times because the same chemical can be used as a dispersant in one case and as an emulsifier or wetting agent in another application. The roles of many of these materials overlap and complement each other.

Surfactants are chemical compounds that have one portion of the molecule which is hydrophilic (water loving) and another portion of the molecule which is hydrophobic (water hating). Usually the hydrophobic portion of the molecule will consist of long chain hydrocarbons such as fatty acids, straight, branched, or cyclic hydrocarbons, and aromatic hydrocarbons containing alkyl side chains.

These groups do not mix well with water. The hydrophilic portion of the molecule will contain functional groups which are attracted to the water molecule such as hydroxyl (alcohol), carboxylates, sulfonates, and sulfates.

Surface active agents affect the interfacial forces between materials. They modify the properties of liquid-liquid, liquid-gas, and liquid-solid interfaces by reducing the interfacial tension.

The effect of a surfactant is to lower the surface tension of the aqueous system and to concentrate at the air/liquid interface. Surfactants in waterborne systems generally have a great effect on reducing surface tension. Surfactants vary in their ability to generate foam and they are classified according to the type of charge in the molecule. The excessive use of surfactants in coatings is a contributing cause of unwanted foam. Surfactants generally fall within four categories: nonionic, anionic, cationic, and amphoteric.

Primary functions of surfactant in coatings comprise a minor component based on the total weight of the paint, and make a major contribution to the following properties: pigment wetting and dispersing, color development, washability and cleansability, foam properties, freeze-thaw stability, volatile organic content (VOC), and can stability.

UV ABSORBERS

A significant concern for all coatings manufacturers whose products are subject to exterior exposure is degradation by UV light. This problem can extend itself to the interior areas of a home where certain coatings may also be exposed to sunlight.

The ultraviolet region of the electromagnetic spectrum is divided into:

- near ultraviolet: 4,000-3,000 Angstroms; these wavelenghts are present in sunlight and are not visible to the human eye.
- middle ultraviolet: 3,000-2,000 Angstroms; these wavelengths are not present in sunlight as it reaches the earth's surface.
- long-ultraviolet: 2,000-100 Angstroms; this area borders on X-radiation.

All light sources to some degree emit ultraviolet wavelenghts. In general, the higher the temperature of the source, the shorter are the wavelengths produced. The sun emits very strongly throughout the ultraviolet region, but only the near ultraviolet reaches the surface of the earth. Wavelengths shorter than 2,900 Angstroms are absorbed by the ozone layer.

Although UV light represents only a small fraction of the light reaching the earth's surface, its damage is severe—particularly with coatings exposed to outdoor weathering. Most of the UV light is sufficiently energetic to break the covalent bonds in the polymer structure which holds the coating film together.

The polymeric resin in the coating film is subject to attack by UV light because of the organic nature of the polymer. Ultraviolet rays are readily absorbed by certain organic functional groups in particular. Excited to a higher energy state, free radicals are formed and the degradation process has begun.

Certain polymers have chromophores as part of the chemical structure of the polymer, aromatic resins in particular. However, even the polymers which do not contain chromophores as part of the polymer have enough added material in the formulation (crosslinking agents, pigments, catalysts, extenders, flow control agents, biocides, etc.) to cause the absorption of UV light and subsequent degradation. Just because chromophores are present in the molecular structure, and UV light is absorbed, does not necessarily mean that the bonds will dissociate and the polymer will degrade. It only means that the *potential* is there for destruction of the film.

Sunlight, oxygen, and water all work together to cause coating degradation of the polymer. In the process, free radicals are formed that react with atmospheric oxygen to generate peroxy radicals. These very quickly form hydroperoxides which in turn generate a radical on the polymer backbone itself. The weak hydroperoxide will cleave easily in the presence of heat and sunlight and produce more radicals. As this process occurs, the polymers mechanical and chemical structure is slowly degraded and broken down. We usually see this in the form of peeling, flaking, chalking and fading.

Absorption and degradation are very complicated processes.

All of the commercial UV absorbers and stabilizers that we use as additives act on the absortion or degradation process. The UV absorbers (known as UVAs for ultraviolet absorbers) prevent the excitation state by absorbing the UV light that would produce it. Absorbers today have good thermal stability and some have the capability of being crosslinked to the coating polymer. UVAs are designed such that they preferentially absorb UV light, dissipate the absorbed energy and do not cause degradation of the polymeric film.

UV absorbers compete for the incoming UV light with the polymer itself. The more effective the use of UVAs in an exterior coatings, the less prone the coating will be to the visual effects of UV degradation such as chalking, loss of gloss etc. UVAs depend on the thickness of the coating to be effective and are even more effective when used in combination with HALS.

WETTING AGENTS

Wetting agents are included in the broad classification of surface active materials (surfactants). Wetting is the process in which a liquid spreads over the substrate, which is usually a solid.

The term refers to those materials which lower the surface tension between the liquid coating which is to be applied and the substrate on which it is to be applied. A drop of water placed on a piece of metal will not "wet" the metal. This is because the surface tension of water is very high and some other chemical is needed to help wet the substrate surface. Because a particular surfactant is a good wetting agent for one substrate, does not mean that it will help to wet another substrate. This needs to be determined in the laboratory or by assistance from the supplier.

Wetting agents in solvent systems help to improve the dispersion of the pigment and to stabilize the system. Most pigments are surrounded by a thin layer of water. A wetting agent used in the dispersion helps to remove the water layer. The polar groups on the wetting agent take the place of the polar water molecule on the pigment surface. In so doing, the hydrophobic end of the wetting agent (or tail) is very compatible with the hydrophobic resin. In general, the anionic wetting agents are used with inorganic pigments and the non-ionic types are used with organic pigments. Wetting agents for solvent-borne coatings are anionic, cationic, neutral.

Attaining the right level of wetting agent is important because too much dispersant can cause flocculation. Flocculation can also occur if no dispersant is present and the pigment has not been properly wetted out. Without good wetting, high viscosity is apt to be present in the mill base, dispersion time will be long, and the finished coating may show flocculation of the pigment. In addition, settling may occur as well as poor tinting strength and a loss of gloss. In solvent systems only the pigment is dispersed; in a latex system both the pigment and binder are dispersed.

CHEMICAL SPECIALTIES SPOTLIGHT: supplier listing

ABCO Enterprises, Inc.
3450 Eagle Dr.
Allegan, MI 49010
Phone: (616) 673-5822
FAX: (616) 673-6005
Steve Melville, Technical Sales
- Printing Ink Dispersants & Vehicles

Aceto Corp.
One Hollow Ln.
Lake Success, NY 11042
Phone: (516) 627-6000
FAX: (516) 627-6093
Roy Goodman, Group Vice President
- Antioxidants
- Anti-Rust Agents
- Anti-Sagging Agents
- Catalysts
- Coalescing Agents
- Masking Agents & Re-Odorants
- Monomers
- Photocuring Materials/Photoinitiators
- Preservatives
- Thickening Agents
- UV Absorbers
- Water Treatment Chemicals

Air Products & Chemicals
7201 Hamilton Blvd.
Allentown, PA 18195
Phone: (610) 481-8932
FAX: (610) 481-2276
- Anti-Foaming Agents
- Catalysts
- Corrosion Inhibitors
- Dispersing Agents & Surfactants
- Ink Additives
- Printing Ink Dispersants & Vehicles
- Printing Ink Varnishes & Compounds
- Water Treatment Chemicals

Akcros Chemicals America
500 Jersey Ave.
New Brunswick, NJ 08903
Phone: (908) 247-2202
FAX: (908) 247-8416
James V. Parell, Business Mgr.; Donald G. Hampson, General Mgr.
- Adhesion Promoters
- Anti-Blocking Agents
- Anti-Floating Agents
- Anti-Flooding Agents
- Anti-Foaming Agents
- Anti-Settling Agents
- Anti-Skinning Agents
- Bodying Agents
- Catalysts
- Dispersing Agents & Surfactants
- Flocculants
- Light Stabilizers
- Monomers
- Plasticizers
- Preservatives
- Printing Ink Dispersants & Vehicles
- Reactive Diluents
- Stabilizers
- Stearates

Alco Chemical
Div. of National Starch & Chemical
P.O. Box 5401
Chattanooga, TN 37343
Phone: (423) 629-1405
FAX: (423) 698-8723
Wayne A. Kibble, Marketing Mgr.; Dan Verstrat, Technical Mgr.; Ron Swope, Application Specialist
- Anti-Settling Agents
- Bodying Agents
- Dispersing Agents & Surfactants
- Flow Control Agents
- Misc. Viscosity, Suspension and Flow Control Agents
- Suspension Agents
- Thickening Agents
- Thixotropic Agents
- Water Treatment Chemicals

Alcoa Industrial Chemicals
P.O. Box 300
Bauxite, AR 72011
Phone: (800) 860-3290
FAX: (501) 776-4717
A.J. Taliaferro, National Sales Mgr.
- Fillers—Natural, Cellulosic, Polymeric
- Flame and Smoke Retardants

Algan Products Business
Div. of BFGoodrich
16925 Park Circle Dr.
Chagrin Falls, OH 44023
Phone: (216) 543-9829
FAX: (216) 543-7523
Pearce Tye, Product Mgr.; Jay Friedman, Director of Sales and Marketing
- Driers
- Printing Ink Varnishes & Compounds
- Varnishes
- Waxes

American Casein Co.
109 Elbow Ln.
Burlington, NJ 08016-4123
Phone: (609) 387-3130
FAX: (609) 387-7204
Robert E. Ball, Technical Sales
- Adhesion Promoters
- Dispersing Agents & Surfactants
- Ink Additives
- Misc. Other Chemical Specialties
- Misc. Viscosity, Suspension and Flow Control Agents
- Printing Ink Dispersants & Vehicles
- Stabilizers
- Suspension Agents
- Thickening Agents

American Chemet Corp.
P.O. Box 437
Deerfield, IL 60015
Phone: (847) 948-0800
FAX: (847) 948-0811
Kim Klatt, Vice President, International; Skip Klatt, Vice President, Sales
- Preservatives

American Colors, Inc.
160 E. Market St.
Sandusky, OH 44879
Phone: (419) 621-4000
FAX: (419) 625-3979
Robert Bourne, Christie Cupp
- Misc. Other Chemical Specialties

ANGUS Chemical Co.
1500 Lake Cook Rd.
Buffalo Grove, IL 60089
Phone: (847) 215-8600
FAX: (847) 215-8626
- Amine Neutralizers
- Misc. Other Additives
- Preservatives
- Reactive Diluents

Arco Chemical Co.
3801 West Chester Pike
Newtown Square, PA 19073
Phone: (610) 359-2000
FAX: (610) 359-2841
- Adhesion Promoters
- Anti-Foaming Agents
- Dispersing Agents & Surfactants
- Glycols
- Misc. Other Chemical Specialties
- Misc. Viscosity, Suspension and Flow Control Agents
- Monomers
- Plasticizers

Astor Corp.
1425 Oakbrook Dr., Ste. 600
Norcross, GA 30093
Phone: (770) 448-8083
FAX: (770) 840-0954
- Abrasives/Anti-Skid
- Anti-Blocking Agents
- Ink Additives
- Printing Ink Varnishes & Compounds
- Surface Conditioners & Lubricants
- Waxes

Atomergic Chemetals Corp.
222 Sherwood Ave.
Farmingdale, NY 11735
Phone: (516) 694-9000
FAX: (516) 694-9177
- Antioxidants
- Corrosion Inhibitors
- Preservatives

BASF Corp.
3000 Continental Dr.
Mount Olive, NJ 07853
Phone: (800) 933-2273
FAX: (201) 426-3562
Brenda Hogan
- Light Stabilizers
- UV Absorbers
- Waxes

Buckman Laboratories, Inc.
1256 N. McLean Blvd.
Memphis, TN 38108
Phone: (901) 272-8304
FAX: (901) 726-5970
Charles E. Carncross, Vice President, Coatings & Plastics; Walt Conti
- Anti-Foaming Agents
- Anti-Rust Agents
- Catalysts
- Corrosion Inhibitors
- Flame and Smoke Retardants
- Flocculants
- Ink Additives
- Light Stabilizers
- Misc. Other Additives
- Misc. Other Chemical Specialties
- Preservatives
- Water Treatment Chemicals

BYK-Chemie USA
P.O. Box 5270
Wallingford, CT 06492
Phone: (203) 265-2086
FAX: (203) 284-9158
Robert McMullin, Business Mgr.
- Anti-Blocking Agents
- Anti-Floating Agents
- Anti-Flooding Agents
- Anti-Foaming Agents
- Anti-Sagging Agents
- Anti-Settling Agents
- Catalysts
- Dispersing Agents & Surfactants
- Ink Additives
- Surface Conditioners & Lubricants
- Thioxotropic Agents
- Suspension Agents

Calgon Corp.
P.O. Box 1346
Pittsburgh, PA 15234
Phone: (412) 494-8298
FAX: (412) 494-8688
George A. Weber, Technical Service Mgr., Bil Siefring
- Preservatives

Cardolite Corp.
500 Doremus Ave.
Newark, NJ 07105
Phone: (201) 344-5015
FAX: (201) 344-1197
Deidre G. Igo, Marketing Communications Mgr.
- Plasticizers
- Reative Diluents

Cargill, Inc.
P.O. Box 5694/MS 2
Minneapolis, MN 55440-5694
Phone: (800) 842-3631
FAX: (612) 742-6722
Bill Reutz, Dan Kovac, Annella Haegele
- Reactive Diluents

CasChem
40 Avenue A
Bayonne, NJ 07002
Phone: (800) CAS-CHEM
FAX: (201) 858-0308
- Catalysts
- Corrosion Inhibitors
- Flow Control Agents
- Misc. Viscosity, Suspension and Flow Control Agents
- Plasticizers
- Waxes

CCP
P.O. Box 419389
Kansas City, MO 64141-6389
Phone: (816) 391-6000
FAX: (816) 391-6141
M. Kaza, M. Riemann, M. Foster, J. Stadler, D. Arment, B. Brown
- Anti-Sagging Agents
- Flow Control Agents
- Misc. Other Additives
- Misc. Viscosity, Suspension and Flow Control Agents
- Printing Ink Dispersants & Vehicles
- Printing Ink Varnishes & Compounds
- Reactive Diluents
- Thixotropic Agents
- Varnishes
- Waxes

Chattem Chemicals, Inc.
3801 St. Elmo Ave.
Chattanooga, TN 37409
Phone: (423) 821-7616
FAX: (423) 825-0507
- Bodying Agents
- Catalysts
- Ink Additives
- Misc. Viscosity, Suspension and Flow Control Agents
- Thickening Agents
- Water Treatment Chemicals

Ciba-Geigy
540 White Plains Rd.
Tarrytown, NY 10591-9005
Phone: (914) 785-2000
FAX: (914) 785-3043
- Catalysts
- Corrosion Inhibitors
- Ink Additives
- Misc. Other Additives
- Photocuring Materials/Photoinitiators
- Stabilizers

Cortec Corp.
4119 White Bear Pkwy.
St. Paul, MN 55110
Phone: (612) 429-1100
FAX: (612) 429-7122
- Anti-Rust Agents
- Corrosion Inhibitors
- Ink Additives
- Misc. Other Additives
- Misc. Other Chemical Specialties
- Preservatives

CPS Chemical Company, Inc.
123 White Oak Ln.
Old Bridge, NJ 08857
Phone: (908) 607-2700
FAX: (908) 607-2562
- Flocculants
- Misc. Other Additives
- Misc. Other Chemical Specialties
- Monomers
- Photocuring Materials/Photoinitiators
- Water Treatment Chemicals

CR Minerals Corp.
14142 Denver West Pkwy., Ste. 101
Golden, CO 80401
Phone: (303) 278-1706
FAX: (303) 278-7729
Laura M. Banks; Arlen Cornett
- Fillers—Natural, Cellulosic, Polymeric
- Flatting Agents

Crosfield Co.
101 Ingalls Ave.
Joliet, IL 60435
Phone: (815) 727-3651
FAX: (815) 727-5312
Todd Ryne, Business Mgr.
- Anti-Blocking Agents
- Flatting Agents

CYTEC Industries, Inc.
Five Garret Mountain Plaza
W. Paterson, NJ 07424
Phone: (201) 357-3276
FAX: (201) 357-3065
- Adhesion Promoters
- Antioxidants
- Catalysts
- Dispersing Agents & Surfactants
- Flame and Smoke Retardants
- Flocculants
- Ink Additives
- Light Stabilizers
- Misc. Other Chemical Specialties
- Monomers
- Photocuring Materials/Photoinitiators
- Plasticizers
- Printing Ink Dispersants & Vehicles
- Stabilizers
- Static Preventive
- UV Absorbers

Daniel Products Co., Inc.
400 Claremont Ave.
Jersey City, NJ 07304
Phone: (201) 432-0800
FAX: (201) 432-0266
Martin L. Feldman, Vice President, Marketing; Michael C. Frantz, Vice President, Sales
- Anti-Blocking Agents
- Anti-Floating Agents
- Anti-Flooding Agents
- Anti-Foaming Agents
- Anti-Settling Agents
- Bodying Agents
- Dispersing Agents & Surfactants
- Driers
- Flatting Agents
- Flow Control Agents
- Ink Additives
- Misc. Other Additives
- Misc. Other Chemical Specialties
- Misc. Viscosity, Suspension, and Flow Control Agents
- Printing Ink Dispersants & Vehicles
- Surface Conditioners & Lubricants
- Suspension Agents
- UV Absorbers
- Waxes

Day-Glo Color Corp.
4515 St. Clair Ave.
Cleveland, OH 44103
Phone: (216) 391-7070
FAX: (216) 391-7751
Jon Aber, Marketing Mgr.
- Polymeric Pigments
- Printing Ink Dispersants & Vehicles
- Printing Ink Varnishes & Compounds

The Degen Co.
200 Kellogg St.
P.O. Box 5240
Jersey City, NJ 07305
Phone: (201) 432-1192
FAX: (201) 432-8483
- Plasticizers
- Printing Ink Dispersants & Vehicles
- Printing Ink Varnishes & Compounds

Dock Resins Corp.
1512 W. Elizabeth Ave.
Linden, NJ 07036
Phone: (908) 862-2351
FAX: (908) 862-4015
- Flow Control Agents

CHEMICAL SPECIALTIES SPOTLIGHT: supplier listing

Dominion Colour Corp.
19 East 5th St.
Paterson, NJ 07524
Phone: (201) 278-0206
FAX: (201) 742-0166
- Anti-Settling Agents
- Corrosion Inhibitors
- Dispersing Agents & Surfactants
- Driers
- Glycols
- Homogenizers
- Plasticizers
- Polymeric Pigments
- Stabilizers
- UV Absorbers

Dover Chemical Corp.
3676 Davis Rd., NW
Dover, OH 44622
Phone: (800) 321-8805
FAX: (330) 364-1579
- Antioxidants
- Corrosion Inhibitors
- Dispersing Agents & Surfactants
- Flame and Smoke Retardants
- Misc. Other Additives
- Misc. Other Chemical Specialties
- Preservatives

The Dow Chemical Co.
P.O. Box 1206
Midland, MI 48641-1206
Phone: (800) 447-6369
FAX: (517) 832-1465
- Adhesion Promoters
- Caustics and Caustic Sodas
- Coalescing Agents
- Dispersing Agents & Surfactants
- Fillers—Natural, Cellulosic, Polymeric
- Freeze Thaw Stabilizers
- Glycerine
- Glycols
- Misc. Other Chemical Specialties
- Preservatives
- Water Treatment Chemicals

