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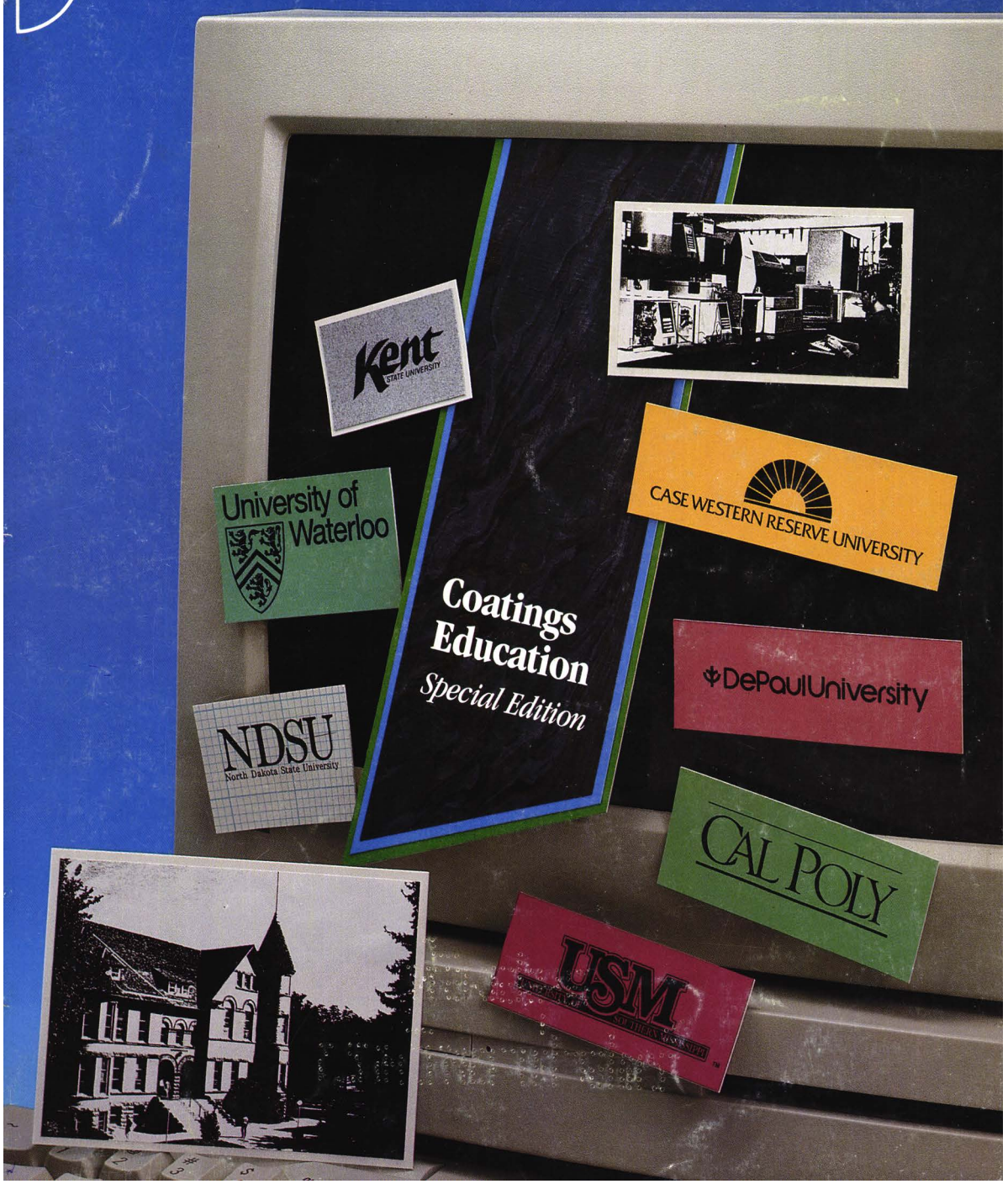

The Main Event

Federation of Societies for Coatings Technology
1994 Annual Meeting & Paint Industries' Show

Excellence Through Innovation

October 12•13•14, 1994

Ernest N. Morial
Convention Center
New Orleans, Louisiana

Join the Federation of Societies for Coatings Technology and your fellow coatings professionals from around the world at the 72nd Annual Meeting and 59th Paint Industries' Show, October 12-14, 1994 in New Orleans.

Excellence Through Innovation

... On the Show Floor

The Paint Industries' Show offers a unique learning experience. Excellence Through Innovation centers on the challenges and opportunities facing all professionals in the industry.

• More than 250 Exhibitors

... At Technical Program Sessions

The 72nd Annual Meeting will be the best yet, with a variety of technical program sessions running concurrently during the show.

Annual Meeting Technical Session Topics

- *Advanced Coatings Research*
- *Color Technology*
- *Corrosion Inhibitive Coatings*
- *Process Safety Management*
- *Low VOC Coatings*
- *Manufacturing*
- *New Technologies*
- *Powder Coatings*
- *Radiation Curing*

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New Orleans

Yours to Imagine, Discover, Remember

The Paint Industries' Show returns to the Crescent City of New Orleans at the newly expanded Ernest N. Morial Convention Center. Last held in New Orleans in 1989, the Paint Show has gained even more support from manufacturers and suppliers and is today the world's largest exhibition of raw materials, equipment and services for the paint and coatings manufacturing industry.

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How to Register by Mail or Fax

Join the thousands of coatings professionals who will attend the FSCT Annual Meeting and Paint Industries' Show in New Orleans. A variety of registration options are available to meet most attendee requirements – whether you attend for the entire event or just one day. A social guest program is also available. To be part of the Main Event, please contact the FSCT to receive the Advance Registration Packet.

Registration

	Advance Registration	On-site Registration
Federation of Societies for Coatings Technology Members		
• Full Three-Day Show	$75	$90
• One Day (Wednesday or Thursday)	–	70
• One Day (Friday)	–	40
Non-Members		
• Full Three-Day Show	$100	$125
• One Day (Wednesday or Thursday)	-	90
• One Day (Friday)	–	50
Special Social Program	$60	$70
• Call for program details		

A $10 charge will be made for cancellations received prior to October 1. A $25 charge will be made for cancellations received after that date.

Paint Show Hotel and Shuttle Service

Twelve New Orleans hotels have reserved blocks of rooms for the '94 Paint Show. Official housing forms are provided in the Advance Registration Packet. The cutoff for requesting accommodations is September 1.

Shuttle service will be provided between the cooperating hotels and Ernest N. Morial Convention Center.

For more details on registration, hotel accommodations or to obtain a registration packet, please call the FSCT at (215) 940-0777 or Fax at (215) 940-0292.

VISA, MasterCard and American Express gladly accepted.

Show Hours

Wednesday, October 12
12:00 noon – 5:00 p.m.

Thursday, October 13
9:00 a.m. – 5:00 p.m.

Friday, October 14
9:00 a.m. – 12:00 p.m.

Deadline for Advance Registration is October 1!

FSCT 1994
New Orleans Convention Center
New Orleans, LA
October 12-13-14, 1994

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VOLUME 66 NUMBER 833

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Committee Activities

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Comment

Education '94—Where We Are and Where We Are Going

From Constituent Society programs to Committee activities to the Annual Meeting program, the current and future status of education within the Federation is positive! Throughout the organization, projects being undertaken are having an impact on all segments of the industry, from educators and students to practitioners, and even on the young people who won't be joining the industry until the 21st century.

Many of FSCT's Constituent Societies hold first-rate seminars to benefit everyone from the beginner to the seasoned veteran. In places like Chicago, with its SYMCO program, to the Pacific Northwest and Southern Society Annual Meetings, attendees have heard industry experts discuss pertinent topics. Philadelphia, Cleveland and several other Societies disseminate information through intense one-, two-, and three-day seminars. If this isn't enough, several other Societies (Toronto is one that comes to mind) work closely with local colleges and universities to conduct coatings related courses.

Nationally, two recently completed courses attracted interested participants from the United States, Canada, and Mexico. Chicago was the site of "Formulating for the New Clean Air Act" in March and the 1994 Spring Week program, "Adhesion in Coatings: Technology and Characterization," was held in Minneapolis. The Professional Development Committee developed the Chicago seminar and the Technical Advisory Committee deserves credit for the Spring Week seminar. Based on these successes, you can expect more programming in 1995 from these and other FSCT committees.

Not to be outdone, the Annual Meeting Program Committee has been quietly working to expand the technical offerings at FSCT's premier event. This year, look for the program to include "Early Bird" sessions on specific topics related to the industry and expect some new wrinkles in the standard programs. The sessions being developed by the new FSCT/NPCA Manufacturing Management Committee and the Professional Development Committee deserve special attention in New Orleans because of the topics and the format. The Annual Meeting Program Committee is certainly taking the theme "Excellence Through Innovation" literally.

To make this scenario complete, we can't overlook the industry's future participants. Through the work of the Coatings Industry Education Foundation, scholarships and grants are being awarded to colleges and universities at record rates. The Educational Coordinating Committee is also preparing to launch its Science/Chemistry Resource Kit, which will assist those interested in mentoring to youngsters about science, chemistry, and the coatings industry. This will bring the industry to future generations.

Added together, these actions make FSCT your "Educational Resource" and a valuable asset to your career.

Michael G. Bell

Michael G. Bell
Director of Educational Services

Abstracts of Papers in This Issue

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

A Kinetic Study of the Reaction of Epoxidized Rubber and Carboxylic Acids—J.K. Copeland and S.F. Thames

JCT, No. 66, 833, 59 (June 1994)

The coatings industry has long been interested in multifunctional crosslinking agents that emit no volatile organic compounds (VOC) during curing and are nontoxic. For instance, several traditional crosslinking agents are extensively employed, yet are subject to degradation to formaldehyde on the one hand or can possess residual isocyanates on the other. Ring opening reactions of epoxides are an ideal chemical reaction for there are no VOCs, no formaldehyde nor residual isocyanates. Therefore, we undertook a study to investigate the feasibility of a novel epoxide reagent as a multifunctional crosslinking agent. Specifically, *poly-cis*-isoprene has been epoxidized and evaluated as a reactant with a variety of carboxylic acids via isothermal differential scanning calorimetry (IDSC). Accordingly, we measured the enthalpy of the reaction at various temperatures and reactant concentrations. The change in heat with time is proportional to the change in the reactant concentration with time as the ring opening of epoxides with carboxylic acids gives chain modification via ester formation.

Therefore, we determined the reaction order and energy of activation. The reaction order was determined to be first order in acid. Three acids ranging in pKa's from 1.26 to 4.95 were studied, which provided a range of activation energies from 42.9 to 115.9 kJ/mol.

Film Formation from Conventional and Miniemulsion Latex Systems Containing Dimethyl Meta-Isopropenyl Benzyl Isocyanate (TMI®)—A Functional Monomer/Crosslinking Agent—Y.Inaba, E.S. Daniels, and M.S. El-Aasser

JCT, No. 66, 833, 63 (June 1994)

A series of model styrene (St)/n-butyl acrylate (BA) copolymer latexes with glass transition temperatures below room temperature were prepared by either conventional or miniemulsion polymerization techniques as model systems for studies of film formation. The functional monomer TMI® (META) (dimethyl meta-isopropenyl benzyl isocyanate; CYTEC Industries/American Cyanamid Co.) was used as a functional monomer/crosslinking agent. A small amount of methacrylic acid (MAA) was introduced in some formulations to enhance the crosslinking reactions. A redox initiation system was used to reduce premature crosslinking during the

Etude Cinétique de la Réaction de Caoutchoucs Epoxyfiés et les Acides Carboxyliques—J.K. Copeland et S.F. Thames

JCT, No. 66, 833, 59 (June 1994)

L'industrie des revêtements a longtemps été intéressée aux agents réticulants multifonctionnels qui n'émettent aucuns composés organiques volatiles (COV) durant la cuisson, et qui ne sont pas toxiques. Par example, plusieurs agents réticulants traditionnels sont empolyés de façon intensive, mais sont sujet au dégagement de formaldéhyde d'un côte et peuvent posséder des isocyanates résiduels de l'autre. Les réactions d'ouverture des cycles des époxys sont des réactions chimiques idéales ne dégageant pas de COV, formaldéhyde ou résidus d'isocyanates. Donc, nous avons entrepris une étude pour tester un nouveau réactif époxy comme agent de réticulation multifonctionnel. Plus spécifiquement, le poly-cis-isoprène a été époxyfié et évalué comme réactif avec un gamme d'acides carboxyliques via la calorimétrie isothermique à balayage différentiel (IDSC). De cette façon, nous avons mesuré l'enthalpie de la réaction à plusieurs températures et concentration de réactifs. Le changement de chaleur avec le temps est proportionnel au changement de la concentration de réactif avec le temps, où l'ouverture du cycle des époxy avec les acides carboxyliques donne une modification de chaîne via la formation d'ester.

Formation de Film à Partir de Systèmes Conventionnels et de Miniémulsions au latex Contenant L'isocyanate de Méta-Isopropényl Benzyl (TMI®)—Un Monomère/Agent de Réticulation Fonctionnel—Y. Inaba, E.S. Daniels, et M.S. El-Aasser

JCT, No. 66, 833, 63 (June 1994)

Une série de latex copolymériques styrène (St)/n-butyl acrylate (BA) avec des températures de transition vitreuse sous la température de la pièce ont été préparés avec l'aide de techniques conventionelles de polymérisation et de techniques de miniémulsions comme modèles pour l'étude de la formation de film. Le monomère fonctionnel TMI® (META) (isocyanate de diméthyl méta-isopropenyl benzyl; CYTEC Industries/American Cyanamid Co.) a été utilisé comme un monomère fonctionnel/agent de réticulation. Une petite quantité d'acide métacrylique (MAA) a été introduite dans quelques formulations pour améliorer les réactions de réticulations. Un système d'initiation rédox a été utilisé pour réduire la réticulation prématurée durant la polymer-

Estudio Cinetico de la Reaccion Hules Epoxidizados y Acidos Carboxilicos—J.K. Copeland y S.F. Thames

JCT, No. 66, 833, 59 (June 1994)

La industria de recubrimientos se ha interesado enormemente en los agentes multifuncionales de entrecruzamiento que no emiten compuestos orgánicos volátiles (VOC) durante el curado y no son tóxicos. Por ejemple, varios agentes tradicionales de entrecruzamiento utilizados estan sujetos a la degradación a formaldehído por un lado y por otro puede poseer isocianatos residuales. Las reacciones de apertura de anillos de epoxidos son una reacción química ideal para que no haya VOCs, ni formaldehído ni tampoco isocianatos residuales. Se ha tomado un estudio para investigar la factibilidad de un reagente epoxido novedoso como agente multifuncional de entrecruzamiento. Especificamente, el poli-cis-isopreno ha sido epoxidado y evaluado como un reactante con una variedad de acidos carboxilicos vía escaneo de calorimetría diferencial isoterma (ISDS), además se han tenido mediciones de la entalpía de reacción a varias temperaturas y las concentraciones del reactante. Los cambios en el calor con el tiempo son proporcionales a los cambios en la concentración del reactante con el tiempo mientras que la abertura de anillos de epoxidos con acidos carboxilicos dan una modificacion de cadenas via formación ester.

Formacion de Pelicula de Sistemas Latex Convencionales y Miniemulsion Conteniendo Dimetil Meta Isopropenil Bencil Isocianato (TMI®)—Un Monomero Funcional/Agente de Entrecruzamiento—Y. Inaba, E.S. Daniels y M.S. El-Aasser

JCT, No. 66, 833, 63 (June 1994)

Se prepararon una serie de modelos de copólimeros latex de estireno/n-butil acrilato (BA) con temperaturas de transición vitrea por debajo a la de la temperatura del cuarto donde fueron preparados para cada una de las técnicas de polimerización convencional o de miniemulsion como sistemas modelo para estudios de formación de pelicula. El monómero funcional TMI® (META) (Dimetil meta-isopropenil bencil isocianato; CYTEC Industries/American Cyanamid Co.) fue usado como un monómero convencional/agente de entrecruzamiento. Se introdujó en algunas formulaciones una pequeña cantidad de ácido metacrilico (MAA) para engrandecer las reacciones de entrecruzamiento. Un sistema de iniciación redox fue usado para reducir el entrecruza-

polymerization. A combination of an ionic surfactant (sodium lauryl sulfate) and co-surfactant (hexadecane or cetyl alcohol) was used as the mixed emulsifier for the miniemulsion system.

This paper describes the performance of TMI as a crosslinking agent and the effects of the combination of TMI and MAA on the latex film formation process.

High-Solids Coatings Using Benzylanilinium Sulfonates—T. Morimoto and S. Nakano

JCT, No. 66, 833, 75 (June 1994)

Benzylanilinium sulfonates (**1n**) were synthesized by reacting benzylchloride with N,N-dimethylaniline, followed by the exchange of Cl^- with RSO_3^-. The benzylanilinium sulfonates reacted with H_2O, releasing sulfonic acid only at temperatures greater than 75°C, although this temperature varied according to the p-substituents on the 1n benzyl group.

Clear coating solutions, consisting of an acrylic polyol, hexamethoxymethylmelamine (HMMM), and **1n**, gave cured films over 125°C. Clear coating solutions containing 1n showed superior storage stability and curability compared to that of clear coating solutions containing amine blocked p-toluenesulfonic acid, a widely used acid catalyst. Furthermore, coating solutions containing **1n** showed reduced baking times.

Consequently, it was found that **1n** acts as an effective latent thermal acid catalyst for the crosslinking reaction between acrylic polyols and melamine resins.

Hygrothermal Stress Evolution During Weathering in Organic Coatings—D.Y. Perera and M. Oosterbroek

JCT, No. 66, 833, 83 (June 1994)

Hygrothermal stresses developing in two clearcoats exposed to two types of accelerated weathering were determined. The physical and chemical changes induced by weathering produce a continuous increase of tensile and compressive stresses which ultimately causes it to crack. It was found that the stress magnitude and the duration of exposure at which the coating cracks depend on the type of the accelerated weathering. Also, the rate of stress relaxation decreases with duration of weathering. However, the shape of curves describing the stress dependence on duration of weathering is the same provided that the main mechanism of coating degradation does not change.

When combined with other techniques, the measurement of stress appears to be an important way of studying coating durability. It also enables one to determine if a coating undergoes physical aging, another phenomenon altering the coating properties.

isation. Une combinaison d'un surfactant ionique (sulfate de sodium lauryl) et d'un co-surfactant (hexadécane ou alcool cétylique) a été utilisée comme mélange émulsifiant pour le système de miniémulsion.

Cette publication décrit la performance du TMI comme un agent de réticulation et les effets de la combinaison du TMI et MAA sur le procédé de la formation d'un film au latex.

Revêtements à Haute Teneur en Matières Solides Utilisant des Sulfonates de Benzylanilinium—T. Morimoto et S. Nakano

JCT, No. 66, 833, 75 (June 1994)

Des sulfonates de benzylanilinium (**1n**) ont été synthétisés en combinant le chlorure de benzyl avec le N,N-diméthylaniline, suivi par l'échange de Cl^- avec RSO^-_3. **1n** a réagi avec H_2O donnant de l'acide sulfonique, seulement à des températures supérieures à 75°C, malgré le fait que la température a variée selon les substituts-p sur le groupe **1n** benzyl.

Des solutions claires, constituées d'un polyol acrylique, l'hexaméthoxyméthylmélamine (HMMM) et **1n**, ont donné des films réticulés à plus de 125°C. Des solutions claires contenant **1n** ont démontré une supériorité à l'entreposage et à la réticulation comparativement aux solutions claires contenant l'acide p-toluènesulfonique, lequel est largement utilisé comme catalyseur acide. De plus, des solutions contenant **1n** ont démontré des temps de cuisson réduits.

En somme, il a été démontré que **1n** agit comme un catalyseur acide thermique latent trés efficace pour la réticulation entre les polyols acryliques et les résines mélamine.

Evolution du Stress Hygrothermique Durant de Viellissement de Revêtements Organiques—D.Y. Perera et M. Oosterbroek

JCT, No. 66, 833, 83 (June 1994)

Les stress hygrothermiques se développant dans deux couches claires exposées à deux types de vieillissement accélérés, ont été déterminés. Les changements physico-chimiques induits par le vieillissement produisent une augmentation continue des stress de traction et de compression, lesquels causent ultimement un craquement du revêtement. Il a été démontré que la magnitude du stress et la durée de l'exposition pour lequel le revêtement craque, dépend du type de viellissement accéléré. Egalement, le taux de relaxation du stress décroit avec la durée du vieillissement. Par contre, la forme des courbes décrivant la dépendance du stress sur la durée du vieillissement est la même, en autant que le mécanisme principal de dégradation du revêtement ne change pas.

Lorsque combinée avec d'autres techniques, la mesure de stress apparaît être un paramètre important pour l'étude de la durabilité des revêtements. Elle permet également de déterminer si un revêtement subit un vieillissement physique.

miento prematuro durante la polimerización. También fue usado una combinación de un surfactante iónico (sulfato de lauril sodio) y un consurfactante (hexadecano) como un emulsificador de mezcla para el sistema de miniemulsión.

Este documento describe el desarrollo del TMI como un agente de entrecruzamiento y los efectos de la combinación del TMI y el MAA en el proceso de la formación de película latex.

Recubrimientos Altos Solidos Usando Sulfonatos de Benzilanilino—T. Morimoto y S. Nakano

JCT, No. 66, 833, 75 (June 1994)

Los sulfonatos de benzilanilinio (**1n**) fueron sintetizados por la reacción de bencil-cloruro con N,N-dimetilanilina, seguida por el intercambio de Cl^- con RSO_3^-. El **1n** reaccionó con H_2O liberando ácido sulfónico solo a temperaturas mayores de 75°C, sin embargo, esta temperatura varió de acuerdo a los p- substituyentes en los grupos **1n** bencil.

Soluciones de recubrimientos de película decorativa las cuales consisten de un poliol acrilico, hexametoximelamina (HMMM) y **1n**, dan películas curadas arriba de los 125°C. Las soluciones que contienen **1n** muestran una estabilidad superior de almacenaje y curabilidad comparado con las soluciones que contienen acido p-toluensulfónico amina, usado ampliamente como acido catalizador. Además, las soluciones de recubrimiento que contienen **1n** muestran una reducción en el tiempo de horneado.

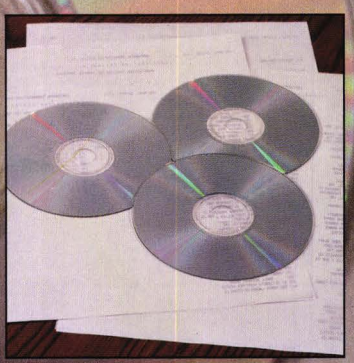
Consecuentemente, se encontró que el **1n** actua como un ácido catalizador latente para la reacción de entrecruzamiento entre polioles acrílicos y resinas de melamina.

Evolucion de la Resistencia Higrotermica Durante la Exposicion a la Intemperie de Recubrimientos Organicos—D.Y. Perera y M. Oosterbroek

JCT, No. 66, 833, 83 (June 1994)

Se determinó la resistencia higrotérmica en dos recubrimientos de película decorativa expuestos a dos tipos de exposición acelerada a la intemperie. Los cambios físicos y químicos inducidos por esta exposición producen un incremento continuo de las resistencias a la tensión y compresión las cuales causan que se estos recubrimientos se rajen. Se encontró que la magnitud de la resistencia y la duración a la exposición a la cual el recubrimiento se raja depende del tipo de exposición. Sin embargo, la forma de las curvas describen la dependencia de la resistencia en duración de intemperismo.

Cuando se combine con otras tecnicas de medición de resistencia este será un importante camino para el estudio de la durabilidad del recubrimiento. Es posible determinar si otro fenómeno altera las propiedades del recubrimiento.



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"Futureview" Is Focus of Annual Meeting Keynote Address By Leading Technology Forecaster, Daniel Burrus

One of the nation's leading science and technology forecasters, Daniel Burrus, will present the Keynote Address at the Opening Session of the FSCT's 70th Annual Meeting, being held in New Orleans, LA, on October 12-14.

Mr. Burrus is the founder and president of Burrus Research Associates, Inc., a research and consulting firm that specializes in global innovations in science and technology, their creative application, and future impact.

His firm uses specially developed information-gathering techniques which enable it to help corporations, associations, and universities creatively apply cutting-edge information as they develop both short- and long-range plans.

His company's mission is to assist people of all ages understand and profit from technological change, and to become excited and involved in building a better tomorrow by discovering creative uses for the new tools of science. Their client list includes a wide range of industries, including many Fortune 500 companies, such as IBM, AT&T, Exxon, DuPont, Chrysler, Philip Morris, and Motorola.

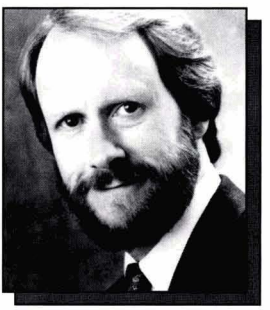
Mr. Burrus produces a variety of publications including the *Technology Futures Newsletter*, and is the author of several audio and video cassette learning programs.

His interest in research became apparent in his third year of college when he became one of the first undergraduates in the nation to direct a federal research grant. He went on to found and manage five businesses in a variety of fields, one of which, in the field of aviation, was a national leader with over 30 locations.

Mr. Burrus has produced his own cable television show entitled "Futurescope," and has delivered over 800 speeches in the past six years to top executives, sales people, and educators.

In his timely and provocative presentations, Mr. Burrus helps his audiences understand how to make a rapidly changing business environment a competitive advantage by getting all members of an organization involved in creatively utilizing the latest technology.

The Opening Session will be held on Wednesday, October 12, at the Ernest N. Morial Convention Center.



Futureview: Your Creative Edge

According to Daniel Burrus, we are now entering the golden era of innovation and invention. Creativity, the force behind all progress, is not typically a subject covered in schools. It seems elusive, yet we all place a high value on it. All people have creativity within them.

The speaker maintains that by developing your creative potential and using it to its fullest, you can become more efficient, more productive, more vibrant and more alive. His presentation is designed around "Futureview" with emphasis on giving a useful process for developing and using creativity.

"Excellence Through Innovation"—1994 Technical Program Theme

In keeping with the theme, "Excellence Through Innovation," the Annual Meeting Program Committee has developed a dynamic program which focuses on innovations in technology and presents state-of-the-art information.

The Annual Meeting will open with the popular Technical Focus presentation. This year, the speaker is Mark Holt of CIBA GEIGY in Ardsley, NY. He will discuss innovative work which exemplifies the Annual Meeting Program theme.

New to the FSCT event are "Early Bird" sessions which will be held on Thursday, October 13, to give more detailed information on pertinent subjects. Initial topics will cover "Empowerment" and "Quality."

In addition, a wide variety of technical presentations will be offered focusing on areas of interest, such as advanced topics in coatings research, color technology, innovations in the development of VOC compliant corrosion inhibitive coatings, and an ISO 9000 case study. Highlights include a presentation on the human side of process safety management and formulating for low VOC coatings. The technical program will also include Roon Award Competition papers, the *American Paint & Coatings Journal*/A.F. Voss Award Competition papers, and international papers.

The highlight of the Annual Meeting is the Mattiello Memorial Lecture, to be delivered by Dr. Richard R. Eley, Senior Scientist at The Glidden Company. The Mattiello Lecture, which concludes the Annual Meeting technical program, is scheduled for Friday morning at 10:30 a.m.

FSCT Paint Industries' Show—The Coatings Industry's "Main Event"

The largest coatings-related exhibition in the world—the FSCT Paint Industries' Show—will be held in conjunction with the Annual Meeting at the Ernest N. Morial Convention Center—New Orleans. More than 270 supplier companies to the coatings manufacturing industry will be present to discuss their newest products and services. In over 90,000 sq. ft. of exhibits will be displayed a wide variety of raw materials, production equipment, containers and filling equipment, laboratory apparatus, and testing devices for the paint and coatings producer.

Key personnel from the top technical and sales staff of supplier companies will be available to provide attendees with an opportunity to learn of the latest developments in their products and services.

(Continued on page 13)

Daniel Burrus to Present Keynote Address; Additional Annual Meeting & Paint Show Highlights

(Continued from page 12)

Exhibit hours will be: Wednesday, October 12—10:00 a.m.-5:00 p.m.; Thursday, October 13—9:00 a.m.-5:00 p.m.; and Friday, October 14—9:00 a.m.-12:00 Noon.

Registration Fees

Advance registration fees include three days of admission to the Paint Industries' Show and all concurrent program sessions of the FSCT Annual Meeting.

Advance registration discounts will be available until **September 1**. The advance fees are $75 for members and $100 for non-members. The fee for social guests is $60 in advance. Retired members and their spouses may register for the special advance only fee of $25 each.

Registration credentials will be mailed to advance registered attendees in September.

On-site rates are $90 for members, $125 for non-members, and $70 for social guests.

The Registration Services Area will be located at the Ernest N. Morial Convention Center.

Hotels and Reservations

Twelve hotels have reserved blocks of rooms for the Federation event. The Marriott and the Sheraton will serve as co-headquarters for the Annual Meeting and Paint Industries' Show. Other hotels include the Doubletree, Holiday Inn Crowne Plaza, Westin Canal Place, Fairmont, Monteleone, Le Meridien, Omni Royal Orleans, Radisson Suites, Hilton, and the Holiday Inn Downtown.

All reservations must be placed through the FSCT Housing Bureau to obtain preferred rates. Housing information was sent to all members in May.

Special Zone Fares

Air travel expense to the Annual Meeting and Paint Industries' Show can be reduced by using discounted zone fares offered by Delta Airlines. No Saturday night stay is required. To take advantage of these discounts, refer to the following file code when contacting Delta:

Call (800) 241-6760 and mention I5014.

Zone fares on both Delta and United Airlines are available from the FSCT Travel Desk. For domestic U.S., call (800) 448-FSCT. For calls outside the U.S., contact (215) 628-2549. Faxes may be sent to (215) 628-0310. **Mention FSCT Paint Show.**

If you desire a Saturday night stay, a five percent discount on the lowest fare applicable can be obtained. On all discounted fares, there may be certain restrictions and penalties for changes or cancellations. Airport surcharges may apply.

Social Guest Program: 'Big Easy' Arts and Entertainment

Activities for social guest registrants begin at the Marriott on Wednesday, October 12, with an Welcome Social, featuring local artists demonstrating their vocal, culinary, and decorative talents to the participants.

On Thursday, October 13, following a continental breakfast at the Marriott Hotel, registered social guests will depart on deluxe motorcoaches for a visit to the exquisite city estate Longue Vue House and Gardens, once home to the prominent Stern family. There, guests will have an opportunity to stroll the beautifully landscaped grounds, tour the mansion, enjoy refreshments under the pavilion, and attend informative programs on various collections displayed at Longue Vue.

After Longue Vue, guests will board motorcoaches for the Convention Center to attend the Federation's Mardi Gras Magic Luncheon. The festivities include Big Easy entertainment and a presentation by a local expert on the symbolism of the Mardi Gras Krewe and colors.

Following the luncheon, participants will have time on their own to explore the many New Orleans attractions and shops.

Social guest registration is $60 in advance and $70 on site, and includes the Wednesday Social, Thursday Breakfast and Tour, and the Mardi Gras Magic Luncheon.

• *Registration is limited to 700 participants* •

Mardi Gras MAGIC Annual Luncheon

The Federation's Annual Awards Luncheon will be held on Thursday, October 13 at the Convention Center. In addition to the presentation of FSCT Awards, the Luncheon will feature a re-creation of Mardi Gras Magic, complete with Big Easy music and a Mardi Gras Tableau.

Luncheon tickets can be purchased in advance or on-site at $25 each. Social guest registration *includes* the Luncheon ticket.

New FSCT Video Reviews VOC Determination Test Procedures

A new coatings test procedure video, "VOC Determination Errors . . . How to Avoid the Pitfalls," is now available through the FSCT. Prepared by the Technical Committee of the New York Society for Coatings Technology, this new video provides a step-by-step review of the procedures used to determine the VOC content of coatings.

The 23-minute video offers relief for coatings manufacturers dealing with ever-increasing pressure to develop finishes with lower VOC content. It reviews the following current ASTM test procedures: D 1475—Test Method for Density of Paint, Varnish, Lacquer and Related Products; D 2369—Test Method for Volatile Content of Coatings; D 3792—Test Method for Water Content of Water-Reducible Paints by Direct Injection into a Gas Chromatograph; D 3960—Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings; and D 4017—Test Method for Water in Paints and Paint Materials by Karl Fischer Method.

The video has been designed to give coatings formulators a detailed overview of the procedures used to evaluate the VOC content in products and provide information to make it easier to avoid errors in the testing process. A necessary addition to any company library, it has an easy-to-understand format and will be beneficial to everyone responsible for conducting tests in the lab, from the newly hired to the seasoned veteran . . . the rookie chemist to the technical director.

The new video is available through FSCT Headquarters at the price of $50. To order, contact Meryl Cohen, FSCT, 492 Norristown Rd., Blue Bell, PA 19422; (610) 940-0777.

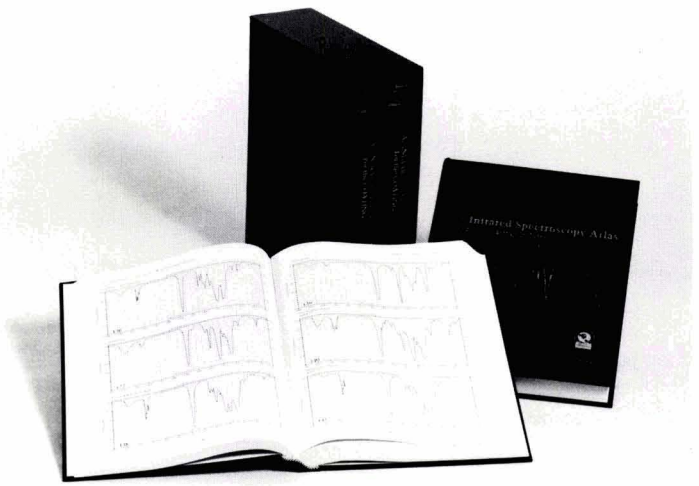
NPCA to Hold Annual Meeting, Oct. 10-12 at New Orleans Hilton

The National Paint & Coatings Association will hold its annual meeting on October 10-12, at the New Orleans Hilton and Towers, in New Orleans.

NPCA will admit advance registered attendees* of the FSCT Annual Meeting and Paint Industries' Show to the Forum Sessions being held during its annual meeting at no additional charge. These sessions will be conducted at the New Orleans Hilton on Monday and Tuesday, October 10 and 11. For admittance to these sessions, FSCT convention attendees must complete NPCA's complimentary registration form available at the NPCA registration area located in the New Orleans Hilton Hotel.

*Offer valid for Regular Advance Registrants only.

An Infrared Spectroscopy Atlas for the Coatings Industry



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A fully indexed literature survey represents the most complete bibliography published in this type of text. It is organized into sections such as theory, general information, reviews, instrumentation, experimental techniques, compilation of spectra, quantitative analysis, coatings, polymers applications and pigment applications. Each section is in chronological order.

This handsome set is packaged in a sturdy slip case for easy shelf storage.

Also, a computerized database of all the spectra featured in the Atlas has been developed by the Nicolet Instrument Corp., in cooperation with the Federation. The Nicolet Coatings Technology Database is available at additional cost from Nicolet to assist in computer searching during quantitative infrared analysis.

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Regulatory UPDATE

June 1994

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.

Department of Transportation
Research and Special Programs Administration
April 29, 1994—59 FR 22132
Hazardous Materials Transportation; Registration and Fee Assessment Program
Action: Notice of filing requirements

The Hazardous Materials Registration Program will begin registration-year 1994-95 on July 1. Anyone transporting or offering for transportation certain hazardous materials is required to file a registration statement and pay a fee to the Department of Transportation (DOT) on a yearly basis. Anyone who registered for the 1993-94 registration year should have received a new registration statement form in April. All others may obtain a form or additional information by contacting David W. Donaldson, Office of Hazardous Materials Planning and Analysis, Hazardous Materials Safety, RSPA, DOT, Washington, D.C. 20590, (202) 366-4109.

Department of Labor
Occupational Safety and Health Administration
April 19, 1994—59 FR 18508
Abatement Verification
Action: Notice of proposed rulemaking

The Occupational Safety and Health Administration (OSHA) is accepting comments on a proposal that would require employers to certify hazard abatement and submit abatement plans and progress reports if the employer has received an OSHA citation. OSHA is also proposing to tag cited equipment to alert affected employers that a hazardous condition exists while abatement is being accomplished. OSHA is requesting comments and recommendations that will assist the agency in developing final regulations.

Please submit comments in quadruplicate to the Docket Officer, Docket No. C-03, OSHA, Rm. N-2625, U.S. Department of Labor, 200 Constitution Ave., N.W., Washington, D.C. 20210, (202)219-7894. Comments are due on or before July 18, 1994. For further information, contact James Foster, OSHA, Office of Public Affairs, (202)219-8151.

Superfund—The House Energy and Commerce Subcommittee on Transportation and Hazardous Materials unanimously approved legislation to reform the superfund law. The language in the administration-backed bill is drastically different from the original administration bill introduced in February.

The most recent version of the Superfund Reform Act (H.R. 3800) contains newly drafted provisions that include voluntary cleanup and the states role in the program.

Early in April, Rep. Al Swift (D-WA) refused further action on the bill because of continued disagreements over remedy selection. EPA then drafted a compromise plan covering liability, a dispute-resolution insurance fund, remedy selection, and community participation provisions. The bill approved by the House subcommittee is based primarily on the revised EPA draft.

As approved by the subcommittee, the bill also includes modifications regarding liability for "pollutants and contaminants." It would cap annual payments by the federal government for "orphan shares" at $300 million and eliminate some liability exemptions for the federal government. Additional language clarifying liability under superfund for certain recycling transactions was also included.

An issue that remains contentious is the establishment of an insurance fund to resolve claim disputes over superfund liability. The language drafted by the EPA does not have the support of a number of significant insurance and industry groups. In the approved bill, the original insurance language was changed to eliminate provisions allowing insurance companies to recover 50% of their litigation costs from unsuccessful industry suits.

The subcommittee passage of this bill clears the way for consideration by the powerful House Energy and Commerce Committee. The 21-0 vote for passage has invited both Capitol Hill staff and EPA representatives to speculate that it is indeed possible for a superfund reform bill to become law during this session of Congress.

Clean Water Act—Environmental, industry, and state groups still have major concerns with a Clean Water Act (CWA) reauthorization bill despite the many attempts to redraft the measure. Because of those concerns, the bill's sponsor, Rep. Norman Mineta (D-CA), has agreed to hold additional hearings on the measure as well as other CWA issues. Although often scheduled, the CWA hearings have consistently been postponed throughout April and May.

In the first substitute of his original bill (H.R. 3948), Mineta's most significant variation is the addition of provisions dealing with wetlands and the allocation formula under the state revolving loan fund program. Another draft (reportedly bipartisan) that is currently circulating among House Democrats contains provisions that include risk assessment and unfunded mandates. According to the draft proposal, a risk assessment must be conducted for each standard, effluent limitation, or other regulatory requirement under the

CWA. This draft does not include certain provisions addressed in the Mineta proposals, such as mixing zones and ground water protection.

On the Senate side, the Environment and Public Works Committee cleared the way for full Senate consideration by approving a modified version of a CWA bill in February. Like the House bill, S. 1114 is comprehensive legislation. It is expected to reach the floor before the August recess.

Toxics Substances Control Act—Despite the fact that the Toxic Substances Control Act (TSCA) does not continue a provision for periodic reauthorization, Sen. Harry Reid (D-NV) is attempting to do just that.

In a recent statement, Sen. Reid announced he would hold the first of two hearings at the end of May to assess changes that are needed to strengthen the current law. According to the announcement, Sen. Reid would like to "ensure an efficient, streamlined, and safe process for industrial chemical marketing and use."

Reportedly, the second hearing will be held outside of Washington sometime before August when Sen. Reid will introduce a reauthorization bill. TSCA was created to review new and already commercialized industrial chemicals for possible adverse health and environmental effects. There have been no major changes to the statute since its inception in 1976, and it is unlikely any major bill will pass this year.

States Proposed Legislation and Regulations

Alabama

Lead—AL S. 17 (Lindsey) authorizes the State Board of Health to develop a program relating to indoor lead hazard reduction; authorizes the establishment of certain fee schedules. The bill was introduced on April 26 and reported with substitute from the Senate Committee on Economic Affairs on April 26.

Hazardous Waste (Regulation)—The Alabama Department of Environmental Management (DEM) has changed the effective date to June 1, 1994 for implementing amendments to the state's aboveground storage tank trust fund regulations. For additional information, contact James Stevens of the DEM, (205) 270-5606.

The Alabama DEM has amended the state's storage tank trust fund program to include aboveground tanks. The revisions also describe eligibility standards for funding. For additional information, contact the DEM at (205) 270-5606.

Arizona

Air Quality (Regulation)—The Arizona Department of Environmental Quality (DEQ) has proposed rules relating to air pollution control; updates New Source Performance Standards (NSPS) and National Emission Standards for Hazardous Air Pollutants (NESHAPs) to obtain delegated authority for enforcement of recent federal regulations implementing the Clean Air Act Amendments of 1990; covers test method for dichloromethane and 1,1,1-trichloroethane in paints and coatings. For further information, contact Martha L. Seaman, Rule Development Section, DEQ, (602) 207-2222.

California

Graffiti—CA A. 3167 (Epple) finds that graffiti is a serious problem in this state, and states legislative intent; regulates the sale and display of all aerosol paint, liquid dye or polish, and marker pens containing anything other than a solution that can be removed by water after it dries, and defines these products. As of April 20, the bill is in interim study.

CA S. 1779 (Bergeson) among other things, increases the penalties for acts of vandalism resulting in defacement, damage, or destruction valued at $400 or more, but less than $50,000; authorizes a peace officer to arrest persons whom the officer has reasonable cause to believe has committed specified acts of vandalism, whether or not the acts were committed in his presence; requires minors who commit vandalism to provide restitution. The bill was released from the Senate Committee on Judiciary on April 19 and is now in the Committee on Appropriations. It is expected to pass.

Air Quality (Regulation)—The California Air Resources Board (CARB) has issued revisions to the state's Air Toxic "Hot Spots" regulations designed to streamline the program. Included among the revisions are procedures for removing facilities from the program and a new streamlined biennial reporting form. For additional information, contact Kirk Oliver of CARB at (916) 322-2884.

The CARB has adopted a regulation establishing that any substance listed as a hazardous air pollutant under the Federal Clean Air Act is to be treated as such for state purposes as well. For additional information, contact Kirk Oliver, CARB, (916) 322-2884.

On April 25, 1994, the South Coast Air Quality Management District (SCAQMD) released a draft plan for clean air that calls for improving local air quality over the next 15 years by relying on over 100 new or recently adopted control strategies. Included among the measures is the district's expansion of its Regional Clean Air Incentives Market program. For more information, contact Ron Ketcham, SCAQMD, (909) 396-3213.

On April 8, 1994, the SCAQMD extended the deadline by which furniture manufacturers must comply with lower VOC-emitting wood furniture coating standards that were established in 1988 under the district's Rule 1136. According to the new compliance schedule, the VOC limit for clear topcoats not containing an ozone-depleting substance was raised from 350 to 680 grams per liter until August 15, 1994. The VOC limits for low-solids stains, toners, and wash coats were raised from 380 to 800 grams per liter. For additional information, contact the SCAQMD's public affairs department at (909) 396-3213.

Connecticut

Lead—CT H. 5560 (Committee on Housing) provides incentives and a comprehensive system of lead paint abatement and management in private multi-family residential structures containing 50 or more dwelling units. The bill passed the House on April 29 and was sent to the Senate.

CT H. 5561 (Committee on Housing) establishes a comprehensive lead risk reduction plan for housing authorities. The bill was reported favorably from the Joint Committee on Banks on April 27 and reported favorably from the Joint Committee on Insurance and Real Estate on April 28. It is currently in the Joint Committee on Judiciary.

Labeling—CT H. 5111 (Committee on General Law) requires warning labels of combustibility to be placed on drying oils and drying oil products. The bill passed the House on April 13 and the Senate on April 27.

Lead—CT S. 209 (Committee on Banks) concerns lead-paint removal in connection with mortgage lenders; avoids

further burdening of residential sellers by requiring abatement of lead-paint at real estate closings in the current depressed real estate market. The bill was reported favorably from the Joint Committee on Judiciary on April 14.

Iowa

Air Quality (Regulation)—The Iowa Environmental Protection Commission (EPC) has proposed regulations that would establish a voluntary clean air act operating permit program for small sources as an alternative to the regulations mandated by the Federal Clean Air Act. For additional information, contact Christine Spackman, Iowa Department of Natural Resources, (515) 281-8852.

Kentucky

Lead—KY S. 289 (Neal) originally would have (1) prohibited lead abatement activities by individuals not licensed; (2) required the Kentucky Environmental Protection Cabinet to develop criteria and procedures for certifying and licensing various categories of individuals involved in lead abatement activities; (3) established minimum elements for qualification; and (4) established procedures for license renewals. As signed by the Governor on April 18, the bill now calls for the appropriate committee of the legislature to "study the problem of lead hazard reduction" and the need for methods of licensing and certifying lead hazard reduction personnel; appropriates $10,000 for the study which is to be completed with a report by October 31, 1995.

Louisiana

Air Quality (Regulation)—The Louisiana Department of Environmental Quality (DEQ) has extended an emergency regulation controlling VOC emissions in furtherance of the state's effort to reduce VOC emissions by 15% by the year 1996, as required by the Federal Clean Air Act. Another emergency regulation to control VOC emissions has been extended in the Baton Rouge area. The regulations were effective March 15, 1994 and expire July 13, 1994 or upon issuance of a final regulation, whichever comes first. For additional information, contact the DEQ at (504) 765-0110.

Hazardous Waste (Regulation)—The Louisiana DEQ has issued a final regulation specifying registration requirements for owners of new underground storage tanks and buyers and sellers of such tanks, as well as certification requirements for owners and the installers of the tanks. For additional information, contact David Hughes, DEQ, (504) 765-0399.

Maryland

Lead—MD H. 760 (Taylor) establishes the Lead Poisoning Prevention Program and the Lead Paint Poisoning Commission; establishes risk reduction standards for affected properties; requires owners of affected properties to satisfy certain risk reduction standards and provides for certain inspections. The bill was signed by the Governor on May 2.

MD S. 673 (Blount) establishes a Lead Poisoning Prevention Commission; establishes a lead hazard reduction standard with which properties that are effected by the Act must comply; provides specified exceptions; authorizes owners of affected property to make specified offers to lead poisoned children; specifies the procedures for accepting or rejecting an offer; establishes a Lead Poisoning Prevention Fund; specifies the insurance requirements that an owner of an affected property must have; specifies the purpose of the Act. The bill was reported unfavorably from the Senate Committee on Judicial Proceedings on April 11. The Maryland legislature adjourned on April 11.

Massachusetts

Environmental Crimes—MA S. 943 (Durand) further protects the environment by empowering the courts to seize assets (a state "rico" bill) of those who are convicted of environmental crimes and using the proceeds to enhance environmental law enforcement. The bill was released from the Joint Committee on Natural Resources and Agriculture on May 2. It has been referred to the Senate Committee on Ways and Means.

Lead (Market Share Liability)—H. 3976/S. 735 (Jehlen/Jacques) authorizes the use of market share liability in civil actions brought against certain producers or manufacturers of lead-based paint. The bills were amended by the Joint Judiciary Committee and sent to the House Ways and Means Committee on May 5.

Minnesota

Toxics-in-Packaging—MN S. 1788 (Johnson, J.) relates to waste management; among other things, the bill establishes a process for resolution of disputes related to toxics in packaging and clarifies the prohibition on toxics in packaging. This bill is an amendment to its 1991 toxic-metals-in-paints law. If the bill passes, the following key provisions would be implemented as part of the amended law:

- Paints manufactured after September 1, 1994 for sale or use in Minnesota must contain no lead, cadmium, mercury, or hexavalent chromium which has been intentionally introduced.
- The concentration of any of the above metals which may be incidentally present in paint cannot exceed 100 parts per million per metal.
- Paint products are exempt from the above provisions if the manufacturer notifies the Commissioner of the Pollution Control Agency by no later than August 1, 1994: (1) that compliance is not technically feasible and (2) how compliance will be achieved by July 1, 1997. The exemption expires on July 1, 1997.
- By July 1, 1996, manufacturers of exempted products must inform the agency of progress being made toward meeting the law's requirements.
- Users of paints containing one or more of the proscribed metals may submit, on behalf of the manufacturer, a request for the exemption only if the manufacturer fails to submit its own request for exemption.