Dow Corning Corp.
P.O. Box 0994
Midland, MI 48686-0994
Phone: (517) 496-4000
FAX: (517) 496-4586
- Adhesion Promoters
- Anti-Blocking Agents
- Anti-Floaming Agents
- Catalysts
- Dispersing Agents & Surfactants
- Ink Additives
- Surface Conditioners & Lubricants
- Water Repellents—Silicone, Corrosion Inhibitors

Dry Branch Kaolin Co.
Route 1, Box 468-D
Dry Branch, GA 31020
Phone: (912) 750-3500
FAX: (912) 746-0217
- Abrasives/Anti-Skid
- Fillers—Natural, Cellulosic, Polymeric
- Flatting Agents
- Ink Additives

DuPont
1007 Market St., B14374
Wilmington, DE 19898
Phone: (302) 774-0542
Roger Decker
- Abrasives/Anti-Skid

Dynamic Color Solutions
2024 S. Lenox St.
Milwaukee, WI 53207
Phone: (800) 657-0737
FAX: (414) 769-2585
Cathy Higgins, Vice President, Sales & Marketing
- Misc. Other Additives

Eagle Zinc Co.
Div. of T.L. Diamond & Co., Inc.
30 Rockefeller Plaza
New York, NY 10112
Phone: (212) 582-0420
FAX: (212) 582-3412
Allen S. Perl, Vice President
- Misc. Other Additives
- Misc. Other Chemicals Specialties
- Preservatives

Eastman Chemical Company
Coatings, Inks & Resins Div.
P.O. Box 431
Kingsport, TN 37662-5280
Nancy Gilley, Printing Ink Products; Pam Bradshaw, Coating Products
- Adhesion Promoters
- Anti-Sagging Agents
- Coalescing Agents
- Flow Control Agents
- Glycols
- Ink Additives
- Misc. Other Additives
- Misc. Other Chemical Specialties
- Misc. Viscosity, Suspension and Flow Control Agents
- Monomers
- Plasticizers
- Printing Ink Dispersants & Vehicles
- Printing Ink Varnishes & Compounds
- Thickening Agents
- Waxes

Elf Atochem North America, Inc.
2000 Market St.
Philadelphia, PA 19103
Phone: (215) 419-7000
FAX: (215) 419-7930
- Adhesion Promoters
- Catalysts
- Caustics and Caustic Sodas
- Corrosion Inhibitors
- Flame and Smoke Retardants
- Misc. Other Additives
- Misc. Other Chemical Specialties
- Plasticizers
- Preservatives
- Stabilizers
- Stearates

EM Industries, Inc.
7 Skyline Dr.
Hawthorne, NY 10532
Phone: (914) 592-4660
FAX: (914) 592-9469
Suzanne Bernardi, Marketing Mgr.
- Ink Additives

Engelhard Corp.
Pigments and Additives Group
101 Wood Ave.
Iselin, NJ 08830
Phone: (908) 205-5000
FAX: (908) 321-0250
Lisa Karasic, Marketing Communication Mgr.
- Fillers—Natural, Cellulosic, Polymeric

EXXON CHEMICAL
13501 Katy Freeway
Houston, TX 77079
Phone: (713) 584-7600
- Coalescing Agents
- Plasticizers
- Printing Ink Dispersants & Vehicles
- Reactive Diluents

The Feldspar Corporation
A Subsidiary of Zemex Industrial Minerals
1040 Crown Pointe Pkwy.
Atlanta, GA 30338
Phone: (770) 392-8660
FAX: (770) 392-8670
Kurt Weitz, Technical Director
- Abrasives/Anti-Skid
- Dispersing Agents & Surfactants
- Fillers—Natural, Cellulosic, Polymeric
- Misc. Other Additives

Floridin Co.
1101 N. Madison St.
Quincy, FL 32312
Phone: (904) 627-7688
FAX: (904) 875-1757
Dave Ruff, General Mgr.; John Wolford, General Sales Mgr.
- Anti-Sagging Agents
- Anti-Settling Agents
- Fillers—Natural, Cellulosic, Polymeric
- Flow Control Agents
- Misc. Viscosity, Suspension and Flow Control Agents
- Suspension Agents
- Thickening Agents
- Thixotropic Agents

Franklin Industrial Minerals
612 10th Ave., N.
Nashville, TN 37203
Phone: (615) 259-4222
FAX: (615) 726-2693
Robert C. Freas, Sr. Vice President, Marketing; David Puryear, Vice President, Sales
- Fillers—Natural, Cellulosic, Polymeric
- Flame and Smoke Retardants
- Misc. Other Additives

Fuji Silysia Chemical, Ltd.
121 SW Morrison St., Ste. 865
Portland, OR 97204
Phone: (503) 295-1933
FAX: (503) 295-1832
Brad Schmitt, Technical Rep.; Rod Hughes
- Anti-Blocking Agents
- Flatting Agents

Garrison Industries, Inc.
181 Cooper Dr.
El Dorado, AR 71730
Phone: (501) 862-5692
FAX: (501) 862-9628
- UV Absorbers

GE Specialty Chemicals
501 Avery St.
Parkersburg, WV 26105
Phone: (304) 424-5698
FAX: (304) 424-5871
Dan Fox; Gina Harm
- Antioxidants
- Misc. Other Additives
- Misc. Other Chemical Specialties
- Stabilizers

BFGoodrich
9911 Brecksville Rd.
Cleveland, OH 44141
Phone: (216) 447-5000
FAX: (216) 447-5770
John Falsone; Jim Paperfuss; Dennis O'Toole
- Anti-Foaming Agents
- Dispersing Agents & Surfactants
- Flatting Agents
- Flow Control Agents
- Ink Additives
- Misc. Other Additives
- Misc. Other Chemical Specialties
- Misc. Viscosity, Suspension and Flow Control Agents
- Plasticizers
- Printing Ink Dispersants & Vehicles
- Printing Ink Varnishes & Compounds
- Surface Conditioners & Lubricants
- Suspension Agents
- Thickening Agents
- Varnishes
- Water Treatment Chemicals

Grace Davison
P.O. Box 2117
Baltimore, MD 21203-2117
Phone: (410) 659-9000
FAX: (410) 659-9213
J.A. Chwirut, Marketing Mgr., Coatings Products
- Anti-Blocking Agents
- Corrosion Inhibitors
- Flatting Agents
- Misc. Other Additives
- Misc. Viscosity, Suspension and Flow Control Agents
- Texturizers

C.P. Hall Company
311 S. Wacker Dr., Ste. 4700
Chicago, IL 60606
Phone: (312) 554-7400
FAX: (714) 554-7499
- Adhesion Promoters
- Anti-Foaming Agents
- Antioxidants
- Coalescing Agents
- Dispersing Agents & Surfactants
- Fillers—Natural, Cellulosic, Polymeric
- Flame and Smoke Retardants
- Glycerine
- Glycols
- Homogenizers
- Ink Additives
- Light Stabilizers
- Misc. Other Additives
- Misc. Other Chemical Specialties
- Misc. Viscosity, Suspension, and Flow Control Agents
- Plasticizers
- Printing Ink Dispersants & Vehicles
- Reactive Diluents
- Stabilizers
- Stearates
- Surface Conditioners & Lubricants
- Suspension Agents
- UV Absorbers
- Water Repellents—Silicone, Corrosion Inhibitors
- Water Treatment Chemicals
- Waxes

Henkel Corporation
300 Brookside Ave.
Ambler, PA 19002
Phone: (215) 628-1000
FAX: (215) 628-1111
- Anti-Floating Agents
- Anti-Foaming Agents
- Anti-Rust Agents
- Anti-Sagging Agents
- Anti-Settling Agents
- Flow Control Agents
- Glycerine
- Ink Additives
- Photocuring Materials/Photoinitiators
- Preservatives
- Thixotropic Agents

Hercules Incorporated
Div. of Aqualon
1313 N. Market St.
Wilmington, DE 19894
Phone: (302) 594-6653
FAX: (302) 594-6662
- Bodying Agents
- Flow Control Agents
- Ink Additives
- Misc. Other Chemical Specialties
- Misc. Viscosity, Suspension and Flow Control Agents
- Printing Ink Dispersants & Vehicles
- Suspension Agents
- Thickening Agents
- Thixotropic Agents

Hickson Specialties Inc.
1955 Lake Park Dr.
Smyrna, GA 30080
Phone: (800) 449-1204
FAX: (770) 801-1560
Carl Talbot; Stan Schwartz
- Abrasives/Anti-Skid
- Anti-Foaming Agents
- Dispersing Agents & Surfactants

Hitox Corp.
P.O. Box 2544
Corpus Christi, TX 78403
Phone: (512) 883-5591
FAX: (512) 883-7619
- Fillers—Natural, Cellulosic, Polymeric
- Flame and Smoke Retardants

Hoechst Celanese Corp.
5200 77 Center Dr.
Charlotte, NC 28217
Phone: (704) 559-6038
FAX: (704) 559-6780
Helmut Ricke, Marketing Mgr., Polymer Additives
- Flame and Smoke Retardants
- Ink Additives
- Light Stabilizers
- Printing Ink Dispersants & Vehicles
- Static Preventive
- UV Absorbers
- Waxes

HÜLS AMERICA, INC.
220 Davidson Ave.
Somerset, NJ 08873
Phone: (800) FOR-HULS
- Adhesion Promoters
- Anti-Floating Agents
- Anti-Flooding Agents
- Anti-Foaming Agents
- Anti-Rust Agents
- Anti-Sagging Agents
- Anti-Settling Agents
- Anti-Skinning Agents
- Bodying Agents
- Catalysts
- Coalescing Agents
- Dispersing Agents & Surfactants
- Driers
- Flocculants
- Flow Control Agents
- Misc. Other Additives
- Misc. Viscosity, Suspension and Flow Control Agents
- Preservatives
- Thickening Agents
- Thixotropic Agents
- Water Repellents—Silicone, Corrosion Inhibitors

Interfibe Corp.
6001 Cochran Rd., Bldg. A, Ste. 202
Solon, OH 44139
Phone: (216) 248-2266
FAX: (216) 248-2132
Richard Karnemaat, Technical Director; Chris Sullivan, V.P. Marketing; John Sullivan, V.P. Sales
- Misc. Viscosity, Suspension and Flow Control Agents

International Specialty Products
1361 Alps Rd.
Wayne, NJ 07470
Phone: (201) 628-4000
FAX: (201) 628-4117
Mike Nickerson, Filters; Steve Hinden, Preservatives; Sotiri Papoulias, Coatings; Mary Davis, UV Absorbers
- Adhesion Promoters
- Dispersing Agents & Surfactants
- Ink Additives
- Light Stabilizers
- Misc. Other Additives
- Misc. Other Chemical Specialties
- Monomers
- Polymeric Pigments
- Preservatives
- Printing Ink Dispersants & Vehicles
- Reactive Diluents
- Stabilizers
- Thickening Agents
- UV Absorbers

Ishihara Corp. (USA)
600 Montgomery St.
San Francisco, CA 94111
Phone: (415) 421-8207
FAX: (415) 397-5403

CHEMICAL SPECIALTIES SPOTLIGHT: supplier listing

Keiko Watts, Marketing Mgr.
- Catalysts
- Ink Additives
- Static Preventive

Jarchem Industries Inc.
414 Wilson Ave.
Newark, NJ 07105
Phone: (201) 344-0600
FAX: (201) 344-5743
- Acids (Non-Fatty)
- Dispersing Agents & Surfactants
- Driers
- Flocculants
- Flow Control Agents
- Freeze Thaw Stabilizers
- Glycerine
- Ink Additives
- Misc. Other Additives
- Misc. Other Chemical Specialties
- Misc. Viscosity, Suspension and Flow Control Agents
- Monomers
- Photocuring Materials/Photoinitators
- Plasticizers
- Preservatives
- Printing Ink Dispersants & Vehicles
- Reactive Diluents
- Stabilizers
- Surface Conditioners & Lubricants
- Suspension Agents
- Water Repellents—Silicone, Corrosion Inhibitors
- Waxes

SC Johnson Polymer
1525 Howe St.
Racine, WI 53403
Phone: (414) 631-4353
FAX: (414) 631-4079
- Dispersing Agents & Surfactants
- Ink Additives
- Printing Ink Dispersants & Vehicles
- Waxes

Kenrich Petrochemicals, Inc.
140 East 22nd St.
Bayonne, NJ 07002
Phone: (201) 823-9000
FAX: (201) 823-0691
- Adhesion Promoters
- Anti-Rust Agents
- Anti-Settling Agents
- Catalysts
- Corrosion Inhibitors
- Dispersing Agents & Surfactants
- Ink Additives
- Misc. Other Additives
- Misc. Viscosity, Suspension and Flow Control Agents
- Plasticizers
- Reactive Diluents
- Static Preventive
- Suspension Agents

Keystone Aniline Corp.
2501 W. Fulton St.
Chicago, IL 60612
Phone: (312) 666-2015
FAX: (312) 666-8530
- Polymeric Pigments

Kraft Chemical Co.
1975 N. Hawthorne Ave.
Melrose Park, IL 60160
Phone: (708) 345-5200
FAX: (708) 345-4005
Ron Weiland, Sales Mgr.; Stanton Lewis, Industry Mgr.
- Anti-Foaming Agents
- Anti-Rust Agents
- Anti-Sagging Agents
- Caustics and Caustic Sodas
- Corrosion Inhibitors
- Dispersing Agents & Surfactants
- Fillers—Natural, Cellulosic, Polymeric
- Flame & Smoke Retardants
- Flocculants
- Glycerine
- Misc. Other Additives
- Misc. Other Chemical Specialties
- Plasticizers
- Preservatives
- Stearates
- Thickening Agents
- Thixotropic Agents
- Water Repellents—Silicone, Corrosion Inhibitors
- Water Treatment Chemicals
- Waxes

Lawter International
990 Skokie Blvd.
Northbrook, IL 60062
Phone: (847) 498-4700
FAX: (847) 498-0066
- Adhesion Promoters
- Ink Additives
- Polymeric Pigments
- Printing Ink Dispersants & Vehicles
- Printing Ink Varnishes & Compounds
- Waxes

Lubrizol
29400 Lakeland Blvd.
Wickliffe, OH 44092
Phone: (216) 943-1200
FAX: (216) 943-5337
Jim Stephanadis; Howard Brake
- Adhesion Promoters
- Anti-Blocking Agents
- Anti-Floating Agents
- Anti-Flooding Agents
- Anti-Sagging Agents
- Anti-Settling Agents
- Corrosion Inhibitors
- Dispersing Agents & Surfactants
- Flow Control Agents
- Monomers
- Surface Conditioners & Lubricants
- Thickening Agents
- Thixotropic Agents

3M/Specialty Chemicals
3M Center, Bldg. 223 6S-04
St. Paul, MN 55144
Phone: (612) 733-3112
FAX: (612) 736-8643
Judy Dow-Grant, Marketing Mgr.; Todd Duvick
- Acids (Non-Fatty)
- Catalysts
- Dispersing Agents & Surfactants
- Ink Additives
- Photocuring Materials/Photoinitiators
- Static Preventive

Magnesium Elecktron Inc.
500 Point Breeze Rd.
Flemington, NJ 08822
Phone: (800) 366-9596
FAX: (800) 782-5883
- Adhesion Promoters
- Anti-Blocking Agents
- Catalysts
- Driers
- Ink Additives
- Thickening Agents

Meadowbrook Co.
Div. of T.L. Diamond & Co., Inc.
30 Rockefeller Plaza
New York, NY 10112
Phone: (212) 582-0420
FAX: (212) 582-3412
Allen S. Perl, Vice President
- Corrosion Inhibitors
- Misc. Other Additives
- Misc. Other Chemical Specialties
- Preservatives

Michelman
9080 Shell Rd.
Cincinnati, OH 45236
Phone: (513) 793-7766
FAX: (513) 793-2504
Marty Riehmann, Sales Manager
- Anti-Blocking Agents
- Corrosion Inhibitors
- Ink Additives
- Surface Conditioners & Lubricants
- Water Repellents—Silicone, Corrosion Inhibitors
- Waxes

Micro Powders, Inc.
580 White Plains Rd.
Tarrytown, NY 10591
Phone: (914) 793-4058
FAX: (914) 472-7098
Warren Pushaw, Technical/Sales; David Gittleman, Quality Control
- Abrasives/Anti-Skid
- Anti-Blocking Agents
- Anti-Settling Agents
- Flatting Agents
- Ink Additives
- Surface Conditioners & Lubricants
- Texturizers
- Waxes

Mineral Pigments
12116 Conway Rd.
Beltsville, MD 20705
Phone: (301) 210-3400
FAX: (301) 210-4967
Dave Murphy, Sales Mgr.; John Kurnas
- Anti-Rust Agents
- Corrosion Inhibitors

Mississippi Lime Co.
7 Alby St.
P.O. Box 2247
Alton, IL 62002-2247
Phone: (800) 437-5463
FAX: (618) 465-7786
David F. Viox, Sales & Marketing Mgr.
- Fillers—Natural, Cellulosic, Polymeric

NYCO® Minerals, Inc.
124 Mountain View Dr.
Willsboro, NY 12996
Phone: (518) 963-4262
FAX: (518) 963-4187
Lauri Heald, Customer Support Rep.
Fillers—Natural, Cellulosic, Polymeric
Misc. Other Additives

Occidental Chemical Corp.
P.O. Box 809050
Dallas, TX 75380-9050
Phone: (214) 404-4198
FAX: (214) 448-6676
David Graham, Business Mgr. OXSOL
Caustics and Caustic Sodas
Flame and Smoke Retardants
Glycols
Misc. Other Chemical Specialties

OMG Americas
2301 Scranton Rd.
Cleveland, OH 44113
Phone: (216) 781-8383
FAX: (216) 781-5919
Antioxidants
Anti-Settling Agents
Anti-Skinning Agents
Catalysts
Driers
Ink Additives
Stabilizers
Thickening Agents

Penta Manufacturing Co.
P.O. Box 1448
Fairfield, NJ 07007
Phone: (201) 740-2300
FAX: (201) 740-1839
George M. Volpe, Senior VP; Mark J. Esposito
Acids (Non-Fatty)
Antioxidants
Anti-Rust Agents
Anti-Skinning Agents
Corrosion Inhibitors
Driers
Glycerine
Glycols
Light Stabilizers
Masking Agents & Re-Odorants
Misc. Other Additives
Misc. Other Chemical Specialties
Plasticizers
Stearates
UV Absorbers

Petrolite Corp.
6910 E. 14th St.
Tulsa, OK 74112
Phone: (800) 331-5516
FAX: (918) 834-9718
Rodney Foster
Dispersing Agents & Surfactants
Ink Additives
Waxes

Phenoxy Associates
800 Cel River Rd.
Rock Hill, SC 29730
Phone: (803) 328-3825
FAX: (803) 328-3827
Steve Lustig, Commercial Director
Adhesion Promoters
Anti-Rust Agents
Bodying Agents
Misc. Other Additives
Misc. Viscosity, Suspension and Flow Control Agents
Thixotropic Agents

Pico Chemical Corp.
400 E. 16th St.
P.O. Box 340
Chicago Heights, IL 60411
Phone: (708) 757-4910
FAX: (708) 757-4940
Caustics and Caustic Sodas
Misc. Other Additives
Misc. Other Chemical Specialties
Water Treatment Chemicals