The conference report was adopted by the Senate on April 29 and the House on May 2. The bill is expected to be signed by the Governor. For additional information, contact NPCA's David Lloyd, Heidi McAuliffe, or Jim Sell at (202) 462-6272.

Lead—MN S. 2710 (Solon) relates to lead abatement programs; modifies standards for home assessments; removes specific standards from the statutes; specifies information to be collected and disseminated; requires notice to the Department of Health of all violations identified in home assessments; bars removal of intact paint unless proven to be a source of actual lead exposure; provides for standards for activities which are not lead abatement but which may disrupt lead-based paint surfaces. The Conference Committee Report was adopted by the Senate on April 28 and the House on April 29.

Hazardous Waste (Automotive Paint)—MN S. 2923 (Chandler) requires persons engaged in retail or wholesale of motor vehicle paint, thinner, or reducer to keep records of federal hazardous waste generator ID numbers or purchasers and list the number on receipts; bars sales to persons without such ID numbers; exempts small quantities

(under six ounces) and aerosol products intended for use by the general public; makes violations gross misdemeanors and provides civil remedies. The bill was introduced on April 20 and referred to the Senate Committee on Commerce and Consumer Protection.

New York

Hazardous Waste (Regulation)—The New York State Environmental Board approved a number of regulations on April 27 addressing the storage, handling, and release of hazardous substances, including: requirements for upgrading underground storage tanks; standards for inspecting, cleaning, and closing chemical tanks; provisions for increasing the scope of reporting spills or releases of hazardous substances; and mandates for owner/operators of bulk storage facilities to prepare and submit "best management plans" for their facilities. For more information, contact the New York Department of Environmental Conservation at (518) 457-4351.

Air Quality (Regulation)—The New York DOT has issued final regulations implementing the Federal Clean Air Act mandate that employers of 100 or more employees in severe ozone nonattainment areas must provide employees with options that reduce their average occupancy of vehicles. The rule was effective April 6, 1994. For more information, contact Robert Ancar, DOT, (518) 457-2064.

North Carolina

Occupational Health and Safety (Regulation)—The North Carolina Department of Labor (DOL) has amended safety regulations for general industry incorporating the federal OSHA standard for hazardous waste operations and emergency response. For more information, contact Jill Cramer, DOL, (919) 733-7166.

North Dakota

Air Quality (Regulation)—The North Dakota Department of Health and Consolidated Laboratories (DHCL) has amended the state's clean air regulations to conform to the clean air operating permit program requirements mandated by the Federal Clean Air Act. For additional information, contact Terry O'Clair, DHCL, (701) 221-5188.

Ohio

Lead—OH S. 162 (Drake) requires lead screening of certain young children; creates a tax credit for lead abatement; provides for licensure of persons performing lead abatement; and provides that it is an unlawful discriminatory practice to refuse to sell to or rent housing because it will be occupied by a young child or pregnant woman. The bill was signed by the Governor on April 1.

Air Quality (Regulation)—The Ohio Environmental Protection Agency (OEPA) has issued a final regulation requiring owners and operators of major stationary sources of volatile organic compounds (VOCs) in marginal and moderate ozone nonattainment areas to submit annual facility VOC emission inventories. The regulation became effective on April 1, 1994. For additional information, contact Tammy Beets, OEPA, (614) 644-2905.

Oklahoma

Lead—OK H. 2063 (Leist) relates to the Oklahoma Lead-Based Paint Reduction and Regulation Act; provides that the Environmental Quality Board shall promulgate rules governing lead-based paint activities; requires the board to establish a schedule of fees for certification of abatement of contractors and training and lead-based paint activity programs. The House refused to concur in Senate amendments on April 21. The bill was sent to Conference Committee. If signed by the Governor, the law will be effective July 1, 1994.

OK H. 2497 (Hamilton) establishes the Comprehensive Childhood Lead Poisoning Prevention Program, to be administered by the State Department of Health. Requires the State Board of Health to promulgate rules regarding lead toxicity screening of certain children, risk assessment, blood lead tests, health education and counseling and other requirements, and creates a nine-member Childhood Lead Poisoning Prevention Advisory Council. The bill was sent to the Governor on April 28.

Graffiti—OK S. 971 (Haney) makes it a misdemeanor to knowingly sell paint containing metallic powders dispensed from a pressurized container, or any glue, to a person under 18 years of age. On April 26 the House refused to concur in Senate amendments. The bill was sent to Conference Committee.

Wisconsin

Toxic Chemical Reporting—WI A. 732 (Black) requires additional types of facilities to complete toxic chemical release forms and submit them to the Department of Natural Resources. The bill was signed by the Governor on April 8.

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Far-Reaching Proposed Regulation in British Columbia: The province of British Columbia, Canada, is considering a Post-Consumer Paint Stewardship regulation which would prohibit any retailer, brand-owner and/or manufacturer of latex and solvent-borne consumer paint, including stains and varnishes, from the sale or distribution of any paint in that province unless they belong to a BC Independent Funding Organization (IFO). The intent of the regulation would be to encourage the reuse and recycling of post-consumer paint as well as provide for adequate recovery, treatment, and disposal of residual post-consumer paint. As currently drafted, violation of the regulation would trigger a $5,000 fine per offense. The BC Paint Reuse Society would be responsible for establishing and administering a program to collect and dispose of post-consumer paint as well as enforcement of the regulation. The Society would consist of multi-stakeholders including, but not limited to, a manufacturer, a retailer, a member from the environmental community, a representative from the Ministry of Environment, Lands and Parks, and a representative from the Canadian Paint and Coatings Association.

In an effort to divert attention away from mandatory take-back requirements or taxes, industry representatives have tentatively agreed to support the IFO, which would be responsible for managing most aspects of post-consumer paint collection and disposal, including consumer education. The long-term strategy is to encompass industry suppliers as well as product users (contractors, consumers) in the IFO to fund paint collection and disposal.

Essentially, this DRAFT regulation would transfer the issue of post-consumer disposal from local solid waste management officials to the paint industry. This regulation could have a significant affect on the U.S. paint industry which markets, sells, or distributes paint and coatings in Canada. While the province of British Columbia is drafting this regulation, both Quebec and Ontario provinces are also considering similar regulations. For additional information, contact NPCA's Soonie McDavid at (202) 462-6272.

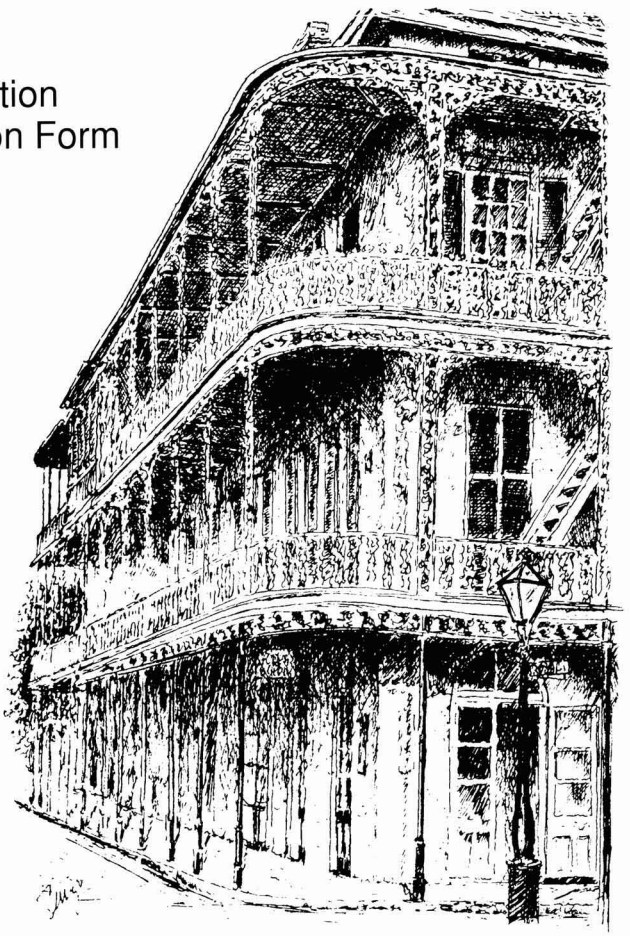
Federation of Societies for Coatings Technology

72nd Annual Meeting & 59th Paint Industries' Show
FSCT 1994
New Orleans Convention Center
New Orleans, LA
October 12-13-14, 1994

1994 Annual Meeting & Paint Industries' Show

- Hotel Information
- Reservation Application
- Advance Registration Form

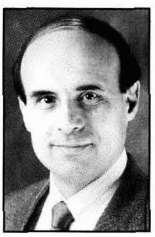
"Excellence Through Innovation"



Ernest N. Morial Convention Center
Wednesday, Thursday, Friday • October 12-13-14, 1994
New Orleans, Louisiana

The combined Annual Meeting and Paint Industries' Show, to be held at the Ernest N. Morial Convention Center, is a major educational activity of the Federation of Societies for Coatings Technology. This international coatings manufacturing industry event consists of three days of technical program sessions and exhibits, running concurrently. Registration is required for admission.

From the President:



John A. Lanning
President, FSCT

Welcome to the Big Easy! We invite you to participate in the main event of the coatings industry—the Federation's 72nd Annual Meeting & 59th Paint Industries' Show. Here in New Orleans, we will meet with representatives from over 60 countries to experience the paint and coatings industry's largest exhibition of raw materials, equipment, and services. In addition, the technical programs will offer a variety of dynamic topics sure to assist you in achieving "Excellence Through Innovation."

To be held in the newly expanded Ernest N. Morial Convention Center, this unique program is rivalled in excitement only by a city that offers such attractions as the French Quarter, the Superdome, Bourbon Street, and the bayous! As you might imagine, the 1994 Annual Meeting and Paint Show will be an event to be remembered! Don't delay—make plans now to be a part of it all "way down yonder in New Orleans!"

"Excellence Through Innovation"

Attendees at the 1994 Annual Meeting can attend technical programs on a wide variety of pertinent topics revolving around the theme, "Excellence Through Innovation." Program sessions are being developed to cover the following topics:

- Advanced Topics in Coatings Research
- Color Technology
- Innovations in the Development of VOC Compliant Corrosion Inhibitive Coatings:Testing and Technology
- The Human Side of Process Safety Management
- Formulating for Low VOC Coatings
- Roon Award Competition Papers
- APJ/Voss Award (Society) Competition Papers
- International Papers
- ISO 9000 Case Study

Presentation subjects will include:

- Powder Coatings
- Accelerated Testing
- Epoxy Coatings
- Additives
- Waterborne Coatings
- Dispersion Technology
- UV Technology

To be a competitor in tomorrow's coatings industry, you will have to be well versed in customer satisfaction, committed to continuous improvement, and prepared to work with and develop new technologies. These sessions will give you answers and insights to meet these challenges.

Papers will be presented by industry experts, familiar with what it takes to achieve success. They will convey to you that, more than ever before, customer satisfaction requires a balance of enhanced performance, cost effectiveness, and product consistency. You'll learn the latest in products, processes and packaging, in addition to finding out about the new technologies that will make "Excellence Through Innovation" a reality.

New to the event are "Early Bird" sessions on Thursday, October 13, to give you more detailed information on pertinent subjects. Initial offerings will cover "Empowerment" and "Quality" The program will again open with the popular Technical Focus Speaker on Wednesday, October 12, at 1:00 p.m.

Two additional presentations you'll want to attend are the Keynote Address at Wednesday morning's Opening Session and the Mattiello Memorial Lecture, scheduled for Friday morning at 10:30 a.m. Both sessions are in the "must attend" category of all serious coatings professionals!

Make it a point to visit the Poster Session on Thursday. This all-day event will feature non-commercial work covering new ideas and techniques in coatings research and will let you glimpse at the work of future industry leaders.

World's Premier Paint Show to Feature Products of Over 250 Companies

The largest coatings-related exhibition in the world—the FSCT Paint Industries' Show—will be held in conjunction with the Annual Meeting at the Ernest N. Morial Convention Center—New Orleans. Over 250 supplier companies to the coatings manufacturing industry will be present to discuss their newest products and services. In over 90,000 sq. ft. of exhibits will be displayed a wide variety of raw materials, production equipment, containers and filling equipment, laboratory apparatus, and testing devices for the paint and coatings producer.

Key personnel from the top technical and sales staff of supplier companies will be available to provide attendees with an opportunity to learn of the latest developments in their products and services.

Exhibit hours will be:

Wednesday, October 12 .....10:00 a.m.-5:00 p.m.
Thursday, October 13 .....9:00 a.m.-5:00 p.m.
Friday, October 14 .....9:00 a.m.-12:00 Noon

Hotel Information

Whether you desire the value of a moderately-priced hotel, or the luxury of an upscale property, the choice is yours. The FSCT has arranged for convention rates at 12 official Paint Show hotels. All reservations must be placed through the FSCT Housing Bureau to obtain the preferred rates. The Housing Bureau will confirm all reservations. *(Housing opens June 15.)*

Do it Your Way and Save!

You have the convenience of placing a phone call or faxing your request for hotel accommodations to the FSCT Paint Show Housing Bureau.

Call! 800-345-1187 or 504-566-5005

Have the information requested on the Hotel Reservation Form available before you place your call. Reservationists are available 7:00 a.m. - 7:00 p.m., Monday through Friday, Central Time. Reservations will be immediately confirmed over the phone and also by mail or fax if fax number is provided.

Fax! 504-522-6123

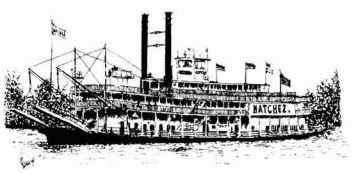
Anytime, any day. Fax the Hotel Reservation Form at your convenience. Be sure to include a phone and fax number and retain your copy of the form for your records. Confirmations will be sent via fax within three working days of receipt of request.

Mail!

Send your form to the FSCT Paint Show Housing Bureau for processing. Be sure to include a phone and fax number and keep a copy of the form for your records. Your confirmation will be mailed or faxed, if a fax number is provided.

Deposits

A $100 deposit per guest room and $100 deposit per suite is required in order to process requests. This is a refundable deposit if the reservation is cancelled 72 hours prior to arrival. The following methods of payment are acceptable: checks made payable to the FSCT Paint Show Housing Bureau or credit cards. Credit card choices include American Express, MasterCard, or Visa. Please note that the deposit will be applied immediately to the credit card used.



Deadlines

To obtain the convention rates, reservations must be placed by September 1. Reservations placed after September 1 will be on a space available basis. To make reservations after September 9, call the hotel directly.

Changes/Cancellations

For changes or cancellations prior to September 9, call the FSCT Paint Show Housing Bureau at 504-566-5005 or fax your change to 504-522-6123. After September 9, call the hotel directly.

Registration Information

The Advance Registration fees include three days of admission to the Paint Industries' Show and the Opening Session, and all concurrent program sessions of the Annual Meeting. To register, simply complete the Advance Registration Form and forward it with payment to FSCT. The Advance Registration prices will be available until **September 1**. The form with accompanying payment must be received at FSCT by September 1. Registration options are listed below:

Full Time	Advance	On-Site
Member	$ 75	$ 90
Non-member	$100	$125
Social Guest	$ 60	$ 70

Your registration credentials will be mailed to you in advance of the Annual Meeting & Paint Industries' Show. Badges for registrations received after September 1 will be available in the FSCT Paint Show Registration Area.

The Registration Services Area will be located at the Ernest N. Morial Convention Center and will be open over the following days and times to assist you.

Day	Time
Tues., October 11	8:00 a.m. - 5:00 p.m.
Wed.-Thurs., October 12-13	7:30 a.m. - 5:00 p.m.
Fri., October 14	7:30 a.m. - 12 Noon

On-site registration will also be available during the times noted above.

Method of Payment

Acceptable types of payment include checks in U.S. funds made payable to FSCT, as well as credit cards: VISA, MasterCard, and American Express. Payment is due with registration form. Forms received without payment will not be processed. Please note: **if payment is made with a credit card, the form may be faxed to FSCT Headquarters Office. If faxing, please do not mail original form.**

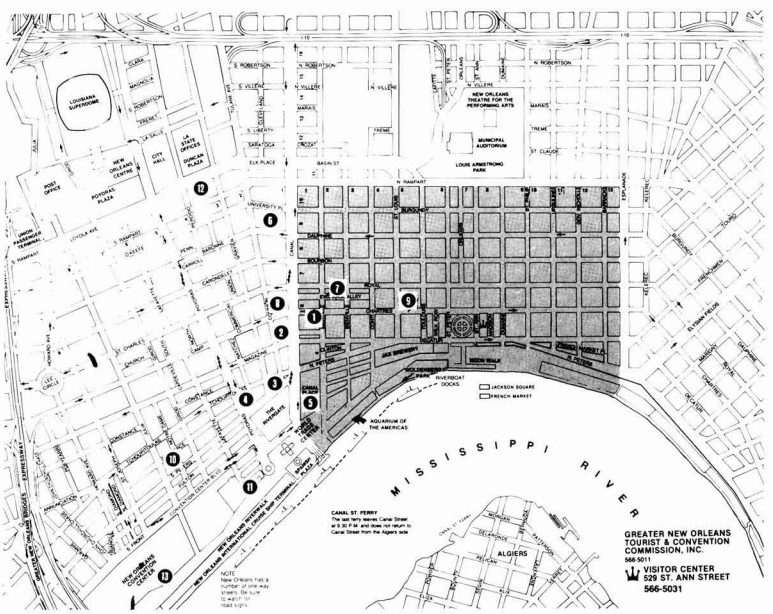
Cancellation and Refund Policy

All cancellations must be submitted in writing to the FSCT Headquarters Office. All badges that have been mailed must be returned to FSCT for refund processing. Cancellations received by September 28 will be subject to a $10 handling charge. A $25 charge will apply after that date.

1994 Paint Show Hotel Summary

Hotel	Room Type and Rates: Single	Double	Suites: 1 BR	Suites: 2 BR	No. of Restaurants/ Bars	Swimming Pool	Health Club
*Marriott (Standard)	$138	$158	$550-1,100	$688-1,238	3/2	yes	yes
(Concierge level)	146	166					
*Sheraton (Standard)	138	158	250-1,000	350-1,185	4/4	yes	fitness center
(Executive)	158	178					
Doubletree	115	135	225-250	325-375	1/1	yes	yes
Holiday Inn Crowne Plaza	125	145	560	685	2/2	yes	exercise room
Westin Canal Place	130	150	240-400	400-1,500	1/2	yes	yes
Fairmont	125	145	295-1,200	475-1,200	3/3	yes	fitness center
Monteleone	127	147	290-520	430-680	3/2	yes	yes
Le Meridien	140	160	450-500	650-1,500	1/2	yes	yes
Omni Royal Orleans	140	160	325	525	3/4	yes	yes
Radisson Suites	125	145			1/1	yes	no
Hilton (Standard)	145	165	504-1,490	695-1,685	4/5	yes	jogging track
(Executive)	165	185					
(Towers)	185	205					
Holiday Inn Downtown	90	105			1/1	yes	no

*Marriott and Sheraton will be co-headquarters. Guest rooms at both hotels will be limited to 10 per company.



Shuttle Schedule

Route 1

Meridien ..... Sheraton
Sheraton ..... Canal Street
Doubletree ..... South Peters
Holiday Inn Crowne Plaza ..... South Peters

Route 2

Westin ..... North Peters
Marriott ..... Canal Street
Omni Royal Orleans ..... Marriott*
Monteleone ..... Marriott*

*Limited shuttle service will be available from the Royal Orleans and the Monteleone to the Marriott.

Route 3

Holiday Inn Downtown ..... Loyola Street
Fairmont ..... Baronne Street

Schedule

Tues., Oct. 11 ..... 8 a.m. - 5 p.m.
Wed., Oct. 12 .... 7:30 a.m. - 6 p.m.
Thurs., Oct. 13 ... 7:30 a.m. - 6 p.m.
Fri., Oct. 14 ..... 7:30 a.m. - 3 p.m.

Legend

1 — Marriott
2 — Sheraton
3 — Doubletree
4 — Holiday Inn Crowne Plaza
5 — Westin Canal Place
6 — Fairmont
7 — Monteleone
8 — Le Meridien
9 — Omni Royal Orleans
10 — Radisson Suites
11 — Hilton
12 — Holiday Inn-Downtown
13 — Convention Center

Hotel Reservation Form

(Housing opens June 15)

MAIL FORM & DEPOSIT TO:

FSCT Paint Show
1520 Sugar Bowl Dr.
New Orleans, LA 70112

PHONE/FAX:

(800) 345-1187 Continental U.S.
(504) 566-5005 International
FAX: (504) 522-6123

HOTEL PREFERENCE

List the hotels of your preference. First choice will be assigned if available. List other preferences to avoid delay. If your first choice is not available, your deposit will be applied to your next available choice. The deadline is September 1.

(1) _____ Hotel (2) _____ Hotel (3) _____ Hotel

RESERVATION REQUEST

Number of rooms requested ☐

Names of Occupants	Room Type	Rate	Arrival	Departure

For additional reservation requests, feel free to copy this form.
Requests for the Marriott and Sheraton will be limited to 10 rooms per company.

DEPOSIT

A deposit of $100 per room is required. No form will be processed without a deposit. Credit cards will be billed immediately for first night's deposit.

Credit Card: ☐ American Express ☐ Mastercard ☐ VISA Cardholder's Signature: _____

_____ Card Number _____ Expiration Date _____ Print Cardholder's Name

or Check made payable to: "Paint Show Housing Bureau" $ _____ enclosed. Check No. _____

DIRECT CONFIRMATIONS TO:

Name: _____ Telephone: _____

Company: _____ FAX: _____

Address: _____

City/State (Province): _____ Zip Code (Mailing Code): _____

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

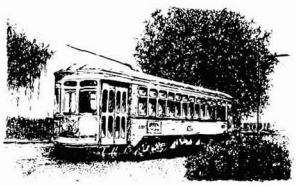
If requested room rate is not available, the nearest rate will be assigned by the FSCTPaint Show Housing Bureau. We cannot guarantee that the accommodations will be assigned in your preferred hotels.

☐ _____ requires special assistance. Please call: _____
Name

Airport & City Transportation

From New Orleans International Airport:
Airport Shuttle (service to downtown hotels, provided by Airport Shuttle New Orleans) is $10 each way. The shuttle may be boarded by the baggage claim area. The trip takes approximately 30 minutes.

Taxi Service from the airport to downtown hotels is $21 per person, $10 per person with two passengers, and $6 per person with three passengers.



Slash Air Fare Expense

Minimize your travel expense to the Paint Show by using discounted zone fares offered by **Delta Airlines** to the Paint Show. NO SATURDAY NIGHT STAY IS REQUIRED!

From City	Regular Coach	FSCT Zoned Fares
Atlanta	$576	**$408 - 464**
Chicago	$1,210	**$408 - 514**
Denver	$1,006	**$348 - 408**
Los Angeles	$1,196	**$448 - 518**
New York City	$990	**$408 - 514**

To obtain these fares, you, your secretary, or your travel agent must refer to the following file codes when contacting the airlines:

Delta 1-800-241-6760 mention code I5014

FSCT Travel Desk: mention Paint Show
Domestic U.S. 1-800-448-FSCT
International 1-215-628-2549
Fax: 215-628-0310

FSCT Travel Desk is able to provide zone fares on both Delta and United Airlines. If you desire a Saturday night stay, a 5% discount on the lowest fare applicable can be obtained. On all discounted fares, there may be certain restrictions and penalties for changes or cancellations. Airport surcharges may apply.

Mardi Gras MAGIC Annual Luncheon

Curious why droves of people flock to New Orleans in February for its biggest party, Mardi Gras? Then attend the Federation's Annual Awards Luncheon on Thursday, October 13. Along with the re-creation of Mardi Gras Magic, featuring Big Easy music and a Mardi Gras Tableau Presentation, will be the presentation of Federation awards.

Luncheon tickets can be purchased in advance or on-site at $25 each. Social guest registration includes the Luncheon ticket.

Social Program
'Big Easy' Arts and Entertainment

Activities for social guest registrants begin at the Marriott on Wednesday, October 12, with an Afternoon Social for re-acquainting with friends and meeting new ones over refreshments and local entertainment. New Orleans is a city whose mystique has captured the imagination of both its locals and visitors. The Social will feature local artists demonstrating their vocal, culinary and decorative talents to the participants.

On Thursday, October 13, following a continental breakfast at the Marriott Hotel, registered social guests will depart on deluxe motorcoaches for a visit to the exquisite city estate Longue Vue House and Gardens, once home to the prominent Stern family. There, guests will have an opportunity to stroll the beautifully landscaped grounds, tour the mansion, enjoy refreshments under the pavilion, and attend informative programs on various collections displayed at Longue Vue.

After Longue Vue, guests will board motorcoaches for the Convention Center to attend the Federation's Mardi Gras Magic Luncheon. The festivities include Big Easy entertainment and a presentation by a local expert on the symbolism of the Mardi Gras Krewe and colors.

Following the luncheon, participants will have time on their own to explore the many New Orleans attractions and shops.

Social guest registration is $60 in advance and $70 on site, and includes the Wednesday Social, Thursday Breakfast and Tour, as well as the Mardi Gras Magic Luncheon.

Registration is limited to 700 participants.

NPCA to Meet Same Week

The National Paint & Coatings Association will hold its annual meeting on October 10-12, at the New Orleans Hilton and Towers, in New Orleans.

NPCA will admit advance registered attendees of the FSCT Paint Industries' Show to the Forum Sessions being held during its annual meeting at no additional charge. The Forum Sessions will be conducted at the New Orleans Hilton on Monday and Tuesday, October 10 and 11. For admittance to these sessions, FSCT Paint Show attendees must complete NPCA's complimentary registration form available at the NPCA registration area located in the New Orleans Hilton Hotel.

1994 Advance Registration

FSCT Annual Meeting & Paint Industries' Show

New Orleans, LA • October 12-14, 1994

DEADLINE—SEPTEMBER 1

Registration credentials will be mailed to the address noted if received at FSCT Headquarters by **September 1**.

If received after that date, they may be picked up on-site at the Ernest N. Morial Convention Center.

BADGE INFORMATION: This is how your badge will read and where it will be mailed.

FIRST NAME (as you wish it to appear on badge)

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.

SOCIAL GUEST BADGE INFORMATION:

FIRST NAME (as you wish it to appear on badge)

FIRST NAME LAST NAME

MAILING ADDRESS (or P.O. Box)

CITY STATE/PROV.

POSTAL CODE

BUSINESS CLASSIFICATION DATA FOR INDUSTRY REGISTRANT:

YOUR COMPANY (CHECK ONE ONLY)

- 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
- YY ❑ Environmental Services
- JJ ❑ Other

YOUR POSITION (CHECK ONE ONLY)

- 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

Registration Fees:

A ❑ FSCT Member FSCT Society _____	$75.00
B ❑ Non-Member	$100.00
D ❑ Social Guest	$60.00
G ❑ Special Fee for Retired Member	$25.00
H ❑ Special Fee for Social Guest of Retired Member	$25.00

FSCT Mardi Gras Luncheon Tickets: (Thurs., Oct. 13)

(Social guest registration includes the luncheon)

❑ NUMBER REQUIRED: _____
$25 EACH

Method of Payment:

Payment is due with registration form.
We are pleased to accept faxes for credit card payment only.

Total Amount Due $ _____

Please Check One:

❑ Enclosed is Check #_____
payable in U.S. Funds to FSCT

❑ Charge to the following card:

___ MC ___ VISA ___ AMEX

Card No.

Expiration Date: __/__ Mo. __/__ Yr.

Signature (Credit card registrations only)

Please print cardholder's name

All registrations received **by September 1** will be processed and Registration Credentials will be mailed to the address provided. All registrations received **after September 1** will be processed and can be picked up at the Paint Show Registration Services Area. A $10 charge will be made for cancellations received prior to September 28. A $25 charge will be made for cancellations received after that date.

Mail completed form to:

FSCT, 492 Norristown Rd., Blue Bell, PA 19422-2350

(For credit card registrations only—**FAX: 215-940-0292**—do not mail original)

1994 Paint Industries' Show

Current List of Exhibitors

Aceto Corp.
Adhesion International
ACT Labs., Inc.
Advanced Software Designs
Air Products & Chemicals, Inc.
Air Quality Sciences, Inc.
Akzo Nobel Chemicals, Inc.
Akzo Nobel Resins
Alcan-Toyo America, Inc.
Alcoa Industrial Chemicals
Allied Signal Corp.
Alt-Chem International
C.M. Ambrose Co.
American Chemical Society
Amoco Chemical Co.
ANGUS Chemical Co.
Anker Labelers USA, Inc.
Aqualon Co.
Arco Chemical Co.
Ashland Chemical, Inc.
Atlas Electric Devices Co.
Aztec Peroxides Inc.

BASF Corp., Chem. Div.
Blackmer Pump
Bohlin Instruments
Brookfield Engineering Labs.
Brookhaven Instruments Corp.
Buckman Laboratories
Burgess Pigment Co.
BYK-Chemie USA
BYK-Gardner, Inc.

C&E News
Cabot Corp., CAB-O-SIL & Special Blacks Div.
Caframo Ltd.
Calgon Corp.
Cappelle Inc.
Cardolite Corp.
CB Mills, Div. of Chicago Boiler
CCP Polymers
Celite Corp.
Chemical & Engineering News
Chemical Week Associates
CIBA-GEIGY Corp.
Cimbar Performance Minerals
The Coatings Laboratory Inc.
Coatings Magazine
Color Communications, Inc.
Color Corp.
Colorgen Industrial Group, Inc.
ColorTec Associates
Columbian Chemicals Co.
Consolidated Research, Inc.
CPI Purchasing Magazine
CR Minerals Corp.
Crosfield Co.
Cuno, Inc.
Custom Fibers International
CYTEC Industries

D/L Laboratories
Daniel Products Co., Inc.
Datacolor International
Day-Glo Color
Degussa Corp.
University of Detroit-Mercy
Disti
Dominion Colour Corp.
Dow Chemical USA
Dow Corning Corp.
Draiswerke, Inc.
Drew Industrial Div.
Dry Branch Kaolin Co.
DSA Consulting, Inc.
DSM Resins U.S., Inc.

Eagle Zinc Co./ Meadowbrook
Eastern Michigan University
Eastman Chemical Co.
Ebonex Corp.
ECC International
Eiger Machinery, Inc.
Elcometer, Inc.
Elf Atochem North America
Elmar Industries, Inc.
EM Industries, Inc.
Engelhard Corp.
Engineered Polymer Solutions
Epworth Mfg. Co., Inc.
EQ—The Environmental Quality Co.
Etna Products Inc., Spec. Chems.
European Coatings Journal
Exxon Chemical Co.

Fawcett Co., Inc.
Federation of Societies for Coatings Technology
Filter Specialists, Inc.
Fischer Technology Inc.
Fluid Management
FMJ International Publications
Fryma, Inc.
Fugi Silysia Chemical Ltd.
H.B. Fuller Co.

Paul N. Gardner Co., Inc.
Georgia Pacific Resins, Inc.
The BFGoodrich Co., Specialty Chemicals
The Goodyear Tire & Rubber Co., Chem. Div.
W.R. Grace & Co., Grace Div.
Guertin Polymers

Haake, Inc.
C.P. Hall Company
Halox Pigments
Harcros Pigments, Inc.
William Harrison Corp.
Henkel Corp., Coatings & Inks
Heraeus DSET Laboratories
Heucotech Ltd.
Hilton-Davis Co.
Hockmeyer Equipment Corp.
Hoechst Celanese Corp., Pigments
Horiba Instruments Inc.
J.M. Huber Corp., Calcium Carbonate Div.
J.M. Huber Corp., Clay Div.
Hüls America Inc.
Hunter Associates Laboratory
Huntsman Corp.

Ideal Mfg. & Sales Corp.
Industrial Paint & Powder Magazine
INSITEC, Inc.
Interfibe Corp.
International Resources, Inc.
International Specialty Chemicals
International Specialty Products
ITT Marlow/ITT A-C Pump

S.C. Johnson Polymers
Journal of Coatings Technology

K-T Feldspar Corp.
Kady International
Kemira, Inc.
Kenrich Petrochemicals, Inc.
King Industries, Inc.
KTA-Tator, Inc.

LaQue Center/Kure Beach Atmospheric Testing
Leeds & Northrup
The Leneta Co.
Liquid Controls Corp.
Littleford Day Inc.
The Lubrizol Corp.
Luzenac America

3M, Specialty Chemicals Div.
3M/Zeelan Industries, Inc.
MacBeth, Div. of Kollmorgen
Magnesium Elektron, Inc.
Malvern Instruments
Malvern Minerals Co.
The McCrone Group
McWhorter, Inc.
The Mearl Corp.
Michelman, Inc.
Micro Powders, Inc.
Microfluidics Int'l Corp.
Micromeritics
Micromet Instruments, Inc.
Mid-States Eng. & Mfg. Co.
Milton Can Co.
Milwhite, Inc.
Mineral Pigments
Ming-zu Chemical Industries
MiniFIBERS, Inc.
Minolta Corp.
Mississippi Lime Co.
Univ. of Missouri-Rolla
Modern Paint & Coatings
Morehouse-Cowles, Inc.
Morton International, Inc.
Mountain Mineral Co., Ltd.
Myers Engineering

Nacan Products Ltd.
National Chemical Company
National Paint & Coatings
Netzsch Inc.
Neupak, Inc.
New Way Packaging Mach.
Norman International
North Dakota State University
NYCO Minerals Inc.

Oak Printing
Obron Atlantic Corp.
Ohio Polychemical Co.
Olin Chemicals
Omega Recycling Technologies
Ortech International
OSi Specialties, Inc.

Paar Physica USA, Inc.
Pacific Micro Software Eng.
Paint & Coatings Industry Magazine
Pen Kem Inc.
Peninsula Polymer
Phenoxy Associates
Poly-Resyn, Inc.
PPG Industries, Inc., Silica Products
PPG Industries, Inc., Specialty Chem., Chem. Group
PQ Corp./Potters Industries
Premier Mill Corp.
Progressive Recovery, Inc.
Pyosa, S.A. de C.V.

The Q-Panel Co.
Quantachrome Corp.
K.J. Quinn & Co., Inc.

Raabe Corp.
Ranbar Technology, Inc.
Red Devil Equipment Co.
Rheox, Inc.
Rohm and Haas Co.
Ronningen-Petter
Charles Ross & Son Co.
Russell Finex Inc.

San Esters Corp.
Sandoz Chemicals Corp.
Sanwa Chemical Industries Co., Ltd.
Schenectady International
Schuller Filtration Inc.
Scott Bader, Inc.
Semi-Bulk Systems, Inc.
Serac, Inc.
Shamrock Technologies
Sheen Instruments Ltd.
Shell Chemical Co.
Sherwin-Williams Chemicals
Silberline Manufacturing Co.
Sino-American Pigment Systems
Software 2000, Inc.
Sonoco Products Co.
South Florida Test Services
Southern Clay Products, Inc.
Univ. of Southern Mississippi
Specialty Minerals, Inc.
Startex Chemical Inc.
Steel Structures Painting Council
Sub-Tropical Testing Services
Süd-Chemie, Rheologicals
Sun Chemical Corp.
Sunkyong Industries Ltd.
Systech Environmental

21st Century Conatiners, Inc.
TA Instruments, Inc.
Tayca Corp.
Tego Chemie Service USA
Thiele Engineering Co.
Transac Inc.
Troy Corp.

U.S. Borax, Inc.
U.S. Sack Corp.
Union Carbide Corp.
Union Miniere
Union Process, Inc.
United Mineral & Chemical Corp.

Van Waters & Rogers, Inc.
R.T. Vanderbilt Co., Inc.
Versa-Matic Pump Co.
Viking Pump, Inc., A Unit of IDEX
Vorti-Siv/MM Industries, Inc.

Wacker Silicones Corp.
Wilden Pump & Engineering
Witco Corp.

X-Rite, Inc.

Zeneca Biocides
Zeneca Resins

Federation of Societies for Coatings Technology

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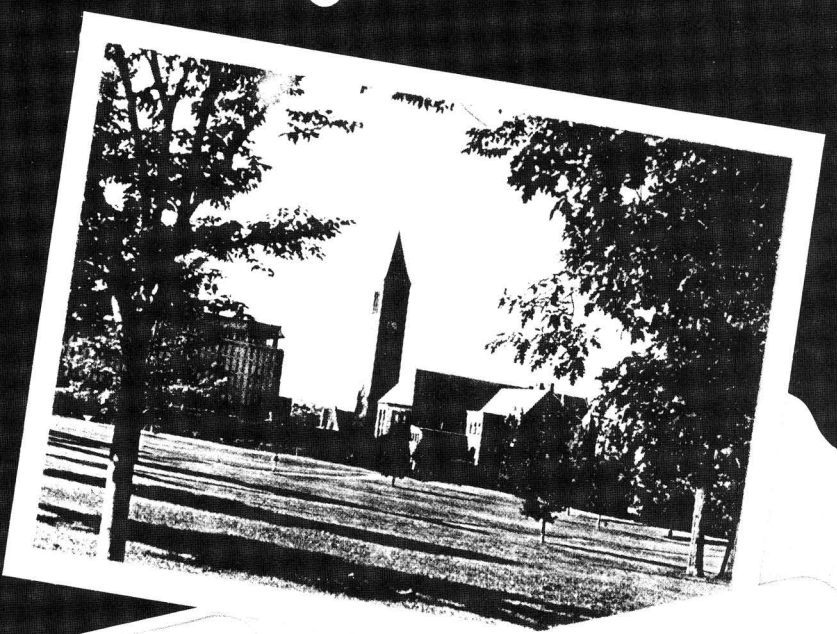
Federation of Societies for Coatings Technology

Coatings Education



1994

- ☑ Report from Federation Educational Coordinating Committee Chairman
- ☑ Report from CIEF President
- ☑ Report from FSCT Professional Development Committee Chairman
- ☑ University Coatings Programs
- ☑ FSCT Educational Committee Guide for Coatings Courses

Education—The Federation's Primary Objective

Over the course of the last several years, education—of our current membership, of our future members, and of our communities at large—has become an important focus for Federation activities. The Educational Committee and its executive arm, the Educational Coordinating Committee (ECC), have had an active role in our reexamination of this most significant function. In looking at the Federation of Societies for Coatings Technology's charter, three of our five principal objectives are concerned with education.

Don Boyd

We live in an age where the word chemical has become a synonym for drug. Technology is mistrusted and misunderstood; it is painted as a hostile force bent on poisoning our environment. We, who participate in technical societies everywhere, must become more proactive—informing our neighbors about our work: its benefits, its responsibility, and its methodology. The rational appreciation of coatings technology can only take place when individuals within our community take it upon themselves to educate their fellow citizens about what they do and how they do it.

Our local sections have long been active in this role. I chair the Educational Committee of the Federation. Each year, the Educational Chairpersons of the 26 Constituent Societies get together during the meeting of this committee to share their work. Projects often include participating in local high school job fairs, sponsoring short courses, helping with science fairs, mentoring for local schools, and offering scholarships to colleges and universities. This type of effort is the front line in our struggle against scientific ignorance, both of coatings technology and of science in general. Once people are aware of the effort expended by our industry to be responsible citizens toward our environment and to be efficient, safe suppliers of the beauty and protection provided by coatings, they appreciate our work. I am sure that each of us who has gone into our communities has experienced that "Oh yeah, I see..." comment from someone who has gained an understanding of the essential nature of coatings. Coatings provide beauty and protection which are essential to the long, efficient use of a broad spectrum of products, from automobiles to zithers.

People have become more and more reliant on news provided by the media, which continually shows its bias against science and technology. Reporting often comes from the angle of the sensational rather than that of fact. As technologists, we should have the facts about our industry. We must be willing to present them to as broad an audience as will listen. We must present our industry fairly and openly. As members of a technical society, we must do more:

—Finding the opportunities for one-on-one education;

—Informing fellow citizens in our local communities, getting their support and understanding; and

—Working with youth to foster knowledge and interest in science in general and in coatings in specific.

The future of our industry and our jobs depends on our quality and quantity of our efforts.

But how does the FSCT fit into this picture? We of the ECC have been trying to find out. Nobody belongs to the Federation, you all belong to local coatings Societies. The FSCT is an umbrella organization which supports your local efforts. As we work at the Federation level, we must find ways to make the local educational activities easier and more meaningful. Sharing ideas and successes is important and the interchange made possible by the meetings of the full Educational Committee are very important. However, we feel that the ECC must be proactive. We must help and encourage efforts by the local Societies focusing on education. We are now putting together a set of materials which should help individual members of local Societies to tackle educational opportunities in their community. This "Coatings Science Resource Kit" will contain ideas and support materials for:

—A 30-40 minute discussion of coatings science and its place in science and technology;

—Demonstrations and subject matter to support a lecture in a high school or college chemistry course; and

—A short coatings related teachers unit for high school chemistry.

We are only starting to develop this information and your input would be welcome. Please do not hesitate to call either me (Don Boyd, PPG Industries, Inc., (412) 487-5252) or Mike Bell (FSCT, (610) 940-0777) if you have ideas.

The ECC is helping the Federation to support your local educational efforts in other ways, as well. We have recently initiated a matching funds program. The FSCT provides matching funds, up to $400, to help local Societies in their educational programs. Funds have been given to support scholarship programs, both for university bound students and for members continuing their education, to support educational nights at local Society meetings, and to support science fair participation. Our intent is to help smaller Societies and smaller programs not to be thwarted by lack of funds. We must encourage **broad** participation.

We have also sponsored a project aimed at improving the science and technology presented at our local sections. The FSCT Society Speakers Program is currently getting underway. This program would provide, at the expense of the Federation, an "outstanding" talk from a coatings technology leader. These speakers would be selected by the ECC and the talks would be supported with audio/visuals of the highest quality. The opportunity to hear an FSCT speaker would be made available to all Societies about every other year through the FSCT office. We are currently finalizing plans to start this going in the 1994-95 program year.

Many other exciting activities are afoot within the Federation. Our continuing commitment to higher education is now being administered by the Coatings Industry Education Foundation (CIEF), whose activities are documented in another article in this issue. The FSCT Professional Development Committee has its excellent, ongoing efforts to provide opportunities for our membership to deepen their knowledge of coatings and grow in the technology.

But your work, within your community, is the most important educational opportunity that we have. The Federation is dedicated to supporting local Society efforts in education. These efforts are the most important things we can do, for our industry and for our communities as a whole. Please find a way to participate.

Don Boyd
FSCT Educational Coordinating Committee Chairman

Coatings Industry Education Foundation

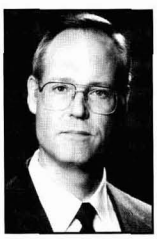
The primary goals of the Coatings Industry Education Foundation (CIEF) are to advance—through education and research—the Chemical, Physical, and Mathematical Sciences relating to the technology of protective coatings, and to aid in the dissemination of the results of such research and education to the public, through scientific publications and lectures. To accomplish this mission, the Trustees of the CIEF review requests for fellowships, scholarships, equipment grants, and research grants from institutions of higher education which are actively engaged in offering—or creating—coatings programs as part of their curriculum. Such requests must be submitted in writing to the CIEF Board of Trustees in the autumn of each year, by a deadline which is announced annually.

These requests must include at least the following information:

- Nature and extent of the college or university's current—or planned—coatings programs;
- Type of students—e.g., undergraduate, graduate, full-time, etc.;
- Number of students in the program;
- Number of students who will be affected by potential CIEF involvement;
- Targeted uses for CIEF support—e.g., undergraduate scholarships, capital and research grants, graduate fellowships, grants-in-aid, direct project support, general program support, student loans, etc.;
- Methods which will be employed for verifying the usefulness and effectiveness of the supported programs;
- Current employers of Coatings Program graduates for the previous three academic years;
- Availability and amount of Coatings Program scholarships available from other sources; and
- Description of the selection criteria for recipients of scholarships and fellowships.

After weighing all of this information—and seeking any additional information which it deems necessary to arrive at a balanced decision—the Board of Trustees announces a decision to fund, partially fund, or decline the various proposals which it has received. These decisions reflect not only the quality of the proposals, but also the anticipated future value of the proposed program, given the funds available.

Requests for academic year 1995-96 must be received by the Trustees no later than September 30, 1994, and should be submitted to the President of the CIEF as follows: George R. Pilcher, Akzo Coatings Inc., P. O. Box 147, Columbus, OH 43216-0147. All properly documented requests will be considered, and a disposition sent to the originator by or before February 15, 1995.



George Pilcher

The future of the coatings industry lies in the education of our youth, both at the undergraduate and graduate levels. It is the CIEF's mission to foster this educational process through the use of scholarships, grants, and fellowships so that the future of the coatings industry may gain ever increasing benefit from the scholars, scientists, and technologists of tomorrow.

George R. Pilcher, President
Coatings Industry Education Foundation

FSCT Professional Development Committee

The Federation's Professional Development Committee is tasked with providing for the professional development of the technical staff of the coatings industry through such continuing education activities as short courses, seminars, speakers bureaus, and financial support of academic speakers for local Society meetings.

To fulfill its duties, the Committee:

(1) Initiated the "Technical Focus Speaker Award" at the Annual Meeting of the Federation, honoring current achievements in research.

Roger Woodhull

(2) Has commissioned a videotape presentation, "Good Tests—Bad Testing," detailing the state of product quality control in the industry, which is available through the Federation.

(3) Sponsors the symposium, "Advanced Topics in Coatings Research," at the Annual Meeting each year. This program features "cutting edge" technical presentations by industry experts.

(4) Sponsors seminars designed to offer advanced professional training in work related areas, such as:

- The Federation's "Quality Management Series"—programs which have offered tools to improve methods and techniques, personal training, and business performance. Titles include:

—"Statistical Process Control, Levels I and II";

—"How to Implement Total Quality Management and Secure ISO 9000 Series Certification";

—"Gauge/Measurement Process Assessment and Improvement";

—"Design of Experiments";

—"The Influence of Substrates and Application Methods/Techniques on Coatings Performance"; and

—"Formulating for the New Clean Air Act."

The Professional Development Committee takes its responsibilities seriously, to the Federation, our industry, and to the dedicated coatings professionals who make up our organization. The mandate to offer educational opportunities and training will continue to furnish its direction, and provide the benchmark on which to measure its performance.

Roger Woodhull
Chairman, Professional Development Committee

Coatings Education

California Polytechnic State University

Undergraduate Polymers and Coatings Program

California Polytechnic State University, San Luis Obispo has just completed the third year of its polymers and coatings program. This program, which is offered as a concentration within the chemistry major by the Chemistry Department, is the first of its kind in the western United States. Cal Poly is one of the 21 campuses of the California State University system, enrolls over 15,000 students, and is nationally recognized for the excellence of its programs in architecture, agriculture, engineering, and the sciences. The school maintains a history of graduating students with special abilities in applied fields. Extensive hands-on experience with modern instrumentation and equipment is a hallmark of the undergraduate education offered at Cal Poly. The polymers and coatings program was developed with the support of the Western Societies for Coatings Technology and particularly the Los Angeles and Golden Gate Societies. These Societies, including the Pacific Northwest Society, provide financial support and equipment necessary for the coatings and polymers laboratory, provide internships and scholarships for students in the concentration, and help with recruitment of disadvantaged students from inner-city areas. The Societies also provide guest speakers and help arrange field trips to appropriate companies several times a year. Special recognition must be given to James Calkin (E.T. Horn), Jeff Mitzner (TransWorld Chemicals), and Joe Reilly (Rohm and Haas Co.) of the Los Angeles Society, Jack Duis (Pacific Coast Chemicals Co.) of the Golden Gate Society, and John Westendorf (Westendorf Chemical Co.) and Steven Rearden (Imperial Paint Co). of the Pacific Northwest Society for their substantial support during the past year. Support is also sought from other industries. The Western Coatings/Cal Poly Foundation was developed to provide a means for individuals or companies to support the program financially. This foundation is a major source of support for the Cal Poly program. The Los Angeles Society and the Foundation annually sponsor a golf tournament held in early spring to benefit the Cal Poly program. The current budget crisis in California has delayed the hiring of new permanent faculty for the program but requests from qualified industry and academic personnel to spend a sabbatical year at Cal Poly are most welcome.

During the past year, the polymers and coatings laboratory has been significantly upgraded through the acquisition of new equipment, including a computer-controlled rotational viscometer system purchased with funds provided by the Coatings Industry Education Foundation (CIEF). The Hewlett-Packard Co. provided a state-of-the-art chromatography system for the lab, including both pyrolysis gas chromatography and gel permeation chromatography systems through its University Equipment Grant Program.

This concentration provides educational and professional experience to chemistry majors who wish to specialize in polymers and coatings sciences, and to materials engineering majors who wish a background in polymers and coatings. The program meets the American Chemical Society requirements for certification as a chemistry/polymers degree. Cal Poly students are receiving scholarships sponsored by the Los Angeles Society for Coatings Technology. Ten students are receiving scholarships supported by the Federation through CIEF.

The concentration includes five courses, including two laboratory courses, and comprises a total of 18 quarter units. An industrial internship, lasting from three to six months, is a central part of the program. Ten students took part in internships this past year. Companies participating in the internship program included Kelly-Moore Paint Co., Smiland Paint Corp., Dunn-Edwards Corp., Benjamin Moore & Co., Spraylat Corp., Ellis Paint Co., Behr Process Corp., Coatings Resource Corp., the Aerospace Corporation, Chemron, and Rohm and Haas Co. Graduates completing the concentration will have the academic knowledge, technical training, and applied experience to enter the polymer and coatings industries. Graduates have been actively recruited by industries in California, and throughout the US.

Industry-Related Research

Students and faculty are involved in a number of research projects in the coatings area, with co-sponsorship of industry. Cal Poly has been actively involved in California's paint recycling efforts through the state Paint Recycling Task Force. Projects sponsored by paint companies, major chemical companies, and the California Air Resources Board are also underway. All students are required to complete a senior research thesis and industries are encouraged to involve Cal Poly in their research projects.

CAL POLY
CALIFORNIA POLYTECHNIC STATE UNIVERSITY

A one-week lecture and laboratory short course in basic polymer and coatings chemistry is planned for June 21-25, 1994. For further information on the polymers and coatings program at Cal Poly, please contact Dr. Dane Jones, Chemistry Department, California Polytechnic State University, San Luis Obispo, CA 93407; (805) 756-2528.

Case Western Reserve University

The Department of Macromolecular Science is a major educational and research strength of Case Western Reserve University (CWRU), Cleveland, OH, with activities in all areas of polymer science and engineering. The activities of the department continue to reflect the exciting national and international developments in the polymer field. Faculty interests span the entire spectrum of polymer research, including synthesis, physical characterization, structure-property relationships, theoretical modeling, polymer processing, and materials development.

The department was founded in 1963 and is now entering its 31st year. It is one of nine departments in the Case School of Engineering. Currently, the department has 14 full time faculty, plus one active emeritus member (Professor Simha). In addition, 10 professors from other departments (Chemistry, Physics, Biomedical Engineering, Chemical Engineering, Pathology, and Orthopaedics) hold associate appointments in Macromolecular Science. There are 10 adjunct faculty from other institutions and from industry.

The graduate student body continues to grow. In September 1993, 115 students were registered for research and course credit leading towards the M.S. or Ph.D. Degree in Macromolecular Science. The M.S. Degree, from this or another institution, is required of all students before acceptance for the Ph.D. Degree program. Most graduate students are supported by research assistantships from research grants to the faculty. During 1992-93, 21 Ph.D. and 12 M.S. Degrees were awarded. In addition, 30 undergraduate students were registered for the B.S. Degree in Engineering (major field: Polymer Science and Engineering), of whom six graduated in 1992-93. The latter program was the first such undergraduate engineering degree in the U.S. to obtain ABET (Accreditation Bureau for Engineering and Technology) accreditation (awarded in 1976). There also are 21 post-doctoral research associates and visiting scholars working in the research laboratories. The departmental staff comprises 12 administrators and secretaries and four technicians.

The most exciting development for the department continues to be the progress towards construction of the new building to house our research and educational activities. Detailed planning for the new Kent Hale Smith Laboratory for Science and Engineering began in 1990 with the selection of Shepley, Bullfinch, Richardson ,and Abbott as architects.

When complete it will have 80,000 gross square feet, providing 48,000 net sq. ft. of laboratories, classrooms, and offices. In addition, there will be 10,000 sq. ft. of unfinished "shell space" in the basement for further expansion. The faculty has worked closely with the architects to optimize the laboratory designs for both present needs and future flexibility. Ground breaking occurred in April 1992, at the site located on the former parking lot off Adelbert Road, facing the Medical School and the new Biomedical Research Building. The department's new building is connected to the A.W. Smith (Chemical Engineering) Building by a third floor bridge. The new building is adjacent to the Rockefeller (Physics) Building and to the Millis (Chemistry and Biology) Building. The new laboratory is thus centrally located to facilitate interactive research. Construction began immediately after ground breaking. A cornerstone ceremony was held on October 10, 1992 with completion of the building projected for May 1994.

Research support for the department exceeded $6 million during 1992-93, from a combination of federal, state, and industrial sources. An important facet of the departmental activities throughout its existence has been the Industrial Sponsors Program, which has provided discretionary funds that make possible the initiation of new projects. The present members of the program are: Dow; DuPont Company; BFGoodrich Company; Hoechst-Celanese; Miles, Inc.; Phillips Petroleum; Shell; 3M Company; and Xerox. The 53rd Industrial Sponsors Symposium was held on March 30-31, 1994, and included presentations by faculty members, students, and post-doctoral research associates, plus student posters.

Six major research centers have their home base within the structure of the Department of Macromolecular Science. In July 1992 the National Science Foundation (NSF) Materials Research Grant (MRG) on Liquid Crystalline Polymers was renewed. This Center was initiated in 1986 under the direction of Professor Koenig. The present renewal grant for $550,000 per year for three years is under the joint direction of Professors Blackwell and Percec to support interactive research projects involving nine faculty from Macromolecular Science, Physics, and Chemistry. Polymer-dispersed liquid crystals are the subject of interest for ALCOM, the NSF Science and Technology Center (STC) for the study of Advanced Liquid Crystalline Optical Materials. ALCOM is a joint research activity of CWRU, the University of Akron (UA) and Kent State University. The Director of its activities at CWRU is Professor Koenig. The NASA Center for the Commercialization of Space, directed by Professor Baer, supports research on polymers, metals and ceramics, in collaboration with faculty in the Department of Materials Science.

Much of the industrial funding comes through the Edison Polymer Innovation Corporation (EPIC), a consortium of CWRU, UA, and over 70 companies, to support polymer research at the two institutions. EPIC industrial sponsorship is supplemented by funds from the State of Ohio's Thomas Edison Program. Founded in 1985, EPIC has provided over $7 million in research support to CWRU. Support is channeled to the department through two research centers: MACRO EPIC, directed by Professor Lando, and the Center for Applied Polymer Research (CAPRI), directed by Professor Hiltner. EPIC also has provided the collaborative mechanism for establishment of the Center for Molecular and Microstructure of Composites (CMMC), directed by Professor Ishida. The CMMC was initiated by a grant from the NSF with state, industry, and university matching funds, providing a total budget of $1 million per year for four years to be divided between the two institutions.

Research on coatings is focused by the EPIC Center for Adhesives, Sealants, and Coatings (ECASC), which evolved from the previous Center for Adhesives, Sealants, and Coatings (CASC) at CWRU and its successor, the InterUniversity Center for Adhesives, Sealants and Coatings (ICASC) involving both CWRU and UA. The continuing development and expansion of this activity to encompass wider faculty and research topic activity is a substantial component of the overall research underway in the two universities. The ECASC Advisory Board is made up of representatives from EPIC member companies with business interests in adhesives, sealants, and coatings. The Co-Directors of ECASC are Professors Alan Gent, of UA, and Charles E. Rogers, of CWRU. Dr. David P. Tate (216-838-5015) is the Executive Manager of ECASC for EPIC.

Current research programs related to coatings, supported by EPIC and other funding sources, include: L shear stability of emulsions studies of finite element analysis modeling, with experimental substantiation, of static and dynamic deformations of multilayer coatings (the derived programs will be provided on user-friendly software); materials modification and spectroscopic studies of surface characterization for improved control of coatings adhesion; high barrier coatings and resins; low-shrinkage (zero and expanding) coatings and adhesives; electron beam curing; diamond-like coatings materials; the mechanism of corrosive attack on

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epoxy-coated mild steel; the surface characterization of electrogalvanized steel for coatings applications (emphasis on blistering); Langmuir-Blodgett films as coatings and membranes; liquid crystalline materials (many related studies of synthesis, characterization, and properties); mixing and flow of multicomponent systems; fatique, crazing and fracture of polymer materials, including environmental attack; surface characteristics of unsaturated polyester gel coats; polymeric emulsions and blends; effects of mechanical deformation on permeability of polymers; effects of mechanical deformation on the photodegradation of automotive coatings polymer materials.

There are many studies of closely related topics concerned with various aspects such as rheology of sterically stabilized dispersions, surface chemistry and physics, fracture mechanics, composition and structure of multicomponent/multiphase systems, sorption, diffusion and permeation of polymer films and coatings, polymer blends and composites, polymer processing and mixing, synthesis and properties of a broad scope of polymeric materials and an extensive range of polymer characterization studies using many established and new techniques including NMR imaging and state-of-the-art surface and microscopy analysis.

The educational program in coatings is based on the graduate level course, "Fundamentals of Adhesives, Sealants, and Coatings" (EMAC 482), with C.E. Rogers and J.C. Weaver as co-instructors, with the added participation of R.M. Evans and S.-Q. Wang. This three credit course is given in the spring semester, usually on the CWRU Instructional Television Network (video tape) which is available to off-campus students and people in industry. Other courses are concerned with surface science and technology and with the wide curriculum topics of the Department of Macromolecular Science leading to the B.S., M.S. and Ph.D Degrees in Polymer Science and Engineering. Special semester courses on "Adhesion and Adhesives and Sealants" and on "Coatings Science and Technology" are to be presented in coming fall semesters. Short courses on topics relevant to adhesives, sealants, and coatings are presented on a regular basis by ECASC.

For more information, contact Professor John Blackwell, Department Chairman, or Professor Rogers, CWRU, Cleveland, OH, 44106-7202; (216) 368-4172/6376; Fax: (216) 368-4202.

DePaul University

DePaul University is the center for graduate education in coatings technology in the Chicago area. The Master of Science program in coatings technology was instituted in the Department of Chemistry in 1986. The Chicago area has a high concentration of coatings companies; Akzo Coatings Co., The Glidden Co., Rust-Oleum Corp., The Sherwin-Williams Co., The Valspar Corp., among others, have manufacturing research and development facilities here. There is a continuing need in the Chicago area for chemists schooled and skilled in coatings technology to serve this industry.

The mission of the university's coatings program, which has been set up with the cooperation of the Chicago Society for Coatings Technology, is to provide students with the skills necessary for work in research and development in the coatings field.

The main objectives of the coatings technology program are twofold: (1) to satisfy the demand for technical professionals in the coatings industry at an advanced level, and (2) to provide an opportunity for Bachelor of Science level coating chemists in the Chicago area to enhance their knowledge and skill for improved levels of performance and advancement in salary and rank.

The program has a focus on graduate level (Master of Science). Mostly part-time students are enrolled (part-time/full-time student ratio is about 10/1). The program requires graduate admission to DePaul University through its College of Liberal Arts and Sciences. An Associate Dean serves as the Coordinator of Graduate Programs. This program in coatings technology is housed and administered in the Chemistry Department by Dr. Gregory Kharas. Candidates should have earned the Bachelor of Science Degree in Chemistry or its equivalent. The 12-course curriculum will require about nine quarters of evening study.

The following full-time faculty are involved in the Coatings Technology Master of Science Program:

Physical Chemistry—Professor Avrom A. Blumberg: B.S. 1949, Rensselaer, Polytechnic Institute; Ph.D., 1953, Yale University.

Organic Chemistry—Professor Fred W. Breitbeil, III: B.S. 1953, M.S., 1957, Xavier University, Cincinnati, Ohio; Ph.D., 1960, University of Cincinnati. Postdoctoral Fellow, 1961-62, Iowa State University.

Inorganic Chemistry—Associate Professor and Chair Sara J. Melford: B.S., 1964, Bowling Green State University; Ph.D., 1968, Northwestern University. NSF Postdoctoral Fellow, 1968, Rice University.

Physical Chemistry—Professor Edwin F. Meyer: B.S., 1959, DePaul University; Ph.D., 1962, Northwestern University. NATO, Postdoctoral Fellow, Queen's University of Belfast, N. Ireland; NAS-NRC Postdoctoral Fellow, U.S. Naval Research Laboratory, Washington, D.C.

Organic Chemistry—Professor of Chemistry Thomas J. Murphy: B.S., 1963, University of Notre Dame; Ph.D., 1967, Iowa State University. N.I.H. Postdoctoral Fellow, 1967-68, Ohio State University.

DePaul University

Inorganic Chemistry—Professor Sanat K. Dhar: B.S. 1947, Calcutta University; M.S., 1959, Ph.D., 1961, Wayne State University. Postdoctoral Fellow, 1961, Northwestern University; Postdoctoral Research Assistant, 1962-64, Argonne National Laboratories.

Organic and Polymer Chemistry—Assistant Professor Gregory B. Kharas: M.S., 1968, Institute of Petrochemical and Gas Industry; Ph.D., 1981, Technion-Israel Institute of Technology; Postdoctoral Fellow, Case Western Reserve University, 1982-1983; Postdoctoral Research Associate, University of Lowell, MA, 1983-1984.

The following equipment is used in instruction related to the coating program: Brookfield viscometers models RVT and LVF; fineness of grind gage; wet film gages; film applicators; sward hardness rock; Zahn viscosity cups; B.K. drying recorder; cone and plate viscometer; HunterLab color and color-difference meter model D25D; FTIR spectrometer 1710 (Perkin Elmer); FTIR spectrometer 1600 (Perkin Elmer); UV-vis spectrometer (Beckman); DSC-TGA (Polymer Laboratories Inc.); HPLC with UV, IR, and conductivity detectors (Spectra Physics); GC-MS system (Hewlett Packard); QTest I computerized mechanical tester (MTS

Systems Corp.); and gel permeation chromatograph (Millipore).

Most of the equipment is housed in two research and teaching laboratories (one is carrying a plaque that reads "POLYMERS AND COATINGS LABORATORY; EQUIPPED, IN PART, WITH A GENEROUS GRANT FROM THE COATINGS INDUSTRY EDUCATION FUND").

Resources of the rest of the College of Arts and Sciences and the University as a whole are available to provide support in areas ranging from computer usage and statistical design to on-line library searches.

Since coatings systems are complex combinations of polymers, pigments, and other chemicals, the course of study involves most branches of chemistry including organic, polymer, physical, inorganic, and analytical chemistry. The program courses include: a minimum of 44 quarter hours, including any five from this set of six (substitutions, with other 300 or 400 level chemistry courses, may be made with permission of the chair):

(Course; Frequency; Number of Students)
—CHE 422, 424 Adv. Inorganic Chemistry I, II; Annual; 15-20
—CHE 450, 452 Adv. Organic Chemistry I, II; Annual; 15-20
—CHE 470, 472 Adv. Physical Chemistry I, II; Annual; 10-15
—CHE 430 Polymer Synthesis; Biannual; 10-15
—CHE 432 Physical Chemistry of Polymers; Biannual; 15-20
—CHE 434 Polymer Characterization; Biannual; 15-20
—CHE 460 Coatings Technology I; Biannual; 10-15
—CHE 461 Coatings Technology Laboratory I; Annual; 5-10
—CHE 462 Coatings Technology II; Biannual; 15-20
—CHE 463 Coatings Technology Laboratory II; Annual; 10-15

About 25 students are participating in the program. All students in the Coatings Technology Program are graduate students, enrolled in the Master of Science Degree Program. Most students in the program are part-time.

During the past academic year the program was funded by DePaul University. CIEF has generously contributed funds for a graduate fellowship and equipment, which were matched by DePaul.

Any fellowship monies received by DePaul University are awarded according to demonstrated financial need and academic merit. The Office of Financial Aid will assist the Chemistry Department in determining need; the Chemistry Department will determine the academic merit of fellowship applicants.

Funding Sources

	Grad Fellowship	Capital Grant	Research Grant
Institution support	$5,060	$10,000	—
Outside support[a]	—	—	$1,250
Current CIEF support	$7,500	$9,380	—
Totals	$12,560	$19,380	$1,250

(a) A grant from the Chicago Society for Coatings Technology.

The CIEF funding in 1992-1993 academic year was used to establish the **CIEF Graduate Fellowship in Coating Science**. Timothy Wheeler has become the first recipient of the fellowship. He is enrolled in the Master in Coatings Technology Graduate Program and, in addition to taking courses, is doing research in the area of synthesis and characterization of new alternating copolymers for potential coating applications. Although Mr. Wheeler just started last spring, he has already been able to prepare several novel alternating copolymers and presently is involved in their characterization. The results of the thermal analysis of the copolymers were presented at the Pittsburgh Analytical Conference (PITCON 94) in Chicago and the fall American Chemical Society Meeting in Washington. All published and presented work included a credit to CIEF.

The Coatings Technology Program at DePaul University has received the endorsement and active support of the Chicago Society for Coatings Technology. The department works closely with the Chicago Society Educational Committee to assure relevancy of the program and provide assistance ranging from technical information to job placement.

DePaul graduates are highly competitive on the open job market, all students having secured positions well in advance of graduation.

For further details, contact Dr. Gregory B. Kharas, Chemistry Dept., DePaul University, 1036 W. Belden Ave., Chicago, IL 60614; (312) 362-8185.

Kent State University

The Coatings Program at Kent State University (KSU) Kent, OH, will remain in the Chemistry Department but starting next year it will become part of the newly formed Separation and Surface Science Center (SSSC).

This Center will be the umbrella for the Ohio Separation Science Consortium, Coatings and Rheology Laboratory (CRL), and the Analytical Instrumentation Facility (AIF).

Ohio Separation Science Consortium

The State of Ohio has formally recognized the importance of separation science and the strong academic/industrial collaborations which already exist at Kent State University in this area. Many unique surface chemistry modifications of chromatographic separation material have been developed at KSU that improve upon the commercial column substrates used for routine analysis. Recently, members of the center were judged first in a statewide consortium competition and received $1.75 million in funding targeted for the acquisition of new state-of-the-art instrumentation related to separation science technology. A unique aspect of this project involves the establishment of a laboratory instrumentation network which will be housed at KSU and made available as a research/development tool to members of the SSSC and industrial partners as well as to other colleges and universities in Ohio. The Separation Science Consortium serves to foster inter-university and academic-industrial research collaborations.

The Coatings and Rheology Laboratory

The CRL was established at KSU in 1965 by Raymond R. Myers and Carl J. Knauss. The laboratory had partial long-term support from the then operating Paint Research Institute of the FSCT. Much of its continuing research relates to the wetting, adhesion, dispersion of pigments, and stabilization of colloidal dispersions in liquid media and their effects on flow properties (rheology) in spreading and leveling of coatings as they are modified by their surface chemistry. The CRL research almost always is involved with surfaces and is presently staffed by Dr. Knauss, Richard R. Ruch, and students.

A major educational program associated with the CRL was begun in 1972 by Dr. Knauss to train undergraduate and graduate students in the field and to provide industrial practitioners with a series of courses and workshops in modern aspects of surface coatings and composites. In addition, the Coatings Laboratory sponsors several adjunct professorships for industrial researchers in the Chemistry Department.

The Educational Component

The educational component consists of a series of credit courses presented on Saturday mornings in the fall for chemistry majors and coatings personnel from companies in northeastern Ohio.

Other short-term courses are presented during the year for industrial coatings personnel from around the country. These courses and offering dates are as follows:

"Weathering Techniques for Coatings and Polymers"—September 28-30, 1994

"Introduction to Coatings Technology"—October 4-7, 1994

"Applied Rheology for Industrial Chemists"—April 24-28, 1995

"Dispersion of Pigments and Resins in Fluid Media"—May 8-12, 1995

"Adhesion Principles and Practice for Coatings and Polymer Scientists"—May 22-26, 1995

The Analytical Instrumentation Facility

The AIF was established by Roger Gilpin in 1986 through an Ohio Board of Regents Research Challenge Award. Dr. Gilpin, Department Chairman, is an internationally known scientist and a recognized expert in several areas of modern analytical chemistry and instrumentation. The facility makes available a broad range of analytical instrumentation for collaborative research and development activities between staff members and industrial partners. Since its inception, numerous companies in Ohio, as well as throughout the nation, have used the facilities, many on a continuing basis. The facility is currently self-supporting and growing at a healthy rate and has been used by many coatings companies for some special analytical evaluations. The industrial contact for this facility and reporting of results has primarily been routed through the CRL.

Graduate and Current Students

During the years that the CRL has been at Kent State a number of full-time students have been partially supported by the PRI, the Educational Committee and the Coatings Industry Education Foundation (CIEF) of the Federation of Societies for Coatings Technology. I would like to reflect on only two recipients at this writing. One, an earlier graduate of KSU, and another presently receiving scholarship support.

A previous graduate of our department was one of the individuals supported by the PRI. It was recently announced that he is to present the Joseph J. Mattiello Memorial Lecture this fall at the FSCT Annual Meeting in New Orleans, LA. The lecturer will be Dr. Richard R. Eley who is presently a senior scientist in the Polymer Physics Group for The Glidden Co. Dr. Eley received his B.S. in Chemistry and his Ph.D. in Physical-Inorganic Chemistry from KSU. His main research work with Glidden is related to rheology; he was introduced to the subject in our laboratory while he was a student in our department.

The previous early scholarship students are aspiring into higher levels of research and development in their industrial organizations and these graduates are progressing at various companies such as Sherwin-Williams, Master Builders, Americhem, Plasti-Kote, Harrison Paint, and numerous other companies throughout the country.

I would like to call your attention to one of our present students who is taking advantage of chemistry's cooperative/work study program as well as an FSCT scholarship. He presently is working as a Co-op student for Americhem while completing his junior year and expects to continue with them upon graduation. This student, Eric Yarabenetz, would not have developed an interest in coatings if it had not been for the scholarship. He was pictured in our report in the February 1993 JOURNAL OF COATINGS TECHNOLOGY and completed preparation of samples for our research paper, "The Use of Thermally Stimulated Current to Measure Properties of Coatings," which was presented at the FSCT's 1993 Annual Meeting in Atlanta, and will be published in the JCT.

Other students are presently at various stages in their schooling and are developing an interest in coatings by electing the coatings courses as required for the Federation scholarships.

Future Plan

The development of the facilities with the new instrumentation and the defining of the methods of operation of the Separation and Surface Science Center is progressing and should be in operation by this fall. The details of how this center enters into our future coatings program are previously described.

The Chemical-Physical Program for graduate-level research has been offered by the chemistry and physics departments for numerous years. The emphasis of the program is being redirected to include the Liquid Crystal Institute whose effort is mainly involved with liquid crystal displays. Chemists there are working to develop liquid crystals that meet electrical and optical properties sought by the physicists.

Applications of the liquid crystal coatings to glass and polymer substrates require the coating scientist's expertise in application methods and surface chemistry for dispersing, wetting, and applying thin layers of conductive liquid crystals on the substrates. The Institute has received a number of patents, some of which have been licensed for industrial production.

For additional information, contact Carl J. Knauss or Richard Ruch, Department of Chemistry, Kent State University, Kent, OH 44242; (216) 672-2327/2034.

University of Missouri-Rolla

The undergraduate B.S. Degree in Chemistry with specialization in polymers and coatings has been accredited by the American Chemical Society as one of only five or so accredited programs in polymer science in the United States. The faculty for the Polymers and Coatings Science Program include:

Dr. Frank Blum, Professor of Chemistry—Polymer-solvent/polymer-surface interactions; polymer characterization; colloid chemistry; microemulsions, liquid crystals, micelles, and viscles; NMR spectroscopy and diffusion.

Dr. Harvest Collier, Associate Professor of Chemistry—Synthesis and characterization of inorganic and heterocycle-containing polymers; investigation of thermal and conductive properties of inorganic and polymer systems; preparation and characterization of metallomacrocycles; kinetics and mechanism of macrocycle reactivity.

Dr. Nicholas Leventis, Assistant Professor of Chemistry—Synthesis and characterization of redox complementary electrocromic polymers; chemical sensor devices based on conducting polymers; microelectrochemical devices.

Dr. James Stoffer, Professor of Chemistry and Director, Graduate Center for Materials Research—Polymers and coatings science; polymerization processes; organic and polymerization mechanisms; the science of paints and coatings; transparent coatings.

Dr. Michael Van De Mark, Associate Professor of Chemistry and Director of

the Coatings Institute—Polymer synthesis and characterization; polymer/solvent interaction; ionomeric gels; modified electrodes via polymer adsorption; corrosion inhibition through ligating polymers; organic oxidative electrochemistry.

Academic Education

The undergraduate program continues to strengthen. We now require our students who major in Coatings and Polymer Science within the Chemistry Department to write a senior thesis. This thesis is to be written in the form of a paper as though it were to be published. This approach is designed to strengthen the student's ability to complete a project, organize information, and technically write in a concise and formal way. We anticipate a significant improvement in our students' written communication skills. Many major corporations have indicated that written communication skills is a major problem nationally. The UMR campus has addressed this problem through comprehensive incorporation of this goal into every curricula.

The graduate program in chemistry continues to grow with the enrollment being over 80, of which approximately half are doing coatings and polymer science research. The second largest group within chemistry are those involved in environmental analysis. The need for organic and inorganic analytically trained environmental chemists is and will be strong well into the next century.

Dr. Nicholas Leventis will be joining the department in January. Dr. Leventis is involved in polymer electrochemistry and in electronics. He will make an excellent addition to our department.

Research

Coatings project titles from UMR include: Water Reducible Acrylic Polymer Dynamics in the Reduced State; Flash Rust Inhibition—A Mechanistic Study; Synthesis and Characterization of New Phthalocyanines (NASA); Thermal Release Coatings Technology (Airforce); Synthesis of Poly(Spiromacrocycles); Waterborne Paint Strippers (Hoechst/Celanese); Recycled Glass for Coatings Application; Optical Brightener-Glass for Coatings Applications; Anticorrosion-Glass for Coatings Application; Inorganic Polymer Encapsulation of Reactive Coatings; Water-Based Camouflage Coatings; Synthesis and Characterization of Semi-Conductive Polymers; Spectroscopic Characterization of Biodegradeable Composites; Development of Metal Ion Binding Epoxy Polymers; Preparation and Evaluation of High Temperature Wire Coatings for Transformers and Motors (OPTEC Corp.); The Use of Ultrasonics for the Dispersion of Pigment for Inks (K. C. Coatings); Development of Viscosity Reduction Agents for Epoxies; Evaluation of Alumina as a Thickener (Vista); Use of Aluminum Trihydroxide as an Extender Pigment (ALCOA); Sol-gel Processes for Use as a Coating; Waterborne Chlorinated Polyolefins as Adhesion Promoters for Plastic (Eastman); Ultrasonically Initiated Free Radical Catalyzed Polymerizations; Microwave Polymerizations; Transparent Composites.

UMR is involved in research projects for numerous corporations both large and small as well as the Air Force, NASA, the Navy, and many other federal agencies. If you have research needs with which we can assist, please feel free to contact us. We are always looking for projects for the students to work on, since research projects are a part of both the undergraduate as well as the graduate program. Please contact us if you are interested in having a project at UMR.

Alliance for Advanced Coatings Research

The Alliance represents a coordinated effort between Missouri Enterprise (a Missouri Economic Development Center) and the University of Missouri-Coatings Institute to work with the coatings industry to produce a "cutting edge" operating model facility for the production of small batch coatings, powder coatings technology development, and modern testing for the evaluation of components and formulated coating materials. This effort involves Harvest Collier as the President and Dennis Roedemeier who is Director of Missouri Enterprise, as well as the faculty and students involved in coatings from UMR.

A major startup focus of the Alliance has been to seek the involvement of coatings industry equipment manufacturers to participate in placing state-of-the-art manufacturing and testing equipment in the facility for operational demonstrations. Initial responses from the industry have resulted in supplying the laboratory with testing equipment and some manufacturing equipment for small batch waterborne coatings production.

The facility is housed in the new Missouri Enterprise Business Development Center located on West 18th Street just across Highway 63 from UMR. The facility has over 6,000 square feet of space with 20-foot ceilings and an enclosed laboratory space at one end. Initial projects with the Alliance have led to the development of recycled glass for use in coatings, the development of coatings additives that are used as quality control measures during application and evaluation, and assisting over a dozen companies as their technical resource in new coatings systems both for national and international markets.

For further information about the Alliance or the Coatings Program at UMR, contact James Stoffer, Professor of Chemistry and Director, Graduate Center for Materials Research, University of Missouri-Rolla, Chemistry Dept., Rolla, MO 65401; (314) 341-4420.

University Extension
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North Dakota State University

For the third consecutive year, North Dakota State University (NDSU) has been placed by *U.S. News* and *World Report* on an elite list of colleges and universities named as the "major leagues of higher education." The academic environment in the Fargo/Moorhead area certainly created incentives for these headlines and here are some facts from 1993: Last fall the university accommodated the largest enrollment ever; A new $10.5 million computer center is fully operational; construction of a $400,000 skywalk, which links Hultz and Ladd Halls across West College Street, is finished; Dunbar and Ladd Halls underwent major renovation projects in which additional coatings research labs were created, with modern laboratory and hood space; and finally the Fargo Dome is now the official home for the Bison football team.

Although there are many organizational changes at NDSU, the Department of Polymers and Coatings (P&C) continues to focus on three major missions: undergraduate and graduate education, polymers and coatings research, and

continuing education by offering short courses. As in the past, the department works closely with the coatings and chemical industries and their suppliers to assure relevance to the programs. An Industrial Advisory Board composed of 27 prominent industrial scientists met with P&C staff and students this fall for three days during NDSU homecoming week to discuss our graduate and undergraduate programs. This year's meeting was indeed well attended and highly constructive. P&C faculty appreciates the board's input. During the Industrial Advisory Board meeting, the P&C graduate students and faculty gave research seminars and 14 poster presentations during an evening poster/dinner session. The poster session allowed one-on-one interactions between the students and industry.

Last year the 3M Company established an Assistant Professorship in the P&C Department. Officials from 3M offered NDSU an up-front grant with the agreement that matching funds be raised from 3M employees, retirees, or directors who are alumni and friends of NDSU. The NDSU/3M Challenge, conducted successfully by our NDSU Foundation Officer, Linda McKenzie, was met. Support from the 3M Employee Challenge Team, which consisted of Gary Asmus, Jerry Bankers, Rick Berglund, Curt Guilbert, Dick Hartshorn, Glen Larson, Dale Peppel, DuWayne Radke, Orin Score, and David Sorensen is greatly appreciated. Of course, this position would not be established without all those who so generously donated contributions to match the NDSU/3M Challenge grant. A plaque listing contributors is now proudly mounted in the Polymers and Coatings Department office. This grant not only helps the P&C Department, but also establishes a role model showing how, in these troubled economic times, private industry and academia can work together.

Among many candidates, the 3M Assistant Professorship position was offered to Dr. Mark D. Soucek, who after receiving his Ph.D. Degree in Chemistry from the University of Texas, Austin, in 1990, spent the past three years as a National Research Council Postdoctoral Fellow at NASA Langley Research Center. His research interests range from high performance polymers in hybrid inorganic/organic composites to the development and synthesis of new catalysts utilized in polymerization or crosslinking reactions.

Undergraduate Education

Undergraduate education has always been one of the top priorities at NDSU. Enrollment in coatings courses remains steady, and one of the major attractions to undergraduates is the scholarship program which exceeds $40,000. Faculty and students are grateful for the scholarship programs, which provide the opportunity for students to become involved in coatings science. Specifically, special thanks go to the following active contributors for the 1992-93 academic year: Albert C. Bean, Coatings Industry Education Foundation, Glidden, Messer Award, George A. Nichols, Northwest Society for Coatings Technology, PPG Industries (Donald P. Hart and Frederick M. Loop Memorials), Alfred Rheineck Memorial, John F. Rooney, Carlton L. Rydstrom Memorial, Ernest T. Trigg Foundation, Valspar, and the Zeno Wicks Fund. This is the third year that Miles Inc. will sponsor an undergraduate summer research program. Inquiries concerning the 1994 summer coatings research program for undergraduates should be directed to Professor G.P. Bierwagen at (701) 237-7633.

Graduate Education

Our graduate student training meets the highest standards. Students take advanced graduate courses from disciplines related to their research areas and conduct research under their professors' supervision. All Ph.D. candidates receive $12,000/year tuition-free teaching or research assistantships. Research support comes from such companies as DuPont, Hitachi Chemical, Hüls-Nuodex, FMC, James River, 3M, Medtronic, Valspar, as well as the U.S. Department of Agriculture and the Office of Naval Research. A first-year graduate fellowship program was established in the Polymers and Coatings Department by the Coatings Industry Fund. Although taking advanced courses is a part of graduate education, the primary objective of the M.S. and Ph.D. Degrees is to utilize classroom and lab experience in polymers and coatings research. This is where our students excel. Inquiries or questions regarding our graduate program can be directed to Professor Marek W. Urban, Director of the Polymers and Coatings Graduate Program at (701) 237-7633).

Continuing Education

Intensive coatings science short courses offered to coatings industry by the P&C Department faculty have a long-standing tradition at NDSU and have served the coatings industry for over a decade. The 1994 Coatings Science Course will be offered June 5-17. Questions about course content can be directed to Professor Marek Urban, Course Director, and registration inquiries regarding the 1994 Polymers and Coatings short course can be answered by calling Debbie Shasky, Course Coordinator at (701) 237-7633 or FAX (701) 237-8439.

Polymers and Coatings Department Faculty

Professor Gordon Bierwagen, besides his duties as Regional Editor for North America for the *Progress in Organic Coatings Journal*, continues to focus his research interest on computer modeling of high PVC coatings, pigment dispersion and adsorption, CPVC studies, EXPERT systems for coatings, characterization of corrosion in coated systems, and surface properties of waterborne polymers. This research, in particular the corrosion program, will have a significant impact on further understanding physical coatings properties. Last fall, Professor Bierwagen presented papers on corrosion at the 12th International Corrosion Congress (September 1993), and at the Electrochemical Society Meeting (October 1993), and lectured at the Third Annual ASM/ESD Advanced Coatings Technology Conference in Detroit (November 1993).

Professor Ed Glass continues research on water-soluble polymers, with perhaps one of the most successful symposia in the history of the American Chemical Society National Meetings on this topic. Last year, he organized the Water-Soluble Symposium during the fall ACS National Meeting in Chicago. Dr. Glass has edited four books in this area, and is presently editing a fifth book from the August 1993 symposium. He is also involved in organizing workshops in this area and continues to lecture at MIT summer short courses on coatings rheology. As a follow-up to the Waterborne Coatings Workshops in San Francisco in 1992 and Chicago in 1993, a Low VOC Workshop was organized for March 1994 in San Diego. His research group continues to publish and present research papers at national and international scientific meetings. A particularly active research program involves the studies of associative thickeners with pigments, but much of his activity during the past year has focused on the use of water-soluble polymers in cosmetic and medical applications.

Professor Mark Soucek, after completing his post-doctoral appointment last summer at NASA, joined the P&C Department as an Assistant Professor and, after a short orientation period, is involved in teaching undergraduate coatings courses offered by the department, and organizing his research group. Dr. Soucek gave a lecture at The 3M Company in St. Paul, MN, and is actively involved in getting his research off to a strong start.

Professor Marek Urban continues his previous research themes with the primary focus on molecular level adhesion to plastics monitored spectroscopically, stratification processes in coatings, dynamics and mobility of small

molecules in polymeric coatings, and nonequilibrium crosslinking reactions in coatings monitored by photoacoustic FTIR spectroscopy. He was an invited speaker at the 19th Coatings Research Conference in Athens, Greece, and also gave invited lectures in Europe, and the Symposium on Adhesion held during the fall American Chemical Society National Meeting in Chicago. Last year his Advances in Chemistry Series #236 book entitled, *Structure-Property Relations in Polymers: Spectroscopy and Performance*, was published by ACS, and this year the book, *Vibrational Spectroscopy of Surfaces and Interfaces*, was published by Wiley-Interscience. Dr. Urban was nominated by the ACS to function as Editor of the American Chemical Society Book Series titled *Polymer Surfaces and Interfaces*.

In addition to Dr. Loren Hill (Monsanto senior fellow), who is a P&C Adjunct Professor, the department is pleased to announce two new Adjunct Professors—Dr. Brian Skerry (Sherwin-Williams) and Dr. Juergen Braun (retired, DuPont). Both of them actively participate in departmental research and teaching activities.

Dr. Allan Fischer, Dean of College and Science and Mathematics, currently is serving as interim chair of the Polymers and Coatings Department.

For more details, contact Dr. Marek W. Urban, Associate Professor, Dept. of Polymers and Coatings, North Dakota State University, Fargo, ND 58105; (701) 237-7859; Fax: (701) 237-8439.

University of Southern Mississippi

The coatings program at the University of Southern Mississippi (USM) is located in the Department of Polymer Science. USM was designated a comprehensive university in 1962, and is accredited by the Southern Association of Colleges and Schools. The student population now numbers 13,000, and the university offers 89 Bachelor's, 60 Master's, and 19 Doctoral Degrees.

The Department of Polymer Science, founded in 1972, encompasses focused program in undergraduate and graduate instruction and in research. Originally founded as the Pan American Tung Research Institute in 1964, the department now comprises 10 faculty members, 141 undergraduate students, and 65 graduate students, located in a state-of-the-art, $28 million Polymer Science Research Center. The students usually pursue careers in industry upon completing their formal education. Our graduate students represent a national texture from all corners of this nation. A significant proportion of our graduates seek careers in the coatings industry.

The coatings course (theory and lab) is an important part of the undergraduate curriculum. Undergraduates are required to complete a research program prior to graduation, and, in addition, most of the undergraduates are involved in extracurricular research projects, under the supervision of faculty members. The faculty of the Polymer Science Research Center is drawn from various disciplines including chemistry, physics, and chemical engineering. The multidisciplinary nature of the program is exemplified by strong collaboration between faculty members in the investigation of joint areas of research, with the aim of gaining an understanding of the fundamental principles which underlie polymeric materials.

Within this multidisciplinary atmosphere, graduate students participate in challenging course work that broadens their undergraduate background, and directs them to creative, dynamic problem-solving approaches to advanced polymer science.

Weekly seminars and colloquia are an important part of teaching and research in the Polymer Science Center. The emphasis on presenting research papers nationally is demonstrated by the fact that in 1993, our students won the Federation's Alfred L. Hendry Award for the best student paper, AAIC Student of the Year Award, Second Prize for the Poster Session at the FSCT's Annual Meeting and Paint Industries' Show, and a best student paper award at the Mississippi Academy of Sciences.

Throughout the year, Short Courses in Coatings Technology and Formulation are offered to participants from industry.

The Waterborne, Higher-Solids and Powder-Coatings Symposium, held in New Orleans, LA, during February each year, is organized jointly by the Department of Polymer Science and the Southern Society for Coatings Technology. This symposium is now truly international in scope and it is recognized as a premier conference on environmentally-compliant coatings. For many years, the department has been strongly supported with scholarship assistance from the Federation of Societies for Coatings Technology, and both the Dallas and Southern Societies.

The department is well equipped to conduct research, with a powder-coatings and compounding laboratory, spray booth, and equipment to test weathering and photo-aging of coatings samples. Computer-controlled latex polymerization and high-pressure polymerization equipment is directed towards research in new polymeric materials for coatings. A large effort is devoted to finding new materials, from renewable resources, such as guayule rubber, lesqueralla oil, and vernonia oil.

Students have opportunities to work with a wide-range of sophisticated instrumentation such as 400 MHz solid state NMR, environmental scanning electron microscope, single-crystal and powder X-ray diffractometers, FTIR/Raman spectrophotometer, GC-mass spectrometry, but they are also taught by faculty to know the value of everyday equipment such as testing hardness, viscosity, etc.

For more information, contact The University of Southern Mississippi, Polymer Science Department, P.O. Box 10076, Hattiesburg, MS 39406-0076; (601) 266-4868.

University of Waterloo

Coatings research at the University of Waterloo, Waterloo, Ontario, Canada, is in the Institute for Polymer Research, which spans the departments of Chemistry, Chemical Engineering and Mechanical Engineering. The University of Waterloo was established in 1957 and currently enrolls some 25,000 students. Waterloo produces more chemistry, physics, engineering, mathematics, and computer science majors than any other university in Canada. It is nationally recognized as a leader in research and education.

The Institute of Polymer Research (IPR) was established in 1984 to provide research services to polymer-related industries and comprehensive graduate instruction in polymer science and engineering. Originally founded as the University of Waterloo Copolymer Group in 1979, IPR combines the polymer research capabilities of 12 faculty members and about 50 graduate students. Nearly all the students move to industrial positions when they graduate. The Institute is made up of faculty members and representatives of major North American chemical companies. It has become one of the leading centers of polymer expertise devoted to creating an imaginative, results-oriented program of graduate studies and research in experimental polymer science and engineering.

Students undertaking graduate study and research under the supervision of IPR members have a choice of several programs: Masters and Doctoral Degrees in Chemical Engineering, Chemistry, Physics, and Mechanical Engineering. The Institute awards industry-sponsored scholarships in Polymer Science and Engineering, including scholarships from the Coatings Industry Education Foundation (CIEF).

An attractive option for many graduate students is the cooperative M.Sc. or Cooperative Ph.D. program. In the Co-op M.Sc. program, an initial semester of course work is followed by two semesters of research off campus in an industrial or government laboratory. Following this first-hand exposure to an industrial research program, the student returns to campus to complete an original research project. In the Co-op Ph. D. program, students have an opportunity to undertake a more detailed applied research project before completing their thesis requirements on campus.

Major funding support in recent years has helped provide state-of-the-art research equipment and facilities, including: polymerization pilot plant, with vessels up to 25-liter capacity; high pressure polymerization vessels; twin screw extruder; size exclusion chromatography apparatus with continuous viscometer and laser light scattering detectors; dynamic mechanical spectrometer for rheological and cure characterizations; impedance spectroscopy (10^{-4} Hz to 1 GHz); 300 MHz high resolution NMR spectrometer; disc centrifuge and Coulter counter for latex particle size characterization; on-line density/flow/viscosity sensors; instrumented impact testers; thermal characterization equipment; glossmeters; Fourier Transform Infrared spectrometers; and scanning and transmission electron microscopes.

Graduate students are encouraged towards coatings-related research by CIEF scholarships which are awarded on the basis of scholastic records, research ability, and relevance of thesis research to coatings industry interests. The following briefly describes activities of current CIEF scholarship holders.

Gerardo del Rio is a Ph.D. student in Chemical Engineering, working under the supervision of Professor Alfred Rudin. He has been able to quantify the effect of latex particle size on critical pigment volume concentration for water-based coatings using an optical technique. His current research is a study of the effect of latex particle size and thickeners on the rheology and coalescence of film forming systems based in vinyl/acrylic latex. Mr. del Rio is also studying the synthesis of core-shell latex where the core is hydrophilic and the shell is hydrophobic.

Marc Dubé will be completing his Ph.D. in Chemical Engineering in December 1994. He is being supervised by Professor Alex Penlidis. His research concerns a systematic approach to the study of multicomponent polymerization kinetics through carefully designed experiments and mechanistic modeling. The system of interest is the butyl acrylate/methyl methacrylate/vinyl acetate (BA/MMA/VAc) terpolymer. Mr. Dubé's research has covered the bulk, solution and emulsion, homo-, co-, and terpolymerizations of the BA/MMA/VAc system. The systematic approach used in his studies have led to many interesting findings. First, improved reactivity ratios were estimated for the three copolymer systems and were verified over the full conversion range. These improved reactivity ratio estimates were used to successfully predict terpolymer composition. Next, an interesting phenomenon that we refer to as the "double gel effect" was observed, explained, and confirmed for the vinyl acetate-containing copolymers and terpolymers.

Kevin Suddaby is a Ph.D. student in Chemical Engineering, working under the joint supervision of Professor Alfred Rudin and Professor Kenneth O'Driscoll. He has developed methods for characterizing the molecular weight distributions of complex polymer systems, such as the polymer blends and nonhomogeneous polymers found in many coatings systems. He is currently studying methacrylate macromers (low molecular weight polymers possessing a terminal vinyl group) made using catalytic chain transfer. The terminal vinyl group of these macromers enables further polymerization. This makes them useful in high-solids coating formulations, where they can be polymerized after application to a substrate, and in designing compatibilizers for polymer mixtures, since copolymerization results in graft copolymers.

The research programs at the Institute of Polymer Research are reviewed with the members of the Industrial Advisory Board. The industrial membership of the IPR includes 17 companies based in the U.S., Canada, and The Netherlands. Several of these are major components of the coatings industry.

While the IPR serves as an umbrella organization of the polymer researchers at Waterloo, it does not fund research itself. Individual faculty members fund their own research through granting agencies and industrial contracts. Any proprietary research is more readily kept confidential with this agreement. The IPR group includes the following faculty members: Charles M. Burns, with research interests in adhesion, adhesives, and surface property of polymers and compatibilization of polymers; Scott Collins, with research interests in soluble and supported organometallic polymerization catalysts; Thomas Duever, who works in applied statistics, experimental design, and optimization of polymer production processes; Mario Gauthier, with research interests in synthesis and characterization of very highly branched polymers and polymer-supported reagents; Ken O'Driscoll, whose research is in vinyl polymerization kinetics, polymerization reaction modeling, high-solids systems, and use of macromers as comonomers; Alexander Penlidis, who supervises the polymerization pilot plant and has research ongoing in multicomponent polymerization kinetics, mathematical modeling and simulation of polymerization processes, emulsion copolymerization, polymer reactor design and

computer control, and sensors for polymerization reactions; Alan Plumtree, whose work is in mechanical behavior and fracture of polymers and applications of fracture mechanics in characterizing polymeric materials; Garry Rempel, with research interests in polyolefin reaction kinetics, chemical modification of polymers, and kinetics and mechanisms of catalytic polymerization processes; Alfred Rudin, whose research is in polymer characterization, polymer blends, emulsion polymerization, toughening of polymers, and latex-based coatings; Jim Stevens, with research in molecular relaxations in polymer melts and glasses and in ion-conducting polymers; Morris Tchir, who carries out research in the use of NMR spectroscopy for the characterization of polymer structure and properties; and Costas Tzoganakis, with research interests in reactive processing of polymers, polymer rheology, and mathematical modeling and computer simulation of polymer processing.

The following is a brief list of coatings-related graduate research that is currently underway. The faculty supervisor's department and name are listed in parentheses.

(1) Effects of latex polymer particle size on the properties of vinyl-acrylic coatings polymers (Alfred Rudin, Chemistry; Alexander Penlidis, Chemical Engineering).

(2) Production of core-shell emulsion polymers and their use in coatings (Alfred Rudin, Chemistry).

(3) Mechanism of coalescence of film forming latex polymers (Alfred Rudin, Chemistry).

(4) Effects of operating variables on multicomponent emulsion polymerization (Alexander Penlidis, Chemical Engineering).

The undergraduate programs in both Chemistry and Chemical Engineering at Waterloo include polymer options. All of the engineering students and most of the chemistry students are enrolled in the Co-op program and will have relevant industrial experience by the time they graduate. An offer has been made to the Canadian protective coatings industry to mount a coatings specialty as part of the undergraduate chemistry program.

For further information, contact the IPR Director, Professor Rudin, or the Associate Director, Professor Penlidis, at the Institute for Polymer Research, University of Waterloo, Waterloo, Ontario, Canada N2L 3G1; (519) 888-4607; Fax (519) 888-6179.

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6/93

1994 Educational Committee Guide to Coatings Courses, Symposia, and Seminars

This compilation of courses, symposia, and seminars on coatings-related topics is based on information obtained from Constituent Societies of the Federation, educators, and various industry sources.