Poly-Resyn Inc.
534 Stevens Ct.
Dundee, IL 60118
Phone: (847) 428-4031
FAX: (847) 428-0305
Jeff Schreurs, Sales; Bob Schreurs, President
Anti-Sagging Agents
Anti-Settling Agents
Thickening Agents
Thixotropic Agents

PPG Industries, Inc.
3938 Porett Dr.
Gurnee, IL 60031
Phone: (847) 244-3410
FAX: (847) 244-9633
Barbara J. Anderson, Product Mgr.; Karl Nicholas, Sales; Gary Johnson, Sales; Bob McQueen, Sales
Anti-Foaming Agents
Dispersing Agents & Surfactants
Ink Additives
Monomers
Reactive Diluents
Surface Conditioners & Lubricants

PQ Corporation
P.O. Box 840
Valley Forge, PA 19482
Phone: (610) 651-4317
FAX: (610) 251-9060
Anti-Blocking Agents
Preservatives
Stabilizers

Ranbar Technology Inc.
1114 William Flinn Hwy.
Glenshaw, PA 15116
Phone: (412) 486-1111
FAX: (412) 487-3313
Ray Kushner, Joe Markovich
Misc. Other Chemical Specialties
Varnishes

Reedy International
25 E. Front St., Ste. 200
Keyport, NJ 07735
Phone: (908) 264-1177
FAX: (908) 264-1189
Catalysts
Fillers—Natural, Cellulosic, Polymeric
Misc. Other Additives
UV Absorbers

Reynolds Metals Company
Powder and Paste Division
4101 Camp Ground Rd.
Louisville, KY 40211
Phone: (502) 775-4240
FAX: (502) 775-4249
Larry Pitchford, Technical Manager; Gary Wood; Dennis Malloy
Abrasives/Anti-Skid
Corrosion Inhibitors
Fillers—Natural, Cellulosic, Polymeric
Ink Additives

Rheox, Inc.
P.O. Box 700
Hightstown, NJ 08520
Phone: (609) 443-2500
FAX: (609) 443-2422
Anti-Blocking Agents
Anti-Settling Agents
Bodying Agents
Corrosion Inhibitors
Dispersing Agents & Surfactants
Flow Control Agents
Ink Additives
Misc. Viscosity, Suspension and Flow Control Agents
Suspension Agents
Thickening Agents
Thixotropic Agents
Waxes

Rit-Chem Co.
P.O. Box 435
Pleasantville, NY 10570
Phone: (914) 769-9110
FAX: (914) 769-1408
Wayne J. Ritell, Vice President, Sales
Adhesion Promoters
Anti-Foaming Agents
Ink Additives
Photocuring Materials/Photoinitiators
Plasticizers
Reactive Diluents

Rohm and Haas Company
100 Independence Mall West
Philadelphia, PA 19105
Phone: (215) 592-3265
FAX: (215) 592-6909
Dispersing Agents
Monomers
Polymeric Pigments
Preservatives
Thickening Agents

Royale Pigments & Chemicals Inc.
12 Route 17 North, Ste. 309
Paramus, NJ 07652
Phone: (201) 845-4666
FAX: (201) 845-0719
Polymeric Pigments
Stearates
Suspension Agents
Thixotropic Agents
Waxes

San Esters Corporation
342 Madison Ave., Ste. 710
New York, NY 10173
Phone: (212) 972-1112
FAX: (212) 972-4625
Mark K. Smith, Sales Mgr.; Taka Nagashima
Monomers
Photocuring Materials/Photoinitiators

SCM Chemicals
200 International Cir., Ste. 5000
Hunt Valley, MD 21030
Phone: (410) 229-4400
FAX: (410) 229-4466
Gary L. Cianfichi, Market Mgr., Coatings; William S. Eaton, Director, Marketing & Sales, SCM Chemicals Colors & Silica
- Flatting Agents

SHAMROCK TECHNOLOGIES INC.
Foot of Pacific St.
Newark, NJ 07114
Phone: (201) 242-2999
FAX: (201) 242-8074
Mike Oliveri; Joe Coffey
- Anti-Blocking Agents
- Anti-Foaming Agents
- Flatting Agents
- Flow Control Agents
- Surface Conditioners & Lubricants
- Texturizers
- Water Repellents—Silicone, Corrosion Inhibitors
- Waxes

Sherwin-Williams Chemicals
101 Prospect Ave., NW
Cleveland, OH 44115
Phone: (216) 566-1294
FAX: (216) 566-1876
Charles Simpson, Mgr., Technical Services
- Anti-Foaming Agents
- Anti-Rust Agents
- Corrosion Inhibitors
- Flame and Smoke Retardants

Sino American Pigment Systems
1936 University
Berkeley, CA 94704-1024
Phone: (510) 848-8890
FAX: (510) 540-8889
- Flame and Smoke Retardants
- UV Absorbers

Southern Clay Products, Inc.
1212 Church St.
Gonzales, TX 78629
Phone: (210) 672-2891
FAX: (210) 672-3081
Frank Scimecca, Sales/Marketing Mgr.
- Anti-Sagging Agents
- Dispersing Agents & Surfactants
- Flow Control Agents
- Ink Additives
- Suspension Agents
- Thickening Agents
- Thixotropic Agents

Specialty Minerals Inc.
640 N. 13th St.
Easton, PA 18042
Phone: (610) 250-3039
FAX: (610) 250-3344
- Fillers—Natural, Cellulosic, Polymeric

Summit Precision Polymers Corp.
1050 Crestwood Dr.
P.O. Box 99
Mountaintop, PA 18707
Phone: (717) 474-9240
FAX: (717) 474-9250
- Anti-Foaming Agents
- Anti-Rust Agents
- Anti-Sagging Agents
- Bodying Agents
- Flame and Smoke Retardants
- Flatting Agents
- Flow Control Agents
- Ink Additives
- Misc. Other Additives
- Misc. Viscosity, Suspension and Flow Control Agents
- Printing Ink Varnishes & Compounds
- Surface Conditioners & Lubricants
- Texturizers
- Thickening Agents

Suzorite Mineral Products
Subsidiary of Zemex Industrial Minerals
1040 Crown Pointe Pkwy.
Atlanta, GA 30338
Phone: (770) 392-8664
FAX: (770) 392-8670
Joe Antonacci, Technical Director
- Fillers—Natural, Cellulosic, Polymeric
- Flatting Agents
- Ink Additives

Tego Chemie Service
914 E. Randolph Rd.
Hopewell, VA 23860
Phone: (800) 446-1809
FAX: (804) 541-2783
Jeff Burke, Sales Mgr.; Karen Bowling, Technical Representative; Frances Eggleston, Marketing Assistant
- Anti-Blocking Agents
- Anti-Floating Agents
- Anti-Flooding Agents
- Anti-Foaming Agents
- Dispersing Agents & Surfactants
- Flow Control Agents
- Ink Additives
- Misc. Other Additives
- Misc. Other Chemical Specialties
- Surface Conditioners & Lubricants
- Water Repellents—Silicone, Corrosion Inhibitors

Tioxide Americas Inc.
2001 Butterfield Rd., Ste. 601
Downers Grove, IL 60515
Phone: (708) 663-4900
FAX: (708) 663-4903
Kevin Fothergill, Sales Mgr.
- Adhesion Promoters
- Anti-Sagging Agents
- Ink Additives
- Misc. Viscosity, Suspension and Flow Control Agents
- Thickening Agents
- Thixotropic Agents
- UV Absorbers

Troy Corp.
8 Vreeland Rd.
Florham Park, NJ 07932
Phone: (201) 443-0003
FAX: (201) 443-0257
- Adhesion Promoters
- Anti-Floating Agents
- Anti-Foaming Agents
- Antioxidants
- Anti-Sagging Agents
- Anti-Settling Agents
- Anti-Skinning Agents
- Bodying Agents
- Catalysts
- Coalescing Agents
- Corrosion Inhibitors
- Dispersing Agents & Surfactants
- Driers
- Flocculants
- Flow Control Agents
- Ink Additives
- Misc. Other Additives
- Misc. Viscosity, Suspension and Flow Control Agents
- Preservatives
- Printing Ink Dispersants & Vehicles
- Surface Conditioners & Lubricants
- Suspension Agents
- Texturizers
- Thickening Agents
- Thixotropic Agents

Tulco, Inc.
9 Bishop Rd.
Ayer, MA 01432
Phone: (508) 772-4412
FAX: (508) 772-1751
James W. Karner, Marketing/Tech. Support; William J. Fletcher
- Anti-Blocking Agents
- Anti-Foaming Agents
- Anti-Settling Agents
- Flow Control Agents
- Misc. Viscosity, Suspension and Flow Control Agents
- Suspension Agents
- Thickening Agents
- Thixotropic Agents
- Water Repellents—Silicone, Corrosion Inhibitors

U.S. Aluminum, Inc.
408 Route 202
P.O. Box 2190
Flemington, NJ 08822-2190
Phone: (800) 544-0186
FAX: (908) 782-3489
Rhonda Kasler, Customer Service
- Ink Additives
- Misc. Other Additives
- Printing Ink Dispersants & Vehicles
- Printing Ink Varnishes & Compounds

U.S. Borax Inc.
26877 Tourney Rd.
Valencia, CA 91355
Phone: (805) 287-5464
FAX: (805) 287-5545
Kelvin K. Shen, Technical Mgr.; Steve Kulbieda
- Corrosion Inhibitors
- Flame and Smoke Retardants
- Preservatives

U.S. Bronze Powders, Inc.
408 Route 202
P.O. Box 31
Flemington, NJ 08822-0031
Phone: (800) 544-0186
FAX: (908) 782-3489
Rhonda Kasler, Customer Service
- Ink Additives
- Misc. Other Additives
- Printing Ink Dispersants & Vehicles
- Printing Ink Varnishes & Compounds

U.S. Silica Co.
P.O. Box 187
Berkeley Springs, WV 25411
Phone: (304) 258-2500
FAX: (304) 258-8295
John H. Wilson, National Accts. & Distribution Mgr.
- Fillers—Natural, Cellulosic, Polymeric

Union Camp Chemicals
1600 Valley Rd.
Wayne, NJ 07470
Phone: (201) 628-2329
FAX: (201) 628-2840
- Misc. Other Additives
- Misc. Other Chemical Specialties
- Monomers
- Plasticizers

United Mineral & Chemical Corp.
1100 Valley Brook Ave.
Lyndhurst, NJ 07071-3608
Phone: (201) 507-3307
FAX: (201) 507-1506
Sal Morreale, Div. Mgr.
- Flame and Smoke Retardants
- Glycerine
- Misc. Other Chemical Specialties
- Monomers
- Stabilizers
- Water Treatment Chemicals

Van De Mark Group
One North Transit Rd.
Lockport, NY 14094
Phone: (716) 434-2624
FAX: (716) 433-2850
Marilyn Pasitong, Customer Service Mgr.
- Misc. Other Chemical Specialties

R.T. Vanderbilt Co., Inc.
30 Winfield St.
Norwalk, CT 06856
Phone: (203) 853-1400
FAX: (203) 853-1452
Vergil W. Carlson, Sales Mgr., Paint & Paper Department; Janis Anderson; Lynn Peel
- Antioxidants
- Anti-Rust Agents
- Anti-Sagging Agents
- Anti-Settling Agents
- Corrosion Inhibitors
- Dispersing Agents & Surfactants
- Driers
- Preservatives
- Suspension Agents
- Thickening Agents
- Thixotropic Agents

Wabash Gilsonite Blends
707 E. Fayette Ave.
Effingham, IL 62401
Phone: (217) 342-9755
FAX: (217) 342-9827
- Misc. Other Additives
- Printing Ink Varnishes & Compounds

Wacker Silicones Corp.
3301 Sutton Rd.
Adrian, MI 49221-9397
Phone: (517) 264-8500
FAX: (517) 264-8246
Nick Salchert, National Sales Mgr.
- Adhesion Promoters
- Anti-Foaming Agents
- Flow Control Agents
- Ink Additives
- Water Repellents—Silicone, Corrosion Inhibitors

Witco Corporation
One American Ln.
Greenwich, CT 06831
Phone: (800) 494-8776
FAX: (203) 552-2864
Mark Shannahan, Marketing Mgr.; Dave Feuerbacher, Appl. Mgr.
- Amine Neutralizers
- Anti-Blocking Agents
- Anti-Floating Agents
- Anti-Flooding Agents
- Anti-Foaming Agents
- Antioxidants
- Corrosion Inhibitors
- Dispersing Agents & Surfactants
- Flame & Smoke Retardants
- Flatting Agents
- Flow Control Agents
- Freeze Thaw Stabilizers
- Glycerine
- Glycols
- Ink Additives
- Light Stabilizers
- Misc. Viscosity, Suspension and Flow Control Agents
- Plasticizers
- Printing Inks Dispersants & Vehicles
- Stabilizers
- Stearates
- Surface Conditioners & Lubricants
- UV Absorbers
- Water Repellents—Silicone, Corrosion Inhibitors
- Waxes

Zaclon Inc.
2981 Independence Rd.
Cleveland, OH 44115
Phone: (216) 271-1601
FAX: (216) 271-1792
Craig T. Keeley, Business Mgr.; Charles M. Kowalewski, Marketing Mgr.; Sig Olenzak, Technical Service Chemist
- Adhesion Promoters
- Antioxidants
- Corrosion Inhibitors
- Dispersing Agents & Surfactants
- Flocculants
- Misc. Other Chemical Specialties
- Suspension Agents
- Water Treatment Chemicals

Zeneca Biocides
1800 Concord Pike
Wilmington, DE 19850
Phone: (302) 477-8000
FAX: (302) 477-8120
- Preservatives

Zeneca Resins
730 Main St.
Wilmington, MA 01887
Phone: (508) 658-6600
FAX; (508) 657-7978
Susan Anderson, Business Mgr., Graphic Arts; Jim Gistis, Sales Mgr., Graphic Arts
- Printing Ink Dispersants & Vehicles

Zochem
Div. of Hudson Bay Mining & Smelting Co. Ltd.
P.O. Box 1120
Brampton, Ont., L6V 2L8
Canada
Phone:(905) 453-4100
FAX: (905) 453-2920
Scott A. Gilliard, Sales Mgr.
- UV Absorbers

CHEMICAL SPECIALTIES SPOTLIGHT: product listing

Abrasives/Anti-Skid

Astor Corp.
Dry Branch Kaolin Co.
DuPont
Hickson Specialties Inc.
Micro Powders, Inc.
Reynolds Metals Company

Acids (Non-Fatty)

Jarchem Industries, Inc.
3M/Specialty Chemicals
Penta Manufacturing Co.

Adhesion Promoters

Akcros Chemicals America
American Casein Co.
Arco Chemical Co.
CYTEC Industries, Inc.
The Dow Chemical Co.
Dow Corning Corp.
Eastman Chemical Company
Elf Atochem North America, Inc.
C.P. Hall Company
HÜLS AMERICA INC.
International Specialty Products
Kenrich Petrochemicals, Inc.
Lawter International
Lubrizol
Magnesium Elektron, Inc.
Phenoxy Associates
Rit-Chem Co.
Tioxide Americas, Inc.
Troy Corp.
Wacker Silicones Corp.
Zaclon Inc.

Amine Neutralizers

ANGUS Chemical Co.
Witco Corp.

Anti-Blocking Agents

Akcros Chemicals America
Astor Corp.
BYK-Chemie USA
Crosfield Co.
Daniel Products Co., Inc.
Dow Corning Corp.
Fuji Silysia Chemical, Ltd.
Grace Davison
Lubrizol
Magnesium Elektron, Inc.
Micro Powders, Inc.
PQ Corp.
Rheox, Inc.
SHAMROCK TECHNOLOGIES, INC.
Tego Chemie Service
Tulco, Inc.
Witco Corp.

Anti-Floating Agents

Akcros Chemicals America
BYK-Chemie USA
Daniel Products Co., Inc.
Henkel Corp.
HÜLS AMERICA INC.
Lubrizol
Tego Chemie Service
Troy Corp.
Witco Corp.

Anti-Flooding Agents

Akcros Chemicals America
BYK-Chemie USA
Daniel Products Co., Inc.
HÜLS AMERICA INC.
Lubrizol
Tego Chemie Service
Witco Corp.

Anti-Foaming Agents

Miscellaneous

Air Products & Chemicals
Akcros Chemicals America
Arco Chemical Co.
Buckman Laboratories, Inc.
BYK-Chemie USA
Daniel Products Co., Inc.
BFGoodrich
C.P. Hall Company
Henkel Corp.
Hickson Specialties Inc.
HÜLS AMERICA INC.
Sherwin-Williams Chemicals
Summit Precision Polymers Corp.
Tulco, Inc.
Witco Corp.

Nonsilicone

Air Products & Chemicals
Akcros Chemicals America
Buckman Laboratories, Inc.
BYK-Chemie USA
Daniel Products Co., Inc.
BFGoodrich
C.P. Hall Company
Henkel Corp.
Hickson Specialties Inc.
PPG Industries, Inc.
Rit-Chem Co.
SHAMROCK TECHNOLOGIES, INC.
Troy Corp.
Witco Corp.

Silicone

Buckman Laboratories, Inc.
BYK-Chemie USA
Daniel Products Co., Inc.
Dow Corning Corp.
BFGoodrich
C.P. Hall Company
Henkel Corp.
Hickson Specialties Inc.
Kraft Chemical Co.
PPG Industries, Inc.
Tego Chemie Service
Troy Corp.
Wacker Silicones Corp.
Witco Corp.

Antioxidants

Aceto Corp.
Akcros Chemicals America
Atomergic Chemetals Corp.
CYTEC Industries Inc.
Dover Chemical Corp.
GE Specialty Chemicals
C.P. Hall Company
OMG Americas
Penta Manufacturing Co.
Troy Corp.
R.T. Vanderbilt Co., Inc.
Witco Corp.
Zaclon Inc.

Anti-Rust Agents

Aceto Corp.
Buckman Laboratories, Inc.
Cortec Corp.
Henkel Corp.
HÜLS AMERICA INC.
Kenrich Petrochemicals, Inc.
Kraft Chemical Co.
Mineral Pigments
Penta Manufacturing Co.
Phenoxy Associates
Sherwin-Williams Chemicals
Summit Precision Polymers Corp.
R.T. Vanderbilt Co., Inc.

Anti-Sagging Agents

Aceto Corp.
BYK-Chemie USA
CCP
Eastman Chemical Company
Floridin Co.
Henkel Corp.
HÜLS AMERICA INC.
Kraft Chemical Co.
Lubrizol
Poly-Resyn Inc.
Southern Clay Products Inc.
Summit Precision Polymers Corp.
Tioxide Americas Inc.
Troy Corp.
R.T. Vanderbilt Co., Inc.

Anti-Settling Agents

Akcros Chemicals America
Alco Chemical
BYK-Chemie USA
Daniel Products Co., Inc.
Dominion Colour Corp.
Floridin Co.
Henkel Corp.
HÜLS AMERICA INC.
Kenrich Petrochemicals, Inc.
Lubrizol
Micro Powders, Inc.
OMG Americas
Poly-Resyn Inc.
Rheox, Inc.
Troy Corp.
Tulco, Inc.
R.T. Vanderbilt Co., Inc.

Anti-Skinning Agents

Akcros Chemicals America
HÜLS AMERICA INC.
OMG Americas
Penta Manufacturing Co.
Troy Corp.