ALASKA

NATIONAL ASSOCIATION OF CORROSION ENGINEERS

Cathodic Protection—An Introduction—November 6-11, 1994, Anchorage, AK

This week-long course presents the basic principles and applications of galvanic and impressed current cathodic protection systems. Cost: $625 member; $725 nonmember.

Session I—Basic Coating Inspection—November 6-12, 1994, Anchorage

An intensive presentation of the basic technology of coating application and inspection. This session involves lectures, demonstrations, and hands-on training with equipment and instruments in an actual working shop. Upon successful completion of Session I, the participant will have attained industry-accepted NACE Basic Coating Inspector Training recognition. Cost: $1675 member; $1775 nonmember.

Session II—Intermediate Coating Inspection—November 6-11, 1994, Anchorage

Focuses on shop coating processes for steel, advanced inspection techniques, and introduces more sophisticated nondestructive tests and test instruments. Cost: $850 member; $950 nonmember.

Corrosion Control in Oil and Gas Production—November 6-11, 1994, Anchorage

Gives an overview of corrosion control in the oil and gas industry, and establishes an appreciation of the advantages to an integrated approach. Cost: $625 member; $725 nonmember.

Contact: NACE International, Membership Services Department, 1440 South Creek Dr., Houston, TX 77082; (713) 492-0535, Ext. 80.

ARIZONA

HERAEUS DSET LABORATORIES

Weathering Technology I—Held annually in April

This intensive, three-day seminar, covers climate and environmental issues, outdoor conventional and accelerated test methods, artificial accelerated testing, significance of spectra, diagnostic measurement techniques, and sample preparation and mounting. Course instructors present weathering applications for a wide-range of materials, including plastics, textiles, paints and coatings, pharmaceuticals, and chemicals. A comprehensive manual is provided, in addition to classroom sessions and hands-on laboratory sessions. Provide practical experience in sample handling and analysis. Registration fee is $695.

Contact: Barbara Pringle, Heraeus DSET Laboratories, Inc., 45601 N. 47th Ave., Phoenix, AZ 85027-7042; (602) 465-7356.

CALIFORNIA

GOLDEN GATE, LOS ANGELES, PACIFIC NORTHWEST, AND ROCKY MOUNTAIN SOCIETIES FOR COATINGS TECHNOLOGY

Western Coatings Societies' 22nd Biennial Symposium and Show—February 20-22, Hilton Hotel and Towers, San Francisco, CA

Contact: Gordon Pioch, WCSSS Chairman, Eureka Chemical Co., P.O. Box 2205, S. San Francisco, CA 94083.

CALIFORNIA POLYTECHNIC STATE UNIVERSITY
CHEMISTRY DEPARTMENT, SAN LUIS OBISPO, CA

Concentration in Polymer and Coatings Chemistry: Chem 444 Polymers and Coatings I; Chem 445 Polymers and Coatings II; Chem 446 Surface Chemistry of Materials; Chem 447 Polymers and Coatings Lab I; Chem 448 Polymers and Coatings Lab II; Chem 449 Internship in Polymers and Coatings; Mate 206 Materials Engineering

Duration is one year for full program. Individual courses offered fall, winter, and spring quarters.

The purpose of the program is to provide Chemistry and Materials Engineering majors with the skills and background necessary to enter the polymers and coatings industry with a proper background, and to prepare students for graduate study in polymers, coatings, or related fields. The program meets the American Chemical Society requirements for certification as a chemistry/polymers degree. Students must be admitted to undergraduate or graduate degree program at Cal Poly. Current tuition is approximately $620 per quarter.

Contact: Dr. Dane Jones, Chemistry Department, California Polytechnic State University, San Luis Obispo, CA 93407; (805) 756-2528; Fax: (805) 756-1670.

Introductory Short Course in Basic Polymer and Coatings Chemistry—June 21-25, 1994

The purpose of this one-week course is to provide a basic working knowledge of polymer chemistry including methods of preparation, testing, and fabrication of polymeric materials. Specific examples related to modern coatings will be emphasized. Participants will formulate a modern paint using the polymers they synthesized, and will be instructed in the use of modern physical and chemical methods to test coatings. The course is

designed for persons with some chemistry background or persons with some work experience in the coatings industry. Fee: $500 includes all materials for the course, including meals and dormitory lodging on campus. Enrollment is limited.

Contact: Dr. James Westover, Chemistry Department, California Polytechnic State University, San Luis Obispo, CA 93407; (805) 756-2566; Fax: (805) 756-1670.

University of California Berkeley Extension Continuing Education in Engineering, San Francisco, CA

Air Pollution Abatement Technologies: A Comprehensive Seminar on Selecting Control Equipment—July 20-22, 1994, San Francisco, CA

This 2-1/2 day seminar is designed to provide engineers and technical staff with sufficient tools to enable them to confidently undertake abatement control projects for their companies, thereby assuring air quality compliance. Cost: $795.

Compliance with Air Quality Regulations for Paints, Coatings, and Printing Facilities with Special Sessions on Title V Permitting and Title III Air Toxics—July 12-15, 1994, San Francisco

The purpose of this 3-1/2 day course is to present information about the most important consequences of these rules and to provide participants with the tools required to bring coating and printing facilities into compliance. Moreover, participants will be shown how to perform the most important calculations used for permitting and for completing state and EPA forms. Cost: $895.

Contact: Kathy M. Snyder or Richard V. Tsina, Continuing Education in Engineering, UC Berkeley Extension, 2223 Fulton St., Berkeley, CA 94720; (510) 642-4151; Fax: (510) 643-8683.

Chemical Coaters Association International

Compliance Coatings Technical Training Program—June 14-16, 1994, Southern California Edison Center, Irwindale, CA

Update of compliance coatings technology, powder, waterborne and high-solids materials. Provides information on the newest techniques for efficient operation of paint finishing systems; water conservation, energy efficiency, waste minimization. Materials, equipment, processes. Cost: Two days—$295 CCAI member; $325 nonmember; Three days—$320 CCAI member; $345 nonmember.

Contact: Rodger Talbert, Technical Director, CCAI, 2088 Knapp St., N.E., Grand Rapids, MI 49505; (616) 365-7602; Fax: (616) 365-7602

Los Angeles Society for Coatings Technology and Southern California Paint and Coatings Association

Basic Paint Chemistry—September 1994-June 1995, Los Angeles, CA

To provide a general understanding and familiarization of basic paint technology.

Contact: Frank Peters, c/o Los Angelos Society for Coatings Technology, 11278 Los Alamitos Blvd., #104, Los Alamitos, CA 90720; (310) 594-5739; Fax: (310) 594-6862.

National Association of Corrosion Engineers

Lead Abatement Seminar—May 14-17, 1995, San Diego, CA

A complete overview of new regulations and how to comply with federal and state laws; testing and inspection techniques and evaluation; personnel hazards and protective measures; methods of abatement and containment; and procedures testing, disposing of lead-based paint waste. Cost to be determined.

Session I—Basic Coating Inspection—May 7-13, 1995, San Diego

An intensive presentation of the basic technology of coating application and inspection. This session involves lectures, demonstrations, and hands-on training with equipment and instruments in an actual working shop. Upon successful completion of Session I, the participant will have attained industry-accepted NACE Basic Coating Inspector Training recognition. Cost: $1675 member; $1775 nonmember.

Session II—Intermediate Coating Inspection—May 7-12, 1995, San Diego

Focuses on shop coating processes for steel, advanced inspection techniques, and introduces more sophisticated nondestructive tests and test instruments. Cost: $850 member; $950 nonmember.

Session III—Advanced Coating Inspection—May-11, 1995, San Diego

Covers specialized application methods and substrates other than steel. Persons who successfully complete Sessions I, II, and III will attain NACE Intermediate Coating Inspector Training recognition. Cost: $850 member; $950 nonmember.

Contact: NACE International, Membership Services Department, 1440 South Creek Dr., Houston, TX 77082; (713) 492-0535, Ext. 80.

COLORADO

The American Vacuum Society

41st National Symposium of the American Vacuum Society—October 24-28, 1994, Colorado Convention Center, Denver, CO

This one-week symposium will feature programs from the society's eight technical divisions with the following sessions offered relating to coatings: adhesion and polymer/(metal, oxide) interfaces; polymer/organic surfaces and interfaces, including self-assembled monolayers and langmuir-blodgett films; characterization and properties of interfaces; thin films for energy conversion and efficiency/active films; optical, ferroelectric, magnetic, piezoelectric and magneto-optical films; thin film in-situ and post-deposition characterization; thin films for sensors; deposition and characterization techniques on nanostructures in thin films; surface engineering for wear and corrosion protection; environmentally compatible coating technology; manufacturing technology and equipment for coatings; energetic condensation: process, properties, and products; diamond, cubic boron nitride and other ultrahard films.

Contact: Angela Mulligan, American Vacuum Society, 120 Wall St., 32nd Floor, New York, NY 10005; (212) 248-0200; Fax: (212) 983-6745.

National Association of Corrosion Engineers

Basic Corrosion—December 4-9, 1994, Denver, CO

An introductory program designed to provide a basic but thorough survey of the theoretical and practical aspects of corrosion and corrosion control. Cost: $625 member; $725 nonmember.

Cathodic Protection-Theory and Data Interpretation—December 4-9, 1994, Denver

An advanced course providing an in-depth explanation of the operating characteristics of galvanic and impressed current cathodic protection systems. Cost: $625 member; $725 nonmember.

Cathodic Protection Design—December 4-9, 1994, Denver

This course covers the basic methodology and principles involved in the design of effective cathodic protection systems. It also reviews cathodic protection applications and provides practical design examples and sample calculations. Cost: $625 member; $725 nonmember.

Corrosion Control in Oil and Gas Production—December 4-9, 1994, Denver

Gives an overview of corrosion control in the oil and gas industry, and establishes an appreciation of the advantages to an integrated approach. Cost: $625 member; $725 nonmember.

Microbiological Influenced Corrosion—December 4-9, 1994, Denver

This course will provide the student with a practical understanding of what microbiologically influenced is and how it causes and influences corrosion. Methods of identification and detection of MIC, options in treatment of existing MIC in pipeline, offshore rigs, manufacturing facilities, water treatment plants, and various industrial process systems will be reviewed. Techniques for the prevention of MIC in various locations and situation, will be presented. Cost: $625 member; $725 nonmember.

Contact: NACE International, Membership Services Department, 1440 South Creek Dr., Houston, TX 77082; (713) 492-0535, Ext. 80.

FLORIDA

NATIONAL ASSOCIATION OF CORROSION ENGINEERS

Lead Abatement Seminar—May 21-24, 1995, Orlando, FL

A complete overview of new regulations and how to comply with federal and state laws; testing and inspection techniques and evaluation; personnel hazards and protective measures; methods of abatement and containment; and procedures testing, disposing of lead-based paint waste. Cost to be determined.

Basic Corrosion—May 14-19, 1995, Orlando

An introductory program designed to provide a basic but thorough survey of the theoretical and practical aspects of corrosion and corrosion control. Cost: $625 member; $725 nonmember.

Cathodic Protection—An Introduction—May 14-19, 1995, Orlando

This week long course presents the basic principles and applications of galvanic and impressed current cathodic protection systems. Cost: $625 member; $725 nonmember.

Cathodic Protection-Theory and Data Interpretation—May 14-19, 1995, Orlando

An advanced course providing an in-depth explanation of the operating characteristics of galvanic and impressed current cathodic protection systems. Cost: $625 member; $725 nonmember.

Cathodic Protection Design—May 14-19, 1995, Orlando

This course covers the basic methodology and principles involved in the design of effective cathodic protection systems. It also reviews cathodic protection applications and provides practical design examples and sample calculations. Cost: $625 member; $725 nonmember.

Corrosion Control in Oil and Gas Production—May 14-19, 1995, Orlando

Gives an overview of corrosion control in the oil and gas industry, and establishes an appreciation of the advantages to an integrated approach. Cost: $625 member; $725 nonmember.

Designing for Corrosion Control—May 14-19, 1995, Orlando

Reviews the principles of corrosion and corrosion control, and provides a systematic method for applying corrosion prevention to the design process. Covers economic considerations, allowing the student to effectively communicate with both the technologically and financially oriented management groups. Cost: $625 member; $725 nonmember.

Session I—Basic Coating Inspection—May 14-20, 1995, Orlando

An intensive presentation of the basic technology of coating application and inspection. This session involves lectures, demonstrations, and hands-on training with equipment and instruments in an actual working shop. Upon successful completion of Session I, the participant will have attained industry-accepted NACE Basic Coating Inspector Training recognition. Cost: $1675 member; $1775 nonmember.

Session II—Intermediate Coating Inspection—May 14-19, 1995, Orlando

Focuses on shop coating processes for steel, advanced inspection techniques, and introduces more sophisticated nondestructive tests and test instruments. Cost: $850 member; $950 nonmember.

Session III—Advanced Coating Inspection—May 14-18, 1995, Orlando

Covers specialized application methods and substrates other than steel. Persons who successfully complete Sessions I, II, and III will attain NACE Intermediate Coating Inspector Training recognition. Cost: $850 member; $950 nonmember.

Contact: NACE International, Membership Services Department, 1440 South Creek Dr., Houston, TX 77082; (713) 492-0535, Ext. 80.

GEORGIA

NATIONAL ASSOCIATION OF CORROSION ENGINEERS

Basic Corrosion—September 11-16, 1994, Atlanta, GA

An introductory program designed to provide a basic but thorough survey of the theoretical and practical aspects of corrosion and corrosion control. Cost: $625 member; $725 nonmember.

Cathodic Protection-Theory and Data Interpretation—September 11-16, 1994, Atlanta

An advanced course providing an in-depth explanation of the operating characteristics of galvanic and impressed current cathodic protection systems. Cost: $625 member; $725 nonmember.

Cathodic Protection Design—September 11-16, 1994, Atlanta

This course covers the basic methodology and principles involved in the design of effective cathodic protection systems. It also reviews cathodic protection applications and provides practical design examples and sample calculations. Cost: $625 member; $725 nonmember.

Protective Coatings and Linings—September 11-16, 1994, Atlanta

Offers both theoretical and practical information on the use of coatings and linings for corrosion control, and discusses the economic benefits derived from proper selection and application. Cost: $625 member; $725 nonmember.

Lead Abatement Seminar—September 18-21, 1994, Atlanta

A complete overview of new regulations and how to comply with federal and state laws; testing and inspection techniques and evaluation; personnel hazards and protective measures; methods of abatement and containment; and procedures testing, disposing of lead-based paint waste. Cost to be determined.

Session I—Basic Coating Inspection—September 11-17, 1994, Atlanta

An intensive presentation of the basic technology of coating application and inspection. This session involves lectures, demonstrations, and hands-on training with equipment and instruments in an actual working shop. Upon successful completion of Session I, the participant will have attained industry-accepted NACE Basic Coating Inspector Training recognition. Cost: $1675 member; $1775 nonmember.

Session II—Intermediate Coating Inspection—September 11-16, 1994, Atlanta

Focuses on shop coating processes for steel, advanced inspection techniques, and introduces more sophisticated nondestruc-

tive tests and test instruments. Cost: $850 member; $950 nonmember.

Session III—Advanced Coating Inspection—September 11-15, 1994, Atlanta

Covers specialized application methods and substrates other than steel. Persons who successfully complete Sessions I, II, and III will attain NACE Intermediate Coating Inspector Training recognition. Cost: $850 member; $950 nonmember.

Contact: NACE International, Membership Services Department, 1440 South Creek Dr., Houston, TX 77082; (713) 492-0535, Ext. 80.

National Paint and Coatings Association

Production Planning and Inventory Management Seminar—March 17-18, 1994, Atlanta Airport Hilton and Towers Hotel, Atlanta

Learn an integrated approach for planning and controlling manufacturing operations. Paint manufacturers can achieve a balance of customer service, productivity and inventory investment that is optimal for their companies. Seminar restricted to NPCA members only.

Contact: Juliette D. Benedicto, NPCA, 1500 Rhode Island Ave., N.W., Washington, DC 20005; (202) 462-6272; Fax: (202) 462-8549.

HunterLab

Color and Appearance Seminar—January 25, 1995, Atlanta

A one-day introduction to basic color theory plus color and appearance measurement techniques. Topics include: visual color order systems, color scales, appearance attributes, instrumentation, measurement techniques. Tuition: $195, includes continental breakfast and lunch.

Contact: Seminar Coordinator, HunterLab, 11491 Sunset Hills Rd., Reston, VA 22090; (703) 471-6870; Fax: (703) 471-4237.

ILLINOIS

DePaul University

Masters Degree in Coatings Technology—Chemistry Department, DePaul University, Chicago, IL

To satisfy the demand for technical professionals in the coatings industry at an advanced level and to provide an opportunity for Bachelor of Science level coating chemists in the Chicago area to enhance their knowledge and skill for improved levels of performance. The 12-course curriculum will require nine quarters of study. Cost: $230 graduate tuition per credit hour.

Contact: Dr. Gregory B. Kharas, Chemistry Department, DePaul University, 1036 W. Belden Ave., Chicago, IL 60614; (312) 362-8185 or Sec. (312) 362-8180; Fax: (312) 362-6636.

HunterLab

Color and Appearance Seminar—May 3, 1995, Chicago

A one-day introduction to basic color theory plus color and appearance measurement techniques. Topics include: visual color order systems, color scales, appearance attributes, instrumentation, measurement techniques. Tuition: $195, includes continental breakfast and lunch.

Contact: Seminar Coordinator, HunterLab, 11491 Sunset Hills Rd., Reston, VA 22090; (703) 471-6870; Fax: (703) 471-4237.

Society of Manufacturing Engineers (SME) and the Association for Finishing Processes of SME (AFP/SME)

Spray Application Methods for Powder Coatings—October 1994, Chicago

Contact: Maria Conrado, Event Administrator, SME, One SME Dr., P.O. Box 930, Dearborn, MI 48121; (313) 271-1500; Fax: (313) 271-2861.

INDIANA

The Powder Coating Institute

Two-Day Hands-On Powder Coating Workshop—November 15-16, 1994, Gema Volstatic, Indianapolis, IN

The course combines intensive seminars on powder coating materials, their application, troubleshooting, and maintenance, along with first-hand on-site training.

Contact: Mirvat Talaat, PCI, 2121 Eisenhower Ave., Ste. 401, Alexandria, VA 22314; (703) 684-1770; Fax: (703) 684-1771.

Society of Manufacturing Engineers (SME) and the Association for Finishing Processes of SME (AFP/SME)

Developing Effective Powder Coating Applications—June 14-15, 1994, Indianapolis

Advanced Powder Systems Troubleshooting—June 16, 1994, Indianapolis

Contact: Maria Conrado, Event Administrator, SME, One SME Dr., P.O. Box 930, Dearborn, MI 48121; (313) 271-1500; Fax: (313) 271-2861.

LOUISIANA

Federation of Societies for Coatings Technology

72nd Annual Meeting and 59th Paint Industries' Show—October 12-14, 1994, Ernest N. Morial Convention Center, New Orleans, LA

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

University of California Berkeley Extension Continuing Education in Engineering

Compliance with Air Quality Regulations for Paints, Coatings, and Printing Facilities with Special Sessions on Title V Permitting and Title III Air Toxics—June 7-10, 1994, New Orleans

The purpose of this 3-1/2 day course is to present information about the most important consequences of these rules and to provide participants with the tools required to bring coating and printing facilities into compliance. Moreover, participants will be shown how to perform the most important calculations used for permitting and for completing state and EPA forms. Cost: $895.

Contact: Kelly M. Snyder or Richard V. Tsina, Continuing Education in Engineering, UC Berkeley Extension, 2223 Fulton St., Berkeley, CA 94720; (510) 642-4151; Fax: (510) 643-8683.

National Association of Corrosion Engineers

Basic Corrosion—February 5-10, 1995, New Orleans

An introductory program designed to provide a basic but thorough survey of the theoretical and practical aspects of corrosion and corrosion control. Cost: $625 member; $725 nonmember.

Cathodic Protection-Theory and Data Interpretation—February 5-10, 1995, New Orleans

An advanced course providing an in-depth explanation of the operating characteristics of galvanic and impressed current cathodic protection systems. Cost: $625 member; $725 nonmember.

Cathodic Protection Design—February 5-10, 1995, New Orleans

This course covers the basic methodology and principles involved in the design of effective cathodic protection systems. It also reviews cathodic protection applications and provides practical design examples and sample calculations. Cost: $625 member; $725 nonmember.

Protective Coatings and Linings—February 5-10, 1995, New Orleans

Offers both theoretical and practical information on the use of coatings and linings for corrosion control, and discusses the economic benefits derived from proper selection and application. Cost: $625 member; $725 nonmember.

Designing for Corrosion Control—February 5-10, New Orleans

Reviews the principles of corrosion and corrosion control, and provides a systematic method for applying corrosion prevention to the design process. Covers economic considerations, allowing the student to effectively communicate with both the technologically and financially oriented management groups. Cost: $625 member; $725 nonmember.

Session I—Basic Coating Inspection—November 27-December 3, 1994 and February 5-11, 1995, New Orleans

An intensive presentation of the basic technology of coating application and inspection. This session involves lectures, demonstrations, and hands-on training with equipment and instruments in an actual working shop. Upon successful completion of Session I, the participant will have attained industry-accepted NACE Basic Coating Inspector Training recognition. Cost: $1675 member; $1775 nonmember.

Session II—Intermediate Coating Inspection—November 27-December 2, 1994 and February 5-10, 1995, New Orleans

Focuses on shop coating processes for steel, advanced inspection techniques, and introduces more sophisticated nondestructive tests and test instruments. Cost: $850 member; $950 nonmember.

Session III—Advanced Coating Inspection—November 27-December 1, 1994 and February 5-9, 1995, New Orleans

Covers specialized application methods and substrates other than steel. Persons who successfully complete Sessions I, II, and III will attain NACE Intermediate Coating Inspector Training recognition. Cost: $850 member; $950 nonmember.

Contact: NACE International, Membership Services Department, 1440 South Creek Dr., Houston, TX 77082; (713) 492-0535, Ext. 80.

MASSACHUSETTS

University of Massachusetts Lowell, with Cooperation of the New England Society for Coatings Technology

B.S. in Applied Chemistry with an Option in Coatings and M.S. in Plastics with an Option in Coatings & Adhesives—Fall Semester—September to December; Spring Semester—January to May, University of Massachusetts Lowell.

Part-time evening programs. Courses offered in rotation: Coatings Science & Technology I & II; Adhesion & Adhesives I & II; Polymer Science I & II; Coatings Rheology; Mechanical Behavior of Polymers; Plastic Coatings in Electronics; Colloids; Seminar; Thesis. Cost: University Tuition & Fees.

Contact: Rudolph D. Deanin, Plastics Engineering Department, University of Massachusetts Lowell, Lowell, MA 01854; (508) 934-3426; Fax: (508) 458-4141.

HunterLab

Color and Appearance Seminar—February 8, 1995, Boston, MA.

A one-day introduction to basic color theory plus color and appearance measurement techniques. Topics include: visual color order systems, color scales, appearance attributes, instrumentation, measurement techniques. Tuition: $195, includes continental breakfast and lunch.

Contact: Seminar Coordinator, HunterLab, 11491 Sunset Hills Rd., Reston, VA 22090; (703) 471-6870; Fax: (703) 471-4237.

National Association of Corrosion Engineers

Session II—Intermediate Coating Inspection—February 26-March 4, 1995, Boston

Focuses on shop coating processes for steel, advanced inspection techniques, and introduces more sophisticated nondestructive tests and test instruments. Cost: $850 member; $950 nonmember.

Session III—Advanced Coating Inspection—February 26-March 3, 1995, Boston

Covers specialized application methods and substrates other than steel. Persons who successfully complete Sessions I, II, and III will attain NACE Intermediate Coating Inspector Training recognition. Cost: $850 member; $950 nonmember.

Contact: NACE International, Membership Services Department, 1440 South Creek Dr., Houston, TX 77082; (713) 492-0535, Ext. 80.

MICHIGAN

Eastern Michigan University

IDT 400 Polymer and Coating Technology—September 7-December 17, 1994, Eastern Michigan University, Ypsilanti, MI

This 15-week course is to acquaint students on the chemistry of polymeric film formation and the use of pigments in coating technology. This program will review the various chemistries of film formation using triglyceride, alkyd, emulsion and phenolic resin. Describe the utilization of hiding and nonhiding pigments with their role in pigment-binder, pigment volume concentration, and critical pigment volume concentration. Test methods are defined within their role of characterizing film performance. Cost: $263.

IDT 401 Polymer and Coating Technology Lab I—September 7-December 17, 1994, Eastern Michigan University, Ypsilanti

This 15-week course will familiarize students with laboratory techniques used in the coating industry including synthesis of varnishes, alkyds and epoxy esters. Synthesize alkyds including stoichiometry of formulations; formulate paints using various triglycerides; explore various techniques of film evaluation. These are used to acquaint students with real film performance with the chemistry of the polymers they have synthesized. Cost: $288.

IDT-402 Polymer and Coating Technology II—January 8-April 27, 1995, Eastern Michigan University, Ypsilanti

The objective of this 15-week course is to acquaint students with the chemistry of film formation and color technology as it applies to the coatings industry. Program will review the chemistry of film formation using isocyanates, emulsions, epoxy resins and amino resins. The concepts of solvent or waterborne along with high-solid systems are stressed. Colored pigments are introduced along with the methodologies of paint fabrication and film evaluation. Cost: $263.

IDT 403 Polymer and Coating Technology Lab II—January 8-April 27, 1995, Eastern Michigan University, Ypsilanti

This course will acquaint students with laboratory techniques in the synthesis of polymers and their use in coating technology. Synthesize emulsion polymers, amino resins, isocyanate prepolymers and thermoset acrylics. Prepare finished paint systems and evaluate their films on various substrates as applied by air spray, electrostatic or dip techniques. Cost: $288.

IDT 460 Coating Formulation Concepts—January 8-April 27, 1995, Eastern Michigan University, Ypsilanti

The object of this 15-week course is to illustrate formulation techniques and presentation of data. Designed to instruct students on formulation techniques using software programs and accumulate literature data via the ACS base in Washington, DC. Members of industry give presentations, thus, illustrating how practicing coating chemists effectively use suppliers. Culminating student experience is to give a two-hour presentation on a specific assigned project. Cost: $263.

IDT 479A Quality Assurance Techniques for Coating Technology—January 8-April 27, 1995, Eastern Michigan University, Ypsilanti

This 15-week course will show students the application of SPC techniques in coating technology that achieve maximum quality assurance. The concepts and basic philosophy of statistical process control (SPC) are presented including control charts, statistic principles, and experimental design. These tools are included in exercises which illustrate their proper utilization in the coating industry. Cost: $263.

IDT 479B Introduction to Color Technology—September 7-December 17, 1994, Eastern Michigan University, Ypsilanti

A 15-week introductory survey course which blends color measurement and visual aspects of color technology. Will enable students to develop understanding of color as it relates to industrial processes by a combination of lecture and laboratory hands-on experiments of pigmentation, dispersing, and shading techniques. Cost: $263.

Contact: Prof. Taki J. Anagnostou, Eastern Michigan University, 201 Sill Hall, Ypsilanti, MI 48197; (313) 487-1235; Fax: (313) 487-8755.

[Tuition scholarships supported by the Federation of Societies for Coatings Technology at Eastern Michigan University are available for undergraduate students interested in this curriculum.]

University of Detroit Mercy

Polymer Engineering and Science I (CHM 420) (CHM 550-Graduate)—early September to mid-December

Provides an overview of terminology, synthesis, properties, and fabrication of polymers and the systematic coverage of major classes of macromolecules including their preparation, properties, and uses.

Polymer Engineering and Science II (CHM 421) (CHM 551-Graduate)—early January to mid-May

Systematic coverage of major classes of macromolecules including their preparations, properties, and uses.

Polymer Science Coating I (CHM 425) (CHM 525-Graduate)—early September to mid-December

Designed to relate the chemical, physical, and mechanical properties of polymers with their functions as protective coatings. Comparisons are made between coatings made with various polymers such as acrylics, polyesters and polyurethanes, alkyds, and varnishes. The effects of solvents and mixtures of solvents, fillers, wetting and flatting agents are related to the special requirements of coatings. The equipment required for the preparation and applications of coatings is discussed, as well as the necessary evaluation tests and the significance of these tests.

Polymer Science Coating II (CHM 426) (CHM 526-Graduate)—early January to mid-May

A continuation of CHM 425 including the following: comparisons are made between coatings made with various polymers such as acrylics, polyesters, and polyurethanes. The equipment required for the preparation and applications of these coatings is discussed, as well as the necessary evaluation tests and the significance of these tests.

Adhesion and Durability of Polymeric Coatings [Continuing Education Units (CEUs)]

Requirements for a good adhesion; methods of promoting and maintaining adhesion; relationship between coating resins and adhesion; effect of adhesion on performance of coatings; selection of adhesion promoters for plastics and metals; relationships between adhesion, corrosion resistance, and durability of coatings.

Surface Coatings Technology (CEUs)

Principles of formulation; pigment dispersions; paint dryers and additives; formation and structure of paint films.

Selection of Paints and Plastics in Automotive Applications (CEUs)

Plastic types/end use; factors in selection of plastics; reasons for coating plastic substrates; adhesion of coatings to plastics; plastic surface pretreatments.

Problem Solving in Coatings Using Analytical Techniques (CEUs)

Dissection and analysis of coating problems; fundamental understanding of current analytical techniques; selection of proper instruments and accessories; problem solving in paint manufacturing; analysis of paint defects.

Polymer Technology for Coatings (CEUs)

Overview of basic polymer concepts; polymers for automotive coatings emphasized; paint calculations; relationship between polymer structure and coatings properties.

Automotive and Industrial Finish Processing (CEUs)

Cleaning and preparation; coatings application—manual and automatic; finish coating; testing results.

Contact: Dr. Kurt C. Frisch or Mrs. Eleanore Eldred, Polymer Institute, University of Detroit Mercy, 4001 W. McNichols Rd., Detroit, MI 48219; (313) 993-1270; Fax: (313) 993-1409.

Chemical Coaters Association International

MN-276 Electrocoating—Beginning September 7, 1994 (once a week for 15 weeks), Grand Rapids Community College, Grand Rapids, MI

Chemical and equipment training for the operation on electrodeposition paint line. Cost: $144 for residents; $216 for non-residents. Training manual fee: $25.

MN-272 Introduction to Liquid Coatings—Beginning September 6, 1994 (once a week for 15 weeks), Grand Rapids Community College, Grand Rapids

Paint formulation, types of paint, handling of paint, application characteristics, curing, pretreatment, VOC content. Cost: $144 for residents; $216 for non-residents. Training manual fee: $25.

MN-270 System Design and Operation—Beginning September 1, 1994 (once a week for 15 weeks), Grand Rapids Community College, Grand Rapids

Proper design, operation, and maintenance of paint finishing systems for liquid and powder application. Cost: $144 for residents; $216 for non-residents. Training manual fee: $25.

Compliance Coatings Technical Training Program—July 26-28, 1994, Eastern Michigan University, Ypsilanti

Update of compliance coatings technology, powder, waterborne and high-solids materials. Provides information on the newest techniques for efficient operation of paint finishing systems; water conservation, energy efficiency, waste minimization. Materials, equipment, processes. Cost: Two days—$295 CCAI members; $325 nonmembers; Three days—$320 CCAI members; $345 nonmembers.

Contact: Rodger Talbert, Technical Director, CCAI, 2088 Knapp St., N.E., Grand Rapids, MI 49505; (616) 365-7602; Fax: (616) 365-7602

HunterLab

Color and Appearance Seminar—September 14, 1994, Dearborn, MI

A one-day introduction to basic color theory plus color and appearance measurement techniques. Topics include: visual color order systems, color scales, appearance attributes, instrumentation, measurement techniques. Tuition: $195, includes continental breakfast and lunch.

Contact: Seminar Coordinator, HunterLab, 11491 Sunset Hills Rd., Reston, VA 22090; (703) 471-6870; Fax: (703) 471-4237.

MISSISSIPPI

University of Southern Mississippi, Department of Polymer Science

Surface Coatings (PSC 470, 470L)—September to December

This four-hour lecture, one-hour lab course is designed for students with a background in organic and physical chemistry. It is taught at the senior undergraduate/graduate level and includes chemistry and physics of binders, pigments, solvents and additives for surface coatings. Pigment dispersion, coatings formulation, surface chemistry, quality control, testing of raw materials and products, application methods, corrosion, and coatings specifications are included.

Organic Polymer Chemistry I and II (PSC 301, 302)—September to May

This course (three-hour lecture, one-hour lab each term) is a systematic study of polymers, including polymer formation techniques, kinetics, and properties, with emphasis on step and addition polymerization, and stereoregular polymerization.

Polymer Techniques (PSC 341L, 342L)—September to May

Laboratory methods of polymer synthesis, structural determination, and characterization (two-hour lab each).

Polymer Rheology (PSC 360)—September to December

Theory and practice of fluid flow are emphasized (three-hour lecture).

Polymer Processing I (PSC 361, 361L)—January to May

Extrusion technology, reaction injection molding, blown films, and wire coating are emphasized (three-hour lecture, two-hour lab).

Physical Chemistry of Polymers I and II (PSC 401, 402)—September to May

Polymer structure, chain confirmation, solution properties, thermo-dynamics, fractionation, molecular weight measurement, instrumental analysis of polymers, morphology, structure-property relations are taught (three-hour lecture).

Introduction to Macromolecules (PSC 412)—June to August

An introduction to the chemistry and physics of natural and synthetic high polymers (three-hour lecture).

Polymer Kinetics (PSC 480)—January to May

Introduction to polymerization kinetics and reactor design (three-hour lecture).

Undergraduate Research (PSC 490, 490L, 491, 491L)

Individual research. Prospectus is prepared and research plan is executed with final status report required (one-hour lecture, three-hour lab each term).

Graduate Organic Polymer Chemistry I, II, and III —(PSC 701, 702, 703)—September to May

An in-depth study of polymer forming reactions, their scope and limitations. Relationships between molecular weight, polymer structure, and physical properties of polymers are established (three-hour lecture each).

Graduate Polymer Physical Science, I, II, and III (PSC 710, 711, 712)—September to May

Includes such topics as light scattering, end group analysis, osmometry, polymer fractionation, NMR, IR, UV, and visible spectroscopy, thermoanalytical evaluation, mass spectrometry, polymer chain confirmation, macromolecular solutions, molecular weight distribution, morphology, rheology, structure-property relations, and kinetics of addition-, condensation-, and copolymerization (three-hour lecture each).

Physical Properties of Macromolecular Solids (PSC 810)—September to December

Advance study of glassy and crystalline physical state of macromolecular solids emphasizing the influence of morphological structure (two-hour lecture).

Polymer Physics (PSC 811)—September to December

Study of polymer conformation, phenomenological and molecular theories of polymer relaxation and diffusion in polymers (three-hour lecture).

Conformational Analysis (PSC 812) —September to December

Study of molecular interactions that control polymer conformation. Molecular modeling in material design (three-hour lecture).

[Tuition scholarships supported by the Federation of Societies for Coatings Technology at the University of Southern Mississippi are available for undergraduate students interested in this curriculum.]

Coatings Science for Coatings Chemists—June 6-9, 1994, Polymer Science Research Center, The University of Southern Mississippi, Hattiesburg, MS

Emphasis on the theory and practical aspects of the principles of coatings selection, design, formulation, testing, and performance. Interaction of all participants is encouraged. Low VOC and, in general, the search for environmentally compliant coatings is emphasized and includes waterborne, high-solids, and powder coatings. Provide an understanding of all coating components including their chemical structures, mechanism of action, use levels, influence on properties, and the strategy for selection. Cost: $875.

Coatings Science for Coatings Formulators—June 13-16, 1994, Polymer Science Research Center, The University of Southern Mississippi, Hattiesburg

Emphasis on formulating principles, techniques, and equipment. Special emphasis given to economics, VOC regulations, and coating performance criterion of waterborne, high-solids, powder, and modified traditional solvent systems. Provide hands-on, interactive lab sessions comprising approximately 45% of the course. Lab sessions emphasize dispersion equipment and techniques, the selection of raw materials based on economics and anticipated use, formulating techniques, testing procedures, and factors affecting film performance. Cost: $875.

Contact: Dr. Shelby F. Thames, University of Southern Mississippi, Box 10076, Hattiesburg, MS 39406-0076; (601) 266-4080; Fax: (601) 266-5880.

MISSOURI

University of Missouri-Rolla

Chemistry Curriculum (with Specialization in Polymer and Coatings Science)—This program encompasses the standard chemistry curriculum, plus courses in coatings, surface, and polymer chemistry. It is designed to provide undergraduate training in coatings science and technology. This program is accredited by the American Chemical Society.

Students seeking coatings science specialization are encouraged to seek summer employment at a coatings-oriented firm, as well as cooperative work-study programs with such firms. Students also participate in a senior research project in polymer and coatings science. This leads to the B.S. Degree in Chemistry. M.S. and Ph.D. Degree programs are also available for graduate studies.

Chemistry and Inherent Properties of Polymers (Chem 381)

A basic study of the organic chemistry of natural and synthetic high polymers, their inherent properties, and their uses in the plastic, fiber, rubber, resin, food, paper, and soap industries.

Polymer Science Laboratory (Chem 384)

Lectures and laboratory experiments dealing with polymerization reactions, solution properties, and bulk or solid properties will be presented. Each student will prepare polymers and carry out all characterization experiments on actual samples which were prepared.

Fundamentals of Protective Coatings I (Chem 385)

Study of the basic principles of protective coatings with particular reference to the paint and coatings industry. Classification, manufacture, properties, and uses of protective coatings. Emphasis is on the chemistry of the resin and component interactions.

Inorganic Polymers (Chem 401)

A study of nontraditional organic and inorganic polymers and polymerization processes. Survey and discussion of classes of inorganic polymers, their characterization, and application.

Polymer Physical Chemistry and Analysis (Chem 484)

A study of the physical properties of macromolecular systems including polymer solutions, gels, bulk polymers, and rubbers. The chemical characterization of polymers based on their thermal, spectroscopic, microstructure, and molecular weight is also discussed.

Structure and Properties of Polymer (Chem E 375)

A study of the parameters affecting structure and properties of polymers. Syntheses, mechanisms, kinetic factors are emphasized from the standpoint of structural properties.

Corrosion and Its Prevention (Chem E 381)

A study of the theories of corrosion and their application to corrosion and its prevention.

Chemical Engineering of High Polymers (Chem E 383)

Solution properties, molecular weight determination, and bulk properties including rheological behavior of high polymers are studied and used to explain techniques of characterization, manufacture, and processing of representative commercial types.

Chemical Engineering Fluid Dynamics (Chem E 439)

Fundamentals of Newtonian flow, non-Newtonian flow, flow through packed beds, two-phase flow, flow around submerged objects, and other related topics are discussed.

Plasma Polymerization (Chem E 475)

Fundamental aspects of polymer formation in plasma (weakly ionized gas), and properties of polymers formed by such a process will be studied.

Polymer Membranes for Separation (Chem E 476)

Basic principles of transport through a polymer membrane and transport characteristics of some polymers are studied. The selection of polymers and the method of preparing functional membranes for some separate processes are also studied.

(Tuition scholarships supported by the Federation of Societies for Coatings Technology at University of Missouri-Rolla are available for undergraduate students interested in this curriculum.)

Contact: Jim Stoffer or Harvest Collier, Chemistry Department, University of Missouri-Rolla, Rolla, MO 65401; (314) 341-4419.

The Basic Composition of Coatings—Introductory Short Course—March 28-April 1, 1994 and September 12-16, 1994

Offered twice a year, this is a fundamental five-day course for anyone interested in learning about coatings science, with basic information on the materials used, their manufacture, and testing. Many types of paint are studied to show: differences in composition, and quality control tests. Discussion of the chemistry of coatings includes polymer chemistry and analytical chemistry. Also covered are various types of instrumentation. Particular attention will be given to the needs of newcomers to the coatings industry in laboratories, production units, or marketing groups. Course attendees in allied professions have found this course to provide an increased awareness of how their products fit into the area of coatings and have also found new uses for their products. Course Fee: $845.

Introduction to Paint Formulation—Introductory Short Course—April 18-22, 1994; May 16-20, 1994; and September 26-30, 1994

This intensive five-day course will take you through the basic steps of paint formulation, from understanding the process to an actual laboratory formulation. Through study and work in a laboratory, you can learn to formulate paints to meet specific requirements. You will have the opportunity to study and experiment with basic raw materials and their influences on the performance of the finished coating, formulation and testing of coatings in the laboratory to meet the special demands of the job, limitations of plant production equipment and formulation variables for moving a coating from the lab to the plant, and modern chemical instrumentation as applied to coatings.

In the classroom and in the lab, you can put to work the techniques you have learned and test some of your own ideas. Learn how to solve formulation problems imposed by government regulations using methods of calculating formulas that assure you are in compliance. Enrollment is limited. Course Fee: $945.

Basic Coatings for Sales, Marketing and General Personnel—May 2-4, 1994 and July 18-20, 1994

This three-day course is designed especially to aid sales, marketing, and general personnel in the coatings industry to have a better understanding of the composition of coatings. The course includes: composition of coatings; relationship between composition and performance characteristics; customer's specifications and testing techniques as related to formulation criteria; and business aspects of coatings.

The customer's specifications and testing techniques are related to formulation criteria. Paint manufacturers, as well as raw materials suppliers, will find this program vital to improving their sales presentation based on a more thorough knowledge of the coatings process. This course will be held at the St. Louis Airport Marriott Hotel. Fee: $745.

For all University of Missouri-Rolla short courses contact: Michael R. Van De Mark, Director, or Cynthia N. Campbell, Coordinator of the UMR Coatings Institute, 142 Schrenk Hall, University of Missouri-Rolla, Rolla, MO 65401-0249; (314) 341-4419.

NEW JERSEY

HunterLab

Color and Appearance Seminar—November 16, 1994, Parsippany, NJ

A one-day introduction to basic color theory plus color and appearance measurement techniques. Topics include: visual color order systems, color scales, appearance attributes, instrumentation, measurement techniques. Tuition: $195, includes continental breakfast and lunch.

Contact: Seminar Coordinator, HunterLab, 11491 Sunset Hills Rd., Reston, VA 22090; (703) 471-6870; Fax: (703) 471-4237.

The Center for Professional Advancement

Crystallization Technology—July 11-13, 1994, East Brunswick, NJ

This course will be taught in light of the many recent advances in the understanding of crystallization processes. It covers

practical problems of crystallizer operation. Both organic and inorganic systems will be treated in batch and continuous mode.

Practical Pilot Plants—July 18-20, 1994, East Brunswick

This course is intended to familiarize participants with pilot plant design, construction, and operation using today's engineering technology. The course is broad in content, fundamental in concept, and will address all aspects of pilot plants.

Batch Processing for the Chemical and Pharmaceutical Industries—July 25-29, 1994, East Brunswick

The course presents the principles of batch process engineering, and is intended primarily for non-chemical engineers. The core of the course then surveys the design, operation, and control of specialty production facilities. Some review of basic process principles is offered but the emphasis in the course is on proven, effective applications.

Patent Law for Managers, Engineers, and Scientists—August 8-10, 1994, East Brunswick

This course will provide inventors, and those who manage inventors, with a working knowledge of U.S. and international procedures for the protection of intellectual property by patents.

Batch Chemical Reactor Optimization—August 15-17, 1994, East Brunswick

The objective of the course is to give a broad overview of the factors that should be considered in designing a batch reactor system to meet the more difficult operating conditions increasingly called for by today's chemistry.

Designing the "State-of-the-Art" Laboratory—August 29-31, 1994, East Brunswick

This course is intended to provide participants with a broad and practical introduction to good design parameters, which will reflect the state-of-the-art, for contemporary laboratories. Particular emphasis will be placed on laboratory furniture systems, laboratory safety, fume hood applications, architectural considerations (both new and renovation), and HVAC including its associated energy conversation.

Contact: Registrar, The Center for Professional Advancement, P.O. Box 1052, East Brunswick, NJ 08816; (908) 613-4500; Fax: (908) 238-9113.

NEW YORK

MUNSELL COLOR SCIENCE LABORATORY

Device-Independent Color Imaging—June 6-8, 1994, Chester F. Carlson Center for Imaging Science Building, Rochester Institute of Technology, Rochester, NY

An in-depth short course designed to teach the theory of colorimetry and its application to electronic imaging, so called device-independent color. The course will include lectures and laboratories using a Macintosh-based full-color imaging system consisting of a desk-top scanner, display, and continuous-tone printer. The use of colorimeters, color analyzers, spectroradiometers, and spectrophotometers for device characterization will also be covered.

Quantitative Visual Evaluation of Color and Images—June 9-10, 1994, Chester F. Carlson Center for Imaging Science Building on Rochester Institute of Technology, Rochester

An intensive short course covering the quantitative evaluation of visual stimuli, known as psychophysics. Special emphasis is given to the application of psychophysical techniques to the analysis of color and images. This type of analysis is important for those working on or with systems that are intended to produce or reproduce colored stimuli or color images. Participants will learn about the design of psychophysical experiments and the statistical analysis of the experimental results through lectures, demonstrations, and laboratory exercises. The final session of the course is dedicated to the solution of problems the participants may be facing in their work.

Contact: Colleen M. Desimone, Munsell Color Science Laboratory, Rochester Institute of Technology, 54 Lomb Memorial Dr., Rochester, NY 14623-5604; (716) 475-7189; Fax: (716) 475-5988.

NORTH CAROLINA

SOCIETY OF MANUFACTURING ENGINEERS (SME) AND THE ASSOCIATION FOR FINISHING PROCESSES OF SME (AFP/SME)

Furniture Finishing—November 8-9, 1994, High Point, NC

Contact: Maria Conrado, Event Administrator, SME, One SME Dr., P.O. Box 930, Dearborn, MI 48121; (313) 271-1500; Fax: (313) 271-2861.

NORTH DAKOTA

NORTH DAKOTA STATE UNIVERSITY,
DEPARTMENT OF POLYMERS & COATINGS

Intensive Coatings Science Course—June 5-17, 1994, North Dakota State University, Fargo, ND

This course is structured to present a comprehensive, balanced view of the subjects. Tentative topics include: chain-growth and step-growth polymerization resins; acrylic, polyester, alkyds; amine-formaldehyde resins; crosslinking; epoxy resins; urethane coatings; solvents; film formation; rheology; appearance of coatings; pigments and pigment dispersions; coatings performance; current research topics; coatings formulation; low-VOC coatings (powder coatings, high-solids, radiation curing). Cost: (one-week option is available) $2500—two week attendance; $1400—one week attendance.

Contact: Prof. Marek W. Urban, Course Director or Debbie Shasky, Course Coordinator, North Dakota State University, Polymers & Coatings Department, 54 Dunbar Hall, Fargo, ND 58105; (701) 237-7633; Fax: (701) 237-8439.

OHIO

HUNTERLAB

Color and Appearance Seminar—October 5, 1994, Cincinnati, OH

A one-day introduction to basic color theory plus color and appearance measurement techniques. Topics include: visual color order systems, color scales, appearance attributes, instrumentation, measurement techniques. Tuition: $195, includes continental breakfast and lunch.

Contact: Seminar Coordinator, HunterLab, 11491 Sunset Hills Rd., Reston, VA 22090; (703) 471-6870; Fax: (703) 471-4237.

NATIONAL ASSOCIATION OF CORROSION ENGINEERS

Lead Abatement Seminar—January 15-18, 1995, Cincinnati

A complete overview of new regulations and how to comply with federal and state laws; testing and inspection techniques and evaluation; personnel hazards and protective measures; methods of abatement and containment; and, procedures testing, disposing of lead-based paint waste. Cost to be determined.

Basic Corrosion—January 8-13, 1995, Cincinnati

An introductory program designed to provide a basic but thorough survey of the theoretical and practical aspects of corrosion and corrosion control. Cost: $625 member; $725 nonmember.

Cathodic Protection—An Introduction—January 8-13, 1995, Cincinnati

This week-long course presents the basic principles and applications of galvanic and impressed current cathodic protection systems. Cost: $625 member; $725 nonmember.

Designing for Corrosion Control—January 8-13, 1995, Cincinnati

Reviews the principles of corrosion and corrosion control, and provides a systematic method for applying corrosion prevention to the design process. Covers economic considerations, allowing the student to effectively communicate with both the technologically and financially oriented management groups. Cost: $625 member; $725 nonmember.