Bodying Agents

Akcros Chemicals America
Alco Chemical
Chattem Chemicals, Inc.
Daniel Products Co., Inc.
Hercules Incorporated
HÜLS AMERICA INC.
Luzenac America, Inc.
Phenoxy Associates
Rheox, Inc.
Summit Precision Polymers Corp.
Troy Corp.

Catalysts

Aceto Corp.
Air Products & Chemicals
Akcros Chemicals America
Buckman Laboratories, Inc.
BYK-Chemie USA

CasChem
Chattem Chemicals, Inc.
Ciba-Geigy
CYTEC Industries, Inc.
Dow Corning Corp.
Elf Atochem North America, Inc.
HÜLS AMERICA INC.
Ishihara Corp. (USA)
Kenrich Petrochemicals, Inc.
3M/ Specialty Chemicals
Magnesium Elektron, Inc.
OMG Americas
Troy Corp.

Caustics and Caustic Sodas

The Dow Chemical Co.
Elf Atochem North America, Inc.
Kraft Chemical Co.
Occidental Chemical Corp.
Pico Chemical Corp.

Coalescing Agents

Aceto Corp.
The Dow Chemical Co.
Eastman Chemical Company
C.P. Hall Company
HÜLS AMERICA INC.
Troy Corp.

Corrosion Inhibitors

Air Products & Chemicals
Atomergic Chemetals Corp.
Buckman Laboratories, Inc.
CasChem
Ciba-Geigy
Cortec Corp.
Dominion Colour Corp.
Dover Chemical Corp.
Elf Atochem North America, Inc.
Grace Davison
Kenrich Petrochemicals, Inc.
Kraft Chemical Co.
Lubrizol
Meadowbrook Co.
Michelman
Mineral Pigments
Penta Manufacturing Co.
Reynolds Metals Company
Rheox, Inc.
Sherwin-Williams Chemicals
Troy Corp.
U.S. Borax, Inc.
R.T. Vanderbilt Co., Inc.
Witco Corp.
Zaclon Inc.

Dispersing Agents & Surfactants

Dispersing Agents

Air Products & Chemicals
Akcros Chemicals America
Alco Chemical
American Casein Co.
BYK-Chemie USA
CYTEC Industries, Inc.
Daniel Products Co., Inc.
Dominion Colour Corp.
The Feldspar Corp.
BFGoodrich
C.P. Hall Company
Hickson Specialties Inc.
HÜLS AMERICA INC.
International Specialty Products
Jarchem Industries, Inc.
SC Johnson Polymer
Kenrich Petrochemicals Inc.
Kraft Chemical Co.
Lubrizol
3M/Specialty Chemicals
Petrolite Corp.
PPG Industries, Inc.
Rheox, Inc.
Rohm and Haas Company
Southern Clay Products Inc.
Tego Chemie Service
Troy Corp.
R.T. Vanderbilt Co., Inc.
Witco Corp.
Zaclon Inc.

Emulsifying & Wetting Agents

Air Products & Chemicals
Akcros Chemicals America
American Casein Co.
Arco Chemical Co.
CYTEC Industries, Inc.
Daniel Products Co., Inc.
Dover Chemical Corp.
The Dow Chemical Co.
Dow Corning Corp.
BFGoodrich
C.P. Hall Company
Hickson Specialties Inc.
HÜLS AMERICA INC.
International Specialty Products
Jarchem Industries, Inc.
Kenrich Petrochemicals Inc.
Kraft Chemical Co.
3M/Specialty Chemicals
Petrolite Corp.
PPG Industries, Inc.
Tego Chemie Service
Troy Corp.

Driers

Drying Salts

Jarchem Industries, Inc.
OMG Americas

Linoleates

HÜLS AMERICA INC.
OMG Americas
Penta Manufacturing Co.

Octoates

HÜLS AMERICA INC.
OMG Americas
Troy Corp.

Naphthenates

Dominion Colour Corp.
HÜLS AMERICA INC.
OMG Americas
Troy Corp.

Tallates

HÜLS AMERICA INC.
OMG Americas

Water Soluble or Water Dispersible

Daniel Products Co., Inc.
HÜLS AMERICA INC.
OMG Americas
Troy Corp.

Other

Algan Products Business
Daniel Products Co., Inc.
Magnesium Elektron, Inc.
OMG Americas
R.T. Vanderbilt Co., Inc.

Fillers—Natural, Cellulosic, Polymeric

Alcoa Industrial Chemicals
CR Minerals Corp.
The Dow Chemical Co.
Dry Branch Kaolin Co.
Engelhard Corp.
The Feldspar Corp.
Floridin Co.
Franklin Industrial Minerals
C.P. Hall Company
Hitox Corp.
J.M. Huber Corp.
Kraft Chemical Co.
Luzenac America, Inc.
Mississippi Lime Co.
NYCO® Minerals, Inc.
Reedy International Corp.
Reynolds Metals Company
Specialty Minerals Inc.
Suzorite Mineral Products
U.S. Silica Co.

Flame and Smoke Retardants

Alcoa Industrial Chemicals
Buckman Laboratories, Inc.
CYTEC Industries, Inc.
Dover Chemical Corp.
Elf Atochem North America, Inc.
Franklin Industrial Minerals
C.P. Hall Company
Hitox Corp.
Hoechst Celanese Corp.
J.M. Huber Corp.
Kraft Chemical Co.
Occidental Chemical Corp.
Sherwin-Williams Chemicals
Sino American Pigment Systems
Summit Precision Polymers Corp.
U.S. Borax, Inc.
United Mineral & Chemical Corp.

Flatting Agents

CR Minerals
Dry Branch Kaolin Co.
SHAMROCK TECHNOLOGIES, INC.
Witco Corp.

Dispersed

Daniel Products Co., Inc.
BFGoodrich
Grace Davison
Micro Powders, Inc.
Summit Precision Polymers Corp.

Nonmetallic

Crosfield Co.
SCM Chemicals
Summit Precision Polymers Corp.
Suzorite Mineral Products

Flocculants

Akcros Chemicals America
Buckman Laboratories, Inc.
CPS Chemical Co., Inc.
CYTEC Industries, Inc.
HÜLS AMERICA INC.
Jarchem Industries, Inc.

Kraft Chemical Co.
Troy Corp.
Zaclon Inc.

Flow Control Agents

Alco Chemical
CasChem
CCP
Daniel Products Co., Inc.
Dock Resins Corp.
Eastman Chemical Company
Floridin Co.
BFGoodrich
Henkel Corp.
Hercules Incorporated
HÜLS AMERICA INC.
Jarchem Industries, Inc.
Lubrizol
Luzenac America, Inc.
Rheox, Inc.
SHAMROCK TECHNOLOGIES, INC.
Southern Clay Products Inc.
Summit Precision Polymers Corp.
Tego Chemie Service
Troy Corp.
Tulco, Inc.
Wacker Silicones Corp.
Witco Corp.

Freeze Thaw Stabilizers

The Dow Chemical Co.
Jarchem Industries, Inc.
Witco Corp.

Glycerine

The Dow Chemical Co.
C.P. Hall Company
Henkel Corp.
Jarchem Industries, Inc.
Kraft Chemical Co.
Occidental Chemical Corp.
Penta Manufacturing Co.
United Mineral & Chemical Corp.
Witco Corp.

Glycols

Arco Chemical Co.
Dominion Colour Corp.
The Dow Chemical Co.
Eastman Chemical Company
C.P. Hall Company
Occidental Chemical Corp.
Penta Manufacturing Co.
Witco Corp.

Homogenizers

Dominion Colour Corp.
C.P. Hall Company
Witco Corp.

Ink Additives

Air Products & Chemicals
American Casein Co.
Astor Corp.
Buckman Laboratories, Inc.
BYK-Chemie USA
Chattem Chemicals Inc.
Ciba-Geigy
Cortec Corp.
CYTEC Industries, Inc.
Daniel Products Co., Inc.
Dow Corning Corp.
Dry Branch Kaolin Co.
Eastman Chemical Company
EM Industries, Inc.
BFGoodrich
C.P. Hall Company
Henkel Corp.
Hercules Incorporated
Hoechst Celanese Corp.
J.M. Huber Corp.
International Specialty Products
Ishihara Corp. (USA)
Jarchem Industries, Inc.
SC Johnson Polymer
Kenrich Petrochemicals Inc.
Lawter International
Luzenac America, Inc.
3M/Specialty Chemicals
Magnesium Elektron, Inc.
Michelman, Inc.
Micro Powders, Inc.
OMG Americas
Petrolite Corp.
PPG Industries, Inc.
Reynolds Metals Company
Rheox, Inc.
Rit-Chem Co.
Southern Clay Products Co.
Summit Precision Polymers Corp.
Suzorite Mineral Products
Tego Chemie Service
Tioxide Americas Inc.
Troy Corp.
U.S. Aluminum, Inc.
U.S. Bronze Powders, Inc.
Wacker Silicones Corp.
Witco Corp.

Light Stabilizers

Akcros Chemicals America
BASF Corp.
Buckman Laboratories, Inc.
CYTEC Industries, Inc.
C.P. Hall Company
Hoechst Celanese Corp.
International Specialty Products
Penta Manufacturing Co.
Witco Corp.

Masking Agents & Re-Odorants

Aceto Corp.
Penta Manufacturing Co.

Misc. Other Additives

ANGUS Chemical Co.
Buckman Laboratories, Inc.
CCP
Ciba-Geigy Corp.
Cortec Corp.
CPS Chemical Co., Inc.
Daniel Products Co., Inc.
Dover Chemical Corp.
Dynamic Color Solutions
Eagle Zinc Co.
Eastman Chemical Company
Elf Atochem North America, Inc.
The Feldspar Corp.
Franklin Industrial Minerals
GE Specialty Chemicals
BFGoodrich
Grace Davison
C.P. Hall Company
HÜLS AMERICA INC.
International Specialty Products
Jarchem Industries, Inc.
Kenrich Petrochemicals, Inc.
Kraft Chemical Co.
Meadowbrook Co.
NYCO® Minerals Inc.
Penta Manfacturing Co.
Phenoxy Associates
Pico Chemical Corp.
Summit Precision Polymers Corp.
Tego Chemie Service
Troy Corp.
U.S. Aluminum, Inc.
U.S. Bronze Powders, Inc.
Union Camp Chemicals
Wabash Gilsonite Blends

Misc. Other Chemical Specialties

American Casein Co.
American Colors, Inc.
Arco Chemical Co.
Buckman Laboratories, Inc.
CPS Chemical Co., Inc.
Cortec Corp.
CYTEC Industries, Inc.
Daniel Products Co., Inc.
Dover Chemical Corp.
The Dow Chemical Co.
Eagle Zinc Co.
Eastman Chemical Company
Elf Atochem North America, Inc.
GE Specialty Chemicals
BFGoodrich
C.P. Hall Company
Hercules Incorporated
International Specialty Products
Jarchem Industries, Inc.
Kraft Chemical Co.
Meadowbrook Co.
Occidental Chemical Corp.
Penta Manufacturing Co.
Pico Chemical Corp.
Ranbar Technology, Inc.
Tego Chemie Service
Union Camp Chemicals
United Mineral & Chemical Corp.
Van DeMark Group
Zaclon Inc.

Misc. Viscosity, Suspension & Flow Control Agents

Alco Chemical
American Casein Co.
Arco Chemical Co.
CasChem
Chattem Chemicals, Inc.
CCP
Daniel Products Co., Inc.
Eastman Chemical Company
Floridin Co.
BFGoodrich
Grace Davison
C.P. Hall Company
Hercules Incorporated
HÜLS AMERICA INC.
Interfibe Corp.
Jarchem Industries, Inc.
Kenrich Petrochemicals, Inc.
Luzenac America, Inc.
Phenoxy Associates
Rheox, Inc.
Summit Precision Polymers Corp.
Tioxide Americas Inc.
Troy Corp.
Tulco, Inc.
Witco Corp.

Monomers

Aceto Corp.
Akcros Chemicals America
Arco Chemical Co.
CPS Chemical Co., Inc.
CYTEC Industries, Inc.
Eastman Chemical Company
International Specialty Products
Jarchem Industries Inc.
Lubrizol
PPG Industries, Inc.
Rohm and Haas Company
San Esters Corp.
Union Camp Chemicals
United Mineral & Chemical Corp.

Photocuring Materials/ Photinitiators

Aceto Corp.
Ciba-Geigy Corp.
CPS Chemical Co., Inc.
CYTEC Industries, Inc.
Henkel Corp.
Jarchem Industries, Inc.
3M/Specialty Chemicals
Rit-Chem Co.
San Esters Corp.

Plasticizers

Adipates

EXXON CHEMICAL
C.P. Hall Company
Penta Manufacturing Co.

Benzoates

Jarchem Industries, Inc.
Kraft Chemical Co.
Penta Manufacturing Co.

Castor Oil (polymerized/oxidized)

CasChem
The Degen Co.
Jarchem Industries, Inc.
Union Camp Chemicals
Witco Corp.

Castor Oil (raw/refined)

CasChem
The Degen Co.
Jarchem Industries, Inc.
Penta Manufacturing Co.
Witco Corp.

Epoxidized

Akcros Chemicals America
Cardolite Corp.
Elf Atochem North America, Inc.
C.P. Hall Company

Misc. Plasticizers

Arco Chemical Co.
Eastman Chemical Company
EXXON CHEMICAL
C.P. Hall Company
Kenrich Petrochemicals, Inc.
Penta Manufacturing Co.
Union Camp Chemicals

Phosphates

Dominion Colour Corp.
C.P. Hall Company
Penta Manufacturing Co.

Polymerics

Dominion Colour Corp.
BFGoodrich
C.P. Hall Company
Penta Manufacturing Co.

Phthalates

Dominion Colour Corp.
Eastman Chemical Company
EXXON CHEMICAL
C.P. Hall Company
Penta Manufacturing Co.

Sebacates

Jarchem Industries, Inc.
C.P. Hall Company
Penta Manufacturing Co.

Sulfonamides

CYTEC Industries, Inc.
C.P. Hall Company
Rit-Chem Co.

Polymeric Pigments

Day-Glo Color Corp.
Dominion Colour Corp.
International Specialty Products
Keystone Aniline Corp.
Lawter International
Rohm and Haas Company
Royale Pigments & Chemicals Inc.

Preservatives

Biocides

Aceto Corp.
Akcros Chemicals America
ANGUS Chemical Co.
Atomergic Chemetals Corp.
Buckman Laboratories, Inc.
Calgon Corp.
Cortec Corp.
The Dow Chemical Co.
Eagle Zinc Co.
Elf Atochem North America, Inc.
HÜLS AMERICA INC.
Kraft Chemical Co.
PQ Corp.
Rohm and Haas Company
Troy Corp.
U.S. Borax, Inc.
R.T. Vanderbilt Co., Inc.
Zeneca Biocides

Fungicides

Akcros Chemicals America
American Casein Corp.
American Chemet Corp.
ANGUS Chemical Co.
Buckman Laboratories, Inc.
Calgon Corp.
Cortec Corp.
Eagle Zinc
Elf Atochem North America, Inc.
Henkel Corp.
HÜLS AMERICA INC.
Rohm and Haas Company
Troy Corp.
U.S. Borax, Inc.
R.T. Vanderbilt Co., Inc.

Misc. Preservatives

Akcros Chemicals America
Buckman Laboratories, Inc.
Cortec Corp.
Dover Chemical Corp.
Eagle Zinc Co.
International Specialty Products
Jarchem Industries, Inc.
Meadowbrook Co.
Troy Corp.
U.S. Borax, Inc.

Printing Ink Dispersants & Vehicles

ABCO Enterprises, Inc.
Air Products & Chemicals
Akcros Chemicals America
American Casein Co.
CCP
CYTEC Industries, Inc.
Daniel Products Co., Inc.
Day-Glo Color Corp.
The Degen Co.
Eastman Chemical Company
EXXON CHEMICAL
BFGoodrich
C.P. Hall Company
Hercules Incorporated
Hoechst Celanese Corp.
International Specialty Products
Jarchem Industries, Inc.
SC Johnson Polymer
Lawter International
Troy Corp.
U.S. Aluminum, Inc.
U.S. Bronze Powders, Inc.
Witco Corp.
Zeneca Resins

Printing Ink Varnishes & Compounds

Air Products & Chemicals
Algan Products Business
Astor Corp.
CCP
Day-Glo Color Corp.
The Degen Co.
Eastman Chemical Company
BFGoodrich
Lawter International
Summit Precision Polymers Corp.
U.S. Aluminum, Inc.
U.S. Bronze Powders, Inc.
Wabash Gilsonite Blends

Reactive Diluents

Akcros Chemicals America
ANGUS Chemical Co.
Cardolite Corp.
Cargill, Inc.
CCP
EXXON CHEMICAL
C.P. Hall Company
International Specialty Products
Jarchem Industries, Inc.
Kenrich Petrochemicals, Inc.
PPG Industries, Inc.
Rit-Chem Co.

Stabilizers

Ciba-Geigy
CYTEC Industries
Elf Atochem North America, Inc.
GE Specialty Chemicals

Metallic

Akcros Chemicals America

Dominion Colour Corp.
OMG Americas
United Mineral & Chemical Corp.

Nonmetallic

American Casein Co.
C.P. Hall Company
Jarchem Industries, Inc.
PQ Corp.

Vinyl

Akcros Chemicals America
American Casein Co.
International Specialty Products
PQ Corp.
Witco Corp.

Static Preventive

CYTEC Industries, Inc.
Hoechst Celanese Corp.
Ishihara Corp. (USA)
Kenrich Petrochemicals, Inc.
3M/Specialty Chemicals

Stearates

Akcros Chemicals America
Elf Atochem North America, Inc.
C.P. Hall Company
Kraft Chemical Co.
Penta Manufacturing Co.
Royale Pigments & Chemicals Inc.
Witco Corp.

Surface Conditioners & Lubricants

Anti-Marring Agents

Astor Corp.
BYK-Chemie USA
Daniel Products Co., Inc.
Dow Corning Corp.
BFGoodrich
Lubrizol
Michelman
Micro Powders, Inc.
PPG Industries, Inc.
SHAMROCK TECHNOLOGIES, INC.
Summit Precision Polymers Corp.
Tego Chemie Service
Witco Corp.

Slip Sides

C.P. Hall Company
Lubrizol
Michelman
PPG Industries, Inc.
Summit Precision Polymers Corp.
Tego Chemie Service
Witco Corp.

Nonmetallic

C.P. Hall Company
Summit Precision Polymers Corp.

Suspension Agents

Alco Chemical
American Casein Co.
BYK-Chemie USA
Daniel Products Co., Inc.
Floridin Co.
BFGoodrich
C.P. Hall Company
Hercules Incorporated
Jarchem Industries, Inc.
Kenrich Petrochemicals Inc.
Luzenac America, Inc.
Rheox, Inc.
Royale Pigments & Chemicals, Inc.
Southern Clay Products, Inc.
Troy Corp.
Tulco, Inc.
R.T. Vanderbilt Co., Inc.
Zaclon Inc.

Texturizers

Grace Davison
Micro Powders, Inc.
SHAMROCK TECHNOLOGIES, INC.
Summit Precision Polymers Corp.
Troy Corp.

Thickening Agents

Misc. Thickeners

Alco Chemical
American Casein Co.
Eastman Chemical Company
Floridin Co.
BFGoodrich
Hercules Incorporated
HÜLS AMERICA INC.
International Specialty Products
Kraft Chemical Co.
OMG Americas
Rheox, Inc.
Southern Clay Products, Inc.
Summit Precision Polymers Corp.
Troy Corp.
Tulco, Inc.

Solvent

Aceto Corp.
Hercules Incorporated
HÜLS AMERICA INC.
International Specialty Products
Poly-Resyn Inc.
Rheox, Inc.
Southern Clay Products, Inc.

Water

Aceto Corp.
Alco Chemical
American Casein Co.
BFGoodrich
Hercules Incorporated
HÜLS AMERICA INC.
Rheox, Inc.
Rohm and Haas Company
Southern Clay Products, Inc.
Tioxide Americas Inc.
R.T. Vanderbilt Co., Inc.

Thixotropic Agents

Alco Chemical
BYK-Chemie USA
CCP
Floridin Co.
Henkel Corp.
Hercules Incorporated
HÜLS AMERICA INC.
Kraft Chemical Co.
Lubrizol
Phenoxy Associates
Poly-Resyn Inc.
Rheox, Inc.
Royale Pigments & Chemicals, Inc.
Southern Clay Products, Inc.
Tioxide Americas Inc.
Troy Corp.
Tulco, Inc.
R.T. Vanderbilt Co., Inc.

UV Absorbers

Aceto Corp.
BASF Corp.
CYTEC Industries, Inc.
Daniel Products Co., Inc.
Dominion Colour Corp.
Garrison Industries, Inc.
C.P. Hall Company
Hoechst Celanese Corp.
International Specialty Products
Penta Manufacturing Co.
Sino American Pigment Systems
Tioxide Americas Inc.
Witco Corp
Zochem

Varnishes

Algan Products Business
CCP
BFGoodrich
Ranbar Technology, Inc.

Water Repellents—Silicone, Corrosion Inhibitors

Dow Corning Corp.
C.P. Hall Company
HÜLS AMERICA INC.
Jarchem Industries, Inc.
Kraft Chemical Co.
Michelman
SHAMROCK TECHNOLOGIES, INC.
Tego Chemie Service
Tulco, Inc.
United Mineral & Chemical Corp.
Wacker Silicones Corp.
Witco Corp.

Water Treatment Chemicals

Aceto Corp.
Air Products & Chemicals
Alco Chemical
Buckman Laboratories, Inc.
Chattem Chemicals, Inc.
CPS Chemical Co., Inc.
The Dow Chemical Co.
BFGoodrich
C.P. Hall Company
Kraft Chemical Co.
Pico Chemical Corp.
United Mineral & Chemical Corp.
Zaclon Inc.

Waxes

Algan Products Business
Astor Corp.
BASF Corp.
CasChem
CCP
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Eastman Chemical Company
C.P. Hall Company
Hoechst Celanese Corp.
Jarchem Industries, Inc.
SC Johnson Polymer
Kraft Chemical Co.
Lawter International
Michelman
Micro Powders, Inc.
Petrolite Corp.
Rheox, Inc.
SHAMROCK TECHNOLOGIES, INC.
Witco Corp.

CDIC—MAY

1996-97 Society Officers

Paul Guevin, of P.R. Guevin Associates Inc., announced the new officers for 1996-97. They are: President—Bill Jelf, of Akzo Nobel Coatings Inc.; Vice President—Teresa Case, of Fibreglass Evercoat Co., Inc.; Secretary—John Imes, of DuPont; Treasurer—Brian Marzano, of Sun Chemical Corp.; and Ohio Paint Council Representative—Paul Guevin.

President Jack Avery, of Deeks & Co., presented 25-year commemorative pins to Nelson Barnhill, of Delphi Interior & Lighting Systems; Jim Flanagan, of Flanagan Associates Inc.; and Dennis Nie, of Perry & Derrick Co., in honor of their achievements.

President Avery congratulated Rebecca Everhart, of Akzo Nobel Coatings Inc., for receiving the 1996 Lew Larson Memorial Scholarship Award.

Society Representative Bill Hollifield, of Perry & Derrick Co., Inc., reported on the FSCT Board of Directors meeting held in May. Mr. Hollifield stated that several committees were formed to work on each of the three strategic planning categories: membership, organizational structure, and common interest groups.

Hugh Lowrey, of Perry & Derrick Co., Inc., reported on the Ohio Paint Council's Legislative Day.

On behalf on Technical Committee Chair Ken Pendleton, of K.A. Pendleton Co., Inc., President Avery informed the members that the Technical Committee is working on a water-reducible coating system for polypropylene. Also under consideration is a water-reducible chlorinated rubber or possibly a water-reducible resin with ether linkages on the backbone.

Educational Chair Laura Miller, of Perry & Derrick Co., Inc., reported on the recent career day she attended with Paul Theilen, of Cintech Industrial Coatings.

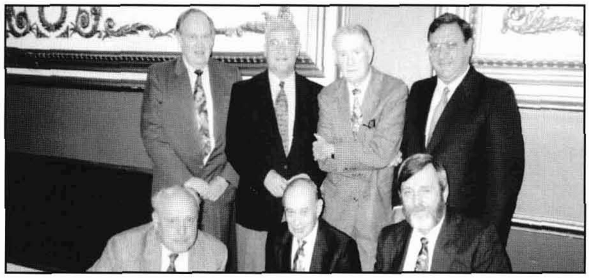
In addition, Ms. Miller also stated that the Educational Committee will concentrate on the education of the membership by providing a series of technical speakers at monthly meetings next year.

CDIC Society member Bruce Strickland, of Chemical Products and Processes, discussed "EXPERIMENTAL DESIGN."

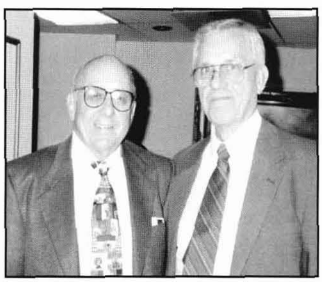
Due to time and cost constraints in the laboratory, variables explored during experi-

Chicago Society Celebrates 75th Anniversary

The Chicago Society for Coatings Technology celebrated its 75th Anniversary on Friday, May 24, 1996, at Drury Lane Oak Brook, in Oak Brook Terrace, IL. During the evening's celebration, incoming President Marcella Nichols presented outgoing President David Stromberg with the Past-President Pin and Certificate of Appreciation and was in turn presented with the Chicago Society Gavel and the Nuodex Gavel. Past Presidents attending the meeting were introduced (see photo below) and Ray Pfohl then recounted some of the Society's history and achievements in commemoration of the 75th Anniversary.



New members of the Chicago Society 25-Year Club include (from left)—Front row: George Gotshall, Glen Hoy, and David Stromberg. Back row: Warren Eggers, Friedrick Failsmezger, Raymond Nicola, and Richard Max.



Gerald Kraft, a 50-year member of the Chicago Society (left), welcomes the newest member to the 50-Year Club, Gilbert Gustafson.

Immediate Past-President Natu Patel (left), presents Richard Cranstoun with the Chicago Society "Outstanding Service Award" for his Educational Committee achievements.

Chicago Society Past-Presidents in attendance at the anniversary celebration included (from left)—Seated: Ken Wilkinson, Karl Schmidt, Warren Ashley, and Evans Angelos. Standing: Bill Fotis, Ray C. Pfohl, Ray Cziczo, Natu Patel, Rick Kenney, Vic Willis, Gus Leep, Tom Daly, Ed Boulger, and Dave Stromberg.

ments are limited. However, effective experimental design makes the exploration of several variables possible. According to Mr. Strickland, fractional factorial design, which uses a series of screening experiments, allows the maximum amount of information from the fewest number of trials. This type of design uses a series of screening experiments, which are derived by setting up a matrix of experiments.

The approach used by Mr. Strickland is also considered a balanced design, because it uses equal numbers of high and low values for a particular test parameter. The speaker stated that this approach permits fewer experiments while achieving the full benefit of doing a full factorial design (where all combinations of variables are tested).

TERESA L. CASE, *Secretary*

CLEVELAND—APRIL

"Acrylic-Polyurethane Hybrid Dispersions"

President Michael Wolfe, of Seegott Inc., announced that Victor Sandorf, of Coatings Development Co., is this year's selection for Society Honorary Membership.

Connie Williams, of The Lubrizol Corp., presented the following 1996-97 officers: President—Rich Mikol, of Tremco, Inc.; President-Elect—James J. Currie, of Jamestown Paint Co.; Secretary—Jennifer Rumberg, of The Mahoning Paint Co.; Treasurer—Lamar Brooks, of Coatings Research Group; Assistant Treasurer—Patricia Wagle, of The Flood Co.; and Member-At-Large—Phil Haagensen, of Chem-Materials Co., Inc.

Society Representative Brenda Carr, of Coatings Development Co., updated the members on the FSCT International Coatings Expo and Technology Conference.

The evening's technical speaker was Philadelphia Society member William Buckley, of Air Products and Chemicals. He discussed "ACRYLIC-POLYURETHANE HYBRID DISPERSIONS FOR WATER BASE."

Mr. Buckley discussed the advantages and disadvantages of dispersion properties. Among the advantages are non-yellowing, outdoor resistance, adhesion, compatibility, and low price. Disadvantages include thermoplasticity, film formation, and chemical resistance.

The speaker also reported on the dispersion properties of polyurethanes. He noted that solvent resistance, film forming, gloss, and a wide scope of properties are some advantages. On the other hand, disadvantages include cost, pH stability, and a presence of NMP-MEK-TEA.

Some applications resulting from combing the acrylic and polyurethane dispersions into a hybrid blend are the following: ink, wood flooring, furniture lacquer, plastic and metal coatings, adhesives, and decorative paints.

In addition, Mr. Buckley used graphs to demonstrate how the different blends or hybrid dispersions performed. All of the test procedures that he referred to were ASTM standards.

The speaker also compared hybrids vs. acrylics. He stated that the advantages of hybrids include: adhesion to a wider variety of substrates, improved solvent resistance, better toughness and flexibility, and good application characteristics under a variety of conditions.

Some of the hybrid applications identified by Mr. Buckley were industrial topcoats, metal primers, auto primers, pipe coatings, plastic coatings, and modifiers for improving acrylic systems.

JAMES J. CURRIE, *Secretary*

GOLDEN GATE—APRIL

"Latex Anti-Corrosive Paints"

Society Representative Pat Shaw, of Radiant Color, discussed the FSCT Strategic Planning issues. She stated that these issues will be discussed on at the FSCT Board of Directors meeting on May 2, in Seattle, WA.

Kathy Shields, of the Redwood City Library reported on the available books relevant to the coatings industry at the library.

The evening's technical presentation "LATEX ANTI-CORROSIVE PAINTS" was delivered by Piedmont Society member Alan Smith, of BASF Corp.

Mr. Smith stated that the technology of latex anti-corrosive systems has been around since the 1960s. He outlined the three different stages of development in the history of these types of coatings, beginning with externally plasticized styrene copolymers. These copolymers evolved to acrylic styrene polymers, which led to the advent of self-crosslinked systems—the latest technology.

According to the speaker, the first two systems featured such anti-corrosive pigments as red lead and chromates for corrosion resistance. The latest system uses lead- and chrome-free alternatives or none at all.

Mr. Smith recommended styrene acrylics for anti-corrosive paints because styrene by its nature is very hydrophobic. The film tends to absorb less water than other vehicles as a result of that property. However, styrene acrylics are sensitive to flash rusting and humidity. The original latex was modified to self-crosslink as the next logical step to address these concerns. Evidently, the hydrophobic properties of the self-crosslinked films were enhanced and the moisture was less likely to penetrate the film and cause flash rusting.

Next, Mr. Smith reported on a test that was designed to measure the amount of water the painted system was absorbing. Painted panels were immersed in water and then weighed after drying to measure the amount of water still in the film. This was repeated for a set number of cycles.

Mixing up the types and orders of the salt spray and humidity tests yielded different rates of degradation. An attempt was made to try to duplicate real life by determining the tests and the order that were needed. These results were then compared to the actual exterior exposure results for the same materials. Using this method, a good accelerated profile was developed which equated well with the real world.

Mr. Smith stated that the correct choice of thickener, cellulosic or urethane, and the level, one-half or two percent, also had a direct bearing on how the coating performed in the salt spray and humidity cabinets. Urethane thickeners seemed to perform best in the accelerated conditions specified.

According to the speaker, the best choice of extender pigments also has a direct bearing on how well the coating performs. For clear testing, a small amount of colored paste was added to the clear to help measure degradation. Additionally, the PVC most efficient is dependent on the type of vehicle used.

Mr. Smith presented slides to emphasize the conclusion that the new self-crosslinking systems seem to work well with absolutely no corrosion inhibiting pigment present.

JEFFERY I. BUCHMAN, *Secretary*

KANSAS CITY—MAY

Officer Elections

The following were elected as officers for 1996-97: President—Randall Ehmer, of Walsh & Associates, Inc.; Vice President—Curry Sanders, of Tnemec Co., Inc.; Secretary—Debbie Koss, of Davis Paint; Treasurer—Ray Rosiere, of Kansas Paint & Color; and Past-President—Lawrence Murphy, of Tnemec Co., Inc.

Educational Committee Chair Kim Nee, of Mozel Inc., thanked Dave Hazlett and Perry Kilpatrick of Tnemec Co., Inc.; Robert Risner, of Weskem-Hall Inc.; and Jim O'Brien for their presentation "How to Make Paint" that was given to the Lakeview Middle School.

In addition, Ms. Nee introduced the Science Fair winners. The first place winner was Christopher Campbell and second place was awarded to Rachel Swearigen.

Mark Algaier, of Hillyard Industries, Inc., reported on the FSCT Board Meeting in

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005	025	045	065	085	105	125	145	165	185	205	225	245	265	285
006	026	046	066	086	106	126	146	166	186	206	226	246	266	286
007	027	047	067	087	107	127	147	167	187	207	227	247	267	287
008	028	048	068	088	108	128	148	168	188	208	228	248	268	288
009	029	049	069	089	109	129	149	169	189	209	229	249	269	289
010	030	050	070	090	110	130	150	170	190	210	230	250	270	290
011	031	051	071	091	111	131	151	171	191	211	231	251	271	291
012	032	052	072	092	112	132	152	172	192	212	232	252	272	292
013	033	053	073	093	113	133	153	173	193	213	233	253	273	293
014	034	054	074	094	114	134	154	174	194	214	234	254	274	294
015	035	055	075	095	115	135	155	175	195	215	235	255	275	295
016	036	056	076	096	116	136	156	176	196	216	236	256	276	296
017	037	057	077	097	117	137	157	177	197	217	237	257	277	297
018	038	058	078	098	118	138	158	178	198	218	238	258	278	298
019	039	059	079	099	119	139	159	179	199	219	239	259	279	299
020	040	060	080	100	120	140	160	180	200	220	240	260	280	300

Your Company
(Check One Block)

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

Your Position
(Check One Block)

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

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005	025	045	065	085	105	125	145	165	185	205	225	245	265	285
006	026	046	066	086	106	126	146	166	186	206	226	246	266	286
007	027	047	067	087	107	127	147	167	187	207	227	247	267	287
008	028	048	068	088	108	128	148	168	188	208	228	248	268	288
009	029	049	069	089	109	129	149	169	189	209	229	249	269	289
010	030	050	070	090	110	130	150	170	190	210	230	250	270	290
011	031	051	071	091	111	131	151	171	191	211	231	251	271	291
012	032	052	072	092	112	132	152	172	192	212	232	252	272	292
013	033	053	073	093	113	133	153	173	193	213	233	253	273	293
014	034	054	074	094	114	134	154	174	194	214	234	254	274	294
015	035	055	075	095	115	135	155	175	195	215	235	255	275	295
016	036	056	076	096	116	136	156	176	196	216	236	256	276	296
017	037	057	077	097	117	137	157	177	197	217	237	257	277	297
018	038	058	078	098	118	138	158	178	198	218	238	258	278	298
019	039	059	079	099	119	139	159	179	199	219	239	259	279	299
020	040	060	080	100	120	140	160	180	200	220	240	260	280	300

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- BB ❑ Manufacturers of Raw Materials
- CC ❑ Manufacturers of Equipment and Containers
- DD ❑ Sales Agents for Raw Materials and Equipment
- EE ❑ Government Agency
- FF ❑ Research/Testing/Consulting
- GG ❑ Educational Institution/Library
- HH ❑ Paint Consumer
- JJ ❑ Other

Your Position
(Check One Block)

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

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Seattle. He stated that FSCT now has a fax-on-demand number for information on seminars and publications. The number is 800-838-5445.

Marvin Dixon, of William Jewell College, presented "CHEM MAGIC."

CURRY SANDERS, *Secretary*

NEW ENGLAND—APRIL

"Aluminum Pigmented Coatings"

New England Society member Clive H. Hare, of Clive H. Hare Inc., discussed the "APPEARANCE CHANGES IN ALUMINUM PIGMENTED COATINGS."

Mr. Hare explained how current coatings (aluminum moisture cure and aluminum epoxy master) having light sensitivity sometimes cause UV degradation. Selective aluminum pigments, however, can reflect UV and heat prior to thermosetting and based on 260 hours in QUV.

Q. Is this process of coatings reversible in the new polymer films?

A. Yes, by adding a new binder system, yet the adhesion of the second coat is very critical due to potential deterioration of the initial coat surface.

RICHARD TWOMEY, *Secretary*

NEW ENGLAND—MAY

"Clean Air Act"

President Chuck Shearer, of Zeneca Resins, announced the following nominations for the 1996-97 officers: President—Michael Iannuzzi, of Camger Chemical Systems; Vice President—Gene Anderson, of ChemCentral Corp.; Treasurer—Richard P. Twomey, of Kronos, Inc.; and Society Representative—Maureen M. Lein, of Davidson Technology Center.

Rudy Deanin, of the University of Massachusetts-Lowell, announced the recipients for the $3,000 college scholarships based on the voting by the Scholarship Committee.

The evening's speaker was Ann E. Arnold, of the U.S. Environmental Protection Agency.

Mrs. Arnold reviewed the Clean Air Act, the VOC-RACT requirements for coating users and suppliers, and discussed air toxic and operating permits.

Q. When are the air regulations going into effect in Massachusetts, New York, and Connecticut?

A. Massachusetts is to be in effect by 1998. Regulations in New York and Connecticut should be effective by the year 2003. In addition, VOC regulations are to be in compliance by September 1998; while later dates are attainment dates. In addition, other reduction regulations have different dates.

RICHARD TWOMEY, *Secretary*

PACIFIC NORTHWEST (VANCOUVER SECTION)—APRIL

"Ambient Cure Waterborne Epoxy Coatings"

Environmental Committee Chair Paul Andreassen, of Consolidated Coatings Corp., reported on a conversation with Paul Iverson, of B.C. Paint, after an article on the paint industry was published in a newspaper. Mr. Iverson told Mr. Andreassen that the industry has a good relationship with the government. Sixty-six drop-off depots for recycling used paint are open, with 85 scheduled by the end of June.

Educational Committee Chair Tom Fairley, of Calcoast Labs Canada Inc., stated that seven applications for the Bill Biddle Scholarship have been received.

All members were urged to comment on the FSCT Strategic Plan. Comments should be forwarded to Yvon Poitras, of Mills Paint Sales Ltd.

The guest speaker was Ernie Galgoci, of Shell Chemical Co., who discussed "AN OVERVIEW OF AMBIENT CURE WATERBORNE EPOXY COATING TECHNOLOGY."