Session I—Basic Coating Inspection—January 8-14, 1995, Cincinnati

An intensive presentation of the basic technology of coating application and inspection. This session involves lectures, demonstrations, and hands-on training with equipment and instruments in an actual working shop. Upon successful completion of Session I, the participant will have attained industry-accepted NACE Basic Coating Inspector Training recognition. Cost: $1675 member; $1775 nonmember.

Session II—Intermediate Coating Inspection—January 8-13, 1995, Cincinnati

Focuses on shop coating processes for steel, advanced inspection techniques, and introduces more sophisticated nondestructive tests and test instruments. Cost: $850 member; $950 nonmember.

Session III—Advanced Coating Inspection—January 8-12, 1995, Cincinnati

Covers specialized application methods and substrates other than steel. Persons who successfully complete Sessions I, II, and III will attain NACE Intermediate Coating Inspector Training recognition. Cost: $850 member; $950 nonmember.

Contact: NACE International, Membership Services Department, 1440 South Creek Dr., Houston, TX 77082; (713) 492-0535, Ext. 80.

The Powder Coating Institute

Hands-On Powder Coating Workshop—August 22-23, 1994, Nordson Corp., Amherst, OH.

The two-day course combines intensive seminars on powder coating materials, their application, troubleshooting, and maintenance, along with first-hand on-site training.

Contact: Mirvat Talaat, PCI, 2121 Eisenhower Ave., Ste. 401, Alexandria, VA 22314; (703) 684-1770; Fax: (703) 684-1771.

Society of Manufacturing Engineers (SME) and the Association for Finishing Processes of SME (AFP/SME)

Spray Application Methods for Powder Coating—September 12-13, 1994 and September 14-15, 1994, Amherst

Selecting the Right Liquid Coating—September 13, 1994, Cincinnati

Liquid Paint Systems Design—September 14-15, 1994, Cincinnati

Environmental Compliance for the Coatings Industry—October 1994, Cleveland

Contact: Maria Conrado, Event Administrator, SME, One SME Dr., P.O. Box 930, Dearborn, MI 48121; (313) 271-1500; Fax: (313) 271-2861.

Case Western Reserve University

Courses are offered by either the Department of Macromolecular Science (EMAC) or by the Department of Chemical Engineering (ECHE), as part of full academic program for B.S., M.S., or Ph.D. Degrees in Macromolecular Science and Engineering. Overall coverage of polymer science and engineering includes topics relevant to coatings science and technology, and research projects directly concerned with coatings.

Courses on the 400-level (first and second year graduate students) often are given over the Instructional Television Network (ITN), via VCR cassette, available to students in industry for either audit or academic credit. Call (216) 368-2982, or write ITN, CWRU, Cleveland, OH 44106.

Polymer Materials (EMAC 176)

The materials properties associated with the use of synthetic and natural polymers in films, fibers, composites, rubbers, paper, foods, etc., are described and correlated with physical and chemical structures.

Introduction to Polymer Science (EMAC 270)

An introduction to the science and engineering of large molecules; correlation of molecular structure and properties of molecules in solution and bulk; control of significant structural variables in polymer synthesis; analysis of physical methods for characterization of molecular weight, and morphology.

Polymer Analysis Laboratory (EMAC 272)

Experimental techniques in polymer synthesis and characterization; synthesis by free radical emulsion, anionic and condensation polymerization; investigation of polymer structure by X-ray diffraction, electron microscopy, infrared, NMR and circular dichroism spectroscopy; molecular weight determination by light scattering and viscosity measurement; study of chemical and mechanical properties.

Polymer Properties and Design (EMAC 276)

Engineering properties of polymers and their evaluation in terms of selection and design procedures. The relation of properties to the chemical and physical structures of polymers and application conditions.

Polymer Engineering (EMAC 376)

Mechanical properties of polymer materials as related to polymer structure and composition. Introduction to melt rheology and electrical, optical, and surface properties of polymers.

Polymer Processing (EMAC 377/477)

Rheological, molecular, structural, engineering, and compounding factors affecting processibility and properties of polymers; principles and procedures for extrusion, melting, calendering, injection molding, coatings and other primary processing methods. Considerations of pertinent mechanisms and theories with emphasis on the application of theory to practice.

Polymer Production and Technology (EMAC 378)

Engineering operations for industrial polymerization procedures. Finishing and fabrication of polymers. Production and technology of plastics, elastomers, fibers, and coatings.

Polymer Processing and Properties Laboratory (EMAC 379)

Experimental and industrial production techniques and practice in mixing, plastics processing, elastomer extrusion, fiber and composites production. Testing of plastics, elastomers, fibers, coatings and composites. Maintenance and quality control. Processing project.

Macromolecular Synthesis (EMAC 470)

The organic chemistry of macromolecules. The mechanisms of polyreactions, the preparation of addition, condensation and biopolymers, and the chemical reactions of polymers.

Physical Chemistry of Macromolecules (EMAC 472)

The major areas of the physical chemistry of macromolecules are treated; theories and experimental methods of polymer solutions, physical methods for determination of chemical structure, and configuration.

Macromolecular Physics (EMAC 474)

Introduction to the physics of amorphous and crystalline polymers. Equilibrium elastic properties of rubbery materials. Viscoelasticity. The liquid-glass and glass-glass transitions. The morphology, characterization and deformation behavior of crystalline polymers.

Applied Macromolecular Science and Engineering (EMAC 476)

Properties, processing and technology of plastics, elastomers, fibers, films, and coatings. The mechanical behavior of polymers related to polymer structure and composition.

X-Ray Crystallography (EMAC 479)

A basic description of the scattering of X-rays by crystalline and semicrystalline solids including polymers. Techniques of structure analysis.

Polymer Composite Processing (EMAC 481)

Factors affecting the selection of composite processing methods. Characteristics and applications of compression, injection and reinforced injection molding of composites. Filament winding and pultusion methods.

Fundamentals of Adhesives, Sealants, and Coatings (EMAC 482)

The principles of film formation, film application methods, and related fabrication factors and procedures. Relevant adhesion theories and practices, aspects of rheological treatments, optical and other factors which affect applications. The nature and properties of constituent polymer materials, pigments, solvents, and other additives. Selection and design of systems for mechanical, surface environmental resistance, and other properties.

Macromolecular Synthesis II (EMAC 570)

A series of advanced topics in methods and mechanisms of polymerization of synthetic and biopolymers. Coordination, emulsion, ionic, and topochemical polymerizations. Novel polymerization methods.

Physical Chemistry of Macromolecules II (EMAC 572)

A series of advanced topics in the physical chemistry of polymers, including conformational statistics of flexible chains, optical properties of polymers, and the physical chemistry of biological materials and systems.

Polymer Rheology (EMAC 575)

A systematic study of deformation and flow of matter, with emphasis on polymeric and colloidal systems. Topics include: rheology of non-Newtonian fluids, the flow properties of simple fluids and dispersions, linear viscoelasticity, polymer solutions and melts, and applications to processing of polymers.

Selected Topics in Macromolecular Synthesis (EMAC 670); Physics (EMAC 671); Physical Chemistry (EMAC 672); Special Topics (EMAC 690)

Content varies depending on the interests of the students and faculty. The topics presented represent advanced and special topics at the forefront of the science and engineering of polymers and polymeric systems. Courses are given on a demand basis.

Characterization of Macromolecules (EMAC 678)

Laboratory experience is gained with the synthesis and characterization of polymers. Methods used include light scattering, viscosity infrared, circular dichroism, and NMR spectroscopy. Solid samples are characterized by X-ray diffraction, electron microscopy, and differential thermal analysis.

The Scientist in the Industrial Environment (EMAC 691)

Course conducted on a seminar basis, focusing on how R&D management plans, justifies and operates within the corporate structure and the areas which R&D encounters in so doing—finance, law, purchasing, manufacturing, marketing, and environmental control.

Surfaces and Adsorption (ECHE 464)

The structure of interfaces including 2-D symmetry, the thermodynamics of interfaces, nature of interactions across phase boundaries, wetting, spreading and surface energetics, adsorption on liquid and solid substrates, properties of adsorbed films; instrumental methods in surface science.

Colloid Science (ECHE 466)

Stochastic processes and interparticle forces in colloidal dispersions. DLVO theory, stability criteria, and coagulation kinetics. Electrokinetic phenomena. Applications to electrophoresis, filtration, flotation, sedimentation, and suspension rheology. Investigation of suspensions, emulsions, gels, and association colloids.

Environmental Effects on Materials Behavior (EMSE 411)

Aqueous corrosion; principles and fundamental concepts recognition of modes; monitoring and testing methods for control and prediction. Applications of engineering problems, design, and economics. Mixed potential theory, principles of production, hydrogen effects, and behavior in metal systems.

Courses are also offered in: Polymers in Medicine (EMAC 471); Biopolymers (EMAC 473); and Characterization of Biopolymers (EMAC 475).

Contact: Charles E. Rogers, School of Engineering, Department of Macromolecular Science, Case Western Reserve University, Cleveland, OH 44106; (216) 368-6376.

Kent State University, Chemistry Department

Surface Coatings I—Chemistry 40093 (undergraduate); Chemistry 5-70093 (graduate)—September 10–December 10, 1994

This survey course covers a broad outline of the technical aspects of the coatings industry. Subjects presented include introduction to the industry, organic chemistry related to binders, drying oils and alkyd resins, modern coating binders, solvents, pigments, extenders, additives, formulation, film formation, metal pretreatment, application methods, and environmental concerns. Fee: $524 (tentative).

Applied Rheology for Industrial Chemists—April 24-28, 1995

Aimed at providing practitioners in the coatings, adhesives, elastomers, and plastics industries with insights which will enable them to write and understand specifications, improve quality control and learn techniques in rheology. The course covers subjects related to rheology, kinematics and dynamics, dispersion, interfacial and polymer rheology, with discussions divided equally between principles and application. Fee: $850.

Dispersion of Pigments and Resins in Fluid Media—May 8-12, 1995

The chemistry and mechanical aspects of the dispersion of pigments and resins in fluid media are discussed. Subjects covered include: theoretical underpinnings of dispersion, ranging from fundamentals of dispersion preparation and modification to stabilization. Practical consequences are shown, followed by expert presentation on the operation of a variety of dispersion equipment and plant practice. Fee: $850.

Adhesion Principles and Practice for Coatings and Polymer Scientists—May 22-26, 1995

This course is designed for industrial scientists and technologists who encounter adhesion problems. Common problems are addressed through theoretical treatments. Closely allied with coatings, as well as rheology, the subject of adhesion is addressed by topics ranging from principles of bonding to surface chemistry, to a wide variety of mechanical properties. Adhesion principles are discussed first, then applied problems that have been solved in the industrial and academic settings. Fee: $850.

Introduction to Coatings Technology—October 4-7, 1994

Presented in cooperation with Chemistry Department and Pacific Technical Consultants, this introductory course is de-

signed to help technical and non-technical newcomers understand the coatings industry, its challenges, and opportunities. It covers the evolution of coatings technology and the progress the coatings industry is making in its rapid change from art to science. Coverage includes: many raw materials and their functions in both architectural and industrial finishes; regulatory restrictions, economic forces; factors that influence the composition and performance of coatings; formulation and calculations including anatomy of paint and chemicals, weight and volume relationships, testing procedures, basic quality assurance, safety, pollution control regulations and waste management. Fee: $675.

Accelerated and Natural Weathering Techniques for Coatings and Polymers—September 28-30, 1994

Presented in cooperation with Chemistry Department and Portage Technical Consultants, this course is designed to help predict the service life of coatings and polymers by accelerated and natural weathering techniques. Lectures include the variation of accelerated and exterior testing as well as a correlation between natural weathering with various spectroscopic methods. Accelerated testing of coatings for corrosion control, along with an overview of laboratory accelerated weathering methods are described. Appearance performance modeling for accelerated data, weathering through FTIR spectroscopy and uses of florescent UV in weathering are presented. Fee: $600.

Fundamentals of Chromatographic Analysis—June 5-9, 1995

Presented in cooperation with Chemistry Department and Varian, this course is designed to provide a coherent overview of chemical separations via chromatographic methods. Materials included are: gas, liquid and thin-layer methods of chromatographic analysis. The course stresses the three techniques as complementary rather than competing processes and is a blend of fundamental information on theory and instrumentation with applications, including coatings. Fee: $850.

Surface Chemistry—Chemistry 4057l—15 Weeks

Theory and behavior of inorganic and organic colloidal dispersions and their applications to industrial chemistry. Subjects include: viscosity sedimentation, diffusion, osmosis, Donnan equilibrium, light scattering, surface tension, absorption, wetting, electrical phenomena, Van Der Waals forces, double layer theory and electropheresis.

Physical Chemistry of Macromolecules—Chemistry 40583—15 Weeks

An introduction to the physical chemistry of macromolecules. Subjects include: molecular forces and bonding, conformation, thermodynamics, molecular weights, collegative properties, light scattering, viscosity, spectroscopy, mechanical properties, rheology and mass transitions.

Contact: Carl J. Knauss, Kent State University, Chemistry Department, P. O. Box 5190, Kent, OH 44242-0001; (216) 672-2327. Fax: (216) 672-3816.

Cleveland Society for Coatings Technology

38th Annual Cleveland Society for Coatings Technology Technical Symposium—May 16, 1995, Cleveland, OH

One-day conference offering a variety of speakers and topics dealing with "new and cutting edge" technology. Cost: $135, includes symposium and dinner.

Contact: Sharie Moskaluk, Sherwin-Williams Co., 601 Canal Rd., Cleveland, OH 44113; (216) 566-3661; Fax: (216) 566-2444.

OREGON

Pacific Northwest Society for Coatings Technology, Portland Section

48th Annual Spring Symposium—May 3-6, 1995, Red Lion Lloyd Center, Portland, OR

This annual spring symposium will follow the same general guidelines of the past symposiums which have taken place in Portland, Seattle, Vancouver, B.C., and this year—Victoria, B.C. A call for papers will come approximately August of 1994. Cost not yet determined.

Contact: Ken Wenzel, Program Chairman, Chemical Distributors, Inc., P.O. Box 10763, Portland, OR 97210; (503) 243-1082; Fax: (503) 243-1162.

Third Annual Environmental Education Seminar—February 15, 1995 (tentative), Shilo Inn—Portland Airport, Convention Center, Portland, OR

The objective of this seminar is to update and inform interested individuals on current environmental issues. The topic will be determined in the fall of 1994. Cost: $35 (tentative).

Contact: John Westendorf, Westendorf Chemical Co., 2627 N.W. Nicols, Portland, OR 97210; (503) 241-3520; Fax: (503) 241-8040.

PENNSYLVANIA

Chemical Coaters Association International

Compliance Coatings Technical Training Program—August 23-25, 1994

Update of compliance coatings technology, powder, waterborne and high-solids materials. Provides information on the newest techniques for efficient operation of paint finishing systems; water conservation, energy efficiency, waste minimization. Materials, equipment, processes. Cost: Two days—$295 CCAI members, $325 nonmembers; Three days—$320 CCAI members, $345 nonmembers.

Contact: Rodger Talbert, Technical Director, CCAI, 2088 Knapp St., N.E., Grand Rapids, MI 49505; (616) 365-7602; Fax: (616) 365-7602

Lehigh University, Emulsion Polymers Institute

25th Annual Short Course in Advances in Emulsion Polymerization and Latex Technology—June 5-9, 1995, Sinclair Laboratory Auditorium, Lehigh University, Bethlehem, PA

The course is an in-depth study of the synthesis, characterization, and properties of high-polymer latexes. The subject matter includes a balance of theory and application as well as balance between chemical and physical problems. Lectures will be given by leading academic and industrial workers. Lectures will begin with introductory material and reviews, and will progress through recent research results. Cost: $900/week; $300/day.

Contact: Dr. Mohamed S. El-Aasser, Emulsion Polymers Institute, 111 Research Dr., Lehigh University, Bethlehem, PA 18015; (610) 758-3598; Fax: (610) 758-5880.

National Association of Corrosion Engineers

Basic Corrosion—April 23-28, 1995, Philadelphia, PA

An introductory program designed to provide a basic but thorough survey of the theoretical and practical aspects of corrosion and corrosion control. Cost: $625 member; $725 nonmember.

Protective Coatings and Linings—April 23-28, 1995, Philadelphia

Offers both theoretical and practical information on the use of coatings and linings for corrosion control, and discusses the economic benefits derived from proper selection and application. Cost: $625 member; $725 nonmember.

Session I—Basic Coating Inspection—April 23-29, 1995, Philadelphia

An intensive presentation of the basic technology of coating application and inspection. This session involves lectures, dem-

onstrations, and hands-on training with equipment and instruments in an actual working shop. Upon successful completion of Session I, the participant will have attained industry-accepted NACE Basic Coating Inspector Training recognition. Cost: $1675 member; $1775 nonmember.

Session II—Intermediate Coating Inspection—April 23-28, 1995, Philadelphia

Focuses on shop coating processes for steel, advanced inspection techniques, and introduces more sophisticated nondestructive tests and test instruments. Cost: $850 member; $950 nonmember.

Session III—Advanced Coating Inspection—April 23-27, 1995, Philadelphia

Covers specialized application methods and substrates other than steel. Persons who successfully complete Sessions I, II, and III will attain NACE Intermediate Coating Inspector Training recognition. Cost: $850 member; $950 nonmember.

Contact: NACE International, Membership Services Department, 1440 South Creek Dr., Houston, TX 77082; (713) 492-0535, Ext. 80.

TENNESSEE

Chemical Coaters Association International

Compliance Coatings Technical Training Program—December 6-8, 1994

Update of compliance coatings technology, powder, waterborne and high-solids materials. Provides information on the newest techniques for efficient operation of paint finishing systems; water conservation, energy efficiency, waste minimization. Materials, equipment, processes. Cost: Two Days—$295 CCAI members, $325 nonmembers; Three Days—$320 CCAI members, $345 nonmembers.

Contact: Rodger Talbert, Technical Director, CCAI, 2088 Knapp St., N.E., Grand Rapids, MI 49505; (616) 365-7602; Fax: (616) 365-7602.

HunterLab

Color and Appearance Seminar—March 8, 1995, Knoxville, TN

A one-day introduction to basic color theory plus color and appearance measurement techniques. Topics include: visual color order systems, color scales, appearance attributes, instrumentation, measurement techniques. Tuition: $195, includes continental breakfast and lunch.

Contact: Seminar Coordinator, HunterLab, 11491 Sunset Hills Rd., Reston, VA 22090; (703) 471-6870; Fax: (703) 471-4237.

Society of Manufacturing Engineers (SME) and the Association for Finishing Processes of SME (AFP/SME)

Polyurethane Coatings—October 18-19, 1994, Nashville

SPC for Paint Lines—October 18-19, 1994, Nashville

Contact: Maria Conrado, Event Administrator, SME, One SME Dr., P.O. Box 930, Dearborn, MI 48121; (313) 271-1500; Fax: (313) 271-2861.

TEXAS

National Association of Corrosion Engineers

Lead Abatement Seminar—March 12-15, 1995, Houston, TX

A complete overview of new regulations and how to comply with federal and state laws; testing and inspection techniques and evaluation; personnel hazards and protective measures; methods of abatement and containment; and procedures testing, disposing of lead-based paint waste. Cost to be determined.

Basic Corrosion—September 18-23, 1994; March 5-10, 1995; June 6-10, 1995, Houston

An introductory program designed to provide a basic but thorough survey of the theoretical and practical aspects of corrosion and corrosion control. Cost: $625 member; $725 nonmember.

Cathodic Protection—An Introduction—September 18-23, 1994; March 5-10, 1995; June 4-9 1995, Houston

This week-long course presents the basic principles and applications of galvanic and impressed current cathodic protection systems. Cost: $625 member; $725 nonmember.

Cathodic Protection-Theory and Data Interpretation—September 18-23, 1994, Houston

An advanced course providing an in-depth explanation of the operating characteristics of galvanic and impressed current cathodic protection systems. Cost: $625 member; $725 nonmember.

Cathodic Protection Design—September 18-23, 1994, Houston

This course covers the basic methodology and principles involved in the design of effective cathodic protection systems. It also reviews cathodic protection applications and provides practical design examples and sample calculations. Cost: $625 member; $725 nonmember.

Corrosion Control in Oil and Gas Production—September 18-23, 1994; June 4-9, 1995, Houston

Gives an overview of corrosion control in the oil and gas industry, and establishes an appreciation of the advantages to an integrated approach. Cost: $625 member; $725 nonmember.

Protective Coatings and Linings—September 18-23, 1994; June 4-9, 1995, Houston

Offers both theoretical and practical information on the use of coatings and linings for corrosion control, and discusses the economic benefits derived from proper selection and application. Cost: $625 member; $725 nonmember.

Designing for Corrosion Control—September 18-23, 1994; June 4-9, 1995, Houston

Reviews the principles of corrosion and corrosion control, and provides a systematic method for applying corrosion prevention to the design process. Covers economic considerations, allowing the student to effectively communicate with both the technologically and financially oriented management groups. Cost: $625 member; $725 nonmember.

Microbiological Influenced Corrosion—September 18-23, 1994; March 5-10, 1995; June 4-9, 1995, Houston

This course will provide the student with a practical understanding of what microbiologically influenced is and how it causes and influences corrosion. Methods of identification and detection of MIC, options in treatment of existing MIC in pipeline, offshore rigs, manufacturing facilities, water treatment plants, and various industrial process systems will be reviewed. Techniques for the prevention of MIC in various locations and situation will be presented. Cost: $625 member; $725 nonmember.

Contact: NACE International, Membership Services Department, 1440 South Creek Dr., Houston, TX 77082; (713) 492-0535, Ext. 80.

East Texas Section of NACE International

Course Corr. 2410.61 Atmospheric Coatings—August 29-December 16, 1994, Kilgore College, Kilgore, TX

This course is part of a two-year corrosion technology degree and is an in-depth study of atmospheric corrosion control including theory and laboratory work in coatings, surface preparation, and application.

Contact: Office of Admissions, Kilgore College, 1100 Broadway, Kilgore, TX 75662; (903) 983-3900; Fax: (903) 983-8600.

VIRGINIA

American Chemical Society

Polymer Chemistry: Principles and Practice—August 14-19, 1994; December 4-9, 1994, Virginia Tech, Blacksburg, VA

This 5-1/2 day session covers polymer synthesis, molecular weight determination, characterization of rheological and viscoelastic behavior, polymer structure and morphology, mechanical testing, elastomers, plastics, and fibers, examples from fields of adhesion and composites, measurement of properties of polymers, which are then discussed as functions of chemical composition, molecular weight, topology, morphology, etc. Cost: $1850 ACS member; $2050 nonmember.

Polymer Synthesis: Fundamentals and Techniques—June 19-24, 1994, Virginia Tech, Blacksburg

This session covers choice of solvents and reaction conditions, preparation of specimens for testing, types of tests, kinetics and thermodynamics of polymerization (practical), hands-on preparations involving all major classes of polymerization. Cost: $1840 ACS member; $1990 nonmember.

Contact: American Chemical Society, Department of Continuing Education, Meeting Code PCPP94, 1155 Sixteenth St., N.W., Washington, DC 20036; Fax: (202) 872-6336.

HunterLab

Computer Color Matching Seminar—March 22-24, 1995, Reston, VA

This color matching seminar provides a review of basic color theory. After review, you will be introduced to the theory and application of colorant formulation in industries such as coatings, plastics, textiles, and inks. Guidelines for beginning and maintaining a computer color recipe prediction system are also discussed. Topics include: color theory review, subtractive color mixing, spectral color matching, spectral curves of colorants, theory of colorant formulation, creating a colorant database. Tuition: $595 per person for two days of Color Matching Theory plus an optional third day at an extra $100 for software training on Match Maker and Easy Match; includes continental breakfast and lunch.

Appearance Workshop—October 12-14, 1994; February 22-24, 1995; April 5-7, 1995; June 7-9, 1995, Reston

This program is a 2-1/2 day color theory workshop held near our headquarters in northern Virginia. The workshop combines classroom lecture and hands-on experiments, and discussions of color theory; the effects of geometric attributes such as gloss and haze on product color and appearance; and thorough descriptions of colorimetry and spectrophotometry. Also, a copy of *The Measurement of Appearance, Second Edition* by Richard S. Hunter and Richard W. Harold will be provided with each registration for your continued study and reference. Topics include: visual color order systems, object and light interaction, color scales/color difference scales, gloss, instrument types/instrument geometries, measurement applications, visual assessment, color mixing. Tuition: $795, includes continental breakfast and lunch each day.

Contact: Seminar Coordinator, Hunter Associates Laboratory, Inc., 11491 Sunset Hills Rd., Reston, VA 22090; (703) 471-6870; Fax: (703) 471-4237.

WASHINGTON

Pacific Northwest Society for Coatings Technology, Puget Sound Section

Basic Coatings for Sales and Marketing Personnel—January 1995, Renton Technical College, Renton, WA

A basic coatings course designed especially to aid sales and marketing people in understanding paint composition and how it relates to performance and cost. Matching customers specification and testing requirements to specific generic types and proprietary paint and coatings formulations. Fee: $95 member; $140 nonmember.

Contact: Beverly Spears, Priestley Oil & Chemical Co., 4510 B St., N.W., Auburn, WA 98001; (206) 859-2979; Fax: (206) 859-3020.

National Association of Corrosion Engineers

Lead Abatement Seminar—May 14-17, 1995, Seattle, WA

A complete overview of new regulations and how to comply with federal and state laws; testing and inspection techniques and evaluation; personnel hazards and protective measures; methods of abatement and containment; and procedures testing, disposing of lead-based paint waste. Cost to be determined.

Session I—Basic Coating Inspection—November 13-19, 1994, Seattle

An intensive presentation of the basic technology of coating application and inspection. This session involves lectures, demonstrations, and hands-on training with equipment and instruments in an actual working shop. Upon successful completion of Session I, the participant will have attained industry-accepted NACE Basic Coating Inspector Training recognition. Cost: $1675 member; $1775 nonmember.

Session II—Intermediate Coating Inspection—November 13-18, 1994, Seattle

Focuses on shop coating processes for steel, advanced inspection techniques, and introduces more sophisticated nondestructive tests and test instruments. Cost: $850 member; $950 nonmember.

Session III—Advanced Coating Inspection—November 13-17, 1994, Seattle

Covers specialized application methods and substrates other than steel. Persons who successfully complete Sessions I, II, and III will attain NACE Intermediate Coating Inspector Training recognition. Cost: $850 member; $950 Non member.

Contact: NACE International, Membership Services Department, 1440 South Creek Dr., Houston, TX 77082; (713) 492-0535, Ext. 80.

WISCONSIN

Integrated Paper Services, Inc.

Coating Chemistry and Technology—September 6-8, 1994, Integrated Paper Services, Inc., Appleton, WI

This course covers all aspects of coating—the paper grades used, coating application, raw materials, end uses, and recycled fibers in coating papers. Limit 30. Fee: $895.

Contact: Integrated Paper Services, Inc. 101 W. Edison Ave., Appleton, WI 54912-0446; (414) 749-3040.

International

CANADA

Toronto Society for Coatings Technology

(Coating Technology—Three Semester Program (individual courses running consecutively). Course location: George Brown College, 200 King St. East, Toronto, Ontario.)

Semester 1—Coating Raw Materials (COAT 9120)—September 7, 1995

Topics include: oils and varnishes, alkyd resins, polyesters, vinyls and amino resins, epoxy, phenolics and silicone resins, acrylics, urethanes and cellulosics, solvents, waterborne resins and emulsions, driers and additives, pigments–physical properties, white and extender pigments, organic colored pigments, blacks and inorganic pigments. Cost $360 CAN.

Semester 2—Trade Sales and Architectural Coatings (COAT 9140)—September 8, 1994

Review of trade sales paint resins, coatings calculations, dispersion process and equipment, pigments and tinting systems, instrumental color matching, oil based formulations, formulating latex paints (two lectures), special formulating know-how, manufacturing methods, exterior durability, quality control. Cost: $360 CAN.

Semester 3—Industrial Coatings (COAT 9160)—January 5, 1995

Review of industrial coatings resins, corrosion, surface preparation and primers, pigments, dispersion and equipment, automotive coatings (OEM), automotive refinish coatings, powder coatings, wood finishes, application methods and equipment, statistical process and quality, environmental and government regulations. Cost: $360 CAN.

Courses will also be offered as "Distance Learning Program."

Contact: Walter Fibiger, ITE Consultants, 86 Castlebury Cr., Unit 17, Willowdale, Ontario, M2H 1W8, Canada; (416) 490-9314.

Pacific Northwest Society for Coatings Technology and British Columbia Paint Manufacturers' Association

Introduction to Paint Technology . .nid-January to mid-March (eight weeks), Kwantlen College, N.wton Campus, Surrey, B.C., Canada

Objective of the course is to provide an introduction to coatings technology, formulation and coatings use. Cost: $165 CAN.

Contact: Dave Pasin, Gibson Paint, 12255 King George Hwy., Surrey, B.C. V3V 3R9, Canada; (604) 580-1575; Fax: (604) 580-1965.

National Association of Corrosion Engineers

Session I—Basic Coating Inspection—October 30-November 5, 1994, Calgary, Alberta, Can.

An intensive presentation of the basic technology of coating application and inspection. This session involves lectures, demonstrations, and hands-on training with equipment and instruments in an actual working shop. Upon successful completion of Session I, the participant will have attained industry-accepted NACE Basic Coating Inspector Training recognition. Cost: $1675 member; $1775 nonmember.

Session II—Intermediate Coating Inspection—October 30-November 4, 1994, Calgary, Alberta

Focuses on shop coating processes for steel, advanced inspection techniques, and introduces more sophisticated nondestructive tests and test instruments. Cost: $850 member; $950 nonmember.

Contact: NACE International, Membership Services Department, 1440 South Creek Dr., Houston, TX 77082; (713) 492-0535, Ext. 80.

Society of Manufacturing Engineers (SME) and the Association for Finishing Processes of SME (AFP/SME)

Industrial Painting Processes—June 7-8, 1994, Toronto, Ont.

Developing Effective Powder Coating applications—September 27-28, 1994, Toronto

Advanced Powder Systems Troubleshooting—September 29, 1994, Toronto

Contact: Maria Conrado, Event Administrator, SME, One SME Dr., P.O. Box 930, Dearborn, MI 48121; (313) 271-1500; Fax: (313) 271-2861.

MEXICO

Federation of Societies for Coatings Technology

1995 Spring Week Seminar—May 15-17, 1995, Cancun, Mexico

Contact: Federation of Societies for Coatings Technology, 492 Norristown Rd., Blue Bell, PA 19422; (215) 940-0777; Fax: (215) 940-0292.

NEW FOUNDLAND

National Association of Corrosion Engineers

Session I—Basic Coating Inspection—July 10-15, 1994, St. Johns, New Foundland

An intensive presentation of the basic technology of coating application and inspection. This session involves lectures, demonstrations, and hands-on training with equipment and instruments in an actual working shop. Upon successful completion of Session I, the participant will have attained industry-accepted NACE Basic Coating Inspector Training recognition. Cost: $1675 member; $1775 nonmember.

BAHRAIN

National Association of Corrosion Engineers

Session I—Basic Coating Inspection—July 2-8 1994, Bahrain

An intensive presentation of the basic technology of coating application and inspection. This session involves lectures, demonstrations, and hands-on training with equipment and instruments in an actual working shop. Upon successful completion of Session I, the participant will have attained industry-accepted NACE Basic Coating Inspector Training recognition. Cost: $1675 member; $1775 nonmember.

Session II—Intermediate Coating Inspection—July 9-14, 1994, Bahrain

Focuses on shop coating processes for steel, advanced inspection techniques, and introduces more sophisticated nondestruc-

tive tests and test instruments. Cost: $850 member; $950 nonmember.

Contact: NACE International, Membership Services Department, 1440 South Creek Dr., Houston, TX 77082; (713) 492-0535, Ext. 80.

HONG KONG

NATIONAL ASSOCIATION OF CORROSION ENGINEERS

Session I—Basic Coating Inspection—June 26-July 2, 1994, Hong Kong

An intensive presentation of the basic technology of coating application and inspection. This session involves lectures, demonstrations, and hands-on training with equipment and instruments in an actual working shop. Upon successful completion of Session I, the participant will have attained industry-accepted NACE Basic Coating Inspector Training recognition. Cost: $1675 member; $1775 nonmember.

Session II—Intermediate Coating Inspection—July 3-8, 1994, Hong Kong

Focuses on shop coating processes for steel, advanced inspection techniques, and introduces more sophisticated nondestructive tests and test instruments. Cost: $850 member; $950 nonmember.

Contact: NACE International, Membership Services Department, 1440 South Creek Dr., Houston, TX 77082; (713) 492-0535, Ext. 80.

SINGAPORE

NATIONAL ASSOCIATION OF CORROSION ENGINEERS

Session I—Basic Coating Inspection—June 12-17, 1994, Singapore

An intensive presentation of the basic technology of coating application and inspection. This session involves lectures, demonstrations, and hands-on training with equipment and instruments in an actual working shop. Upon successful completion of Session I, the participant will have attained industry-accepted NACE Basic Coating Inspector Training recognition. Cost: $1675 member; $1775 nonmember.

Session II—Intermediate Coating Inspection—June 19-24, 1994, Singapore

Focuses on shop coating processes for steel, advanced inspection techniques, and introduces more sophisticated nondestructive tests and test instruments. Cost: $850 member; $950 nonmember.

Contact: NACE International, Membership Services Department, 1440 South Creek Dr., Houston, TX 77082; (713) 492-0535, Ext. 80.

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NPCA Reports on TRI Expansion and Reg-Neg Rules; Seeks Entries for Pollution Prevention Awards Program

The National Paint and Coatings Association (NPCA), Washington, D.C., has submitted comments to the U.S. Environmental Protection Agency (EPA) in response to a proposed rule to expand the Toxic Release Inventory (TRI) chemical list under the Emergency Planning and Community Right-To-Know Act (EPCRA) Section 313.

In January, EPA proposed the addition of 313 chemicals and chemical categories, stating that these chemicals and chemical categories meet the criteria for listing as defined under EPCRA Section 313, based on thorough review of the acute and chronic human health effects, carcinogenicity, and/or environmental effects.

NPCA stated in its comments that the proposed rulemaking, which would double the reporting list of chemicals and chemical categories, exceeds a clear congressional mandate that chemicals be listed on a reasonable basis and would create a substantial burden on all entities required to comply. In addition, NPCA detailed a number of objections to the proposal, including: (1) EPA's proposed listing expansion is largely arbitrary, scientifically unfounded, and ignores its congressional mandate to analyze actual toxicity, dose level, and the potential for exposure for each chemical; (2) the arbitrariness of this proposed listing expansion is compounded by the near impossibility of receiving a subsequent delisting for an individual chemical, due to the requirement that a petitioner disprove presumptions for all the criteria involved, not merely the criterion for which it was purportedly listed; and (3) the proposed rule violates an executive order that requires EPA to prioritize based on risk and to look seriously at practical regulatory alternatives, ignores its obligations under the Regulatory Flexibility Act, and misstates the burden under the Paperwork Reduction Act, especially for small businesses.

EPA Issues Draft Rules

The efforts of the EPA and the participants in the regulatory negotiation (reg-neg) for the wood furniture and kitchen cabinet manufacturing industries have resulted in EPA's issuance of two draft rules. The rules contain the consensus which has been achieved to date by the reg-neg participants for further consideration.

The EPA has issued a draft model volatile organic compound (VOC) rule for committee review. This will provide guidance to the states as they continue to review and refine their state implementation plans (SIPs) for the control of VOCs in ozone nonattainment areas. Due to the tight EPA deadline for issuing this document to the states, this document received its initial industry review before the April 21 Industry Caucus meeting. EPA eventually hopes to issue the draft model rule as a control technique guideline, but has decided to issue the guidance as a draft model rule in order to get the gist of the agreement to state and local regulators as quickly as possible.

Another rule, a draft National Emission Standard for Hazardous Air Pollutants (NESHAP), along with an extensive background document which explains the technical and legal basis for the NESHAP, was issued by the EPA for review by the various caucuses last week. The draft NESHAP contains emissions control levels and work practice strategies which constitute maximum achievable control technology (MACT). It also provides useful information on the regulatory background of the documents, the applicability of the standards, and the compliance, monitoring, and recordkeeping requirements under which those sources covered by the rule will have to operate. The documents will also contain extensive information on the various impacts of the regulation, including economic, environmental, and cost.

While the draft NESHAP covers most of the issues under consideration by the reg-neg committee, the committee has not reached consensus on some key issues. The first of these issues relates to the comparative toxicity of various hazardous air pollutants (HAPs) which are used in wood furniture coatings. The industry caucus has reviewed a proposal which would impose caps on the use of certain HAPs of high concern. Another unresolved issue pertains to incorporating washcoats, another coating step, into a compliant coatings approach to MACT. In this case, some furniture manufacturers make washcoat by thinning topcoats and/or sealers with solvent. Using a solvent which contains HAPs has raised concerns that doing so might cause those washcoats to exceed the proposed compliance level.

EPA is developing a national regulatory program for wood furniture manufacturing under the authority of the Clean Air Act. The agency's use of the reg-neg process is

(Continued on next page.)

Nominations for the 1995 Roy W. Tess Award Sought by the American Chemical Society

The American Chemical Society's (ACS) Division of Polymeric Materials: Science and Engineering (PMSE), Washington, D.C. is seeking nominations for the Roy W. Tess Award in Coatings.

This award, for $1000, will be presented at the 210th meeting of the ACS, August 20-24, 1995, in Chicago, IL.

This major award, which recognizes outstanding individual achievements and noteworthy contributions to coatings science, technology, and engineering, confirms PMSE's long-standing and continuing support and dedication to excellence in the coatings field. The Tess Award is chaired by George R. Pilcher, of Akzo Coatings, Inc. The distinguished members of the Nominating Committee are: Gordon P. Bierwagen—North Dakota State University; Donald W. Boyd—PPG Industries, Inc.; Robert F. Brady Jr.—Naval Research Laboratory; and Frank N. Jones—Coatings Research Institute, Eastern Michigan University.

Nominations will be welcomed from all sections of industry, academia, and government and should be forwarded to George R. Pilcher, Akzo Coatings, Inc., P.O. Box 489, Columbus, OH 43216-0489.

Upon receipt of names, the Chairman will provide a documentation form requesting information on the nominee relevant to patents, publications, and overall qualifications. All finalized nominations for the 1995 Tess Award should be submitted prior to September 1, 1994, although nominations received after that date will be considered for the succeeding year's award.

March Construction Contracts Advance One Percent

According to the F.W. Dodge Division of McGraw Hill, New York, NY, contracting for new construction in March climbed one percent over February's totals. With the value of residential contracts holding steady, a sharp rise for nonresidential building outweighed a retreat for nonbuilding construction (public works and utilities).

The latest month's data raised the seasonally adjusted Dodge Index to 110 (1987=100), up from February's revised 108 and equaling the high reached in October. Following October's peak, the Index had experienced modest slippage in falling to January's 106, before rebounding in the subsequent two months.

Nonresidential construction in March climbed 14%, showing across-the-board strengthening in its commercial, industrial, and institutional components. The annualized dollar amount of contracting, at $98.3 billion, was the strongest rate since July 1990 and provided a good measure of this market's improving status. Commercial building bounced back from a lackluster February, led by a further gain for the already strong store and shopping center category. Offices also contributed with a sharp upturn, helped by the inclusion of several large projects in March's data. March also witnessed further growth for the institutional building categories, particularly school construction, giving firmer evidence that this sector is finally moving beyond the sluggish pace of the past two years.

Residential construction was unchanged in March from its February total. The value of single family starts slipped back slightly, but a rebound by multifamily housing from an especially weak February made up the difference. Regionally, earlier strength shown by the South Atlantic, South Central, and the West subsided, while the Northeast and Midwest registered gains.

Nonbuilding construction, following the burst of activity reported in February, fell back 12% in returning to a more sustainable pace. February drew support from the start of several large power plant projects, so a more typical month in March resulted in a two-thirds decline for utilities. The public works categories eased back a manageable three percent—still remaining eight percent above the average rate posted by this sector in 1993. Highway construction in particular this year is benefiting from the greater funding available from the current transportation legislation.

At the end of three months, total construction contract value on an unadjusted basis was up nine percent over the same period a year ago. The West led all regions with 21% improvement compared with its weak first quarter last year, while the Midwest was second with a gain of 17%. January-March activity in the South Central advanced 12%, while the South Atlantic rose a more subdued three percent. The Northeast, affected by harsh winter weather, was down 13% from 1993's first three months.

Cerdec's MMO Division Undertakes U.S. Sales

Cerdec Corp., Drakenfeld Products' Mixed Metal Oxide (MMO) Division, Washington, PA, will assume total responsibility for the domestic MMO sales from CIBA-GEIGY Corp. U.S. The MMO division was formed one year ago when Cerdec was created as a joint venture between CIBA-GEIGY Corp., Ardsley, NY, and Degussa AG, Frankfurt, Germany.

The MMO Division will continue to sell mixed metal oxides outside the U.S. to the plastics, fiber, coatings, and printing inks industries through worldwide distributor agreements established with CIBA-GEIGY group companies. Distributor agreements have been established in Canada, Mexico, Eastern and Western Europe, Central America, the Middle East, and Pacific Rim. Agreements in Latin and South America are pending.

Spectra-Tech Relocates

Spectra-Tech, Inc. has moved from Stamford, CT, to a new, larger facility in Shelton, CT. The building is over 50,000 square feet and will provide the company with expansion capabilities for manufacturing and research and development. The new address: Spectra-Tech, Inc., 2 Research Dr., P.O. Box 869, Shelton, CT 06484-0869.

NPCA Reports on EPA Issues and Rules; Seeks Entries for Pollution Prevention Awards

(Continued from previous page.)

authorized and set forth under the Federal Advisory Committee Act and the Negotiated Rulemaking Act of 1990. After these consensus rules are completed through negotiations, they will then undergo traditional regulatory public notice and comment procedures.

Reg-Neg Participants Await New EPA Draft

The Keystone Center, which serves as the convener for the architectural and industrial maintenance (AIM) coatings regulatory negotiation (reg-neg), recently informed NPCA and other reg-neg participants that the EPA is continuing to review various issues raised at the last full reg-neg meeting, held February 3-4.

At this meeting, discussions centered on a proposal submitted by the ALARM Caucus, as well as a draft proposal issued by EPA in late January. The reg-neg was convened in fall 1992 to draft a national regulatory program for reducing VOC emissions from AIM coatings.

Keystone said EPA considered the progress at the February meeting adequate to proceed with development of a draft rule. Following its review of certain key issues, EPA is expected to issue another "discussion draft" for review by the full reg-neg committee before the agency issues a notice of proposed rulemaking in the *Federal Register*.

Keystone stated that it has not been determined whether the reg-neg committee will review the draft in a full committee meeting or individually.

In a related development, the April 25 *Federal Register* contained a notice that the EPA expects to issue a notice of proposed rulemaking regarding the AIM VOC regulation in July 1994.

Key issues reportedly under review by EPA are the development of tables of standards for the years 2000 and 2004, as well as possible use of a fee system.

Entries Accepted for Pollution Prevention Awards

NPCA is now accepting entries for the 1994 Pollution Prevention Awards

The program recognizes outstanding achievements by NPCA members in protecting the environment by incorporating waste minimization and/or toxics reduction strategies into their manufacturing operations. While all types of pollution prevention or reduction programs are considered for the awards program, special consideration is given to pollution prevention techniques that also demonstrate financial savings. Techniques should be reproducible for the benefit of other paint manufacturers.

Awards will be presented at NPCA's Annual Meeting in New Orleans, LA, Oct. 10-12. Eligibility is limited to programs that have been in operation at least six months prior to the date of submission. In the interest of fairness, the production volume of each company is taken into consideration during the judging process. The deadline for entries is August 15, 1994.

For additional information, contact NPCA's Soonie McDavid, 1500 Rhode Island Ave., N.W., Washington, D.C. 20005.

A Kinetic Study of the Reaction of Epoxidized Rubber and Carboxylic Acids

J. Kyle Copeland and Shelby F. Thames
University of Southern Mississippi*

The coatings industry has long been interested in nontoxic multifunctional crosslinking agents that do not emit volatile organic compounds (VOCs) during curing. Ring opening of epoxides is an ideal chemical reaction for there are no accompanying VOCs. Therefore, we have investigated the feasibility of a novel epoxide reagent as a multifunctional crosslinking agent. Specifically, epoxidized poly-*cis*-isoprene has been synthesized and evaluated as a reactant with a variety of carboxylic acids via isothermal differential scanning calorimetry. Accordingly, we have measured the reaction enthalpy at various temperatures and reactant concentrations. The change in heat flow with time is proportional to the change in the reactant concentration with time since ring opening of epoxides with carboxylic acids gives chain modification via ester formation.

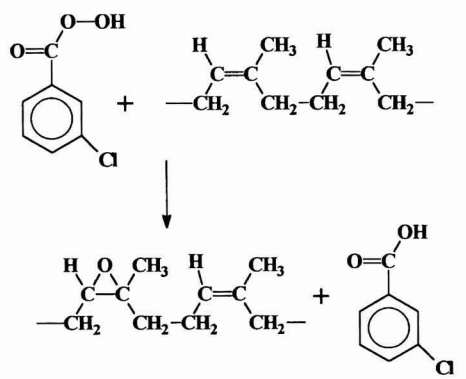
We have also determined the reaction order and energy of activation. Three acids ranging in pKa from 1.26 to 4.95 were studied and provided activation energies ranging from 42.9 to 115.9 kJ/mol. The reaction order was determined to be first order in acid.

INTRODUCTION

Epoxidized rubber is synthesized via the reaction of natural rubber (poly-*cis*-isoprene) and one of several peracids, whereby the polyisoprene unsaturation is replaced by an epoxide group (*Scheme* 1). The unique properties of epoxidized natural rubber have been the subject of numerous investigations, although its applications in coatings compositions is essentially nil. It is known that the properties of epoxidized rubber vary greatly as the epoxide concentration increases from 0 to 100 mole percent,[1] and therefore, we studied its effect in coatings compositions.

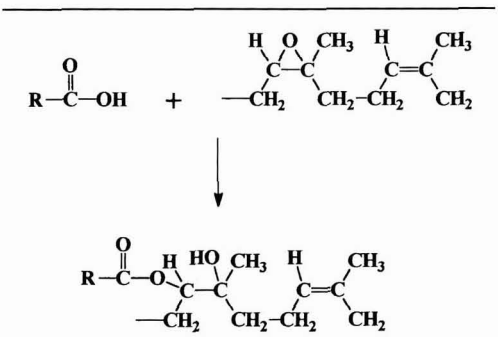
The epoxidation of natural rubber engenders increased density, improved solvent resistance, tensile strength, and wear resistance. Prior studies have shown that carboxylic acids react with epoxidized rubber to form esters (*Scheme* 2).[2-4] Amines react with epoxidized rubber in the presence of a catalyst, but at a considerably lower rate than carboxylic acids.[5] In all cases, the reactivity of the epoxide moiety has proven to be low.

This study focuses on the relative reactivity of epoxidized natural rubber with three carboxylic acids of varying acidities (stearic acid, pKa = 4.95; *meta*-chlorobenzoic acid, pKa = 3.83; and dichloroacetic acid, pKa = 1.26). A relationship between acidity and temperature of reactivity was determined, thereby establishing conditions for epoxidized rubber



Scheme 1—Synthesis of epoxidized rubber from the reaction of *meta*-chloroperbenzoic acid and natural rubber

*Dept. of Polymer Science, Hattiesburg, MS 39406-0076.



Scheme 2—Reaction of carboxylic acid and epoxidized rubber

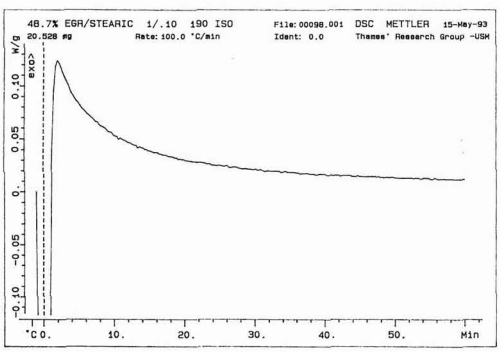


Figure 1—Isothermal DSC scan of epoxidized rubber-stearic acid reaction at 190°C

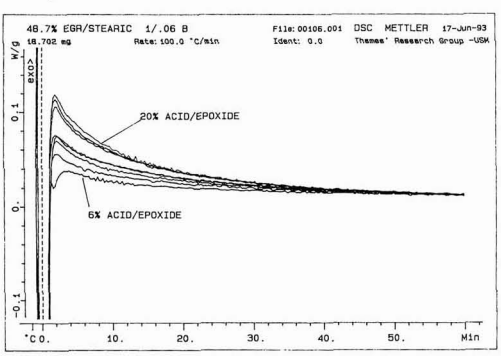


Figure 2—DSC scans of epoxidized rubber-stearic acid reactions with changing acid concentration

to be useful as a nontoxic, nonvolatile organic compound (VOC) contributing crosslinking agent. To simplify the study, only monofunctional carboxylic acids were used as model compounds.

EXPERIMENTAL

Materials

All carboxylic acids and *meta*-chloroperbenzoic acid were purchased from Aldrich Chemical Co. and used as supplied. Low molecular weight-guayule natural rubber was obtained from Firestone and purified by dissolution into methylene chloride followed by precipitation into ethanol and drying to a constant weight.

Preparation of Epoxidized Rubber

Low molecular weight guayule rubber was dissolved in methylene chloride and a calculated amount of *meta*-chloroperbenzoic acid (in a methylene chloride solution) was added dropwise, to yield 50% epoxidation.[6] The reaction was performed at 0°C for 45 min and was buffered with potassium carbonate to scavenge the benzoic acid by-product. The potassium benzoate formed was subsequently removed by vacuum filtration through diatomaceous silica. Proton NMR confirmed 48.7% epoxidation of the available vinyl groups.[7] The epoxidized rubber was dried, weighed, and redissolved in methylene chloride at a known concentration of 0.1184 g per 2.5 mL.

Preparation of DSC Samples

The acids to be evaluated were added to one-dram vials in amounts between 6 and 20 mole percent of the epoxide groups in 0.1184 g of epoxidized rubber (the amount of rubber in 2.5 mL of the epoxidized rubber/methylene chloride solution). Then, 2.5 mL of the epoxidized rubber solution was added. The samples were shaken for 30 min and the methylene chloride was evaporated under nitrogen overnight.

DSC Analysis

A Mettler DSC30 with nitrogen flow was used for all calorimetry experiments. Samples of approximately 20 mg weight were placed into sample pans and then into the DSC at 60°C. The samples were ramped to the desired reaction temperature at 100°C/min heating rate and held isothermally for 60 min under nitrogen. All data curves were normalized to the same baseline for each acid type in order to compensate for differences between the sample and reference pan weights.

RESULTS AND DISCUSSION

Reaction Order

The heat flow for each sample at a given time is proportional to the change in concentration with time. In this instance, heat flow reaches a maximum at approximately two minutes into the reaction, and a minimum after 30 to 60

min, when the concentration of free carboxylic acids is effectively zero (*Figure* 1). *Figure* 2 shows how the initial rate is affected by the concentration of acids. As expected, the initial heat flow increases with increasing amounts of acids. Since the maximum heat flow shown on the DSC thermogram does not correspond to the initial rate, the plot must be extrapolated to time zero to obtain the maximum initial heat flow and thus the initial rate.[2] The point where each plot would intersect time zero is the initial heat flow.

$$\frac{d[COOH]}{dt} = k[Epoxide]^m[COOH]^n \quad (1)$$

$$\frac{dH}{dt} = C\left(\frac{d[COOH]}{dt}\right) \quad (2)$$

Here, C is the constant relating d[COOH]/dt to dH/dt. Therefore, the following can be written:

$$\frac{dH}{dt} = Ck[Epoxide]^m[COOH]^n \quad (3)$$

This equation can be put into linear form. Hence, a plot of the log of dH/dt versus the log of the acid concentration will confirm the reaction order with respect to the acid (*Figure* 3).

$$\log\frac{dH}{dt} = \log(Ck[Epoxide]^m) + n\log[COOH] \quad (4)$$

The reaction orders for *meta*-chlorobenzoic acid and stearic acid were determined to be 1.18 and 1.25, respectively. The values are within experimental error of a first order dependence on acid. The reaction order for dichloroacetic acid was not determined.

Energy of Activation

The energy of activation of each reaction is determined in a similar manner as the reaction order. In this case, the concentration is kept constant and the isothermal temperature is changed for each sample. Therefore,

$$\frac{dH}{dt} = Ck[Epoxide]^m[COOH]^n = (AC[Epoxide]^m[COOH]^n)e^{-\frac{E_a}{RT}} \quad (5)$$

Now, as before, this equation is put into linear form to obtain the following relationship:

$$\ln\frac{dH}{dt} = \ln(AC[Epoxide]^m[COOH]^n) - \left(\frac{E_a}{R}\right)\frac{1}{T} \quad (6)$$

As the temperature of each of the samples changes, the heat flow also changes (*Figure* 4). Thus, a plot of the natural log of the initial heat flow versus 1/T gives a line whose slope is equal to $-E_a/R$, thus the energy of activation is determined (*Figure* 5).

Comparison of the Acids

The pKa values in water for stearic acid, *meta*-chlorobenzoic acid, and dichloroacetic acid are 4.95, 3.83, and 1.26, respectively. An acid with a lower pKa value is expected to be more reactive and hence exhibit a lower activation energy. However, this did not prove to be the case.

An activation energy of 87.16 kJ/mol was determined for stearic acid. Since its pKa is relatively high, this low reactivity was expected.

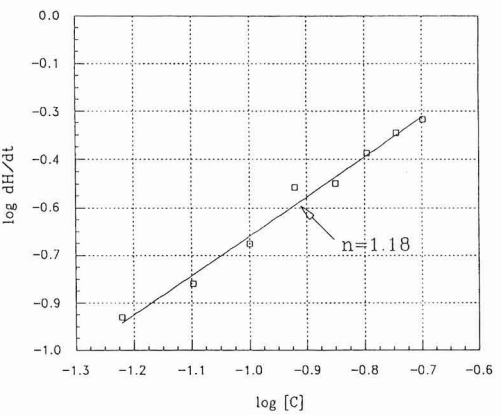


Figure 3—Plot of the log of the initial heat flow versus the log of the reactant concentration

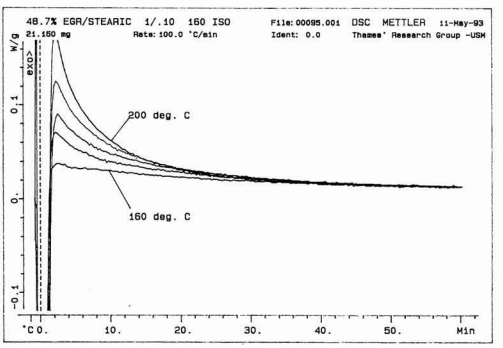


Figure 4—DSC scans of epoxidized rubber-stearic acid reactions with changing temperature

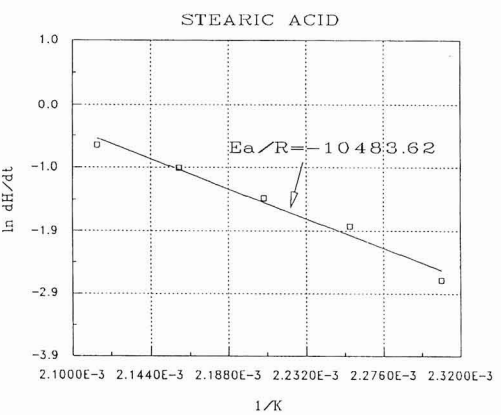


Figure 5—Plot of the natural log of the initial heat flow versus temperature^{-1}

The activation energy of *meta*-chlorobenzoic acid, a considerably more reactive moiety than stearic acid, followed the expected trend with an activation energy of 42.90 kJ/mol.

Dichloroacetic acid, on the other hand, was much less reactive with an activation energy of 115.96 kJ/mol. Based on pKa alone, this acid was expected to have the lowest activation energy. One possible explanation for this observation is that the bulky chlorine atoms retard this already sterically hindered reaction.

CONCLUSION

These data were collected in an effort to determine the viability of using epoxidized rubber as a multifunctional crosslinking reagent. It is apparent that the reactivity of the rubber is low, and due primarily to steric considerations. Therefore, the choice of acid for epoxide ring opening is critical.

The use of epoxidized natural rubber as a crosslinking agent with carboxylic acids requires certain criteria to be successful. First, the temperatures to cure an epoxidized rubber system must be relatively high. Secondly, a carboxylic acid with a pKa < 3.5 is required to achieve a sufficient curing rate. Finally, the reactive acid must be sterically unencumbered.

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Film Formation from Conventional and Miniemulsion Latex Systems Containing Dimethyl Meta-Isopropenyl Benzyl Isocyanate (TMI®)—A Functional Monomer/ Crosslinking Agent

Yoshimi Inaba,† Eric S. Daniels, and Mohamed S. El-Aasser
Lehigh University*

A series of model styrene (St)/n-butyl acrylate (BA) copolymer latexes with glass transition temperatures below room temperature were prepared by either conventional or miniemulsion polymerization techniques as model systems for studies of film formation. The functional monomer TMI® (META) (dimethyl meta-isopropenyl benzyl isocyanate) was used as a functional monomer/crosslinking agent. A small amount of methacrylic acid (MAA) was introduced in some formulations to enhance the crosslinking reactions. A redox initiation system was used to reduce premature crosslinking during the polymerization. A combination of an ionic surfactant (sodium lauryl sulfate) and co-surfactant (hexadecane or cetyl alcohol) was used as the mixed emulsifier for the miniemulsion system.

This paper describes the performance of TMI as a crosslinking agent and the effects of the combination of TMI and MAA on the latex film formation process.

INTRODUCTION

Water-based resins and latexes that are capable of being cured at low temperatures are becoming increasingly more important in meeting stringent environmental regulations for coatings, inks, and adhesives applications. The basic objective of this work was to study the film formation process and final film properties of waterborne latexes containing functional groups which are capable of undergoing low temperature crosslinking reactions. These latexes were formulated using miniemulsion and conventional emulsion polymerization techniques which resulted in the formation of polymer films at moderate temperatures.

The preparation of miniemulsions involves the use of a mixture of an ionic emulsifier and a long-chain fatty alcohol or alkane as a co-surfactant and utilizes an emulsification technique.[1-5] The miniemulsification technique has been used to prepare oil/water (o/w) emulsions with droplet sizes between 0.05 and 0.5 μm; these miniemulsions are fluid, milky, and opaque. In general, aging experiments have shown that miniemulsions comprised of an oil phase with a relatively high water solubility became unstable at a faster rate.[2] Therefore, a series of model styrene (St)/n-butyl acrylate (BA) copolymer latexes were prepared by either conventional or miniemulsion polymerization of the corresponding monomers as hydrophobic model systems for studies of film formation. The n-butyl acrylate was used to lower the glass transition temperature (T_g), of the copolymer, such that continuous latex films are formed at room temperature. The copolymer was formulated to achieve a calculated T_g (using the Fox equation[6]) of approximately 0°C; for this purpose the compounding ratio of St and BA used throughout this study as a standard recipe was maintained at a 1:1 weight ratio.

A combination of an ionic surfactant, sodium lauryl sulfate (SLS) and co-surfactant, hexadecane (HD) or cetyl alcohol (CA) was used as the mixed emulsifier for the mini-

*Emulsion Polymers Institute and Dept. of Chemical Engineering, Bethlehem, PA 18015.
†Toppan Printing Co., Ltd., Sugito-machi, Kitakatsushika-gun, Saitama 345, Japan.

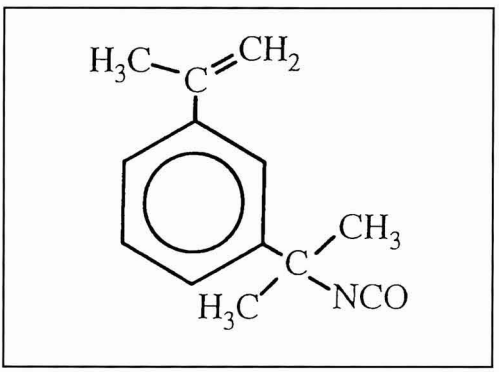

Figure 1—Chemical structure of TMI

emulsion system. Generally, the most stable miniemulsions prepared from styrene monomer have been found to be formed at ionic surfactant/fatty alcohol (e.g., CA) molar ratios between 1:1 and 1:3, with a minimum chain length of C_{12} for the fatty alcohol.[3] In the case where a long chain alkane (e.g., HD) was used as the co-surfactant, Rodriguez et al.[4] suggested that the surfactant/alkane molar ratio needs to be at least 1:4 to form the most stable miniemulsions. Based on previous studies on miniemulsions aforementioned, a 1:3 molar ratio of SLS/CA or a 1:4 molar ratio of SLS/HD was employed in this study in a standard recipe. The functional monomer TMI® (META) (dimethyl meta-isopropenyl benzyl isocyanate; CYTEC Industries/American Cyanamid Co.) (*Figure* 1) was used as a crosslinking agent. TMI is a bifunctional monomer containing a reactive double bond and a tertiary aliphatic isocyanate group. Its structure can be utilized to carry out free radical copolymerization with unsaturated monomers. The isocyanate group in the TMI molecule can be reacted with a variety of functional groups, such as the carboxyl group present in methacrylic acid (MAA). Therefore, a small amount of MAA was introduced in some formulations to enhance the crosslinking reactions. A redox initiation system was employed to polymerize the comonomer miniemulsions at a low temperature in order to reduce premature crosslinking during polymerization. Ammonium persulfate, potassium metabisulfite, and ammonium iron (II) sulfate hexahydrate were used as oxidant, reductant, and activator, respectively.

Table 1—Recipe Used to Prepare Miniemulsion Latexes with Varing Crosslinking Agent Concentrations

Ingredients	Amount (g)
Styrene (St)	12.00
n-Butyl acrylate (n-BA)	12.00
Methacrylic acid (MAA)	0.041–1.65
Dimethyl meta-isopropenyl benzyl isocyanate (TMI)	0.082–4.95
Sodium lauryl sulfate (SLS)	0.765
Hexadecane (HD)	2.403 (SLS/HD molar ratio = 1:4)
Ammonium persulfate	0.085
Potassium metabisulfite	0.085
Ammonium iron (II) sulfate hexahydrate	0.009
DDI water	58.28

Note: Polymerization temperature = 40°C.

The experimental work presented in this paper is intended to describe the influence of the following parameters on the latex particle size and degree of crosslinking of the dried latex films: the crosslinking agent concentration in miniemulsion latexes, the initiator concentration, the St/BA ratio, the emulsifier concentration, the type of co-surfactant, TMI/MAA ratio, and the polymerization method. The film properties were evaluated as a function of drying conditions of the latex systems.

EXPERIMENTAL

Materials

The sodium lauryl sulfate (SLS) (Ultrapure, United States Biochemical Corp.), hexadecane (HD) (Aldrich Chemical Co., Inc.), and cetyl alcohol (CA) (Aldrich), were used as received. Styrene (Aldrich), n-butyl acrylate (Aldrich), and methacrylic acid (Aldrich) monomers were purified by passing them through an inhibitor removal column before use (Aldrich—used to remove tert-butylcatechol from styrene or hydroquinone monomethyl ether from n-butyl acrylate and methacrylic acid to a residual level < 1 ppm at 4 bed volumes/h). Dimethyl meta-isopropenyl benzyl isocyanate (TMI) monomer was employed without additional treatment. A redox initiator system, comprised of ammonium persulfate (J.T. Baker Chemical Co.), potassium metabisulfite (Mallinckrodt Chemical Works Co.), and ammonium iron (II) sulfate hexahydrate (Aldrich) (typically used in a 1:1:0:1 weight ratio), were also used as received. Distilled-deionized (DDI) water was used in all experiments.

Miniemulsification

Miniemulsions were prepared according to procedures reported previously.[1-5] The cetyl alcohol and sodium lauryl sulfate were mixed together in DDI water with agitation at 65°C for two hours. The organic phase (monomer) was then added to the aqueous solution of the mixed emulsifier at room temperature. The crude emulsion was subjected to ultrasonification for 60 sec using a Sonifier Disruptor W-350 (Branson Sonic Power Co.), operated at 50% duty cycle at a power setting of seven at room temperature. When HD was used as the co-surfactant, it was first dissolved in the organic phase (monomer). This mixture was then added to the aqueous emulsifier sodium lauryl sulfate (SLS) solution at room temperature, and the solution was ultrasonified under the same conditions as described.

Polymerization

All polymerizations were carried out in two-ounce glass bottles. Initiator solution was the last ingredient added to the polymerization bottle, which was then purged with nitrogen. The bottles were then rotated end-over-end at 40 rpm in a thermostated bottle polymerizer unit at 40°C for 24 hr.

Table 2—Determination of Crosslinking Density for the Miniemulsion Latex Films by Equilibrium Swelling

Sample	Amount (wt%)	M_x (g/mol)	Crosslink Density (mole xlink/cm^3)
TMI + MAA	3.0	17200	0.53E – 4
TMI + MAA	15.0	1073	8.54E – 4
TMI only	10.0	34010	0.27 E – 4
TMI only	20.0	12970	0.71E – 4

Note: Drying conditions of films: 75°C for two hours; swelling solvent: toluene; TMI/MAA = 2:1 (by weight).

Evaluation Methods

"Shelf-life stability" tests reflecting the growing droplet sizes of these oil-in-water emulsions were carried out at room temperature for various time periods. Each emulsion was found to separate into two or three phases: an emulsion (top or middle) and/or a monomer phase (top) and an aqueous phase (bottom). The shelf-life stability of the emulsions was evaluated by measuring the percentage of the emulsion phase remaining after a specified time period. The stability studies were necessary to determine the concentration of surfactant which imparted stability to the emulsions for a period of time at least as long as the time required to run the experiments. The final conversions of the synthesized latexes were determined gravimetrically, while the particle sizes were obtained by photon correlation spectroscopy (Nicomp Submicron Particle Sizer, Model 370, Pacific Scientific Co.).

The degree of crosslinking was evaluated from swelling experiments using air-dried latex films, which were cast in petri dishes under different drying conditions. Film samples which were approximately 10 mm in length and 0.2 to 0.3 mm in thickness were cut and immersed in acetone [a good solvent for poly (n-butyl acrylate)] or toluene (a good solvent for polystyrene) for 24 hr at room temperature. The swelling ratio was then calculated as the ratio of the weight (or length) of the swollen film (W_s) to that of the initial unswollen (W_o) film. The sample length was measured using a caliper. Equations (1-5)[6-8] employing the theory of Flory and Rehner were used to calculate the molecular weight between crosslinks and the crosslinking density as given in the following.

$$M_x = \frac{-V_1 r_p (c^{1/3} - c/2)}{\ln(1-c) + c + \chi c^2} \quad (1)$$

$$\text{Crosslink Denisty} = \rho_p / M_x \quad < \text{moles crosslinks} / \text{cm}^3 > \quad (2)$$

$$c = \frac{W_o}{\rho_p V_s} \quad (3)$$

$$V_s = \frac{W_o}{\rho_p} + \frac{W_s - W_o}{\rho_s} \quad (4)$$

$$\chi = \beta_1 + V_1(\delta_s - \delta_p)^2 / RT \quad (5)$$

where χ is the Flory-Huggins polymer-solvent interaction parameter; β_1 is the lattice constant of entropic origin; V_1 is the molar volume of the solvent (equal to the solvent molecular weight divided by the solvent density; <cm^3/mole>); δ_s, δ_p is the solubility parameter of solvent and polymer, respectively <(cal/cm^3)$^{1/2}$>; V_s is the volume of the swollen polymer <cm^3>; c is the volume fraction of polymer in the swollen gel; M_x is the number-average molecular weight of the polymer between crosslinks <g crosslinks/mole>; and ρ_p, ρ_s is the density of polymer and solvent, respectively <g/cm^3>.

The isocyanate (NCO) groups resulting from the incorporation of the TMI in the copolymer latex films were identified using FTIR (ATI-Mattson Co.) spectroscopy. A known amount of potassium thiocyanate (KSCN; 1.0 wt% solution in DDI water) was used as an internal standard. Latex samples containing KSCN were cast in petri dishes at room temperature curing conditions; the FTIR spectra was then measured using film samples prepared at thicknesses of approximately 0.2 to 0.3 mm which were cut and placed on a Zn-Se FTIR cell. The relative amount of residual NCO groups in the cured films was evaluated by the absorbance of the NCO (peak at 2255 cm^{-1})/KSCN (peak at 2060 cm^{-1}) ratio.

The surface roughness of the cured miniemulsion latex films was analyzed using an Atomic Force Microscope (AFM) (Park Scientific Instruments Co., Auto Probe CP); a noncontact mode was employed as the measurement method in this instrument.

RESULTS AND DISCUSSION

Effect of the Crosslinking Agent Concentration

Latexes were synthesized using the polymerization recipe given in *Table* 1; final monomer conversions (90% or greater) as a function of TMI content are shown in *Figure* 2. *Figure* 3 shows the relationship between the crosslinking agent concentration and the particle size (volume average diameter; D_v). When only TMI was incorporated into the St/BA copolymer as a crosslinking agent, the particle size was not greatly affected by the presence of TMI. On the other hand, when TMI and MAA were used together, the particle size decreased slightly with increasing crosslinking agent concentration below five weight percent TMI and MAA. Above five weight percent concentration of the TMI and MAA, the particle size exhibits a reverse tendency in that the particle size became larger. This result can be explained by particle coagulation due to particle-particle interfacial crosslinking in the presence of excess amounts of the crosslinking agent.

Changes in the swelling ratio (L_s/L_o, as determined from changes in film length after swelling in a given solvent; indicative of the degree of crosslinking) as a function of the crosslinking agent concentration (either TMI only or TMI and MAA) used in the miniemulsion polymerization recipe

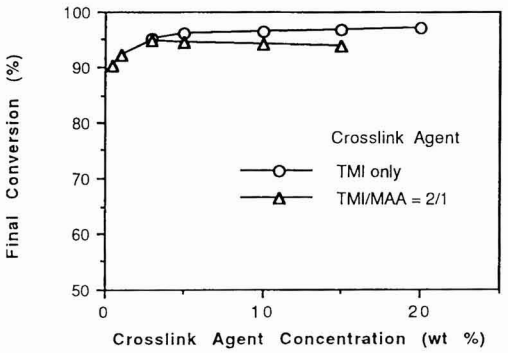

Figure 2—Final conversion of the synthesized miniemulsion copolymer latexes as a function of the crosslinking agent concentration. The crosslinking agents are TMI only or a combination of TMI and MAA (TMI/MAA = 2:1 weight ratio)

are shown in *Figure* 4. The TMI/MAA weight ratio was fixed at 2:1 for all experiments when MAA was used. A solubility parameter (δ_p) value for the copolymer had to be estimated before the crosslinking density for the cured films could be determined. Therefore, a series of solvents with increasing solubility parameters was used to determine δ_p of the copolymer film empirically. Solvents used to swell the crosslinked films included: n-hexane (δ = 7.3), n-butyl acetate (δ = 8.5), toluene (δ = 8.9), methyl ethyl ketone (δ = 9.3), acetone (δ = 10.0), t-butyl alcohol (δ = 10.5), n-butanol (δ = 11.4), and ethanol (δ = 12.8). The films were swollen in solvent for 24 hr and each film was quickly blotted dry and weighed. The swelling ratio (W_s/W_o) was determined for each solvent and plotted against the solubility parameter

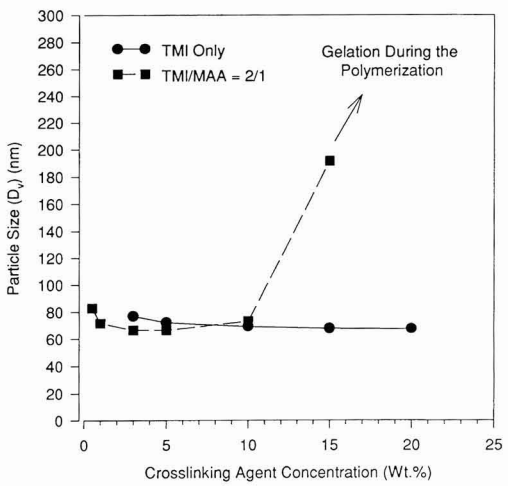

Figure 3—Particle size of the miniemulsion latexes as a function of the crosslinking agent concentration. The crosslinking agents are TMI only or a combination of TMI and MAA (TMI/MAA = 2:1 weight ratio)

(*Figure* 5). The maximum in this plot corresponds to the point where the solubility parameter of the copolymer is the same as that of the solvent. The copolymer solubility parameter was used to determine a value of χ in equation (5), assuming a β value of 0.35.[9] In this case, the χ parameter for the copolymers which contain TMI and MAA or TMI only was calculated to be 0.357 and 0.352, respectively. The molecular weight between crosslinks, as well as the crosslink density of each of these latex films, was calculated by applying equations (1) through (5). The calculated crosslink density results are shown in *Table* 2.

It can be seen from *Figure* 4 and *Table* 2 that the degree of crosslinking, as determined from the latex film swelling measurements, was found to increase with increasing crosslink agent concentrations, even when TMI only was used as the crosslinking agent (i.e., in the absence of any carboxyl groups from MAA). TMI has an isocyanate (NCO) functional group in its molecular structure, and these groups can react with one another during the film formation process at room temperature. A cured latex film prepared with TMI only needs at least 5 to 10 wt% TMI crosslinking agent concentration, based on the total monomer phase to achieve a sufficient degree of crosslinking using this polymerization recipe. Copolymer latexes prepared without TMI were completely dissolved in the solvent (either acetone or toluene). On the other hand, the existence of a small amount of MAA is quite effective in enhancing the crosslinking reaction. The miniemulsion latexes which contain MAA produced films with a significant degree of crosslinking with only 3 wt% of TMI + MAA (TMI/MAA = 2:1), based on the monomer phase. However, gelation was observed when incorporating 20 wt% of TMI + MAA (based on the monomer phase) during the polymerization process. Drying the films at higher temperatures and/or longer drying times also gave higher levels of crosslinking (i.e., lower values of L_s/L_o); however, the entire trend of the relationship between crosslinking agent concentration and the degree of crosslinking was not changed.

Effect of Initiator Concentration

Miniemulsion latexes were prepared using the SLS/HD mixed emulsifier system. A 3.0 wt% mixture of TMI and MAA (TMI/MAA = 2:1) was used as the crosslinking agent; only the redox initiator concentration was changed. The concentration of ammonium persulfate and potassium metabisulfite were changed over a range of 0.005 to 0.2 wt%; the ammonium iron (II) sulfate hexahydrate level was varied from 0.0005 to 0.02 wt%, based on the total weight in the basic recipe given in *Table* 1. The final conversions of the synthesized latexes increased with increasing initiator concentration from 85% conversion for the lowest initiator concentration (0.005 wt%) to 95-96% conversion for initiator concentrations above 0.02 wt%.

The swelling ratios (L_s/L_o) of the dried miniemulsion latex films are shown in *Figure* 6 as a function of the initiator concentration. The results show that the degree of crosslinking in the dried films decreased (i.e., the swelling ratio increased) with an increase in the amount of initiator used. A reduction in the polymer molecular weight and the possibility that some of the NCO groups of the crosslinking agent (TMI) were consumed by initiator decomposition products

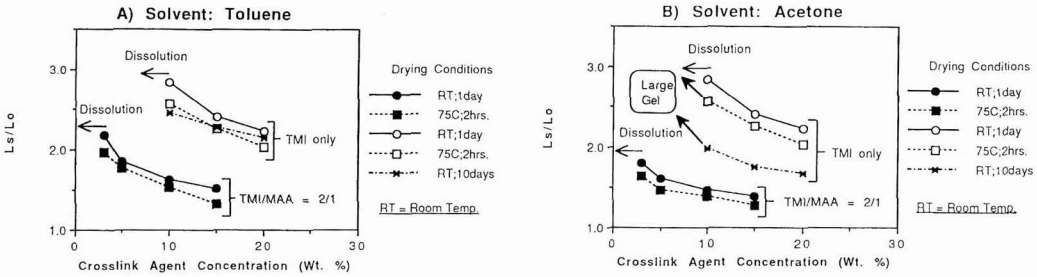

Figure 4—Relationship between the swelling ratio (as determined by dimensional changes of the swollen sample in toluene and acetone) of dried latex films and the crosslinking agent concentration. The crosslinking agents are TMI only and TMI and MAA (TMI/MAA = 2:1 weight ratio); L_s is the swollen sample length and L_o is the initial sample length

(e.g., OH) may reduce the degree of crosslinking. The solubility parameter value of these films are very close to the value for toluene, so that the films swollen with toluene exhibited lower degrees of crosslinking than that of the acetone.

Effect of BA/St Ratio

In these experiments, only the BA/St weight ratio was changed, while the crosslinking agent concentration (a 3.0 wt% mixture of TMI and MAA, at a weight ratio of TMI/MAA = 2:1) and all other reactant concentrations were kept constant using the recipe shown in *Table* 1. The swelling ratios of the dried miniemulsion latex films are shown in *Figure* 7 as a function of the BA/St weight ratio. Films could be prepared from the St/TMI/MAA copolymer latex without BA (i.e., BA/St = 0) even though their T_g was high (approximately 100°C). These films were white in appearance and their film forming ability was attributed to "spot-welds" between adjacent latex particles during the film formation process. These films were evidently crosslinked in spite of the reduced capability for particle-particle interdiffusion to take place in this system, to the extent that a redispersion of the copolymer latex particles was not observed in solvent (either acetone or toluene). This result suggests that particle-particle interfacial crosslinking occurred from the reactions between crosslinking agents located at or near the particle surfaces during the process of film formation in air. Crosslinking inside the latex particles might also occur during the polymerization process.

From *Figure* 7a, the degree of crosslinking, as inferred from the swelling ratio of the latex films swollen with acetone, decreased slightly with increases in the BA content at room temperature curing conditions as indicated by a slight increase in L_s/L_o; however, the films swollen with toluene show an opposite trend. This represents the difference in solubility of polystyrene and poly(n-butyl acrylate) in each solvent. The solubility of the polystyrene homopolymer is higher than the poly(n-butyl acrylate) homopolymer in toluene. In the case of the St/TMI/MAA copolymer latex film,

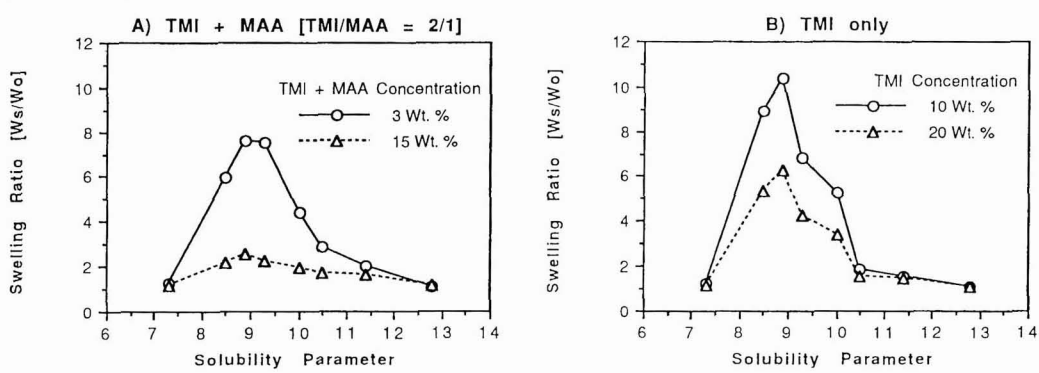

Figure 5—Calibration plots used to determine the solubility parameters of the St/BA/TMI and the St/BA/TMI/MAA miniemulsion latex copolymer films. The latex films were dried at 75°C for two hours prior to swelling in solvent; W_s is the swollen sample weight and W_o is the initial sample weight

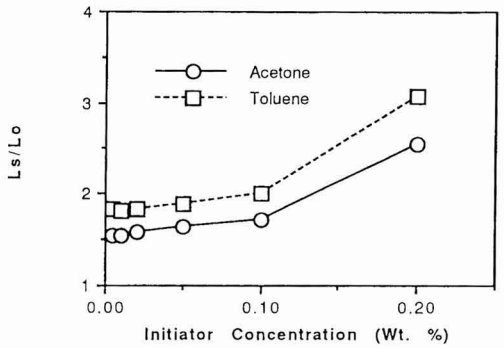

Figure 6—Swelling ratio (L_s/L_o) of the dried miniemulsion latex films as a function of the initiator concentration used in the polymerization recipe (as determined from a change in sample length); L_s is the swollen sample length, and L_o is the initial sample length; acetone or toluene was used as the swelling solvent

the degree of swelling in toluene is higher than in acetone, so that the aforementioned trend was observed. The degree of crosslinking of the latex films was affected by the type of solvent and curing conditions, where the influence of these parameters was seen to decrease with an increase in the BA content in this system. This can be explained by the relative mobility of the respective polymer chains, i.e., crosslinking reactions resulting from the interdiffusion of polymer molecules with a relatively high content of n-butyl acrylate would be faster than the copolymer with a higher styrene content where the polymer chain mobility would be less.

In the case where the films were dried at elevated temperatures (75°C) as shown in *Figure* 7b, the crosslinking results for the latex films swollen with acetone were similar to the room temperature results shown in *Figure* 7a. On the other hand, in the case where toluene was used as the swelling solvent, the degree of crosslinking of the St/TMI/MAA copolymer latex film was influenced by the drying conditions (i.e., 75°C vs room temperature) to a greater extent than the BA/TMI/MAA copolymer latex film. This result is also explained by differences in the extent of polymer interdiffusion. The rate of particle-particle interfacial crosslinking and polymer chain interdiffusion in the St/TMI/MAA copolymer latex film during the film formation process was accelerated at higher temperatures, so that the swelling ratio was changed significantly. On the other hand, the film formation process for the BA/TMI/MAA copolymer latex was facilitated by its low T_g at lower temperatures.

Influence of Emulsifier Concentration and Differences between Mixed Emulsifier Systems

The recipes used to prepare either conventional or miniemulsion latexes are shown in *Table* 3. The emulsifier concentrations and the type of mixed emulsifier systems (for the conventional system: SLS alone; for the miniemulsion systems: SLS/HD or SLS/CA) were varied in these experiments. The MAA/TMI weight ratio was fixed throughout the experiments at a value of 1:2; the total amount of TMI and MAA was maintained at 3 wt%.

The shelf-life stability (reflecting changes in droplet sizes) results for the monomer-in-water emulsions (either conventional or miniemulsions) are shown in *Figure* 8 as a function of the emulsifier (SLS) concentration. These monomer-in-water emulsions were prepared according to the procedure described previously. When SLS was used as the sole surfactant (i.e., the conventional emulsion), the same emulsification procedure was applied, with the only difference being the elimination of the co-surfactant (either HD or CA). The "stability" of the emulsions (prior to initiating their polymerizations) were evaluated by prolonged shelf storage studies at room temperature. Each stored emulsion was found to separate into two or three phases: an emulsion phase (top or middle) and/or a monomer phase (top) and an aqueous phase

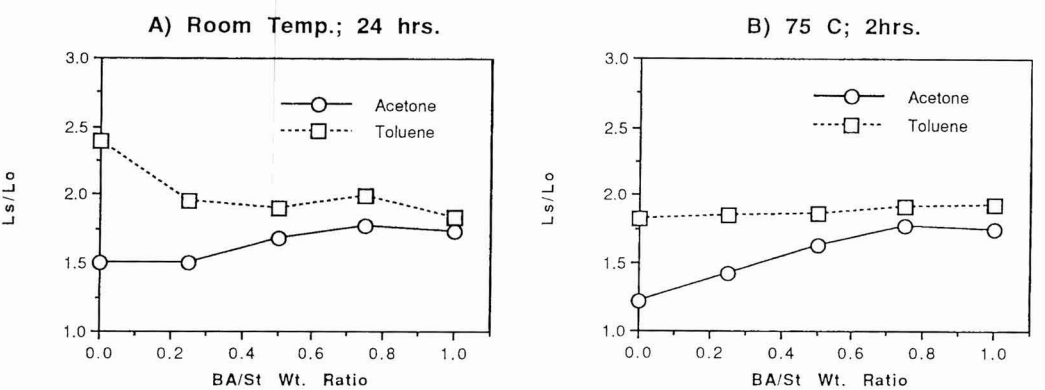

Figure 7—Swelling ratio (L_s/L_o) of the dried miniemulsion latex films as a function of the BA/St weight ratio used in the polymerization recipe (as determined by a change in sample length); L_s is the swollen sample length and L_o is the initial sample weight; acetone or toluene was used as the swelling solvent

(bottom). The shelf-life stability of the emulsions was evaluated by measuring the percentage of the emulsion phase remaining at various unperturbed storage times. A maximum in the percentage of emulsion phase occurs at approximately 0.5 wt% SLS concentration (shown in *Figure* 8a for the conventional emulsion only, with no mixed emulsifier), which coincides with the critical micelle concentration (CMC) of SLS. The stability was slightly decreased with increasing emulsifier concentration above the CMC; this was attributed to droplet growth by coalescence due to the increased ionic strength. *Figures* 8b and c show the stability results for the miniemulsions prepared with SLS/HD and SLS/CA mixed emulsifier systems, respectively. These miniemulsions are stable for a longer period of time in comparison to the conventional control emulsions prepared using SLS only at the same overall surfactant concentration (*Figure* 8a). The role of the co-surfactant is to prevent emulsion droplet destabilization by monomer (oil phase) diffusion.[10] The most stable emulsion was obtained using the SLS/HD mixed emulsifier system.

All latexes prepared by free-radical polymerization at 40°C of conventional emulsions or miniemulsions achieved high conversions (i.e., 90% or higher) regardless of the surfactant concentration used or the nature of the co-surfactant. Latexes prepared using the miniemulsification technique had a larger particle size than the control conventional latexes when the SLS concentration was less than 5 wt%, as shown in *Figure* 9. Since particle nucleation in mini-emulsion polymerization is considered to take place by radical capture in monomer droplets, the final latex particle size is some reflection of the initial monomer droplet size. For SLS concentrations of 5 wt% and above, all latexes give the same particle size. This indicates that the miniemulsion droplet size is comparable to the monomer-swollen micelle size in conventional latexes, or perhaps a mixed nucleation mechanism comprised of micellar and droplet nucleation is dominant at the high SLS concentrations.

Figure 10 shows the relationship between the swelling ratio of the dried latex films (L_s/L_0) (as determined from changes in film length after swelling in a given solvent) and the emulsifier (SLS) concentration. The films prepared from the conventional latexes and the SLS/HD miniemulsion latexes were cured at room temperature. These results show that there was only a slight influence of the emulsifier concentration on crosslinking. On the other hand, the degree of crosslinking of the SLS/CA miniemulsion latex films were remarkably low (i.e., higher L_s/L_0), compared with other latexes prepared with SLS alone and the SLS/HD mixed emulsifier system. It is very likely that the isocyanate functional groups of TMI were consumed by their reaction with the hydroxyl functional groups of the CA during the polymerization process. Reaction between the NCO group of TMI and carboxyl group would not be significant if other active hydrogen functional groups are present.[11] In this case, the hydroxyl groups of the CA reacted with the isocyanate groups at a much faster rate than the carboxyl groups of the MAA. This reaction within the latex particles may reduce both the internal (i.e., homogeneous) crosslinking within the latex particles and interparticle crosslinking during the film formation process, and thus accounted for the observed dissolution of the dried films in toluene.

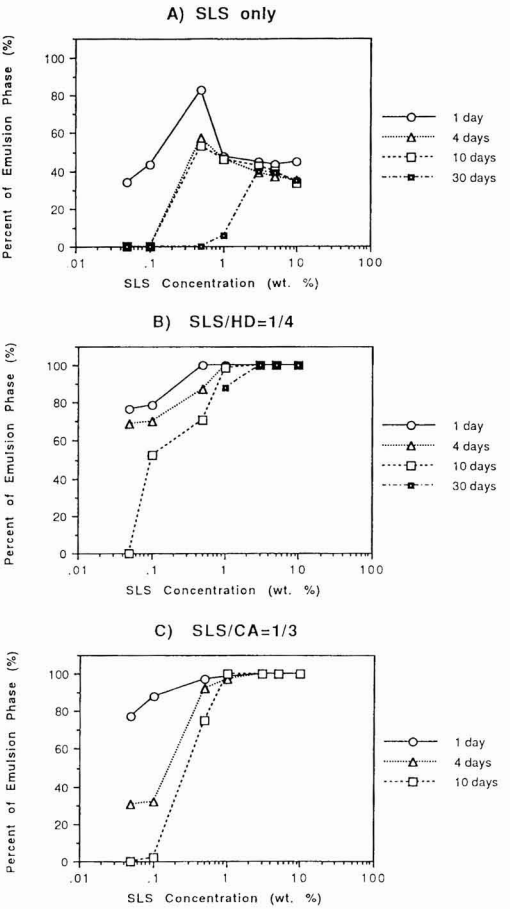

Figure 8—The percent of emulsion phase (representing the room temperature shelf-life stability of the emulsions) versus the emulsifier (total SLS) concentration: (a) SLS only; (b) SLS/HD = 1:4 (molar ratio); and (c) SLS/CA = 1:3 (molar ratio)

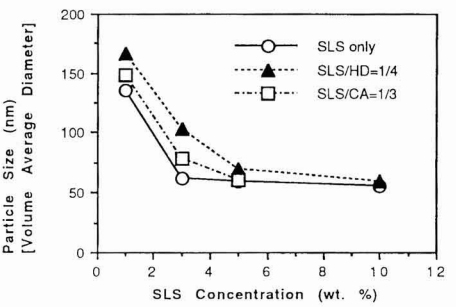

Figure 9—Relationship between the particle size of the synthesized latexes and the emulsifier (SLS) concentration

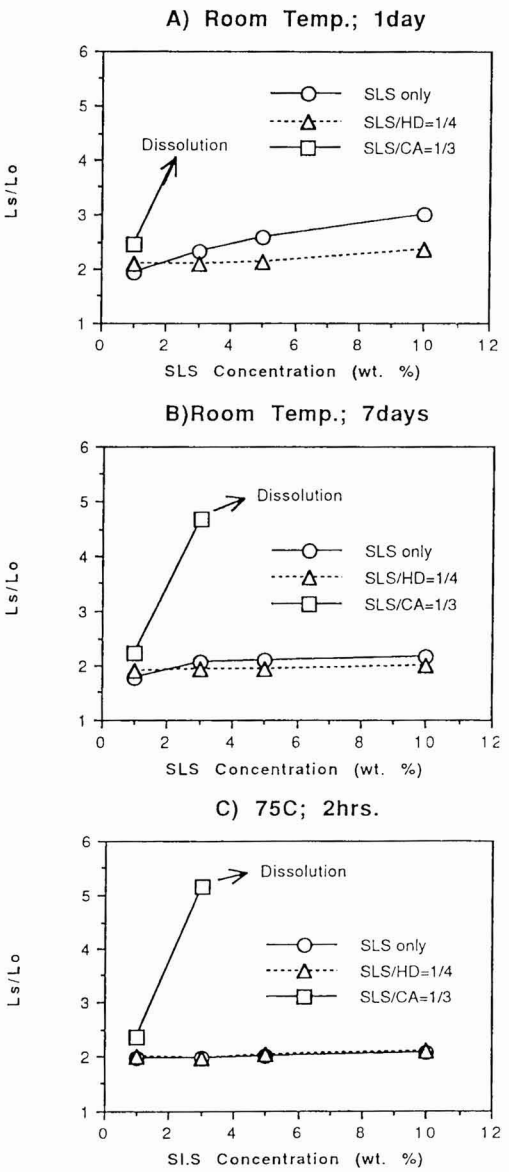

Figure 10—Relationship between the swelling ratio (as determined by dimensional changes in the swollen sample in toluene) of dried latex films and the emulsifier (SLS) concentration. The drying conditions were: (a) room temp., one day; (b) room temp., seven days; and (c) 75°C, 2 hr. L_s is the swollen sample length and L_o is the initial sample length

From *Figure* 10a, the degree of crosslinking of the latex films formulated using SLS only, and SLS/HD mixed emulsifier decreased slightly with increasing SLS concentration when the films were dried at room temperature for one day. When these latexes were cured for longer times (*Figure* 10b) or at higher temperatures (*Figure* 10c), the SLS concentration dependence on the degree of crosslinking was reduced. The swelling ratio became almost independent of the SLS concentration; especially where the films were dried at 75°C for two hours. In the early stage of latex film formation, the presence of the emulsifier (SLS) may disturb the particle-particle contacts and reduce the polymer chain interdiffusion between adjacent latex particles due to the location of emulsifier at the interfacial region between the latex particles. On the other hand, in the case of the latexes which were cured at higher temperatures or for longer times, polymer chain interdiffusion is increased, which reduces the influence of the emulsifier. As a result, the latex films achieved an almost constant degree of crosslinking without any significant influence of emulsifier concentration.

Differences Between Latex Films Dried from St/BA/TMI/MAA Copolymer Latex and a Blend of St/BA/TMI with St/BA/MAA Copolymer Latexes with Varying TMI/MAA Ratios

Miniemulsion latexes were prepared by varying the MAA/TMI weight ratio using HD as a co-emulsifier; conventional latexes were also synthesized according to the recipe shown in *Table* 4.

The final conversions of all of these synthesized latexes were greater than 90% and were not influenced by a change in the MAA/TMI weight ratio. It has been found that for the same surfactant (SLS) concentration (above the CMC), that the overall rate of polymerization of the conventional polymerization is usually faster than that of a miniemulsion system which was formulated using HD as a co-emulsifier.[12] This is mostly due to differences in particle size; the larger particle sizes present in the miniemulsion system lead to lower particle numbers, and thus lower polymerization rates.

Figure 11 indicates that the particle size does depend on the MAA/TMI weight ratio. The main reason for these results is the presence of carboxyl groups from MAA on the surface of the latex particles which enhance colloidal stability during the particle nucleation stage and throughout the course of polymerization and thus results in smaller latex particle sizes. The higher water solubility of MAA may also influence the particle nucleation step by changing the critical chain length of the oligoradicals before precipitation to form nuclei or entry into micelles or monomer droplets. The miniemulsion latexes had larger particle sizes than the conventional latexes. The reason for this trend is the difference in the particle nucleation mechanisms between miniemulsion and conventional polymerization, i.e., particle nucleation occurs mostly by radical or oligoradical entry into monomer-swollen micelles in conventional emulsion polymerization, whereas polymerization in the monomer droplets occurs by radical or oligoradical capture in the case of miniemulsion polymerization.

Figure 12a shows the relationship between the crosslinking density of the cured miniemulsion copolymer latex films and the MAA/TMI weight ratio used in the polymerization

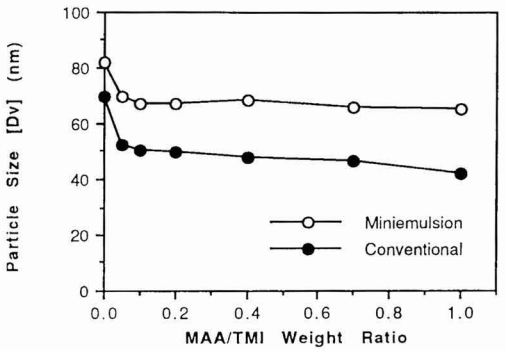

Figure 11—Particle size of the conventional and miniemulsion latexes as a function of the MAA/TMI weight ratio in the polymerization recipe

Table 3—Recipe Used to Prepare Conventional and Miniemulsion Latexes

Ingredients	Amount (g)
Styrene (St)	12.00
n-Butyl acrylate (n-BA)	12.00
Methacrylic acid (MAA)	0.25
Dimethyl meta-isopropenyl benzyl isocyanate (TMI)	0.50
Sodium lauryl sulfate (SLS)	0.012–2.75
Hexadecane (HD)	0.039–8.64 (SLS/HD molar ratio = 1:4)
Cetyl alcohol (CA)	0.031–6.94 (SLS/CA molar ratio = 1:3)
Ammonium persulfate	0.085
Potassium metabisulfite	0.085
Ammonium iron (II) sulfate hexahydrate	0.009
DDI water	58.28

Note: Polymerization temperature = 40°C.

recipe. The total TMI and MAA concentration was kept constant at 3.0 wt% based on the total monomer phase throughout all of these experiments. These results indicate that the presence of a small amount of MAA is quite effective in enhancing the crosslinking reactions, where even the addition of 5 wt% MAA (based on the total TMI + MAA weight, i.e., MAA/TMI = 0.05) resulted in the formation of a crosslinked film under room temperature curing conditions. An optimum crosslinking level was observed for MAA/TMI levels of 0.2 to 0.4 (i.e., 20 to 40 wt% of MAA). A miniemulsion latex which contained TMI only (3 wt% based on total monomer) as the crosslinking agent (in the absence of MAA) also gave crosslinked films under more severe curing conditions (at least 75°C for one day).