KELVIN J. HUGET, *Secretary*

ROCKY MOUNTAIN—MAY

"Accelerated Corrosion Testing"

Society Representative Dick Mullen, of G-3 Industries, Inc., reported on the FSCT Board of Directors Meeting. Among the recommendations proposed were suggestions for restructuring including: elimination of the Executive Committee; reducing the size of the Board of Directors; meeting four times a year, instead of twice; and reducing the number of committees.

It was announced that the Society is currently seeking nominations for Secretary.

The evening's technical speaker was Cleveland Society member Steve Grossman, of the Q-Panel Co. Mr. Grossman discussed "ACCELERATED CORROSION TESTING."

Mr. Grossman recommended that ASTM B 117 (Salt Fog Test) should not be used for corrosion testing, since it does not represent most service environments. According to the speaker, conventional salt spray testing causes the purchase of bad coatings. The results from B 117 tests usually do not correlate well with outdoor exposure results.

Instead, Mr. Grossman stated that cyclic corrosion testing (CCT) has shown better correlation to actually simulating conditions of condensation, humidity, and dryness, hot and cold, and UV exposure. Some of these CCT tests include: Prohesion and CCT1 and 4. Prohesion testing was developed in England and uses a more dilute electrolyte with a pH of 5.0-5.4% in place of the 5% NaCl solution of the B 117 test. The test has a wet period followed by a dry period usually of the same time length.

Mr. Grossman stated that several automotive tests have been standardized including PC-4 (SAE 2334) and an acid rain CCT. ASTM has several committees (D01.27.30 and D01.27.31) standardizing corrosion/weathering test methods including ASTM G 85 and D 5894. Currently ASTM has testing in progress to correlate results between laboratory and eight different exposure sites.

The SAE Automotive Corrosion/Prevention Committee has five-year data on various paint systems which have shown good correlation between lab testing and exposure site results. The correlation (Spearman's Rho) for test method GM9540P was 0.89, and 0.89 for CCT4, but for ASTM B 117 it was –0.38. Spearman's Rho > 0.7 indicates good correlation.

Furthermore, Mr. Grossman said that AMS G-8 Aerospace Coatings Committee has shown that B-117 cannot accurately predict exterior durability particularly for low VOC coatings. The Aerospace Coatings Committee intends to develop test methods which yield quantitative results rather than the empirical rankings of most of the current test methods.

In addition, the speaker informed the attendees that the Cleveland Society for Coatings Technology currently has laboratory and outdoor exposure testing in progress for nine industrial maintenance systems. They are monitoring rust creep, blistering, and surface rusting for the systems. Although outdoor exposure testing has shown wide variability, their laboratory cyclic corrosion tests correlated much better to the outdoor results that the B 117 results did.

Q. Is the scatter of data due to variation in pigmentation?

A. This is not known, because the testing to date has not specifically studied the mechanism of corrosion/weathering in coatings.

JOHN ELVERUM, *Secretary*

New FSCT Members

CLEVELAND

Active

Hille, Richard M.—The Flood Co., Hudson, OH.
Kim, Chong W.—Engelhard Corp., Beachwood, OH.
Naik, Hemant A.—Poly-Carb, Inc., Solon, OH.

DETROIT

Active

Brown, Kenneth H.—PRA Laboratories, Inc., Ypsilanti, MI.
Foster, Leetonio R.—Mercury Paint Co., Detroit, MI.
McCasey, Wendy M.—The Sherwin-Williams Co., Troy, MI.
Rankin, Michael S.—Mercury Paint Co., Detroit.
Van Heule, James G.—IVC Industrial Coatings Inc., Grand Haven, MI.

Associate

Ball, Walter G.—Zinc Corporation of America, Ypsilanti, MI.
Koeppe, Curt E.—Hydrite Chemical Co., Grand Haven, MI.
Schroeder, Michelle J.—ICI Polyurethanes, Sterling Heights, MI.

MONTREAL

Active

Benc, Marijan F.—Chemcentral, Brossard, Que.
Centazzo, Tiziana—H.L. Blachford, Montreal, Que.
Fu, Bernard—Durokote, Laval, Que.
Gupta, Ved P.—Chemor, Inc., Montreal.
Marcotte, Jean—Peintunes Denalt Ltée. St.-Léonard, Que.

Associate

Provost, Pierre Gilles—B.I. Chemicals, Vaudreuil, Que.

NEW YORK

Active

Carver, T. Granville—Cook & Dunn Enterprises, Lodi, NJ.
Chen, Ming J.—OSi Specialties/Witco, Tarrytown, NY.
Greenberg, Harry—Cook & Dunn Enterprises, Lodi.
Igbokwe, Edward O.—Cook & Dunn Enterprises, Lodi.
Jafary, Ishrat A.—Cook & Dunn Enterprises, Lodi.

Associate

Allmand, Lionel C.—Deltech Corp., Whippany, NJ.
Gittleman, David—Micro Powders, Inc., Tarrytown, NY.
Sugerman, Gerald—PPA Technologies Inc., Allendale, NJ.

PHILADELPHIA

Active

Armstead, Joann C.—Specialty Minerals, Easton, PA.
Budman, Theodore M.—Superior Materials Inc., Garden City, NY.
Delap, Dennis J.—Fielco Industries, Huntington Valley, PA.
Gardiner, John L.—Specialty Minerals, Easton.
Garner, Michael J.—Thomas Scientific, Swedesboro, NJ.
Harradine, Alfred J.—Henkel Corp., Ambler, PA.
Kafka, Steven G.—Superior Materials, Inc., Garden City.
Kraushaar, Douglas J.—Tioxide Americas Inc., Clayton, NJ.
Lee, Jimmie S.—DuPont Co., Deepwater, NJ.
Nehra, Mark A.—ICI Surfactants, Wilmington, DE.
Patrick, George R.—Ciba-Geigy Corp., Newport, DE.
Price, Beth A.—Phila, Philadelphia, PA.
Rose, Dennis L.—Retro Tek, Fairless Hills, PA.
Tuszynski, William—Inolex Chemical Co., Philadelphia.

Associate

Allen, Jodi A.—Cytec Industries, Morristown, NJ.
Brown, Michael J.—Hercules Incorporated, Wilmington, DE.
Campbell, Donna M.-PCI Magazine, Philadelphia, PA.
Cech, John—CVC Specialty Chemicals, Inc., Maple Shade, NJ.
Gordon, W. Murray—Sun Co., Inc., Philadelphia.
Manuel, Darryl—Polysat Inc., Philadelphia.
McGrath, Brian J.—Gamry Instruments, Inc., Willow Grove, PA.
Mukkulainen, Bertil V.—Air Products & Chemicals, Allentown, PA.
Mulvey, Joseph L.—Henkel Corp., Ambler, PA.
Piccolino, Elvio—OSi Specialties, Woodcliff Lake, NJ.
Royal, H.L. *Boyer*—H.M. Royal, Inc., Trenton, NJ.
Slick, Daniel M.—SNPE North America, Princeton, NJ.
Zawicki, James D.—Sartomer Co., Inc., Exton, PA.

PIEDMONT

Active

Bates, Russell R.—The Valspar Corp., High Point, NC.
Brodowski, Bruce E.—Froehling & Robertson, Charlotte, NC.
Champion, James A. *Jr.*—KMG Minerals, Kings Mountain, NC.
Gerelus, Dave—Chemcraft Sadolin, Walkertown, NC.
Headd, Kevin O.—Froehling & Robertson, Charlotte.
James, Cheri—The Valspar Corp., High Point.
Malcolm, Eileen T.—The Valspar Corp., High Point.
Sepessy, Sherri D.—The Valspar Corp., High Point.
Vasconcellos, Mark A.—Taotek North America, Charlotte.

Associate

Adrien, Thomas O.—Burgess Pigment Co., Sandersville, GA.
Salas, Carlos M.—Taotek North America, Charlotte, NC.

PITTSBURGH

Active

Crocetti, Amy—Ranbar Electrical Materials, Manor, PA.

SOUTHERN

Active

Brezinski, Darlene R.—Consolidated Research, Kingsford, MI.

Associate

Barrett, Terrence D.—Michelman, Inc., Cincinnati, OH.
Callahan, Kevin F.—Dry Branch Kaolin Co., Union, NJ.
Cheng, Frank—Ciba Polymers.
Flovin, James B.—Kohl Marketing Inc., Clearwater, FL.
Foster, Michael J.—Cook Composites, Brookfield.
Greene, Jim—Wacker Silicones, Adrian, MI.
Haimann, Steve—Hoover Color Corp., Hiwasse, VA.
Jaunzemis, Vilnis P.—Occidental Chemical, Mobile, AL.
Kappock, Paul S.—Olin Chemicals, Cheshire, CT.
Robinson, Robert J.—Bayer Corporation, Pittsburgh, PA.
Smith, Tim—Deeks & Company, Birmingham, AL.
Tishler, Clifford—Zeneca Resins, Wilmington, MA.

ST. LOUIS

Active

Wagner, Paul M.—Marsh Company, Belleville, IL.


R. Mazzariello

S.P. Morell and Co., Armonk, NY, has appointed **Rick Mazzariello** to the position of Sales Manager. Prior to this position, Mr. Mazzariello managed the company's sales efforts in the New England region. He is a member of the New York Society.

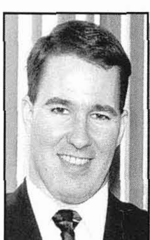
Kenneth T. Loye has assumed the title and responsibilities of Technical Marketing Manager, Coatings for Engelhard Corp., Iselin, NJ. Based at the company's Beechwood, OH, research and development center, Mr. Loye will introduce new industrial coatings products and will set technical service priorities. He is a member of the Cleveland Society.

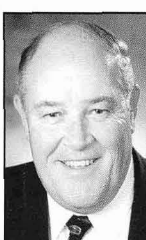
ICI Surfactants, Wilmington, DE, has announced that **Emery A. Cole** has been inducted into the 1995 ICI Round Table. As a winner of the award, Mr. Cole represents the "best of the very best" in ICI's sales force. Mr. Cole is a Senior Technical Representative for the newly formed Ag Technologies Group of ICI Surfactants. Based in Mooresville, NC, he is responsible for sales on the East Coast, the Southeast, Mid-South, and parts of the Midwest.

Fusion UV Curing, Gaithersburg, MD, has appointed **Earl M. Seagrave III** to the position of Direct Sales Representative. Mr. Seagrave will cover North Carolina, South Carolina, and eastern Tennessee.

The Sico Group, Longueuil, Quebec, Canada, has appointed **Jeffrey L. McIntyre** to the position of President of Hancock Paint, Inc., Boston, MA, its U.S. operating company. Mr. McIntyre most recently served as National Sales Manager for the Consumer Paint Products Division.

In other news, **Steve Hungerford** was named Vice-President, Dealer Sales—Sico, U.S.A. Mr. Hungerford will be responsible for the development and implementation of a complete dealer program for the U.S. market.


J.L. McIntyre

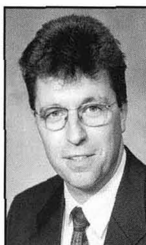

S. Hungerford

Chemcentral Corp., Bedford Park, IL, has named **Roger Landmann** to the position of Resident Sales. Mr. Landmann will relocate to Richmond, VA, from Minnesota, where he currently serves as Sales Representative. Mr. Landmann is a member of the Northwestern Society.

Also, **David McMillin** has accepted the promotion to Sales Supervisor for the company's Greensboro, NC, facility. Mr. McMillin joined Chemcentral in 1988.

Akzo Nobel Resins, Troy, MI, has appointed **Michael J. Kelly** as Director of Sales and Marketing for Coatings Resins—North America. Based in Louisville, KY, Mr. Kelly will report to **Kenneth R. Hyde**.

Rod Cooper has accepted the position of Field Sales Representative for the West Coast Sales Office of Datacolor International, Charlotte, NC. Mr. Cooper brings 10 years of experience as a testing lab manager to the position.


P. Denkinger

Hüls America Inc., Somerset, NJ, has appointed **Peter Denkinger** to the position of Technical Service Manager for the company's Coatings Raw Materials Division. In his new position, Dr. Denkinger will be responsible for technical service activities supporting the coatings raw materials and additives product lines.

Also, **Britt Nordby** was named Scientist for the company's Colorants and Biocides Division. Ms. Nordby will coordinate the development of new techniques, procedures, and databases.


R.M. Bennett

Robert M. Bennett has been named Marketing Manager, Coatings, for Witco's OSi Specialties Group, Danbury, CT. Mr. Bennett will be accountable for the group's coatings activities in both its organo-functional silanes and specialty fluids business units.

Hanley Paint Mfg. Co., Inc., El Paso, TX, has elected the following officers: President—**W. Miles Tunno**; Vice President/General Manager—**Robert C. Eveler**; Vice President/Sales—**Tony M. Carmona**; and Vice President/Manufacturing—**Blake Barnard**.

Ferro Corp., Cleveland, OH, has named **Tony Jones** and **James H. Gavlenski** to Technical Service Representative positions for the Powder Coatings Division.

Mr. Jones, whose most recent position was Materials Coordinator, will be based in Louisville, KY.

Mr. Gavlenski, who will operate out of Chattanooga, TN, most recently served as Senior Sales/Service Representative.

In addition, **Thomas W. Connelly** has joined the staff of Ferro Corp., Cleveland, OH, as Field Sales Representative for the Powder Coatings Division. Based in St. Louis, MO, Mr. Connelly will develop sales in Missouri, Kansas, Iowa, and southern Illinois.

Robert D. Duncan, Executive Vice President of PPG Industries Inc., Pittsburgh, PA, has announced his retirement. Mr. Duncan has served the company for 34 years.

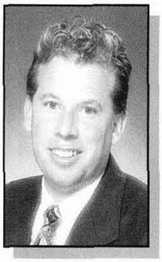
Obituary

Benjamin Chatzinoff, Past-President of the New York Society, died on June 6, 1996. He was 79 years old.

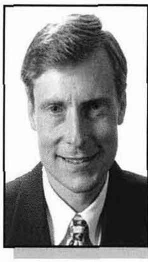
Mr. Chatzinoff received a B.S. Degree in Chemistry from the City College of New York in 1936. He began his career in the coatings industry in 1937 as a chemist with the 20th Century Paint and Varnish Corp. The company later merged into Consolidated Chemical and Paint Corp. Mr. Chatzinoff held various positions within Consolidated, including Technical Director, General Manager, and Secretary. He also served on the Board of Directors. Mr. Chatzinoff concluded his career with Quaker City Chemicals.

As a member of the New York Society, Mr. Chatzinoff was elected President in 1959. He was also the recipient of the Roy H. Kienle Award in 1960 and the PaVaC Award in 1966. Mr. Chatzinoff also served on various technical and administrative committees. He joined the Philadelphia Society in 1969, where he served as Educational Committee Chair from 1972-76 and also chaired a Society seminar in 1974.

Mr. Chatzinoff was active in the Federation as well. He served as Chairman of various committees including the Heckel Award Committee. In addition, Mr. Chatzinoff was Chairman of the Materials Marketing Association (MMA) Awards Committee from 1975-77.



J. Hunt



T. Ashe

Fabricolors Dyes & Pigments, Paterson, NJ, has appointed **Jim Hunt** to the position of Southeast Regional Manager. Mr. Hunt's prior experience in the coatings industry includes the following positions: production management, purchasing, and quality control. He is a member of the Southern Society.

In addition, **Thomas Ashe** has accepted the position of Midwest/West Coast Regional Manager. Mr. Hunt brings over 13 years of experience to this position.

Advanced Chemical Co., Warwick, RI, has named **Leonard M. Eagle** to the position of Product Manager. Mr. Eagle will direct the company's Karat Gold Division. Based in Long Island, NY, he will be responsible for expanding the recently formed division.

Letter to the Editor

To The Editor:

On page 80 of the May 1996 issue of the Journal of Coatings Technology, there is a mistake in the minutes of the March meeting of the New York Society. I did not say that the VOC regulatory requirements have been pushed back to the year 2000. The facts that I reported to the members are as follows:

(1) The AIM VOC regulations will probably go into effect on or about April 30, 1997.

(2) The table of standards for the year 2000 has been deleted.

(3) Before any more stringent regulations are proposed, the EPA and industry representatives will determine if the technology is present to make quality paints with lower VOCs.

As written, my report could lead Society members who are not familiar with what has been happening in the regulatory process since 1992 to believe that they have longer to reformulate than they actually do and that their current products can be manufacturer and sold for at least three years longer than is legal.

Sidney J. Rubin
Brooklyn, NY

The Society of the Plastics Industry (SPI), Inc., has elected the following to the Board of Directors: Chairman—**H. Patrick Jack**, Fina Oil and Chemical Co.; Vice Chairman—**Harry B. Ussery**, Beacon Plastics, Inc.; Treasurer—**Arthur J. Goodsel**, Huron Plastics Group, Inc.; Secretary—**David G. Birney**, Solvay Polymers; and Immediate Past Chairman—**G. Watts Humphrey, Jr.**

The following have joined the board as directors: **Phillip D. Ashkettle**, Reichhold Chemicals Inc.; **Peter F. Bemis**, Bemis Manufacturing Co.; **Tom D. Gill**, DuPont; **Andrae Lehner**, Omega Tool, Inc.; **Richard J. Urso**, The Budd Co.; and **Donald E. Willerth**, Trans Container Corp.

SPI has also elected committee officers to serve for the upcoming year. They are: Chairman of the Committee on Resin Statistics—**Jan B. Neuenfeldt**, The Dow Chemical Co.; Chairman-Elect—**Victor F. Chang**, BASF Corp.; Thermoplastics Resins Director—**Jason Ayoub**, Chevron Chemical Co.; Thermoset Resins Director—**Bruce Mullen**, Ciba-Geigy Corp.; Internal Task Force Director—**Susan L. Melloan**, Shell Chemical Co.; External Task Force Director—**Terry Bonnell**, Phillips Chemical Co.; and Finance Committee Chairman—**Kevin L. Boyle**, Occidental Chemical Corp.

Peter Gallagher has accepted the position of Market Manager—Pacific area for Rheox, Inc., Hightstown, NJ. Mr. Gallagher will be responsible for marketing, technical, and sales support of the company's products to customers and agents in Asia.

Lansco Colors, Passaic, NJ, has announced that **Paula Moore** has joined the staff as Quality Assurance Manager for their line of color pigments. In this capacity, Ms. Moore will be responsible for quality control, working with factories on continuous quality improvement, evaluating new pigments, and providing customer support on quality and technical issues.

Steven J. Gach, has joined the hydrogeological team of TolTest, Inc., Plymouth, MI, as an Engineer. A certified underground storage tank professional, Mr. Gach brings eight years of experience to the position.

In addition, **Kathryn M. Brugman** was named Environmental Engineer. Ms. Brugman specializes in assisting with Clean Air Act compliance.

Robert A. Hotchkiss has been appointed Communications Manager for ICI Polyurethanes (Americas Region), West Deptford, NJ. Mr. Hotchkiss will be responsible for internal and external communications in North and South America.

Michael McCann has been elected to the position of Executive Vice President and Chief Operating Officer for Ruco Polymer Corp., Hicksville, NY. In addition to his corporate sales and marketing responsibilities, Mr. McCann will oversee the operations of the company's manufacturing, purchasing, new business development, and technical services.

Ralph Starkey has been named Southwestern Regional Manager for Red Spot Paint & Varnish, Evansville, IN. Mr. Starkey will be based in Red Spot's Dallas, TX, office.