Figure 12a also compares the crosslinking density of an St/BA/TMI/MAA miniemulsion copolymer latex film with films prepared from a blend of St/BA/TMI and St/BA/MAA miniemulsion latexes. This comparative study was carried out for films with the same ratio of MAA/TMI. The weight ratio in the blend of the miniemulsion latex containing TMI only to the latex containing MAA only was adjusted in order to achieve the desired MAA/TMI ratio. The crosslinking

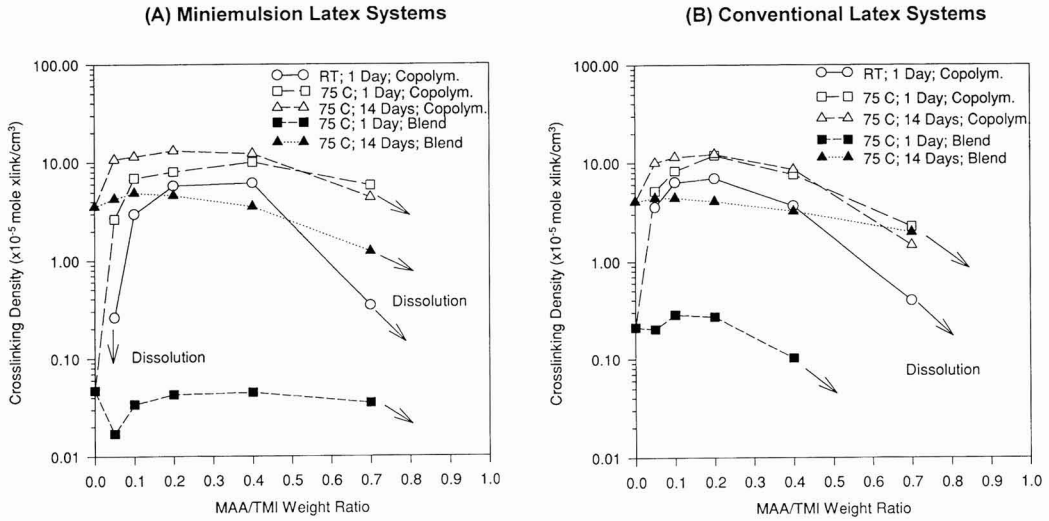

Figure 12—Crosslinking density of cured latex films as a function of the MAA/TMI weight ratio used in the polymerization recipe: (a) miniemulsion latex system, for both St/BA/TMI/MAA copolymer latexes and a blend of St/BA/TMI and St/BA/MAA (1:0 to 0.3:0.7 weight ratio) miniemulsion latexes for varying curing conditions; (b) conventional latex system, for both St/BA/TMI/MAA copolymer latexes and a blend of St/BA/TMI and St/BA/MAA (1:0 to 0.3:0.7 weight ratio) conventional latexes at varying cure times and temperatures

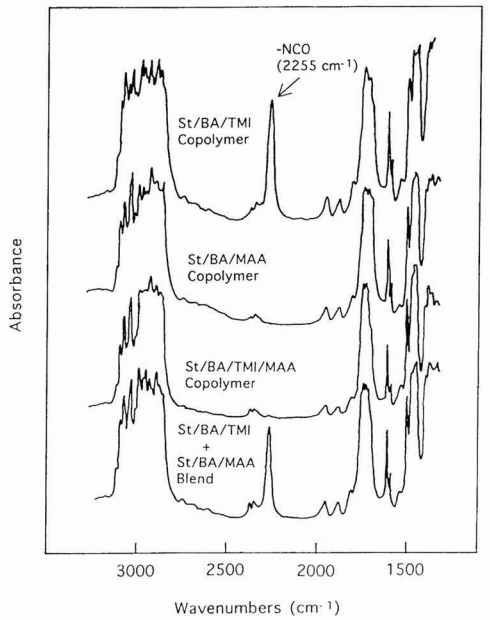

Figure 13—FTIR spectra of the miniemulsion latex films cured at room temperature for 24 hr

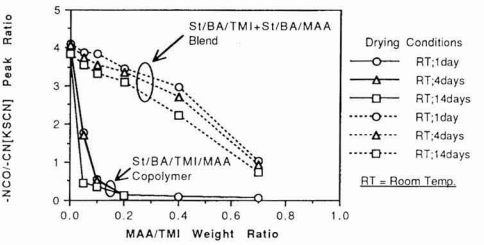

Figure 14—The relative–NCO/–CN(KSCN) FTIR absorbance peak ratio of the miniemulsion latex films as a function of the MAA concentration based on the total TMI + MAA weight. In the case of a blend of St/BA/TMI + St/BA/MAA a weight ratio of 1:0 to 0.3:0.7 of the latexes was used

level of the films prepared by copolymerizing TMI and MAA together with St/BA in the main copolymer chain attained equilibrium conditions (i.e, maximum crosslinking levels) much faster than that of a blended film prepared by mixing St/BA/TMI and St/BA/MAA miniemulsion latexes together. In the case of the latex blend film, long times and higher temperature curing conditions (i.e., 14 days at 75°C) were needed to obtain a sufficient level of crosslinking, reflecting the longer time required for polymer chain interdiffusion to occur between NCO and COOH functional groups

Table 4—Recipe Used to Prepare Conventional and Miniemulsion Latexes with Varying TMI/MAA Ratios

Ingredients	Amount (g)
Styrene (St)	12.00
n-Butyl acrylate (n-BA)	12.00
Methacrylic acid (MAA)	–0.75 Total
Dimethyl meta-isopropenyl benzyl isocyanate (TMI)	(MAA + TMI)
Sodium lauryl sulfate (SLS)	0.762
Hexadecane (HD) [miniemulsion]	2.403 (SLS/HD molar ratio = 1:4 0 (conventional)
Ammonium persulfate	0.085
Potassium metabisulfite	0.085
Ammonium iron (II) sulfate hexahydrate	0.009
DDI water	58.28

Note: Polymerization temperature = 40°C.

on adjacent latex particles during the film formation process. On the other hand, the St/BA/TMI/MAA copolymer latex formed a crosslink network promptly, even at room temperature curing conditions. The conventional latex systems also exhibited similar film formation tendencies as that of the miniemulsion latex system, as shown in *Figure* 12b.

Several cured films were analyzed using FTIR spectroscopy in order to evaluate the extent of reaction of the NCO groups from the TMI with the COOH functional groups from MAA. From *Figure* 13, the St/BA/TMI copolymer latex film dried at room temperature for 24 hr showed a clear NCO peak at 2255 cm^{-1}. However, when 20 wt% of MAA (based on the total TMI + MAA weight, i.e, MAA/TMI = 0.2) was incorporated into the St/BA/TMI copolymer in the polymerization process, the NCO peak has almost disappeared on account of reactions with the COOH functional groups. On the other hand, in a blend of 80 wt% of St/BA/TMI latex with 20 wt% of St/BA/MAA copolymer latex, the final blend film still exhibited a high residual NCO peak equal to that of the St/BA/TMI copolymer film after drying for 24 hr at room temperature. In the absence of MAA, TMI retains its NCO group, and is very stable against atmosphere moisture at room temperature as shown in *Figure* 14, because the NCO moiety is aliphatic and because of steric hindrance effects due to the presence of the alkyl groups which can also retard hydrolysis.[11] Once again, the results shown in *Figure* 14 reflect the difficulty in achieving crosslinking reactions between MAA and NCO groups when they are isolated in separate particles in a latex blend system.

Figure 15 shows the crosslinking density of miniemulsion and conventional latex films as a function of cure time. The rate of crosslinking for the conventional latex films is faster than the miniemulsion latex films in the two cases of the St/BA/TMI (without MAA) copolymer latex films and a blend of a mixture of 80% St/BA/TMI latex with 20% St/BA/MAA latex (i.e., an MAA/TMI weight ratio of 0.2). This difference obviously reflects differences in particle sizes between the miniemulsion and conventional latexes; i.e., for conventional latexes with relatively smaller particle sizes, the polymer chain interdiffusion required for the crosslinking reaction between NCO and COOH groups occurs at a faster rate than that for the miniemulsion latex films (usually with larger particle size). More than 100 hr curing time at 75°C was needed for these two systems (both conventional and miniemulsion) to reach the same level of crosslinking.

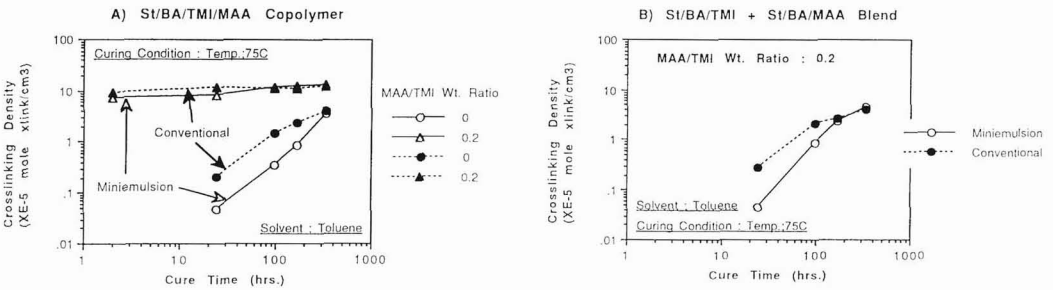

Figure 15—The crosslinking density of the conventional and the miniemulsion latex films versus cure time: (a) St/BA/TMI/MAA copolymer latex film; and (b) a blend of St/BA/TMI and St/BA/MAA copolymer latex film at 4:1 weight ratio

By contrast, when both TMI and MAA are copolymerized and co-exist within the same particle in the weight ratio of 0.2, the crosslink density reaches a much higher level than the previously mentioned cases, within two hours of curing at 75°C (see *Figure* 15a). In this case there is not much difference between the conventional and miniemulsion latex films reflecting a faster rate of curing due to the proximity of the reacting species.

The surface roughness of both the St/BA/TMI/MAA copolymer latex film and the film prepared from a blend of St/BA/TMI + St/BA/MAA latexes, both cured at 75°C for 14 days, were analyzed using an atomic force microscope (AFM). In the noncontact mode of the AFM, the tip-to-sample distance is generally in the range of 5 to 10 nm, so that the AFM is capable of studying soft or elastic samples. The cured St/BA/TMI/MAA copolymer latex film (*Figure* 16a) exhibits a surface which is rougher than that of the St/BA/TMI + St/BA/MAA latex blend film (*Figure* 16b). The average surface roughness (R_a) value of an St/BA/TMI/MAA copolymer latex film and an St/BA/TMI + St/BA/MAA latex blend film are 142.3 nm and 23.1 nm, respectively. In the case of the partially pre-crosslinked latex particles (i.e., the copolymer latex with both TMI and MAA present within the same latex particles), polymer chain interdiffusion between particles is retarded, which results in the formation of a rough surface structure due to shrinkage during the film formation process. The AFM pictures of this system shows mountain and valley-like structures. The surface of the valley-like structure is flat in this picture, perhaps due to the presence of surfactant (SLS) which is squeezed out during the coalescence process of the particles located in the mountain-like structures. On the other hand, the latex blend film exhibits a smoother surface owing to its higher capability for polymer chain interdiffusion prior to the crosslinking reaction between polymer chains containing NCO groups and COOH groups (from MAA) from the separate latex particles in a blend.

CONCLUSIONS

The crosslinked structure of latex films prepared using dimethyl meta-isopropenyl benzyl isocyanate (TMI) as a

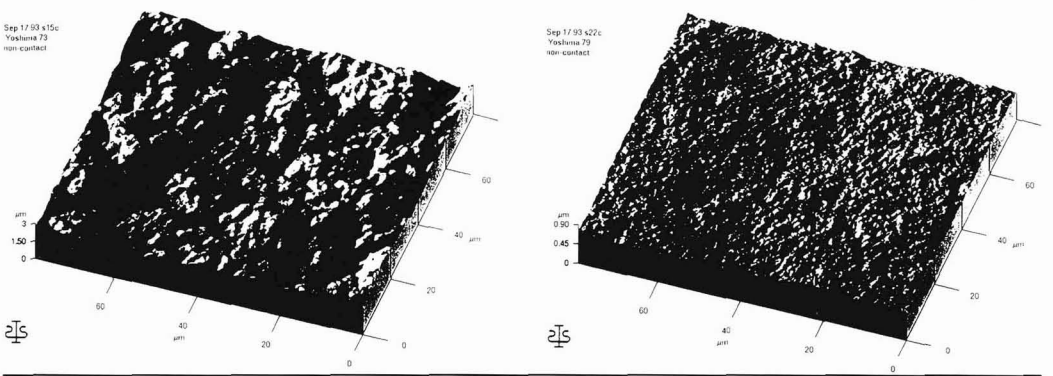

Figure 16—Atomic force microscopy (AFM) three-dimensional image of the miniemulsion latex films cured at 75°C for 14 days: a) St/BA/TMI/MAA copolymer latex film; and (b) a film dried from a blend of a 4:1 weight ratio mixture of St/BA/TMI and St/BA/MAA copolymer latexes

crosslinking agent was effectively enhanced by the presence of a small amount of methacrylic acid (MAA). The films prepared with sodium lauryl sulfate (SLS) alone and the SLS/hexadecane (HD) miniemulsion latexes were cured at room temperature, where the emulsifier concentration was found to have only a minor effect on the crosslinking of the films. On the other hand, the degree of crosslinking of the SLS/cetyl alcohol (CA) miniemulsion latex films was remarkably low, compared with the other latexes described. In this case, it is quite possible that the isocyanate functional groups of the TMI were consumed by the hydroxyl functional groups of the CA during the polymerization process. From the results of a comparison of the crosslinking density and FTIR analysis between St/BA/TMI/MAA copolymer and St/BA/TMI + St/BA/MAA copolymer latex blend films it was seen that TMI retains its NCO groups and is very stable against atmospheric moisture at room temperature. This study also showed that the NCO groups were consumed quickly at low ratios of MAA/TMI in the St/BA/TMI/MAA miniemulsion copolymer latex films, while these groups disappeared much more slowly in the latex blend system at corresponding MAA/TMI ratios. It was also observed that the NCO groups for the latex blend system reacted more quickly as the MAA/TMI ratio was increased; the quantity of NCO groups also decreased with increasing curing times at room temperature.

ACKNOWLEDGMENTS

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High-Solids Coatings Using Benzylanilinium Sulfonates

T. Morimoto and Shinji Nakano
Nippon Paint Company, Ltd.*

Benzylanilinium sulfonates (**1n**) were synthesized by reacting benzylchloride with N,N-dimethylaniline, followed by the exchange of Cl^- with RSO_3^-. Benzylanilinium sulfonates reacted with H_2O, releasing sulfonic acid only at temperatures greater than 75°C, although this temperature varied according to the p-substituents on the **1n** benzyl group.

Clear coating solutions, consisting of an acrylic polyol, hexamethoxymethylmelamine (HMMM), and **1n**, gave cured films over 125°C. Clear coating solutions containing **1n** showed superior storage stability and curability compared to that of clear coating solutions containing amine blocked p-toluenesulfonic acid, a widely used acid catalyst. Furthermore, coating solutions containing **1n** showed reduced baking times.

Consequently, it was found that **1n** acts as an effective latent thermal acid catalyst for the crosslinking reaction between acrylic polyols and melamine resins.

INTRODUCTION

Melamine resins have been used for more than 30 years as curing agents in the coatings industry. They have shown excellent performance and great versatility in many applications. It is well-known that the combination of hexamethoxymethylmelamine (HMMM) and polymers containing OH moieties are useful for high-solids coatings. However, under certain conditions, the curability of coating solutions including HMMM is not sufficient to produce cured films. Acid catalysts,[1] such as p-toluenesulfonic acid (p-TSA), are often used to accelerate the crosslinking reaction between HMMM and polymers containing OH moieties. Since free sulfonic acids reduce storage stability, amine blocked sulfonic acids[2] are widely used as latent acid catalysts. However, even such "latent" catalysts accelerate the crosslinking reaction over a wide temperature range, and it has been difficult to get good storage stability. Consequently, several classes of latent catalysts have been reported.[3-6] Unfortunately, it has been difficult to obtain one-pot high-solids coatings using these catalysts.

Ideal one-pot coating solutions show no viscosity change during storage and good curability at baking temperatures (see *Figure* 1). The curability profile of ideal one-pot coating solutions should appear as shown in *Figure* 1. If the crosslinking reaction proceeds around room temperature, good storage stability is impossible.

Catalysts, in this case, should show the profile outlined in *Figure* 2, because the crosslinking reaction does not proceed around room temperature when the catalyst is neutral, and the crosslinking reaction proceeds at baking temperatures as the catalyst becomes acidic. These catalysts are expected to approach ideal profiles for one-pot HMMM coating solutions.

We have already reported that N-benzyl-N,N-dimethylanilinium SbF_6^- acts as a latent thermal initiator in the cationic polymerization of glycidyl phenyl ether[7] by releasing benzyl cations (*Scheme* 1). We also demonstrated that the cationic polymerization initiated with these compounds could be applied to one-pot coatings crosslinking reactions.[8] These results imply that strong acids, able to initiate cationic polymerization, can be thermally latent by using benzylanilinium structures.

It is also accepted that benzyl cations, a highly reactive species, easily react with nucleophiles possessing active hydrogens converting them to H^+. It is important to study the reactivity of N-benzyl-N,N-dimethylanilinium p-toluenesulfonates[9] (**1n**) with nucleophiles having active hydrogens, since **1n** would react with nucleophiles having active hydrogens releasing sulfonic acid (**3**), a catalyst for the crosslinking reaction between melamine resins, and polymers containing OH moieties, at elevated temperatures. In other words, **1n** are expected to be novel latent acid catalysts to approach an ideal profile for acid catalysts.

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*19-17 Ikedanaka, Neyagawa, Osaka 572, Japan.

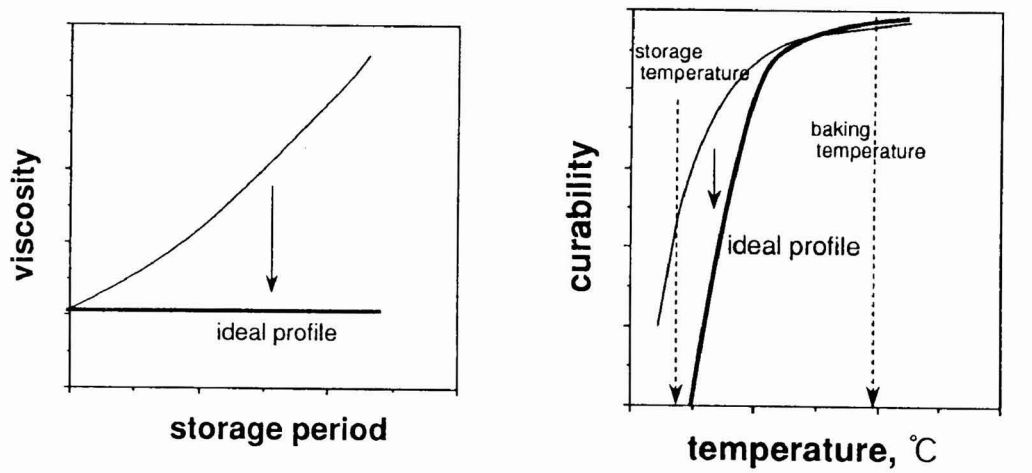


Figure 1—Ideal profiles in one-pot coating solutions

In this paper, we describe the reactivity of **1n** with H_2O, a model compound for nucleophiles containing active hydrogens, and the effect of **1n** on the crosslinking reactive between HMMM and an acrylic polyol, compared to that of amine blocked p-TSA. Furthermore, some properties of clear coatings containing **1n** are also described.

EXPERIMENTAL

Synthesis of 1n

GENERAL METHOD: p-Methoxybenzylchloride (4.71 g, 0.03 mol), N,N-dimethylaniline (3.63 g, 0.03 mol), and acetonitrile (1.23 g) were placed in a four-necked flask fitted with a stirrer and a reflux condenser. The mixture was maintained at 40°C and stirred for 16 hr. After the acetonitrile was removed under vacuum, acetone was added to the mixture to obtain N-(p-methoxybenzyl)-N,N-dimethylanilinium chloride (white powder, yield; 93%).

N-(p-methoxybenzyl)-N,N-dimethylanilinium chloride (2.78 g, 0.1 mol) was dissolved in methanol (30 g) and sodium p-toluenesulfonate (1.94 g, 0.1 mol) was added to the mixture. The solution was evaporated under vacuum after filtering to obtain the crude product (**1d**). Catalyst **1d** was recrystallized from acetone. Other benzylanilinium p-toluenesulfonates were synthesized by a similar method.

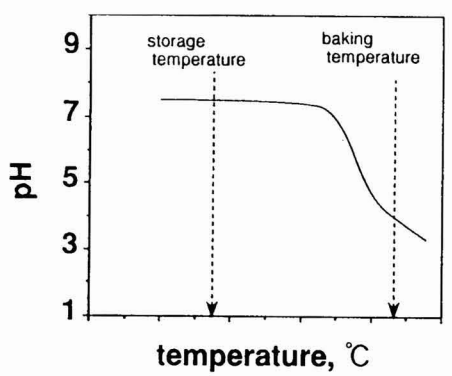


Figure 2—Ideal profiles for catalysts

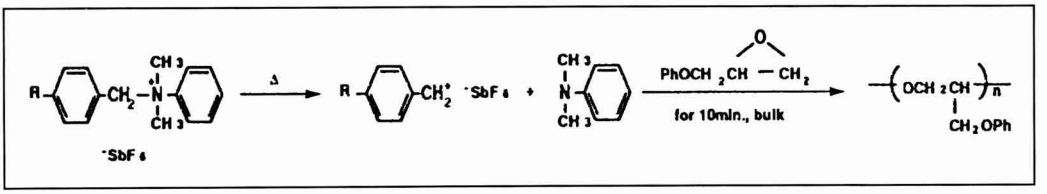
Synthesis of Amine Blocked p-TSA (2n)

Two methods were used in synthesizing amine blocked p-TSA. Catalyst **2a** represents p-toluenesulfonic acid neutralized with di-(2-hydroxyethyl)amine, whereas **2b** represents p-toluenesulfonic acid only 70% neutralized by the same amine.

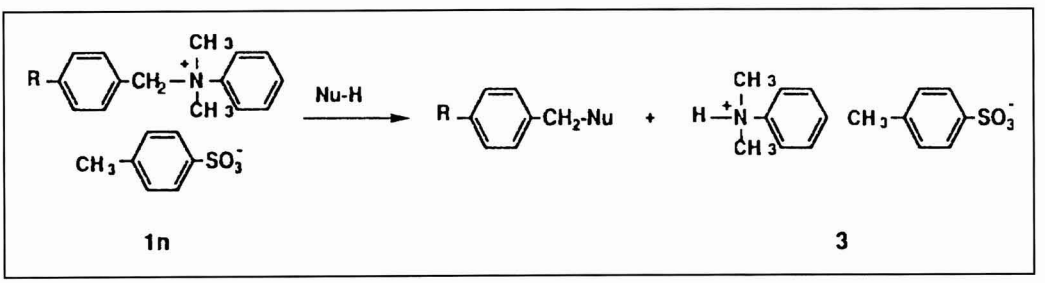
GENERAL METHOD: p-Toluenesulfonic acid monohydrate (19.0 g, 0.1 mol) was dissolved in methanol (30 ml) and di-(2-hydroxyethyl)amine (10.5 g, 0.1 mol) was added to the mixture. The solution was evaporated under vacuum to obtain di-(2-hydroxyethyl)ammonium p-toluenesulfonate (**2a**). Catalyst **2b** was synthesized from p-toluenesulfonic acid monohydrate (19.0 g, 0.1 mol) and di-(2-hydroxyethyl)amine (7.4 g, 0.07 mol) using the same method.

Estimation of 1n Unblocking Temperatures

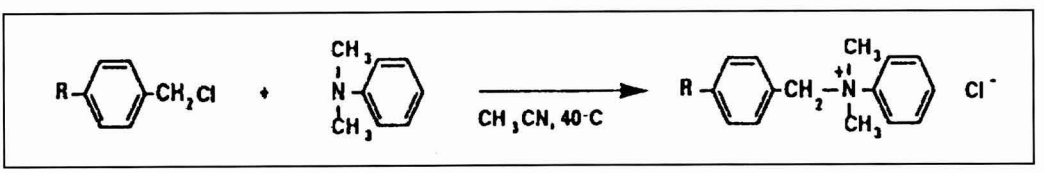
0.03 mmol of each **1n** was dissolved in dimethylsulfoxide-d_6 and 2 mmol of deuterium oxide was added. After mixing, the solution was heated for 10 min in an oil bath after which the ^{1}H-NMR spectrum of the solution was measured. The



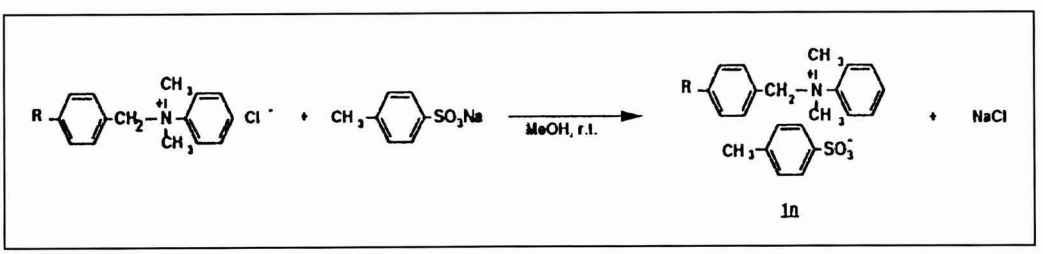
Scheme 1



Scheme 2



Scheme 3



Scheme 4

Table 1—Synthesis of 1n[a]

1n	R	Yield, %	m.p., °C
1a	Cl	80	191.0-192.0
1b	H	88	160.0-161.5
1c	^{t}Bu	81	167.3-168.0
1d	MeO	92	130.6-131.9

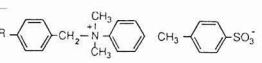
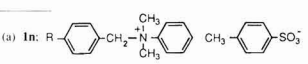
(a) **1n**: R 

Table 2—Unblocking Temperatures of 1n[a]

1n	R	Unblocking Temperatures, °C
1a	Cl	125
1b	H	115
1c	^{t}Bu	105
1d	MeO	75

(a) **1n**: R 

conversion of **1n** to **3** was calculated from the ratio of protons at the α-position of **1n** to that of the protons on the methyl groups of **3**. Unblocking temperatures of each **1n** were defined as the temperature at which five percent of that **1n** was converted to **3**.

Synthesis of Acrylic Polyol

Synthesis of a polymer containing OH moieties was carried out in a round-bottomed flask equipped with a mechanical stirrer, a reflux condenser, a dropping funnel, and a thermometer. Xylene (390 g) was heated to 130°C and stirred. To this, a mixture of styrene (120 g), 2-hydroxyethylmethacrylate (139.2 g), isobutylmethacrylate (30.6 g), isobutylacrylate (168 g), and n-butylmethacrylate (142.2 g) was added dropwise at 130°C over two hours, with t-butylperoctoate as the radical initiator. The temperature was maintained for another two hours.

(Mn; 6400, Mw/Mn; 2.36, estimated by GPC, polystyrene standard, OHV; 99 KOHmg/g, solid %; 61.)

Formulation of Clear Coating Solutions

Two grams of each catalyst were dissolved in 5 g of methanol. (In the case of **1a**, 10 g of methanol was used.) HMMM (60 g) and the acrylic polyol solution (230 g) were then added to obtain clear coating solutions.

Measurement of pH of the Aqueous Solutions

One gram each of **1d** or **2n** was dissolved in 100 g of water and the aqueous solutions heated for 10 min at specific temperatures. The pH of these aqueous solutions was then measured at 20°C using a pH meter.

Evaluation of Storage Stability

The previously mentioned clear coating solutions were diluted with xylene to a viscosity of 30 sec at 20°C using a #4 Ford cup. After the coating solutions were stored at 60°C, the viscosity of each diluted coating solution was checked at 20°C using a #4 Ford cup.

Evaluation of Crosslinking Reaction

Each clear coating solution was applied to steel panels and baked for 20 min at fixed temperatures to obtain cured films. The gel fractions of the cured films were evaluated in acetone using a Soxhlet extractor. Curing temperatures were defined as the temperature at which the gel fraction was 95% of film weight.

RESULTS AND DISCUSSION

Synthesis of Benzylanilinium Sulfonates (1n)

According to *Scheme* 3, benzylanilinium sulfonates were synthesized by the reaction of benzylchloride with N,N-dimethylaniline in acetonitrile, and the chloride anion was exchanged with a tosylate anion by reacting sodium p-toluenesulfonate in methanol (*Scheme* 4). The reaction shown in *Scheme* 4 proceeded smoothly, though sodium p-toluenesulfonate was only slightly soluble in methanol. This reaction is shifted to completion by precipitation of NaCl from the solution.

The data for the identification of **1n** is summarized in *Table* 1.

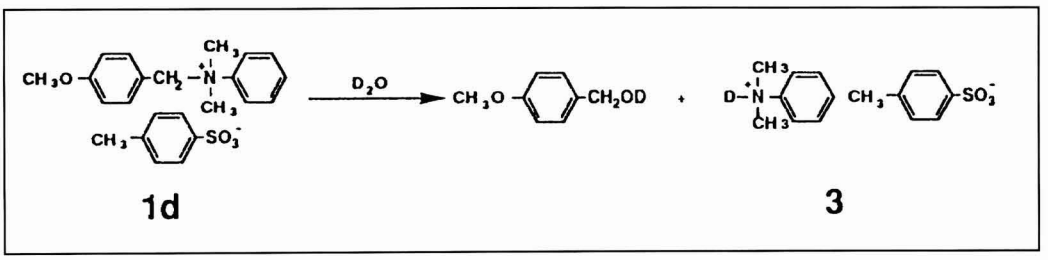
Reaction of 1d with H_2O

The reaction of **1d** with H_2O was monitored by ^{1}H-NMR. *Figure* 3 shows the ^{1}H-NMR spectrum of the reaction between **1d** and D_2O over the temperature range of 60-100°C. As indicated in *Figure* 3, some new signals were observed at temperatures greater than 80°C, and the signals observed at 3.1 ppm and 7.1-7.5 ppm demonstrated that N,N-dimethylaniline blocked p-toluenesulfonic acid (**3**) is released from **1d** in solution, based on the reaction in *Scheme* 5.

Figure 4 shows the effect of temperature on the pH of aqueous solutions containing **1d** or **2n**, model compounds for widely used acid catalysts. The pH of each solution was measured at 20°C after they were heated for 10 min at specific temperatures. The aqueous solution containing **1d** became acidic at temperatures greater than 80°C; however, the aqueous solution containing **2n** maintained the same pH observed at 20°C.

Table 3—Properties of Coating Solutions

Run	Catalysts	Appearance	Solids, %
1	**1a**	clear	53.9
2	**1b**	clear	55.3
3	**1c**	clear	54.4
4	**1d**	clear	55.7
5	**2a**	clear	54.0
6	**2b**	clear	53.9



Scheme 5

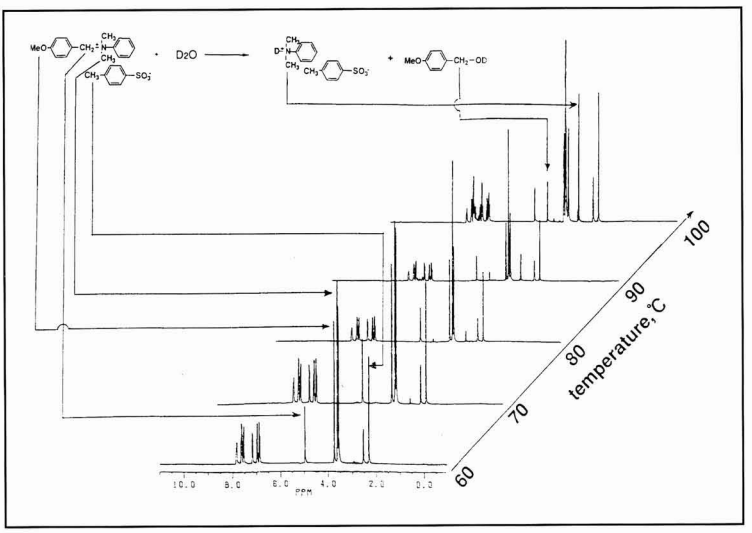


Figure 3—Reaction of 1d with D_2O

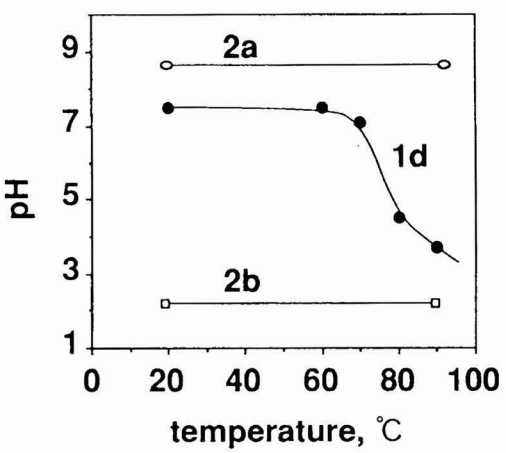


Figure 4—Effect of temperature on pH of a one wt% aqueous solution of each catalyst

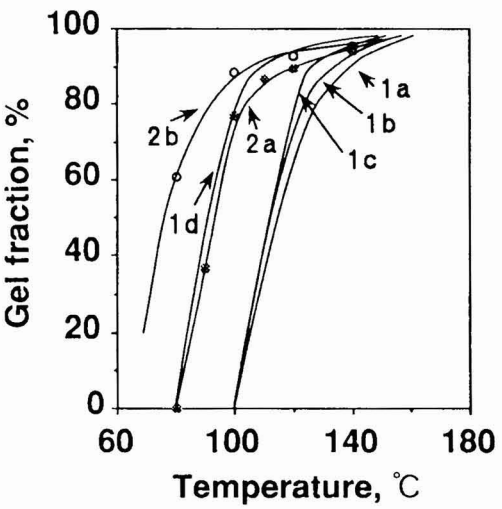


Figure 5—Effect of catalysts on gel fraction

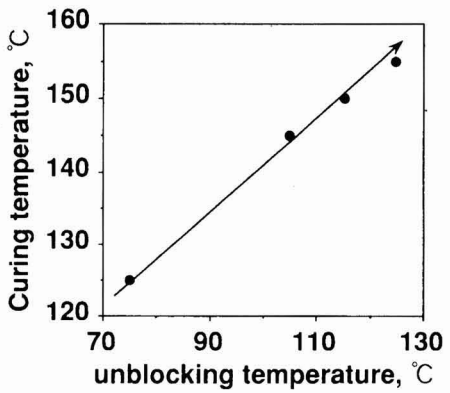


Figure 6—Effect of unblocking temperatures on curing temperatures for coatings containing 1n

Table 4—Curing Temperatures[a] of Coating Solutions

Run	Catalysts	Curing Temperatures, °C
1	**1a**	155
2	**1b**	150
3	**1c**	145
4	**1d**	125
5	**2a**	150
6	**2b**	140

(a) Curing temperature was defined as the temperature at which 95% of gel fraction was obtained.

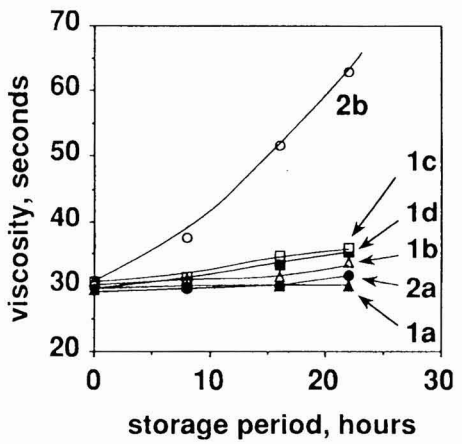


Figure 7—Effect of catalysts on storage stability of coating solutions at 60°C

These results imply that **1d** reacts with H_2O, a nucleophile having active hydrogens, releasing sulfonic acid (**3**), only at elevated temperatures and that **1d** approaches the ideal profile for catalysts shown in *Figure* 2.

The reaction of **1n** with polymer OH moieties should proceed according to the same mechanism to give **3**, only at elevated temperatures, as OH groups also contain active hydrogens.

Consequently, we expect that **1n** will give better storage stability and curability to HMMM coating solutions than amine blocked p-TSA such as **2n** as the curing catalyst for the crosslinking reaction between HMMM and polymers containing OH moieties.

Estimation of Unblocking Temperatures of 1n

Unblocking temperatures of **1n** (*Table* 2) were estimated by reaction with H_2O and estimated using ^{1}H-NMR. They were defined as temperatures at which five percent of **1n** was converted to **3**. Unblocking temperatures of **1n** varied according to the p-substituents on the **1n** benzyl group. Electrodonating effects of the p-substituents influence the bonding strength between the C-atom at the α-position of benzyl group and the N-atom of the ammonium portion. If curing temperatures vary with unblocking temperatures, equal cure of thermosetting coating solutions containing various **1n** would be observed at several different temperatures. Consequently, this means that **1n** are not only useful catalysts for automotive coatings, but can also be used in other coatings baked at different temperatures.

Properties of Coating Solutions

Both **1n** and **2n** were dissolved in methanol, whereupon, HMMM and the acrylic polyol were added to the solution to obtain coating solutions for this study. Both **1n** and **2n** were completely soluble in these coating solutions when added to one weight percent catalyst per solids, and all coating solutions were clear.

Clear coating solutions were diluted with xylene to a viscosity of 30 sec at 20°C using a #4 Ford cup. The percent solids of each coating solution are summarized in *Table* 3. It was found that all the clear coating solutions had a solids content of 53.9% or higher at application viscosity. These values are expected to be higher, if the polymer molecular weight is lowered.

Effect of 1n on Crosslinking Reaction

Each coating solution was baked for 20 min at specific temperatures to evaluate the catalytic activity of each catalyst. The cured films obtained were clear and did not turn yellow.

The crosslinking reaction in each coating solution proceeded smoothly and a gel fraction of over 95% was obtained. Furthermore, a gel fraction of each coating solution containing **1n** reached to 95% more rapidly than those containing **2n**, as shown in *Figure* 5. In other words, **1n** coating solutions showed closer approximation to the ideal profile shown in *Figure* 1 than **2n** coating solutions. It can be considered that **1n** releases sulfonic acid (**3**) only at baking temperatures after reacting with polymer OH groups. From

Table 5—Comparison of Solubility[a] between 1d and TLC-1249

	1d	TLC-1249
Toluene	1	77
Xylene	0.1>	26
Methyl isobutyl ketone	0.1>	16
Butyl acetate	0.1>	9
Methanol	>200	>200
Propanol	30	>200

(a) Amount (g) of each compound soluble in 100 g of a solvent.

these results, it is expected that **1n** are more effective latent acid catalysts than **2n**.

Curing temperatures of clear coating solutions are summarized in *Table* 4. Catalyst **1d** showed a lower curing temperature compared to **2b** (see *Table* 4). The greater catalytic activity of **1d** in the crosslinking reaction is due to the greater acidity of **3** at elevated temperatures, as N,N-dimethylaniline which has a boiling point lower than N,N-di-(2-hydroxyethyl)amine evaporates off.

Effect of Unblocking Temperatures of 1n on Crosslinking Reaction

Curing temperatures of clear coating solutions including **1n** varied according to the p-substituents on the **1n** benzyl group as shown in *Table* 4, and it was found that curing temperatures depended on the unblocking temperatures of **1n** (see *Figure* 6). This result means that the crosslinking reaction proceeded the release of **3** from **1n** according to *Scheme* 2. Consequently, the curing temperatures of coating solutions containing **1n** were linearly related to the unblocking temperatures of **1n**.

Storage Stability of Clear Coating Solutions

Storage stability of each coating solution was checked at 60°C after diluting with xylene to application viscosity. It is well known that low molecular weight monofunctional alcohols inhibit the increase in viscosity; therefore, the amount of methanol added to each coating solution was carefully controlled as shown in the experimental section.

Figure 7 shows the viscosity change of clear coating solutions stored at 60°C. As expected, the **1d** coating solution showed better storage stability than that of the **2b** clear coating solution, although the **1d** coating solution was cured at a lower temperature than that of the **2b** coating solution. The **2a** coating solution showed better storage stability than that of the **1d** coating solution. However, catalytic activity of **2a** in the crosslinking reaction was much lower than that of **1d** (see *Table* 4). These results imply that **1n** act as better latent thermal acid catalysts in the crosslinking reaction between melamine resins and acrylic polyols. The thermal latency of **1n** depends on the pH change, as shown by **1d** at elevated temperatures. From the results shown in *Figure* 4, it can be considered that **1d** is neutral in coating solutions around 60°C and that the crosslinking reaction does not proceed. However, the **1d** coating solution rapidly becomes acidic, accelerating the crosslinking reaction, when **3** is released from **1d** by reaction with polymer OH groups at temperatures greater than 75°C.

Table 6—Properties of Coating Solutions[a] Including TLC-1249

Solids, wt %	50
Storage stability, seconds[b]	12.0[c] →12.4[d]

(a) Data for clear coating solutions diluted to a viscosity of 12 sec at 20°C using a #4 Ford cup.
(b) Viscosity was checked using #4 Ford cup after storing at 40°C for 10 days.
(c) Data before storage.
(d) Data after storage.

Table 7—Properties of Cured Films[a]

Curability,[b] mol/cc	2.2×10^{-3}
Pencil hardness	H
Xylene rubbing	O[c]
Acid resistance[d]	O[c]
Yellowing[e]	0.1[f]
Weatherability[g], %[h]	97

(a) Data for films cured at 140°C for 10 min.
(b) Crosslinking density, measured by dynamic viscoelastometer.
(c) O: not affected.
(d) Tested with 1/10N H_2SO_4.
(e) Data for the film baked at 160°C for 30 min after baking at 140°C for 20 min.
(f) Δb value, measured by a differential colorimeter.
(g) Measured by Ultra Exposure Tester (Suga Test Instruments Co., Ltd.).
(h) Gross retention.

Application of Benzylanilinium Sulfonates to Short-Time Curable Coatings

From the previous data, we have developed a new latent thermal acid catalyst, based on benzylanilinium sulfonate, TLC-1249. TLC-1249 has better solubility than **1d** in many organic solvents (see *Table* 5).

We have developed clear coatings curable in 10 min at 140°C by including TLC-1249 in a coating solution consisting of butylated melamine resins and acrylic polyols. Some properties of these coatings and their cured films are summarized in *Tables* 6-7.

It was found that clear coating solutions containing TLC-1249 met standards required for clear automobile top coatings. This type of clear coating solution is expected to contribute energy savings and higher-solids opportunities to the coatings industry.

SUMMARY

It was found that N-benzyl-N,N-dimethylanilinium sulfonates (**1n**) released N,N-dimethylaniline blocked p-toluenesulfonic acid which in turn catalyzed the crosslinking reaction between melamine resins and polymers containing OH moieties.

Clear coating solutions consisting of **1n**, HMMM, and an acrylic polyol showed better storage stability and curability than those clear coating solutions containing amine blocked p-TSA as the acid catalyst.

In the case of butylated melamine resins, **1n** gave short-time curability to the coating solutions.

Consequently, N-benzyl-N,N-dimethylanilinium p-toluenesulfonates (**1n**) provide superior one-pot high-solids coatings compared with amine blocked p-TSA, when formu-

lated with melamine resins and polymers containing OH moieties.

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Hygrothermal Stress Evolution During Weathering in Organic Coatings

Dan Y. Perera
Coatings Research Institute*

Maarten Oosterbroek
Akzo Research Laboratories Arnhem†

Hygrothermal stresses developing in two clearcoats exposed to two types of accelerated weathering were determined. The physical and chemical changes induced by weathering produce a continuous increase of tensile and compressive stresses which ultimately causes it to crack. It was found that the stress magnitude and the duration of exposure at which the coating cracks depend on the type of the accelerated weathering. Also, the rate of stress relaxation decreases with duration of weathering. However, the shape of curves describing the stress dependence on duration of weathering is the same provided that the main mechanism of coating degradation does not change.

When combined with other techniques, the measurement of stress appears to be an important way of studying coating durability. It also enables one to determine if a coating undergoes physical aging, another phenomenon altering the coating properties.

INTRODUCTION

The development of more durable coatings necessitates improved rapid tests for weathering. Knowledge of the degradation processes, however, are incompletely understood and it must be studied using a variety of techniques such as spectroscopy, thermal analysis, statistical analysis, and changes in the mechanical properties, permeability, and gloss [e.g., references (1) and (2)].

Significant progress has been achieved in understanding the chemical changes occurring during weathering for certain organic coatings. This brought in turn the development of two quantitative tests for rapidly monitoring the rate of photooxidation. One is based on the measurement of the decrease of nitroxyl radicals with ESR[3,4] and the other on the measurement of hydroperoxides (e.g., by iodometric titration) formed during weathering.[5-7] The second method, due to its relative simplicity and greater universality, looks promising.

If chemical changes induced by natural or accelerated weathering are an indisputable major factor in the degradation of most of organic coatings, we also believe that the stress arising in a coating plays an important role and should be taken into consideration. This should especially be true for coatings deteriorating by loss of adhesion and/or cracking.

In an earlier study,[8] we measured the stress developing in a clearcoat exposed to an accelerated weathering cycle and found that the stress within the coating increased and that cracking was due to a static and a dynamic fatigue process.

The increased stress resulted from chemical changes in the coating occurring during accelerated weathering which induced the formation of hydrophilic groups and increased glass transition temperature (T_g).

The main purpose of this paper is to verify the validity of this model for other coating systems and accelerated weathering cycles.

EXPERIMENTAL

Materials

An acrylic/polyurethane (Ac/PU, the same as used before[8,9]) and an acrylic/melamine (Ac/Me) clearcoat were used in this study. For stress measurements they were applied on calibrated stainless steel shims[8,10] previously coated with a primer layer of about 15 μm in order to obtain good adhesion. After application by spraying, the samples were cured for at least one month at 21°C and 50% relative humidity.

*Ave. P. Holoffe, B-1342 Limelette, Belgium.
†CRU Dept., P.O. Box 9300, NL-6800 SB Arnhem, The Netherlands.