Kerr-McGee Chemical Corp., Oklahoma City, OK, has announced the following personnel changes. **W.P. "Pete" Woodward** has been named Senior Vice President—Chemical Marketing. Mr. Woodward most recently served as Director—Pigment Business Management.

Accepting the position of Director—Pigment Business Management is **David W. Ezell**. He was previously Director—Electrolytic and Specialty Products Business Management.

James B. Worthington has been named Director—Specialty and New Products Business Management. He was formerly the Vice President—Research and Development.

B.J. Montgomery was appointed Vice President—Research and Development.

Computational Systems, Inc. (CSI), Knoxville, TN, has named **Robert de Jonge** General Manager of European Operations. Based in Leuven, Belgium, Mr. de Jonge will be responsible for business and sales development, customer satisfaction, promotion of the Reliability-Based Maintenance® philosophy, and distribution of all advanced maintenance products.

Allan DeLange, Vice President of J.L. Manta Inc. has received certification from The National Board of Registration of Nuclear Safety Related Coating Engineers and Specialists, Leola, PA, as a Nuclear Coating Specialist.

Eastman Chemical Co., Kingsport, TN, announced that **James L. Chitwood**, Senior Vice President for Operations outside North America, will assume the additional responsibility of President, Europe, Middle East, and Africa. Dr. Chitwood will relocate to The Hague, Netherlands. He replaces **William R. Garwood** who is retiring.

In other news, **Michael D. Newman** was appointed Vice President, Manufacturing, Latin America region. Mr. Newman will manage Latin American manufacturing in addition to his current responsibilities as Supervisor, Polymer Chemicals, at Carolina Eastman Co., Columbia, SC.

Books/Publications

HMIS Update

The NPCA has updated HMIS and has made available the *HMIS Implementation Manual*. Offering an expanded mix-and-match option for listing PPE and a new label style, these labels work with HMIS training materials and the *HMIS Implementation Manual* to help employers develop and maintain a complete hazard communication program.

Circle No. 30 on Reader Service Card

Corrosion Resistant Coatings

Guide to Whitford Industrial Products describes coatings that reduce wear and corrosion on several industrial and domestic products. It also provides performance profiles on specific coatings and several applications where they decrease friction, release problems, and corrosion.

Circle No. 31 on Reader Service Card

Standards

The ASTM Standards on Color and Appearance Measurement, 5th edition, contains 90 of the latest ASTM standards, nine ISO and ISO/CIE standards, 99 related standards, and seven tables. In addition, 22 ASTM standards have been revised, and 17 are new.

Circle No. 32 on Reader Service Card

Photoinitiator Catalog

A 29-page photoinitiator product bulletin has been published by Sartomer Co. This bulletin outlines physical, performance, and chemical properties of the company's benzophenones, co-initiators, initiators, and photoinitiators.

Circle No. 33 on Reader Service Card

Plastics

The *AIN Plastics Catalog* 96 is a source book of complete lines of mechanical plastics. This comprehensive catalog contains pre-cut sheets, prices per sheet, and available sizes and specifications of unmatched inventory.

Circle No. 34 on Reader Service Card

Colorants

A brochure, provided by Hüls America Inc., highlights the company's G-P-D colorants at full strength and in ratios to TiO_2 of 1:1, 1:5, and 1:20. Also provided for each colorant are tables of physical properties detailing VOC content, composition, resistance to acid and alkaline, discoloration, and light-fastness.

Circle No. 35 on Reader Service Card

Instruments Catalog

A catalog featuring smart RTD and thermocouple calibrators, two-wire infrared temperature monitors, and RTD probe systems has been released by Wahl Instruments, Inc. These instruments are designed to solve temperature application problems such as plant maintenance and waste and pollution management. The instruments and calibration are traceable to NIST, and many are approved by Factory Mutual and Canadian Standard Association for potentially explosive environments.

Circle No. 36 on Reader Service Card

Hydrocarbon Resins

A brochure with full-color graphs highlights the physical, chemical, and application details of hydrocarbon resins available from Hercules Incorporated. The publication contains color, melt viscosity, and softening point of resins, as well as spotlights products in a variety of applications. The guide also includes information on liquid resins and resin solutions.

Circle No. 37 on Reader Service Card

Equipment

Cabinet Oven

An electrically heated cabinet oven from The Grieve Corp. provides operating temperatures up to 500° and measures 22" × 21" × 85". The oven is designed to handle flammable solvents: built-in manual temperature reset, back-up heating, powered exhaust with safety switch, and recirculating blower with safety switch and purge timer.

Circle No. 38 on Reader Service Card

Quaternary Pump

Varian's new quaternary pump automates operations with a switching valve that allows the system to run any of four premixed solvents, to mix three of the four solvents for analysis, or to use the fourth solvent as a wash. This pump offers a degassing and helium sparging design.

Circle No. 39 on Reader Service Card

Pail Inserts

CDF has developed tapered and taller pail inserts for plastic pails, as well as the straight-sided inserts for steel pails. These inserts are FDA-approved and are 15 mil thick. They are designed to reduce cleaning, reconditioning, and replacement of your pails.

Circle No. 40 on Reader Service Card

Driers

Daniel Products Co., Inc., has introduced a replacement for cobalt in driers. This hydrolysis resistant product reportedly minimizes the initial and post-dry color effects associated with cobalt driers. This new drier is designed to improve the color of whites, light colors, and clears, as well as decreasing yellowness.

Circle No. 41 on Reader Service Card

Drumfiller

The AFS Drumfiller has push-button start-up, foot valves at the tips of the fill lances, adjustable dribble-flow, fume collectors, and wiper rings. This Velcon Automated Filling Systems drumfiller positions the incoming drum, locates the bung, removes the plug, fills the drum, reinstalls and torques the bung, and applies a dust seal.

Circle No. 42 on Reader Service Card

Treatment Process

The Baler Equipment Co. has developed a clay process that reportedly converts hazardous waste to nonhazardous material. This product reportedly eliminates sewer surcharges and creates reusable water and non-leachable solids that are acceptable at industrial landfills. This process is designed to benefit small and medium-sized manufacturers with wastewater streams from 50 gallons per week to 50 gallons per minute.

Circle No. 43 on Reader Service Card

Laboratory Apparatus

Stereomicroscope

The new Stemi SV II Apo reportedly provides images with new degrees of brilliance, high contrast, field depths, and color fidelity. It has a wide 11:1 zoom range and planapochromatic correction. Carl Zeiss, Inc., has also provided the user with a 35° viewing angle to allow for extended use.

Circle No. 44 on Reader Service Card

Infrared Microspectroscopy

High-infrared spectra are obtained by placing a single bead on a slide and contacting the bead with the ATR crystal. A new microscope has been developed by Spectra-Tech Inc. This microscope is designed to detect and characterize reactions directly on the bead without cleaving the molecule from the bead.

Circle No. 45 on Reader Service Card

Raw Materials

High Crosslink Density

Ciba Coating Systems has introduced a multifunctional epoxy resin, Araldite EPN 9880 CH. Coatings based on this product may exhibit chemical and thermal resistance. This low-viscosity resin reportedly provides solvent resistance, adhesion, and low volatility when used in baked coatings.

Circle No. 46 on Reader Service Card

Composite Diamond Coating

A composite diamond coating has been developed by Surface Technology, Inc. This coating reportedly provides hardness; wear, abrasion, and impact resistance; anti-corrosion properties; and applicability to common metals and alloys.

Circle No. 47 on Reader Service Card

Flatting Agents

Grace Davison is introducing two new grades of silica flatting agents for coil and general industrial coatings. These flatting agents are designed to offer sheen control, coating smoothness, weatherability, and dispersion characteristics. They provide sheen:gloss ratios from 2.2:1 to 1:1.

Circle No. 48 on Reader Service Card

Transfer Agent/Rheology Modifier

Designed for water-based, pigment printing inks, DREWFAX® 504 reportedly exhibits ink transference properties from printing rollers to the printing substrate. Developed by Ashland Chemical Company's Drew Industrial Division, this transfer agent/rheology modifier is developed for aqueous flexographic inks for corrugated boxes.

Circle No. 49 on Reader Service Card

Pigment Dispersant

Daniel Products Co., Inc., has introduced a multifunctional pigment dispersant for aqueous systems. Disperse-Ayd W-30 reportedly does not promote foam, lower gloss, nor affect dry time, resistance properties, or film hardness. It is compatible with waterborne coatings and inks, and the low VOC aids in development of coatings and inks.

Circle No. 50 on Reader Service Card

Software

CD-ROM

Degussa Corp. has released a CD-ROM to answer questions concerning AEROSIL. The compact disc includes narration, an animated demonstration, and graphics on this fumed silica.

Circle No. 51 on Reader Service Card

Dictionaries

InWords™ and SciWords™ are dictionaries for word-processor users and science professionals. These computer dictionaries were developed by INSO Corporation. Both dictionaries are compatible with many computer programs.

Circle No. 52 on Reader Service Card

Industrial Automation Software

Progressive Recovery, Inc., has developed industrial automation software. This software allows process monitoring, supervisory control, alarming automatic system shutdown, and statistical process control. This application uses Windows and Windows NT to integrate network capabilities and DDE connectivity.

Circle No. 53 on Reader Service Card

Testing Equipment

Single Bounce HATR

Spectra-Tech Inc. introduces the single bounce horizontal attenuated total reflectance (HATR) accessory for FTIR spectrometers. This product reportedly has a small sampling area so less sample is required to obtain spectral information. The HATR is available with either zinc selenide or germanium crystals.

Circle No. 54 on Reader Service Card

Densitometer

A densitometer that is designed to calibrate a variety of film and paper media has been introduced by X-Rite, Inc. The DTP12 reportedly delivers automated calibration and controls black and white output devices. It also handles transmissive and reflective materials and interfaces with MS DOS- and Macintosh-based calibrations software programs.

Circle No. 55 on Reader Service Card

Federation Meetings

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

1996

(Aug. 15-17)—Pan American Coatings Expo. Co-sponsored by Federation of Societies for Coatings Technology, ANAFAPYT, and Instituto Mexicano de Téchnicos en Pinturas y Tintas. Sheraton Maria Isabel Hotel, Mexico City, Mexico.

(Aug. 20-21)—"Computer Uses in the Coatings Industry." Seminar sponsored by the Professional Development Committee. Hyatt Regency O'Hare, Chicago, IL.

(Oct. 22-24)—International Coatings Technology Conference. Chicago Hilton and Towers and McCormick Place North, Chicago, IL.

(Oct. 23-25)—International Coatings Expo (Formerly Annual Meeting and Paint Industries' Show). McCormick Place North, Chicago, IL.

1997

(Nov. 3-5)—International Coatings Technology Conference and Expo (Formerly Annual Meeting and Paint Industries' Show). Georgia World Congress Center, Atlanta, GA.

Special Society Meetings

1997

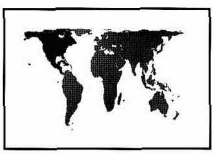
(Feb. 5-7)—24th Annual International Waterborne, High-Solids, and Powder Coatings Symposium. Sponsored by the Southern Society and The University of Southern Mississippi (USM). New Orleans, LA. (Robson F. Storey or Shelby F. Thames, Co-Organizers, WBHS&PC Symposium, Dept. of Polymer Science, USM, Box 10076, Hattiesburg, MS 39406-0076).

(Feb. 18-20)—Western Coatings Societies' 23rd Biennial Symposium and Show. Sponsored by the Golden Gate, Los Angeles, Pacific Northwest, and Rocky Mountain Societies. Disneyland Hotel and Convention Center, Anaheim, CA. (Bruce Cotton, Pluess-Staufer (California), Inc., P.O. Box 825, Lucerne Valley, CA 92356; (619) 248-7306; or Ron Elliott, J.R. Elliott Enterprises, Inc., 300 Thor Pl., Brea, CA 92621; (714) 529-0711).

(May 8-10)—50th Annual Spring Symposium. Sponsored by the Pacific Northwest Society. Panamerican Hotel, Vancouver, British Columbia.

(May 12-14)—Southern Society Annual Meeting. King and Prince Beach and Golf Resort, St. Simons Island, GA. (Eve Irvine, J.M. Huber Corp., One Huber Rd., Macon, GA 31298; (912) 750-5433).

Other Organizations



1996—North America

(Aug. 3-5)—31st National Heat Transfer Conference. Sponsored by American Institute of Chemical Engineers. Westin Galleria, Houston, TX. (AIChE*xpress* Service Center, 345 E. 47th St., New York, NY 10017-2395).

(Aug. 5-8)—50th Sea Horse Institute Conference. Sponsored by LaQue Corrosion Services. Blockade Runner Hotel, Wrightsville Beach, NC. (LaQue Corrosion Services, P.O. Box 656, Wrightsville Beach, NC 28480).

(Aug. 6-7)—BatchMaster Training. Inventory/Production course sponsored by BatchMaster Software Corp. Chicago, IL. (Wendy Curfman, BatchMaster Software Corp., 1500 Pacific Coast Hwy., Ste. E, Seal Beach, CA 90740).

(Aug. 9-14)—31st Intersociety Energy Conversion Engineering Conference. Sponsored by the Institute of Electrical & Electronics Engineers, Inc. Omni Shoreham Hotel, Washington, D.C. (AIChE*xpress* Service Center, 345 E. 47th St., New York, NY 10017-2395).

(Aug. 14-16)—"Correctly Applying SPC Tools in Laboratory and Continuous Flow & Batch Manufacturing Processes." Short course sponsored by Oklahoma State University. Stillwater, OK. (George Collington, Oklahoma State University, Engineering Extension; (405) 744-5714).

(Aug. 19-21)—"Particle Size Analysis." Training course sponsored by Horiba Instruments, Irvine, CA. (Geneen Spence, Horiba Instruments, 17671 Armstrong Ave., Irvine, CA 92714).

(Aug. 19-22)—ARMA Fall Committee Meetings. Sponsored by Asphalt Roofing Manufacturers Association (ARMA). New Orleans, LA. (ARMA, 6000 Executive Blvd., Ste. 201, Rockville, MD 20852-3803).

(Aug. 24)—"FTIR Spectroscopy and NMR Applications to Polymers." Sponsored by the Division of Polymeric Materials: Science and Engineering division of the American Chemical Society (ACS). Orlando, FL. (Edward Glass, North Dakota State University, Polymers and Coatings Department, Dunbar Hall, Rm. 156, Fargo, ND 58105).

(Aug. 24)—"Modern Methods of Particle Size Distribution: Assessment and Characterization." Sponsored by the Division of Polymeric Materials: Science and Engineering division of the American Chemical Society (ACS). Orlando, FL. (Theodore Provder, Workshop Director, ICI Paints, 16651 Sprague Rd., Strongsville, OH 44136).

(Aug. 25-27)—"Particle Characterization and Particle Size Assessment." Sponsored by the Polymeric Materials: Science and Engineering division of the American Chemical Society (ACS). Orlando, FL. (Theodore Provder, Workshop Director, ICI Paints, 16651 Sprague Rd., Strongsville, OH 44136).

(Sept. 4-11)—Manufacturing '96 Conference. Sponsored by the Society of Manufacturing Engineers (SME). McCormick Place, Chicago, IL. (SME, One SME Drive, P.O. Box 930, Dearborn, MI 48121-0930).

(Sept. 8-12)—1996 EOS/ESD Symposium. Sponsored by the ESD Association. Lake Buena Vista, FL. (ESD Association, 7902 Turin Rd., Ste. 4, Rome, NY 13440).

(Sept. 9-12)—Safety in Ammonia Plants and Related Facilities. Sponsored by American Institute of Chemical Engineers. Westin at Copley Place, Boston, MA. (AIChE*xpress* Service Center, 345 E. 47th St., New York, NY 10017-2395).

(Sept. 9-13)—"The Basic Composition of Coatings." Short Course sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (UMR Coatings Institute, 1870 Miner Circle, Rolla, MO 65409).

(Sept. 10)—Rheology Seminar. Sponsored by Brookfield Engineering Laboratories, Inc. New Jersey. (Barbara Cunningham, Brookfield Engineering Laboratories, Inc., Dept. NR-119, 240 Cushing St., Stoughton, MA 02072).

(Sept. 12)—Rheology Seminar. Sponsored by Brookfield Engineering Laboratories, Inc. Cincinnati, OH. (Barbara Cunningham, Brookfield Engineering Laboratories, Inc., Dept. NR-119, 240 Cushing St., Stoughton, MA 02072).

(Sept. 16-17)—Engineering & Construction Contracting Conference. Sponsored by American Institute of Chemical Engineers. Walt Disney World Swan Hotel, Orlando, FL. (AIChE*xpress* Service Center, 345 E. 47th St., New York, NY 10017-2395).

(Sept. 16-19)—Can Technology Conference & Exposition. Sponsored by the Society of Manufacturing Engineers (SME). Hyatt Rosemont, Rosemont, IL. (SME, One SME Drive, P.O. Box 930, Dearborn, MI 48121).

(Sept. 17-19)—Powder Coatings '96. Conference and Exhibition sponsored by The Powder Coating Institute. Indiana Convention Center, Indianapolis, IN. (Goyer Management, P.O. Box 54464, Cincinnati, OH 45254-0464).

(Sept. 17-20)—BatchMaster 3.5 Modules Training Course. Sponsored by BatchMaster Software Corp. Irvine, CA. (Wendy Curfman, BatchMaster Software Corp., 1500 Pacific Coast Hwy., Ste. E, Seal Beach, CA 90740).

(Sept. 22-25)—1996 Manufacturers and Suppliers Workshop and Exposition. Sponsored by The American Ceramic Society. Adam's Mark Hotel, Charlotte, NC. (The American Ceramic Society, 735 Ceramic Place, Westerville, OH 43081-8720).

(Sept. 23-25)—"Particle Size Analysis." Training course sponsored by Horiba Instruments, Irvine, CA. (Geneen Spence, Horiba Instruments, 17671 Armstrong Ave., Irvine, CA 92714).

(Sept. 23-27)—"Introduction to Paint Formulation." Short Course sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (UMR Coatings Institute, 1870 Miner Circle, Rolla, MO 65409).

(Sept. 30-Oct.1)—Florida Plastics Summit. Sponsored by The Society of the Plastics Industry (SPI), Inc. Clarion Plaza Hotel, Orlando, FL. (SPI, 1275 K St., N.W., Ste. 400, Washington, D.C. 20005).

(Oct. 1)—Rheology Seminar. Sponsored by Brookfield Engineering Laboratories, Inc. San Francisco, CA. (Barbara Cunningham, Brookfield Engineering Laboratories, Inc., Dept. NR-119, 240 Cushing St., Stoughton, MA 02072).

(Oct. 3)—Rheology Seminar. Sponsored by Brookfield Engineering Laboratories, Inc. Denver, CO. (Barbara Cunningham, Brookfield Engineering Laboratories, Inc., Dept. NR-119, 240 Cushing St., Stoughton, MA 02072).

(Oct. 2-3)—Fifth Annual Advanced Radiation (UV/EB) Curing Marketing/Technology Seminar. Sponsored by Armbruster Associates, Inc. Marriott Hotel, Newark Airport, Newark, NJ. (David C. Armbruster, Armbruster Associates, Inc., 43 Stockton Rd., Summit, NJ 07901).

(Oct. 7-9)—"Basic Coatings for Sales, Marketing, and General Personnel." Short Course sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (UMR Coatings Institute, 1870 Miner Circle, Rolla, MO 65409).

(Oct. 8-11)—International Process Safety Managment Conference & Workshop. Sponsored by American Institute of Chemical Engineers. Airport Marriott Orlando, Orlando, FL. (AIChE*xpress* Service Center, 345 E. 47th St., New York, NY 10017-2395).

(Oct. 14-17)—15th International Congress on the Applications of Lasers and Electro-Optics. Sponsored by the Laser Institute of America. Radisson Plaza Hotel at Town Center, Southfield, MI. (Daryl Flynn, Laser Institute of America, 12424 Research Pkwy., Ste. 125, Orlando, FL 32826).

(Oct. 14-18)—43rd National Symposium of the American Vacuum Society. Pennsylvania Convention Center, Philadelphia, PA. (American Vacuum Society, 120 Wall St., 32nd Flr., New York, NY 10005).

(Oct. 16-18)—"Ceramic and Glass Solutions for New and Improved Products." Course cosponsored by The New York State College of Ceramics at Alfred University and the New York State Center for Advanced Ceramic Technology. Alfred University, Alfred, NY. (Marlene Wightman, New York State College of Ceramics, Alfred University, Alfred, NY 14802).

(Oct. 16-19)—Joint Fall Meeting of the Basic Science, Nuclear, and Environmental Technology and Cements Division. Sponsored by The American Ceramic Society. San Antonio, TX. (The American Ceramic Society, 735 Ceramic Place, Westerville, OH 43081-8720).

(Oct. 20-23)—"Polyurethanes Expo '96." International Technical Conference & Exposition sponsored by The Society of the Plastics Industry, Inc., (SPI). Bally's Las Vegas Casino and Hotel, Las Vegas, NV. (SPI, Polyurethane Division, 355 Lexington Ave., New York, NY 10017).

(Oct. 23-25)—109th Annual Meeting of the National Paint and Coatings Association (NPCA). Palmer House (Hilton), Chicago, IL. (Cheryl Matthews, NPCA, 1500 Rhode Island Ave., N.W., Washington, D.C. 20005-5597).

(Oct. 27-Nov. 1)—84th Congress & Exposition. Sponsored by the National Safety Council. Orange County Convention Center, Orlando, FL. (Michael J. Taylor, National Safety Council, 1121 Spring Lake Dr., Itasca, IL 60143-3201).

(Oct. 28-30)—"The Fundamentals of Corrosion and Its Control." Sponsored by LaQue Corrosion Services. Holiday Inn SunSpree Resort, Wrightsville Beach, NC. (S. Darden, LaQue Corrosion Services, P.O. Box 656, Wrightsville Beach, NC 28480).

(Oct. 29-31)—Fabtech West Conference & Exposition. Sponsored by the Society of Manufacturing Engineers (SME). San Jose Convention Center, San Jose, CA. (SME, One SME Drive, P.O. Box 930, Dearborn, MI 48121-0930).

(Nov. 1-3)—"Fall Decor '96: Paint and Decorating Show." Sponsored by the National Decorating Products Association (NDPA). Minneapolis Convention Center, Minneapolis, MN. (Teri Flotron, NDPA, 1050 N. Lindbergh Blvd., St. Louis, MO 63132-2994).

(Nov. 3-6)—1996 International Conference. Sponsored by the Adhesive and Sealant Council, Inc. Fairmont Atop Nob Hill, San Francisco, CA. (Kathy Oates Domenick, Director, Education and Training, The Adhesive and Sealant Council, Inc., 1627 K St., N.W., Ste. 1000, Washington, D.C. 20006).

(Nov. 4-6)—"Particle Size Analysis." Training course sponsored by Horiba Instruments, Irvine, CA. (Geneen Spence, Horiba Instruments, 17671 Armstrong Ave., Irvine, CA 92714).

(Nov. 6-8)—ARMA Executive Committee Meeting and Board of Directors Meeting. Sponsored by Asphalt Roofing Manufacturers Association (ARMA). Tucson, AZ. (ARMA, 6000 Executive Blvd., Ste. 201, Rockville, MD 20852-3803).

(Nov. 10-13)—"Organic Coatings: Science and Technology." Sponsored by the State University of New York, Institute of Materials Science and the Division of Polymeric Materials: Science and Engineering division of the American Chemical Society (ACS). Westin Resort, Hilton Head Island, SC. (Angelos V. Patsis, Institute of Materials Science, State University of New York, New Paltz, NY 12561).

(Nov. 10-15)—Annual Meeting of the American Institute of Chemical Engineers. Sponsored by American Institute of Chemical Engineers. Palmer House Hilton, Chicago, IL. (AIChE*xpress* Service Center, 345 E. 47th St., New York, NY 10017-2395).

(Nov. 12-14)—Autofact Conference & Exposition. Sponsored by the Society of Manufacturing Engineers (SME). Cobo Center, Detroit, MI. (SME, One SME Drive, P.O. Box 930, Dearborn, MI 48121-0930).

(Nov. 17-21)—SSPC '96. 1996 International Conference and Exhibition. Charlotte, NC. (Dee Boyle, SSPC, 40 24th St., 6th Floor, Pittsburgh, PA 15222-4643).

(Nov. 19-22)—"The Fourth Color Imaging Conference: Color Science, Systems, and Applications." Sponsored by the Society for Imaging Science & Technology (IS&T) and the Society for Information Display (SID). The Radisson Resort, Scottsdale, AZ. (IS&T, 7003 Kilworth Lane, Springfield, VA 22151; or SID, 1526 Brookhollow Dr., Ste. 82, Santa Ana, CA 92705).

(Nov. 25-26)—Thomas Show. Sponsored by Thomas Scientific. Renaissance Harborplace Hotel, Baltimore, MD. (Thomas Scientific, 99 High Hill Rd. at I-295, Swedesboro, NJ 08085-0099).

1997—North America

(Jan. 21-24)—"Environmentally Compliant Coatings." Short course sponsored by North Dakota State University (NDSU). Crowne Plaza Resort, Hilton Head Island, SC. (Debbie Shasky, Program Coordinator, NDSU, Dept. of Polymers and Coatings, 54 Dunbar Hall, Fargo, ND 58105).

(Jan 28)—PCI Technical Subcommittee on Test Methods and ASTM D01.51 on Powder Coatings. Sponsored by the American Society for Testing and Materials (ASTM). Embassy Suites, Ft. Lauderdale, FL. (Jeffrey Hagerlin, O'Brien Powder Products, 9800 Genard Rd., Houston, TX 77041-7624).

(Feb. 14-15)—"Spring Decor '97: Paint & Decorating Show." Sponsored by the National Decorating Products Association (NDPA). Charlotte Convention Center, Charlotte, NC. (Teri Flotron, NDPA, 1050 N. Lindbergh Blvd., St. Louis, MO 63132-2994).

(Feb. 22-24)—"Interiors Decor Showcase '97." Sponsored by the National Decorating Products Association (NDPA). Toronto Congress Centre, Toronto, Ontario, Canada. (Teri Flotron, NDPA, 1050 N. Lindbergh Blvd., St. Louis, MO 63132-2994).

(Feb. 24-26)—"Basic Coatings for Sales, Marketing, and General Personnel." Short Course sponsored by University of Missouri-Rolla (UMR), St. Louis, MO. (UMR Coatings Institute, 1870 Miner Circle, Rolla, MO 65409).

(Mar. 2-5)—SSPC 1997 Compliance in Industrial Paint Conference. Sheraton Stamford Hotel, Stamford, CT. (Dee Boyle, SSPC, 40 24th St., 6th Floor, Pittsburgh, PA 15222-4643; (412) 281-2331).

(Apr. 7-10)—12th Annual Advanced Composites Conference and Exposition. Sponsored by The Engineering Society (ESD) and SAE International. Westin Hotel, Renaissance Center, Detroit, MI. (Wael Berrached, ESD, 29355 Northwestern Hwy., Ste. 200, Southfield, MI 48034).

(Apr. 7-11)—"Basic Composition of Coatings." Short Course sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (UMR Coatings Institute, 1870 Miner Circle, Rolla, MO 65409).

(Apr. 8-10)—Sixth Annual Advanced Coatings Technology Conference & Exposition. Sponsored by The Engineering Society (ESD) and SAE International. Westin Hotel, Renaissance Center, Detroit, MI. (Wael Berrached, ESD, 29355 Northwestern Hwy., Ste. 200, Southfield, MI 48034).

(Apr. 21-24)—"Introduction to Paint Formulation." Short Course sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (UMR Coatings Institute, 1870 Miner Circle, Rolla, MO 65409).

(May 19-23)—"Physical Testing of Paints & Coatings." Short Course sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (UMR Coatings Institute, 1870 Miner Circle, Rolla, MO 65409-0010).

(June 24)—ASTM D01.51 on Powder Coatings. Sponsored by the American Society for Testing and Materials (ASTM). Holiday Inn at the King, Toronto, Ontario, Canada. (Jeffrey Hagerlin, O'Brien Powder Products, 9800 Genard Rd., Houston, TX 77041-7624).

(July 14-16)—"Basic Coatings for Sales, Marketing, and General Personnel." Short Course sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (UMR Coatings Institute, 1870 Miner Circle, Rolla, MO 65409).

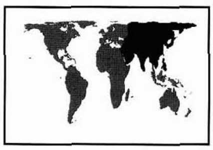
(Oct. 24-25)—"Fall Decor '97: Paint & Decorating Show." Sponsored by the National Decorating Products Association (NDPA). Cervantes Convention Center, St. Louis, MO. (Teri Flotron, NDPA, 1050 N. Lindbergh Blvd., St. Louis, MO 63132-2994).

1998—North America

(Jan 13)—PCI Technical Subcommittee on Test Methods and ASTM D01.51 on Powder Coatings. Sponsored by the American Society for Testing and Materials. Sheraton Harbor Island Hotel, San Diego, CA. (Jeffrey Hagerlin, O'Brien Powder Products, 9800 Genard Rd., Houston, TX 77041).

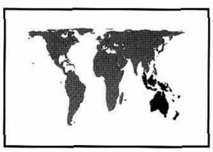
(June 9)—ASTM D01.51 on Powder Coatings. Sponsored by the American Society for Testing and Materials (ASTM). Omni Inner Harbor Hotel, Baltimore, MD. (Jeffrey Hagerlin, O'Brien Powder Products, 9800 Genard Rd., Houston, TX 77041-7624).

1997—Asia



(Oct. 22-24)—"New Developments in Colour Material Science and Technology." 70th Anniversary Conference on Colour Materials Tokyo sponsored by the Japan Sociey of Colour Material. Arcadia Ichigaya (Shigaku Kaikan), Tokyo, Japan. (Shuichi Hamada, Japan Society of Colour Material, Kitamura Bldg. 5F, 9-12, 2-chome, Iwamoto-cho, Tokyo 101, Japan).

1996—Australia

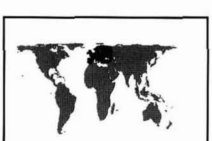


(Aug. 8-11)—"Cradle to Grave, The Life Cycle of Paint Products." Sponsored by the Surface Coatings Association New Zealand (SCANZ). Plaza International Hotel, Wellington, New Zealand. (SCANZ-CON.96 Secretariat, P.O. Box 38 546, Wellington, NZ; 64 4 568 8993).

(Aug. 11-16)—Third International Hydrocolloids Conference. Cosponsored by the CSIRO and the Cooperative Research Centre for Industrial Plant Biopolymers. Landmark Park Royal Hotel, Potts Point, Sydney, Australia. (Gail Hawke, Third International Hydrocolloids Conference, P.O. Box N399, Grosvenor Place, Sydney, NSW 2000, Australia).

(Aug. 14-17)—"Coatings from Start to Finish." Sponsored by the Surface Coatings Association Australia (SCAA). Sydney Convention and Exhibition Centre, Sydney, Australia. (SCAA '96 Secretariat, GPO Box 128, Sydney NSW 2001, Australia; 61 2 262 2277).

1996—Europe



(Sept. 8-9)—"Inherently Conductive Polymers: An Emerging Technology." Sponsored by Advanced Polymer Courses. Hotel Sofitel, Brugge, Belgium. (Matt Aldissi, Advanced Polymer Courses, 536 Main ST., Unit #1, Falmouth, MA 02540).

(Sept. 15-20)—Fifth International Conference on Plasma Source Spectrometry. Sponsored by The Perkin-Elmer Corp. University of Durham, England. (Grenville Holland, Department of Geological Sciences, University of Durham, Science Laboratories, South Road, Durham City DH1 4RL, England).

(Sept. 18-20)—EUROCOAT '96. Congress/Exhibition sponsored by Union des Associations de Culture Méditerranéenne (UATCM). Congress Centre, Genova, Italy. (AITIVA/EUROCOAT '96. Dr. R. Ferretto c/o Boero Colori, Via Molassana, 60, I-16138 Genova, Italy).

(Sept. 18-20)—"Polypropylene '96." Sponsored by Maack Business Services. Zürich, Switzerland. (Maack Business Services, Moosacherstrasse 14, CH-8804 AU/Zürich, Switzerland).

(Oct. 7-9)—Central European Coatings Show. Exhibition and Conference sponsored by FMJ International. Katowice, Poland. (Jane Malcolm-Coe, FMJ International Publications Ltd., Queensway House, 2 Queensway, Redhill, Surrey RH1 1QS, England).

(Oct. 21-22)—"World Congress PET '96." Sponsored by Maack Business Services. Zürich, Switzerland. (Maack Business Services, Moosacherstrasse 14, CH-8804 AU/Zürich, Switzerland).

(Nov. 4-5)—The Sixth Annual Conference on Textile Coating and Laminating. Sponsored by the *Journal of Coated Fabrics*. Dusseldorf Hilton Hotel, Dusseldork, Germany. (Programme Division: Technomic Publishing AG, Missionstrasse 44, Ch-4055 Basel, Switzerland).

(Nov. 11-13)—"Waterborne, High-Solids, & Radcure Technologies." Sponsored by Paint Research Association. Frankfurt, Germany. (Conference Secretary, Paint Research Association, 8 Waldegrave Rd., Teddington, Middlesex, TW11 8LD England).

(Nov. 12-14)—"Resins & Pigments." Exhibition and Conference sponsored by FMJ International. Frankfurt Messe, Frankfurt am Main, Germany. (Jane Malcolm-Coe, FMJ International Publications Ltd., Queensway House, 2 Queensway, Redhill, Surrey RH1 1QS, England).

(Nov. 26-27)—"Forum de la Connaissance 1996." Sponsored by the Association Française des Techniciens des Peintures, Vernis, Encres d'imprimerie, Colles et Adhésifs (AFTPVA). Auditorium de la Tour ELF, Paris-la-Défense, France. (AFTPVA, rue Etex, F-75018 Paris, France).

1997—Europe

(May 12-14)—"Epoxy Technologies for Ambient Cure Protective Coatings." Sponsored by Paint Research Association. Brussels, Belgium. (Conference Secretary, Paint Research Association, 8 Waldegrave Rd., Teddington, Middlesex, TW11 8LD England).

Advertisers' Index

NOTE: The Advertisers' Index is published for the convenience of our readers and as an additional service to our advertisers. The publisher assumes no liability for errors or omissions.

Humbug from Hillman

After a brief dry spell, I'm very pleased that Dave Platt has again made it to the back of the book with a couple of printable stories worthy of your next cocktail party.

Just before giving a lawn party at his estate, a tycoon had his swimming pool filled with poisonous snakes. He called the guests together and announced, "To anyone brave enough to swim across this pool, I will give the choice of a thousand acres of my oil fields, 10,000 head of cattle, or my daughter's hand in marriage."

No sooner were his words spoken when a young man plunged in, swam across the pool and climbed out unscathed but breathless.

"Congratulations," the tycoon greeted him. "Do you want the oil field."

"No," gasped the young man.

"How about the cattle."

"No," he shouted.

"Well, how about my daughter's hand?"

"No,—I just want to know the name of the guy who pushed me in!"

Two fellows who hadn't seen each other for some time met on the street. One was using crutches. "What happened to you?" asked the other.

"I was in a car accident nine months ago."

"And you're still on crutches."

"Well, my doctor says I could get along without them but my lawyer says I can't."

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Lyn Pollock, Director of Marketing of our very own FSCT, found these "actual" notes from parents to teachers in Ann Landers' column in the *Washington Post* (Note to Lyn and Ann Landers: Actually, to give credit where it is due, the whole list was taken from Richard Lederer's 1987 book, *Anguished English*).

Dear Teacher: Please excuse Lisa for being absent. She was sick and I had her shot.

Dear School: I hope you will excuse John for being absent on Jan. 28, 29, 30, 31, 32, and also 33.

Dear Miss Larson: Jack didn't go to school yesterday because he had two teeth taken out of his face.

Mrs. Smith: Please excuse Tommy for being absent yesterday. He had diarrhea and his boots leak.

Dear Teacher: Please excuse Jimmy for being. It was his father's fault.

Dear Mr. Brown: Please excuse Jason for being absent yesterday. He had a cold and could not breed well.

To Mary's Teacher: Please excuse Mary for being absent yesterday. She was in bed with gramps.

Dear Mrs. Anderson: Maryann was absent yesterday because she had a fever and an upset stomach. Her sister was also sick, and her brother had a fever. I wasn't too well, either. There must be something going around. Her father even got hot last night.

Dear Mr. Thomas: Jennifer missed school yesterday for a good reason. We forgot to get the Sunday paper off the porch, and when we found it on Monday, we thought it was Sunday.

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Frank Borrelle writes, "Rose and I are now the proud (?) owners of a computer that comes with Windows 95, Ceilings 38, Floors 15, Walls 77, Foundations 12, and Hard Driveway 42. If I were building a house, this confounded machine would be terrific . . . Got the computer two weeks ago . . . In another month or two, I should be able to turn it on and off without consulting the guide book."

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John Ambury (remember, he's the fellow from Etobicoke) notes that the kindergarten riddle of the month could be: If a hockey player gets athlete's foot what does an astronaut get?—Missile toe.

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The best vanity license plate he's seen recently was an Ontario one that read: J AUH20 . . . Attention Barry wherever you are!!!

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From time to time, the aforementioned Frank Borrelle sends me copies of Larry Hill's excellent column, "Overspray" in *Surface Coatings Australia*. As Larry would put it, I "nicked" the following from his April column: Up here in Burleigh West every second (or 1.5th) person seems to be a bowler. Nearly every day, weather permitting, the village green is crowded with gummies (Get it?) bowling away for dear life's worth. They are more obsessed with bowls than golfers are with golfing. Is that possible? One old chap nearing the end of his days, approached the local priest with a query. "Tell me Father," he said "but do they have bowling greens in Heaven?" "Oh now," said the cleric, "that's a curly one. I doubt whether even the Bishop could answer that. However, I'll set enquiries in train—it'll have to go all the way to Rome."

A few weeks later the priest saw his parishioner in the street. "Hey there, Pat" he calls. "I've got good news and bad news for you. The good news is that they do indeed have bowling greens in Heaven. They are magnificent. In fact, if you'll excuse the expression, they are out of this world."

"That's marvelous, Father, but what's the bad news?" "Well, Pat, you're down to play next Sunday."

And as friend Larry says: "This is terrible.": Two nuns went to the circus but after the show, they were dismayed to find heavy rain had flooded the ground, all the way to the bus stop. They didn't want to get their habits wet. Two clowns came to the rescue and piggy-backed them across the puddles. Half way across, one clown stopped and said to the other, "Do you realize that this is virgin on the ridiculous?"

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