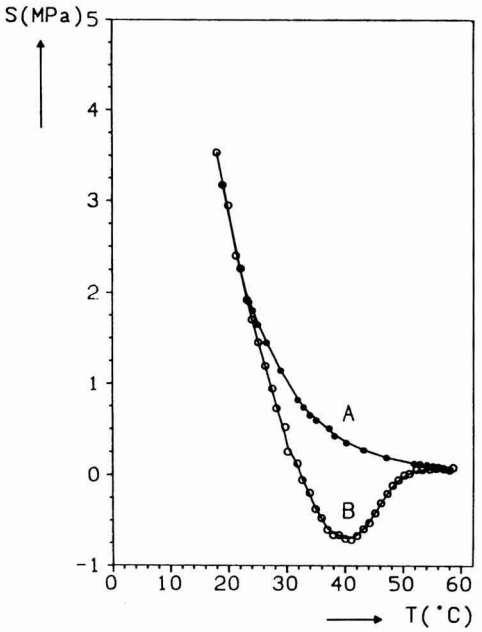

Figure 1—Stress (S) vs temperature (T) for physically aged (B) and unaged (A) Ac/PU-system

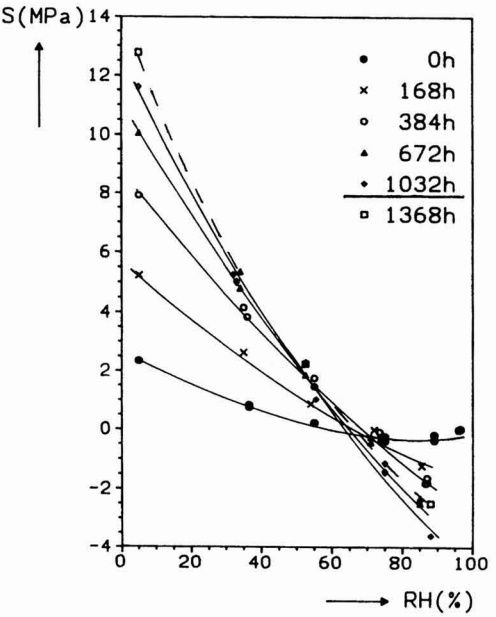

Figure 3—Ac/PU-system. Stress (S) vs relative humidity at 21°C after different periods of weathering (h, hour) in the QUV apparatus

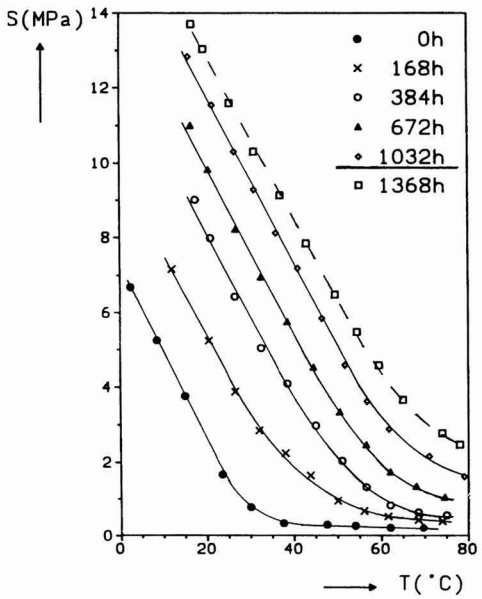

Figure 2—Ac/PU-system. Stress (S) vs temperature (T) at 5% relative humidity after different periods of weathering (h, hour) in the QUV apparatus

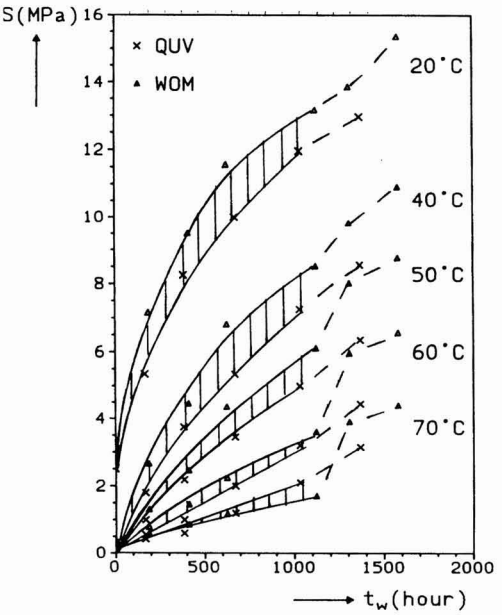

Figure 4—Ac/PU-system. Stress (S) vs duration of weathering (t_w) at 5% relative humidity and different temperatures

Stainless steel substrates were used in this study in order to prevent corrosion during weathering. The total dry thickness of the system was about 100 μm for Ac/PU and about 80 μm for Ac/Me.

Free films for mechanical measurements (viz., stress relaxation) were obtained by applying the Ac/PU on polypropylene substrate. Due to the limited adhesion on polypropylene, the weathering was limited to 300 hr.

Accelerated Weathering

The accelerated weathering was carried out in a:

- QUV apparatus (the Q-Panel Co)
  cycle: four hours UV-B (lamp 313), 60°C
  four hours condensation, 40°C
- Weather Ometer (WOM, Atlas)
  Xenon lamp (CI 6500 watt) with two filters
  Quartz (inside) and
  Borosilicate
  Black panel temperature: 70°C
  Relative humidity = 50%
  Continuous irradiation (102 min dry + 18 min water spray)

Methods

Stress Measurement: The measurement principle is based on the fact that if a coating applied on a substrate is under stress, the coated substrate will deflect in the direction which relieves the stress. The measurement of this deflection (d) and the knowledge of the elastic properties of the substrate permit the calculation of the stress (S).[10]

$$S = \frac{4dE_s t^3}{3l^2 c(t + c)(1 - \upsilon)} \quad (1)$$

where E_s, t, c, l and ν are respectively, the elastic modulus of the substrate, the thickness of the substrate, the thickness of the coating, the distance between the two knife edges on which the substrate is placed, and the Poisson's ratio of the substrate.

After various periods of weathering, the samples were withdrawn from the weathering devices at the end of the dry period and placed in the CoRI-Stressmeter (Braive Instruments, Liège, Belgium). After conditioning for one night under $CaCl_2$ (five percent relative humidity), the stress was measured as a function of temperature.

The measurement of stress as a function of temperature enables one to determine the glass transition temperature (T_g) of a coating. The T_g is defined here as the intersection of the tangents of the curves describing the stress dependence on temperature in the glassy and the rubbery regions.[10,11] The apparatus and the mathematical equation used to calculate the stress are described in reference (10). The curvature of the uncoated substrate was taken as reference.

Stress Relaxation Tests: These tests were made on an Instron apparatus (type 1122) with unweathered and 300 hr QUV-weathered Ac/PU specimens. Each specimen (5 mm wide, 50 mm distance between jaws) was fixed at the upper jaw of the apparatus. After one hour conditioning at a specific temperature, the specimen was fixed to the lower jaw of the apparatus, quickly deformed, and the stress required to hold the strain constant (one percent) measured as a function of time. For all temperatures, this strain is in the elastic region. For all experimental conditions, the relative humidity was identical (10% ± 2).

RESULTS

Physical Aging

The initial measurements carried out with unweathered Ac/PU specimens that had been cured for two months showed that in the glass transition region the dependence of stress on temperature had the shape of a trough (see curve B in *Figure* 1).

This indicates that these samples are in the glassy region at 21°C and 50% relative humidity and are subjected to physical aging.[12] Physical aging is the relaxation process a material in a nonequilibrium glassy state undergoes towards the thermodynamic equilibrium.

As in the case of other techniques (e.g., DSC—relaxation enthalpy in the first scan), physical aging prevents the correct determination of the T_g of a coating by stress measurements. Since physical aging can be eliminated by heating the coating at a temperature above T_g for sufficient time, the unweathered specimens were always heated at 60°C for 15 min before starting the stress measurements. For the weathered specimens, the preheating was unnecessary since, as mentioned previously, the temperature in the QUV and WOM apparatuses in the dry cycle (60° and 70°C) was above their T_g (except for specimens weathered for more than 1000 hr).

Type of Accelerated Weathering

To determine the effect of the type of accelerated weathering, the stress was measured as a function of temperature (at constant relative humidity, 5%) and relative humidity (at constant temperature, 21°C). The results are presented in *Figures* 2 and 3.

In order to facilitate the evaluation of changes occurring during weathering, the stress values obtained at various temperatures and relative humidity from *Figures* 2 and 3 and those obtained during weathering in WOM (not shown in this paper) are replotted versus duration of weathering in *Figures* 4 and 5.

Figure 6 shows the dependence of T_g at (5% relative humidity) on duration of weathering for the Ac/PU system weathered in QUV and WOM. The T_g-values were determined from $S = f(T)_{5\%}$ – measurements (*Figure* 2) and, as already mentioned, due to the fact that this system is multilayer, the T_g represents a mean overall value. The results obtained with the cracked samples are marked in the figures with discontinuous lines.

The experimental data indicate a similarity in weathering behavior in WOM and QUV (*Figures* 4-6). In both cases and in agreement with the results already presented,[8] weathering induces an increase in: (1) the magnitude of the tensile and compressive stresses; (2) T_g (marked by the displacement of the curves to the right in *Figure* 2); and (3) coating sensitivity to moisture [marked by the increase in the slope of the curves describing the S = f(relative humidity) in *Figure* 3].

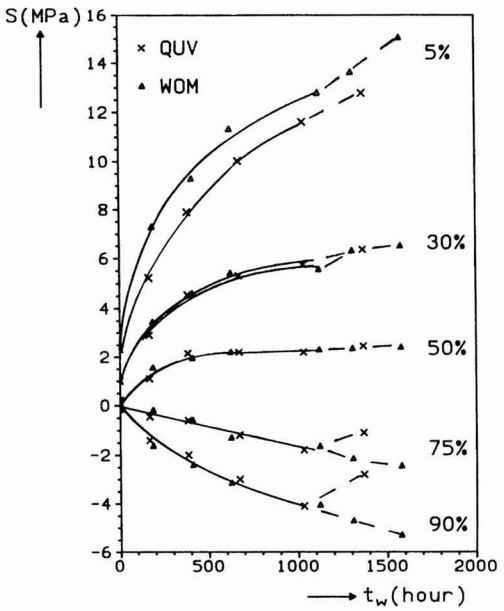

Figure 5—Ac/PU-system. Stress (S) vs duration of weathering (t_w) at 21°C and different relative humidity

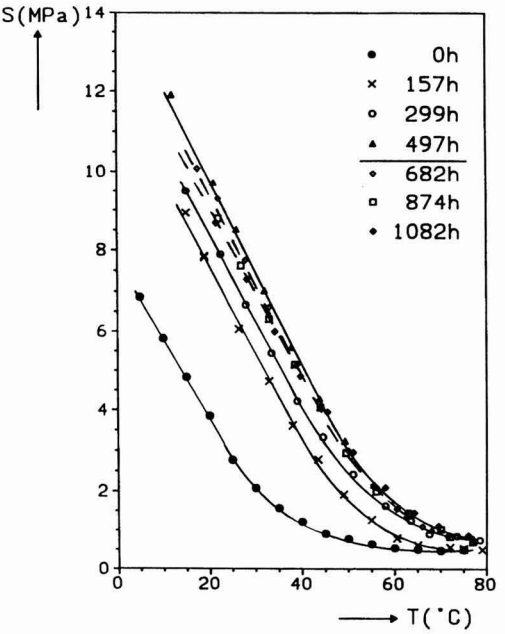

Figure 7—Ac/Me-system. Stress (S) vs temperature (T) at 5% relative humidity after different periods of weathering (h, hour) in the WOM apparatus

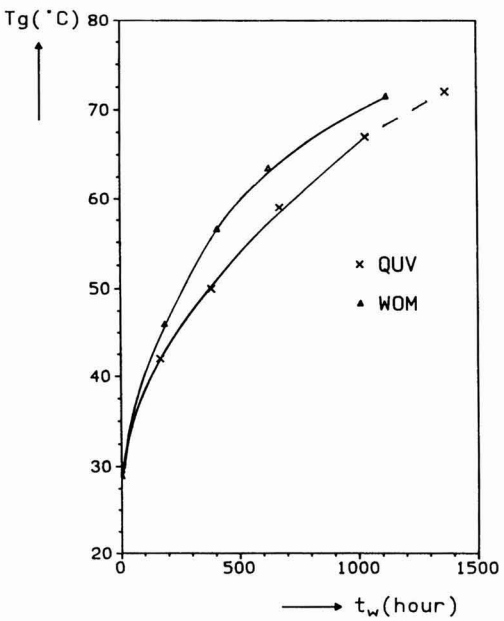

Figure 6—Ac/PU-system. T_g vs duration of weathering (t_w) at 5% relative humidity

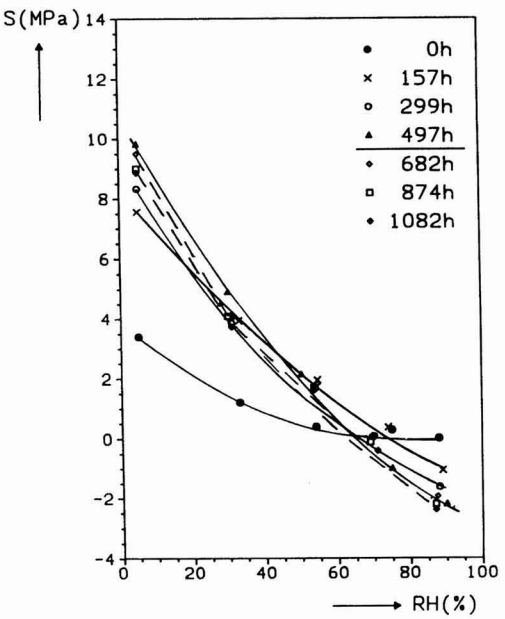

Figure 8—Ac/Me-system. Stress (S) vs RH at 21°C after different periods of weathering (h, hour) in the WOM apparatus

Such behavior is not entirely surprising if one takes into consideration that, despite different weathering conditions (e.g., type of irradiation source, temperature) both weathering tests include dry and wet periods (which submit the coating to continuous hygrothermal stresses) and UV-radiation (which causes chemical changes). It also follows that for an organic coating exposed to different accelerated weathering tests, as long as the main mechanism of degradation is the same, the shape of the curves describing the stress dependence on weathering time will be the same. Nevertheless, the magnitude of stress values and the time at which deterioration (cracking) occurs, will depend on the type of cycle (frequency, relative humidity, T) and the characteristics of the UV source (emission spectrum, intensity).

The increase of T_g with weathering (*Figures* 6 and 9) is important since the higher the T_g, the higher the stress will be (S^T) arising in the coating:[8,13,14]

$$S^T \cong \int_T^{T_g} \frac{E\left(\alpha_F^T - \alpha_S^T\right)}{1 - \upsilon} dT \cong \frac{E\left(\alpha_F^T - \alpha_S^T\right)}{1 - \upsilon} \left(T_g - T\right) \qquad (2)$$

where E = elastic modulus of the coating
υ = Poisson's ratio of the coating
α^T_F and α^T_S = thermal expansion coefficient of the coating and of the substrate, respectively

The exact origin of the increase in T_g with weathering is not yet established. This increase may be due to more than one cause: a loss of residual solvents, cure completion,[13,14] transformation of flexible segments into less flexible ones, and the combination of chain scission with a washing process in which flexible side chains or chain segments are removed. The way in which flexible segments could be transformed into less flexible ones is by oxidation of the hydrocarbon portion to form polar functional groups. Formation of such groups is consistent with the slope changes in *Figures* 3 and 8. Note that chain scission alone would have increased the number of polymer end groups, theoretically yielding a lower T_g,[15] a fact in disagreement with the experimental data.

Figures 7-9 show the results obtained with an Ac/Me system which starts to crack after only 500 hr when weathered in WOM. It can be seen that, while the magnitudes of stress and T_g are different to those of Ac/PU (compare *Figures* 2, 3, and 6 with *Figures* 7-9) the shape of the curves is similar. This probably indicates that the processes causing both coating to crack (embrittlement, development of hygrothermal stress)[8] are essentially the same.

It is worthwhile noting that in the stress calculation [see equation (1)] the total thickness (about 100 μm) was considered, as if the whole film thickness is submitted to weathering. In reality the weathered layer is smaller and other calculations (not discussed in this paper) show that the stress developed in this layer is much higher. If, for example, only a thickness of 50 μm undergoes weathering, then the stress values presented in this paper should be multiplied by about two.

Stress Relaxation

The adverse influence of stress on coating integrity is diminished by its relaxation. Therefore, the higher the stress relaxation rate the less damaging the action of stress will be.

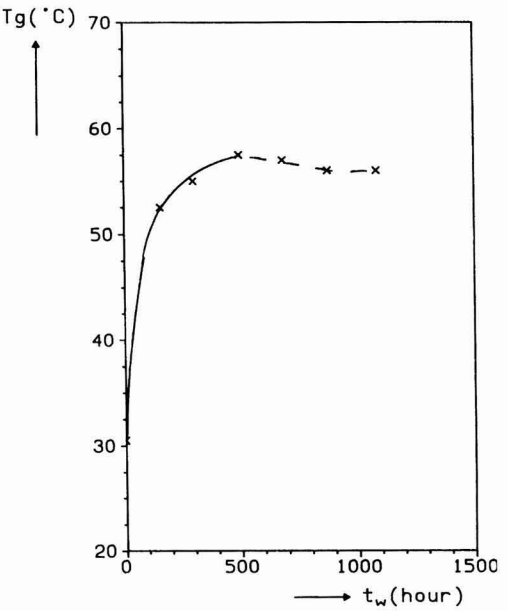

Figure 9—Ac/Me-system. T_g vs duration of weathering (t_w) at 5% relative humidity. Weathering apparatus = WOM

In order to have an idea about the effect of weathering on the relaxation process, experiments were made with unweathered and 300 hr QUV-weathered Ac/PU free films.

The results obtained (see *Figures* 10 and 11) show that the weathered specimens relax much more slowly than the unweathered ones. This is especially evident at intermediate temperatures (*Figure* 11) which correspond to the glass transition regions of the coatings.

At temperatures below 30° or above 60°C, the difference in relaxation rate of weathered and unweathered specimens

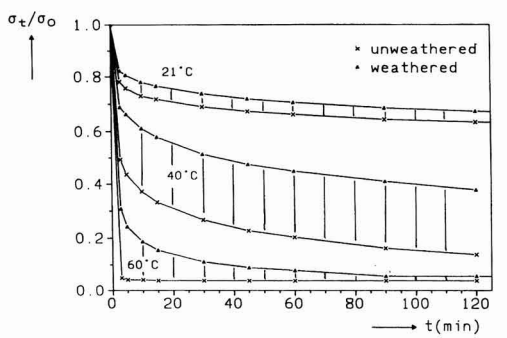

Figure 10—Stress ratio (σ_t/σ_o) vs time (t) at different temperatures for the Ac/PU system unweathered and 300 hr weathered in the QUV apparatus

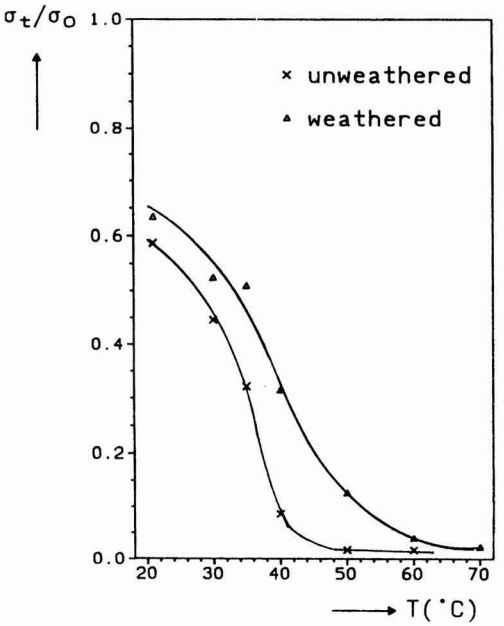

Figure 11—Stress ratio (σ_t/σ_o) vs temperature (T) for the Ac/PU system unweathered and 300 hr weathered in the QUV apparatus after four hours relaxation

is less marked. At these temperatures the coating is either in the glassy state ($T < T_g$) or in the rubbery state ($T > T_g$), where the relaxation process is slow or fast.

The results presented in *Figures* 10 and 11 and the fact that the T_g of the coating increases with weathering (see *Figure* 6) shows that the longer the duration of weathering the lower the stress relaxation rate. This means that, even a higher temperatures (e.g., 40° and 60°C, the temperatures in the QUV apparatus), the coating will be under continuous stress until cracking occurs.

CONCLUSIONS

For the coatings investigated (Ac/PU, Ac/Me), the types of accelerated weathering used (QUV and WOM) cause a continuous increase of tensile and compressive stress which finally cause the coating to crack. This is a result of physical and chemical changes[8] induced by weathering (UV-radiation, variation in temperature and relative humidity) which cause, among other effects, an increase in T_g, an increased sensitivity of the coating to moisture, and a decrease in the stress relaxation rate.

Once the T_g is higher than the environmental temperature, the coatings undergo physical aging. Due to the detrimental effect of this process on coating properties, one should consider it when their durability is studied.

The measurement of stress not only enables one to better understand the mechanisms of coating deterioration but also to determine if an organic coating is subjected to physical aging.

ACKNOWLEDGMENTS

We thank P.J.A. Geuring and A.J.G. van Rooyen, of the Akzo Research Center, Sassenheim, The Netherlands and D. Vanden Eynde, from CoRI, for their stimulating discussions and technical assistance.

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Society Meetings

CDIC ..... MAY

Election of Officers for 1994-95

The slate of officers for 1994-95 were announced as follows: President—Alan L. Machek, of Dow Corning Corp.; Vice President—John C. Avery, of Cintech Industrial Coatings; Secretary—William Jelf, III, of Akzo Coatings, Inc.; Treasurer—Steven E. Prodromo, of Hilton-Davis Co.; and Society Representative—Bill M. Hollifield, of Perry & Derrick Co., Inc. Hugh Lowery, of Perry & Derrick was re-elected as Delegate to the Ohio Paint Council.

Environmental Committee Chairman Kenneth Pendleton, of K.A. Pendleton Co., reported that a variance for (heavy metal) contaminated debris had expired on May 8, 1994. This new regulation prohibits, for example, land filling of items such as computer monitors.

Manufacturing Committee Chairman David R. Sellers, of PPG Industries, Inc. updated members on two committee activities for the upcoming year. A tour of the paint lines at Whirlpool Corp., in Marion, OH, is planned for September, and a speaker on ISO-9000 is scheduled for March.

The guest speakers for the evening were Alan Wharton and Gay Dever, of Thurman Material Handling Systems, whose presentation was on the introduction of the "Drum Runner"—an apparatus designed to facilitate the handling of drums.

The speakers presented, through use of a video, the features of the equipment. As shown, the Drum Runner consists of a four-wheeled cart which utilizes compressed air to drive the lifting mechanism which in turn raises the drum, allowing easy movement from place to place. Release of the air lowers the drums to rest. According to the speakers, the equipment can handle all steel, fiber, and plastic drums.

JOHN AVERY, *Secretary*

CLEVELAND ..... MAR.

"Fluorescent Pigments"

Members elected to serve as Society Officers for the 1994-95 year are as follows: President—Constance Williams, of Lilly Industries, Inc.; Vice President—Michael Wolfe, of Seegott, Inc.; Secretary—Richard A. Mikol, of Tremco, Inc.; Treasurer—James J. Currie, of Jamestown Paint Co.; and Society Representative—Brenda Carr, of Coatings Development Co. In addition, Jennifer Rumber, of the Mahoning Paint Corp., will serve as Assistant Treasurer and Robert L. Toth, of The Glidden Co., will be a Member-at-Large.

The meeting's technical speaker was David A. Heyl, of Day-Glo Color Corp., and he spoke on "FORMULATING COATINGS WITH FLUORESCENT PIGMENTS."

Mr. Heyl's presentation covered the following topics: (1) What is fluorescence; (2) What are fluorescent pigments; (3) Fluorescent coating formulations; and (4) Limitations of fluorescent pigments. When discussing fluorescence, the speaker said, you need to concern yourself with a good visible color spectrum—bright conventional colors reflect a maximum of 90%, fluorescence can reflect as much as 200 to 300%.

Constituent Society Meetings and Secretaries

BALTIMORE (Third Thursday—Martin's West, Baltimore, MD). ALBERT HOLDER, U.S. Navy, David Taylor Research Ctr., Code 2841, Annapolis, MD 21402-5067.

BIRMINGHAM (First Thursday—Strathallan Hotel, Birmingham, England). P. HASSALL, Newtown Industrial Paints Ltd., Silica Rd., Amington Ind. Est., Tamworth, Staffs. B77 4DT, England.

CDIC (Second Monday—Location alternates between Columbus, Cincinnati, Dayton, and Indianapolis). JOHN C. AVERY, Cintech Industrial Coatings, Inc., 2217 Langdon Farm Rd., Cincinnati, OH 45237-4792 .

CHICAGO (First Monday—Sharko's Restaurant, Villa Park, IL). C. DAVID STROMBERG, Standard T Chemical, 290 E. Joe Orr Rd., Chicago, IL 60633.

CLEVELAND (Third Tuesday—Brown Derby, Independence, OH). MICHAEL A. WOLFE, Seegott Inc., 5400 Naiman Pkwy., Solon, OH 44139.

DALLAS (Second Thursday following first Wednesday—Radisson Hotel, Dallas, TX). PAUL KAPLAN, Cookson Pigments, Inc., 2001 San Miguel Dr., Plano, TX 75704.

DETROIT (Second Tuesday—meeting sites vary). TEDD L. STROBEHN, Boehle Chemical Inc., 19306 W. 10 Mile Rd., Southfield, MI 48037.

GOLDEN GATE (Monday before third Wednesday—alternates between Francesco's in Oakland, CA, and Holiday Inn in S. San Franscisco). EVE STROMQUIST, Flecto Corp., 100 45th St., Oakland, CA 94608.

HOUSTON (Second Wednesday—Houston Medallion Hotel, Houston, TX). EDWARD E. BOSS, Bossco Industries, Inc., P.O. Box 680023, Houston, TX 77268-0023.

KANSAS CITY (Second Thursday—Cascone's Restaurant, Kansas City, MO). WILLIAM T. PORTER, Hillyard Industries, Inc., P.O. Box 909, St. Joseph, MO 64502.

LOS ANGELES (Second Wednesday—Steven's Steakhouse, City of Commerce, CA). ROBERT J. SKARVAN, McWhorter Inc., 5501 E. Slauson Ave., Los Angeles, CA 90040.

LOUISVILLE (Third Wednesday—Executive West Motor Hotel, Louisville, KY). ANDREW TRAISTER, Courtaulds Coatings, Inc., 400 S. 13TH ST., LOUISVILLE, KY 40201.

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

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

NEW ENGLAND (Third Thursday—Sheraton Lexington Hotel, Lexington, MA, and other locations in Massachusetts and Rhode Island). CHARLES SHEARER, ZENECA Resins, 730 Main St., Wilmington, MA 01887.

NEW YORK (Second Tuesday—Landmark II, East Rutherford, NJ). CARY GROBSTEIN, Cardinal Color & Chemical, Inc., 50-56 First Ave., Paterson, NJ 07524.

NORTHWESTERN (Tuesday following frist Monday—Jax Cafe, Minneapolis, MN). HAROLD H. CHRISTHILF, The Valspar Corp., P.O. Box 1461, Minneapolis, MN 55440.

PACIFIC NORTHWEST (PORTLAND SECTION—Tuesday before third Wednesday—Rose's, Portland, OR; PUGET SOUND SECTION—Third Wednesday—Barnaby's, Tukwila, WA; VANCOUVER SECTION—Thursday after third Wednesday—Delphi Steak & Pizza, Vancouver). RICHARD C. TOMCZAK, Specialty Polymers, Inc., 17316 E. Riverside Pl., Bothell, WA 98011.

PHILADELPHIA (Second Thursday—Williamson's Restaurant, GSB Bldg., Bala Cynwyd, PA). HOWARD SALMON, Akzo Coatings, Inc. 100 Belmont Dr., Somerset, NJ 08873.

PIEDMONT (Third Wednesday—Ramada Inn Airport, Greensboro, NC). BOB BISHOP, Ashland Chemical Co., P.O. Box 19959, Greensboro, NC 27419.

PITTSBURGH (Second Monday—Montemurro's Restaurant, Sharpsburg, PA). W. RAY LYMAN, JR, Ray Lyman & Co. 3462 Hills Church Rd., Export, PA 15632.

ROCKY MOUNTAIN (Monday following first Wednesday—Zangs Brewery, Denver, CO). PAUL DELMONICO, Old Western Paint Co., Inc., 2001 W. Barberry Pl., Denver, CO 80204.

ST. LOUIS (Third Tuesday—Salad Bowl Cafeteria, St. Louis, MO). JAMES LINDSLEY, Akzo Resins, 2904 Missouri Ave., E. St. Louis, IL 62205.

SOUTHERN (GULF COAST SECTION—third Thursday; CENTRAL FLORIDA SECTION—third Thursday after first Monday; ATLANTA SECTION—third Thursday; MEMPHIS SECTION—bi-monthly on second Tuesday; and MIAMI SECTION—Tuesday prior to Central Florida Section). ROBERT WAYNE WEST, Thompson & Formby, Inc., 10136 Magnolia Dr., P.O. Box 667, Olive Branch, MS 38117.

TORONTO (Second Monday—Cambridge Motor Hotel, Toronto). KEVIN PELLING, Inortech Chimie Inc., 4135 LaStrada Hts., Mississauga, Ontario L5C 3V1, Canada.

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

Mr. Heyl described fluorescent pigments as dyed polymeric resins, typically condensation polymers of melamine, formaldehyde, and toluene sulfonamide. These resins need to possess certain properties to make them feasible as carrier resins for the fluorescent dyes. According to the speaker, they need to be transparent and colorless so they do not affect or interfere with the fluorescent dyes and the color that is developed by the fluorescent dyes. They are also required to be friable and compatible with the dyes and have sufficient chemical and heat stability. When discussing fluorescent pigments in coatings, Mr. Heyl said that they are available in thermoplastic and thermoset types depending on the final product requirements.

Several key market areas where fluorescence may be used include: safety, advertising signs—point of display, aerosol marking paint and utility paints, and hobby sports and toy applications. Mr. Heyl pointed out that solvent selection, bleed, pigment loading, and dispersion are the four main areas to consider when getting involved with formulations with fluorescence. The speaker added that fluorescence have poor exterior light fastness and are very susceptible to color degradation from direct sunlight. To increase outdoor durability, Mr. Heyl suggested adding UV absorber and increase mil thickness of the coating.

MICHAEL A. WOLFE, *Secretary*

GOLDEN GATE ..... APR.

"Vynate Latexes"

California Paint Council (CPC) Executive Director Matt Dustin mentioned that anti-graffiti legislation sponsored by the CPC was currently before the Assembly Public Safety Committee where the bill was encountering last minute opposition. He suggested that Society members with an interest in the bill should call or fax their support. Mr. Dustin also announced the CPC would write a letter addressing billboards placed by Alameda County that target paint as a water pollutant.

A presentation on "VYNATE LATEXES" was delivered by Oliver W. Smith, of Union Carbide Corp.

According to Mr. Smith, Vynate latexes are relatively new.

EVE STROMQUIST, *Secretary*

LOS ANGELES ..... MAR.

"Polyurethane Dispersions"

A moment of silence was observed in memory of Society member Mike Wexler, formerly of WLS Coatings.

Environmental Committee Chairman Dave Muggee, of E.T. Horn Co., reported

that the Department of Transportation (DOT) Research and Special Program Administration (RASPA) is considering eliminating the special label for poisonous materials, Class 6.1, Packaging Group III, "Keep Away from Food" in favor of "Poison." He said chemical companies and motor carriers are in favor of keeping the special label.

The Chairman also mentioned that the American National Standards Institute (ANSI) is proposing to raise the flash point for flammable liquids to 141°F to be consistent with DOT. The DOT has an exemption for liquids with flash points of 100 to 141°F shipped in nonbulk containers to be classed as combustible if no other hazard is present. OSHA currently classes liquids with flash points below 100°F as flammable.

In addition, Mr. Muggee reported that EPA has proposed the addition of 313 new chemicals to be added to the Toxics Reporting Inventory under SARA III, Section 313. Some of the proposed chemicals are: tributyl tin oxide; chlorendic acid; cyclohexanol; dimethyl amine; manmade mineral fibers (Fiberglass); 1,1 methylene bis (4 isocyantocyclohexane) MDI; methylene bis thiocyanate; n-methylolacrylamide; n-methyl-2 pyrrolidone; sodium chlorite; sodium hypochlorite; tetra sodium ethylene diamine; tetra acetic acid; triethylamine; and most chloroflourocarbons.

Dodwell DeSilva, of Aerojet Industries, pdated members on the repercussions of he South Coast AQMD's Regional Clean Air Incentives Market (RECLAIM) Program, also known as the "buying and selling of smog." According to Mr. DeSilva, prior to 1992 emissions were controlled by command and control, whereby permits were issued for spray units, etc. The RECLAIM concept removes the specific source permit and instead assigns a specific number of maximum pounds of VOC to be emitted by each facility. This is also referred to as the "bubble concept."

"Polyurethane Dispersions for Coatings and Inks," was presented by Tony Pajerski, of ZENECA Resins.

Dr. Pajerski reviewed polyurethane dispersions (PUDs) as well as a comparison versus acrylic emulsions. In addition, the talk covered the general aspects of waterborne polymer colloids, emulsion polymers versus condensation polymers, general colloidal stabilization, and polyurethane dispersion synthesis.

The speaker noted that polyurethane colloids are becoming very popular due to environmental legislation. The most popular are polymer dispersions prepared by emulsion polymerization. These colloids, stated Dr. Pajerski, are prepared by a free radical polymerization process which leads to a very high molecular weight material with a fairly narrow molecular weight distribution. In contrast, polyurethane dispersions are made by condensation reaction in which one takes diisocyanates and diols and forms a preformed polymer, which then gets dispersed in water. According to Dr. Pajerski, the two most important processes used to form a prepolymer are referred to as the prepolymer mixing process and the acetone process.

The presenter mentioned that there are two major classes of dispersions: those being ionic, which carry an acid group that is neutralized with an amine, and nonionics, those which have the surfactant molecule attached to the backbone of the polymer.

Another differentiating aspects of these dispersions versus acrylic latexes, said the speaker, relates to particle size and particle size control. The acrylic latexes have particle sizes in the range of 80-100 nanometers whereas polyurethanes typically run at 24-65 nanometers. In addition, according to Dr. Pajerski, acrylic particles are all very much the same size and, by contrast, polyurethanes have a very high polydispersity. Particle size control with latex results from a balance of surfactant concentration, polymer temperature, and initiator concentration. On the other hand, aqueous urethanes are particle size controlled by the amount of dispersing groups you put into the backbone.

Dr. Pajerski reported that colloidal stability is very important in formulating coatings, particularly when combining a urethane with an acrylic emulsion. In acrylics, colloidal stability is affected by initiator fragments, surfactants, and functional groups used in the backbone and they are typically relatively pH stable. In contrast, urethanes as a class are generally stable over a wide variety of pH's.

The speaker noted that morphological characterization done by fluorescence spectroscopy shows that the urethane is quite different than the acrylic. The PUD has an open, swollen morphology. The reasons for this, according to Dr. Pajerski, relate to the synthesis procedure used, the presence of water as a diluent, the nature of the backbone, and the amount of the stabilizing groups in the backbone. In general, PUDs versus acrylic latexes typically have relatively high MFTs with low resultant hardness levels.

Robert Skarvan, *Secretary*

LOS ANGELES.....APR.

"Polymer Development Technology"

A moment of silence was observed for the passing of Society Past-President Leo Forth, Jr. It was noted that Mr. Forth was instrumental in establishing the first Western Societies Coatings Symposium.

John A. Gordon, of Pacific Technical Consultants, requested from the audience any usable laboratory equipment that can be utilized at a coatings laboratory being developed at Cal Poly Pomona (CPP). He mentioned that Myers Engineering has already donated a twin shaft disperser to the program.

Joseph B. Evans, of Trail Chemical Corp., and Edward Barrie, Jr., of Sinclair Paint Co., are coordinating a program to

speak to high school students on the virtues of pursuing a career in the field of paint and coatings. To date, 12 people have volunteered to present talks and the coordinators have developed an outline for the program and presentations.

Environmental Committee Chairman Dave Muggee, of E.T. Horn Co., updated the members on a public workshop to be held on Senate Bill 1731, "Risk Reduction Audits and Plans." The bill requires that facilities determined by the APC or an AQMD that pose a significant risk under the air toxic hotspots law, prepare and implement an audit and plan which will reduce that risk below the significant level in five years.

The first talk of the evening was given by David Roller, of Alpha Consultants. His motivational talk was entitled, "How to Enjoy Getting Up in the Morning and Going to Work."

The technical presentation of the meeting, "The Use of Vynates as an Avenue to New Polymer Development Technology," and was given by Dave Lunzer, of Union Carbide Corp.

In discussing the structure of Vynate and other monomers, Mr. Lunzer pointed out that the amount of substitution on the carbon atom adjacent to the carbonyl group that is present in most of these monomers drastically affects the resistance to hydrolysis of polymers subsequently made with them. By increasing substitution, T_g also increases as the polymer backbone becomes more and more crowded, and subsequently becomes less rigid. According to the speaker, polymers made with a 2:1 and 3:1 molar ratio of vinyl acetate to Vynate proved to have the best balance of properties while still having very good hydrolysis resistance.

Mr. Lunzer pointed out that Vynate polymers have been tested for exterior durability and if formulated properly can give grain crack resistance equal to that of an acrylic. In interior paint, the Vynate polymers reportedly offer good hardness and block and water resistance. In discussing Vynate paints made with urethane, urethane alkali swellable, and hydroxy ethyl cellulose thickeners, the speaker said that high glosses were obtainable with all.

In summary, Mr. Lunzer reported that Vynates are designed to give good gloss and water and block resistance. Wide varieties of polymers, suitable for many end uses, can be made with Vynate because it copolymerizes with a wide variety of monomers.

Q. How do the Vynates perform on metal with respect to adhesion and corrosion?

A. We have not done any work in this area yet.

Robert Skarvan, *Secretary*

NEW YORK ..... MAR.

"FBI Forensic Lab Work"

FSCT President-Elect Joseph P. Walton, of Jamestown Paint Co., addressed the members on the education of our youth on the importance of the paint and coatings industry. He stated that many of the Constituent Societies are attracting the youth through science fairs, etc. He stressed that the FSCT is focusing more on education and that there are numerous opportunities available for our members to continue their education, in particular, through the effort of the Coatings Industry Education Foundation and the Professional Development Committee.

Mr. Walton also mentioned the cooperative efforts between the FSCT and NPCA in recent years, in particular the Panorama™ Coatings MSDS System on CD-ROM.

The second guest speaker was FSCT Executive Vice President Robert F. Ziegler.

He updated members on the progress of the Panorama project and current activities of the 1994 Annual Meeting and Paint Industries' Show to be held in October in New Orleans, LA.

Technical Committee Chairman Sheila Westerveld, of Standard Coating Corp., reported that the committee is currently working on two studies. One is a rheological modifiers study and the other is on defoamers.

Society President Armand J. Stolte, of RHEOX, Inc., presented Emil Vyskocil, of Eastech Chemical Inc., with an award for the presentation of the paper "Silicone Additives for High-Solids Coatings," at the FSCT Annual Meeting in Atlanta.

The meeting's technical speaker was James E. Corby, of the FBI. With the use of slides, Mr. Corby's discussion focused on the microscopic, microchemical, and instrumental techniques used in the analysis, comparison, and identification of coatings and their ingredients. He explained how paints and coatings applied to cases such as the World Trade Center bombing, the Waco, Texas case, and the recent Ames spy case. Mr. Corby explained that they try to put a person back at the scene of the crime by something that was left there or something that was taken away. One of the best ways to do that is through trace evidence, and one of the best forms of trace evidence is paint. He noted that evidence at a crime scene can prove or disprove an alibi.

Q. When a cemetery or a house of worship is spray painted, do you get involved with that type of crime?

A. Yes we do get involved, especially when it is of a racial origin and violates civil rights. It then becomes a Federal offense.

CARY GROBSTEIN, *Secretary*

NEW YORK ..... APR.

"Kaolin Clays in Exterior Latex Paints"

Environmental Committee Chairman Alfred A. Sarnotsky, of Spraylat Corp., reported that the State of New York has issued a draft document dealing with regulating the people who paint furniture for the secondary woodwork industry.

President Armand J. Stolte, of RHEOX, Inc., mentioned that in cooperation with the Cleveland Society, brochures highlighting the Society's 37th Annual Technical Symposium were available at the meeting.

The technical speaker for the meeting was Southern Society Member Thad T. Broome, of J.M. Huber Corp. He spoke on "KAOLIN CLAYS IN EXTERIOR LATEX PAINTS."

Mr. Broome explained that this study has been going for over four years and a variety of kaolin exterior pigments have been tested, i.e., delaminated and calcined. The following six pigments were used in this study: (1) hydrous kaolin clay; (2) conventional calcine kaolin; (3) premium calcine kaolin; (4) structured pigment; (5) six micron calcium carbonate; and (6) kaolin based structured flatting pigment. According to the speaker, all of the mentioned pigments have a variety of oil absorption and brightness levels.

Three vinyl acrylics were studied as well. They were Unocal 37-7, Union Carbide 376, and Unocal 3083. Mr. Broome reported little differences in the performances of the three resins.

For the study, a secondary line of latex flat house paints was utilized and the speaker explained the composition of each of the paints. Calcium carbonate performed better to control mildew growth that was introduced by the alkyd primer. The speaker concluded by stating that those pigments with calcium carbonate extender and with kaolin clay performed the best.

CARY GROBSTEIN, *Secretary*

ST. LOUIS ..... APR.

"Mass Flow Meters"

Larry Walker, the recipient of the Society's Scholarship Award, expressed his thanks for the opportunity to attend a short course at the University of Missouri-Rolla.

"CORIOLIS EFFECT MASS FLOW METERS," was discussed at the meeting by Steve Smith, of Micro-Motion Corp.

The speaker explained that coriolis flow meters offer a precise method of mass measurement. The meters reportedly measure mass as affected by acceleration unlike volumetric devices that do not measure mass, only volume regardless of density.

JAMES B. LINDSLEY, *Secretary*

TORONTO ..... APR.

"Automotive Paint"

Jim Agostino, of K-G Packaging Ltd. was presented with a 25-Year Membership Pin.

The technical presentation entitled, "LEARNING TO ANTICIPATE THE WEATHERABILITY PERFORMANCE OF AUTOMOTIVE PAINT JOB." was given by John Gerlock, of Ford Motor Co.

Dr. Gerlock began his talk with a review of the components involved in coating both metal and plastic substrates found in today's automobiles. Although both substrates share common components, such as a clearcoat, a basecoat, and a primer, metal surfaces receive additional treatment of electrodeposition (E-Coat) and phosphate treatments. On the other hand, added the speaker, plastic substrates are treated with adhesion promoters to ensure bonding of the coating to the plastic surface(s).

The speaker outlined four possible methods for testing any given coating system:

(1) Ask suppliers (fast/inexpensive)

(2) Outdoor testing (slow/reliable)

(3) Accelerated testing (fast (false) results)

(4) Paint cars and see (slow/expensive)

As shown, it is apparent that a fast and reliable testing of these finishes does not exist. However, according to Dr. Gerlock, if you look past such problems as gloss loss, cracking, peeling, and color changes, and focus on measuring rates of chemical changes within the coating system involved, then perhaps a compromise testing method is available. The results of this testing approach found that 80% of the UV light absorbers incorporated into today's automotive finishes migrate into the reaction injection molding (RIM) components of the automobile (i.e., bumpers, facia, etc.).

Dr. Gerlock continued by reviewing the photooxidation of paint and chemical pathways involved in the breakdown of the various polymers in a paint film. However, such a breakdown is not immediate. This is primarily due to the polymeric and multicrosslinked nature of these coating films.

Current research has also pointed to the role of polymer end groups in the performance of various coating films, stated the speaker. Specifically, it is known that these end groups have an effect on the photochemical degradation of the paint film. According to Dr. Gerlock, IR spectroscopy is employed for the quantitative measurement(s) of the products of photooxidation in the clearcoat component of the paint film. In addition, the rate of growth of these products can also be tracked by using the IR technique.

Another point to consider, added the speaker, was the amount of time the UV light reaches the basecoat. Such information forms a quantitative measurement of an automobile's finish "lifespan," a very important criteria in the sales and marketing effort of today's manufacturers.

In conclusion, Dr. Gerlock's talk delved into the area of "tracing" the carbonyl components found in the paint film through means of O-18 (heavy oxygen).

Q. Has the use of cathodic protection devices entered into your work?

A. No. I am not entirely sure of the relevance of such an approach in the type of work I have outlined in the talk. The issue of cathodic protection relates more to the science of corrosion.

KEVIN PELLING, *Secretary*

Elections

CDIC

Associate

Blecha, Walter K.—Kish Crosby Inc., Louisville, KY.

CLEVELAND

Active

Hartsough, Robert R.—Graphite Products, Brookfield, OH.
Wickert, Frank A.—Tremco Manufacturing, Cleveland, OH.

Associate

Marek, Peter A.—Dar-Tech, Inc., Maple Hts., OH.

LOUISVILLE

Associate

Funkhouser, Roy V.—Law Environmental, Louisville, KY.
Sharrock, Robert F.—Daicolor-Pope, Inc., Cincinnati, OH.

MONTREAL

Active

White, Barton—Canbro, Inc., Valleyfield, Que.

NEW YORK

Active

Gaglani, Kamlesh—Troy Chemical Corp., Newark, NJ.
Gniecko, James—CIBA-GEIGY Corp., Ardsley, NY.
Hipolito, Pepito—Agate Lacquer Mfg. Co., Long Island City, NY.
Venturini, Michael T.—The Mearl Corp., Buchanan, NY.

Associate

Carroll, Robert E. III—R.E. Carroll Inc., Trenton, NJ.
Gilbert, Murray H.—R.E. Carroll Inc., Trenton.

Retired

Wilson, Donald D.—Summit, NJ.

NORTHWESTERN

Active

Addie, Benjamin A.—S.B. Foot Tanning Co., Redwing, MN.
Hughes, Janis M.—Honeymead Products, Mankato, MN.

Associate

Grout, John E.—Olin Corp., Downers Grove, IL.

PACIFIC NORTHWEST

Active

Paulsen, Damon V.—Fuller-O'Brien Paints, Kirkland, WA.
Riegert, Daniel—Quad Group Inc., Spokane, WA.

Associate

Bantowsky, Margit—Department of Ecology, Olympia, WA.
Frye, Bill—Hahn Northwest, Inc., Portland, OR.
Gattman, Rob—DuPont Co., Vancouver, WA.
Hungerford, A.C.—Columbia River Carbonates, Woodland, WA.
North, Steve—The Coast Group, Vancouver, B.C.
Prins, Ben D.—Imasco Minerals Inc., Surrey, B.C.

Educator/Student

Schwegler, Spencer B.—W. Wash. Painters Appreticeship, Seattle WA.

PITTSBURGH

Active

Emmert, Glenn—PPG Industries, Inc., Springdale, PA.
Federoff, Donna L.—Betz Laboratories, Pittsburgh, PA.
Pinchok, Michael Jr.—PPG Industries, Inc., Springdale.
Ulrich, Alfred D.—Washington Penn Plastic, Washington, PA.

Associate

Rice, David E.—Degussa Corp., Akron, OH.
Singer, Miriam P.—Rohm and Haas Co., Damascus, MD.

ROCKY MOUNTAIN

Active

Beardall, Carwin—Messmer's, West Jordan, UT.
Toplisek, Thomas S.—Biochem Systems Inc., Golden, CO.

SOUTHERN

Active

Beard, Frederick T.—Akzo-Nobel, Clinton, MS.
Drew, Antonius M.—Superior Polymers, Inc., Miami, FL.
Hackmeyer, Lee—Associated Paint, Inc., Medley, FL.
Quayle, Bruce B.—Atlas Chemical Co., Miami.
Tinta, John T.—Akzo-Nobel, Clinton.
White, Randall H.—Akzo-Nobel, Clinton.

Associate

Gregg, Jimmy C.—KRONOS, Inc., Matthews, NC.
Hembree, Carol—PPG Industries, Inc., Cumming, GA.
Joye, Richard R.—Ross Chem Inc., Fountain Inn, SC.
Keck, Francis D.—Reichhold Chemicals, Inc., Stockbridge, GA.
Knight, William J.—CYTEC Industries, Atlanta, GA.
Magan, Phil R.—Olin, Marietta, GA.

TORONTO

Active

Joshi, Bharat N.—Schenectady Chemicals Canada Ltd., Scarborough, Ont.
Tapper, A. William—Color Your World, Toronto, Ont.
Ting, Timothy K.—Benjamin Moore & Co., Ltd., Toronto.
Vergunst, Paul R.—Benjamin Moore & Co., Ltd., Toronto.

People

F. Anwari

Freidun (Fred) Anwari has joined the staff of the Industrial Coatings Department in the applications area and technical service laboratories for waterborne coatings of The BFGoodrich Co., Specialty Chemicals, Performance Resins and Emulsions Division, Cleveland, OH. Mr. Anwari spent the last nine years with the Coatings Research Group, Inc. He currently serves on the Board of Directors of the FSCT, is President of the Cleveland Society, and was Chairman of Cleveland's Technical Committee for six years.

Dar-Tech, Cleveland, OH, has announced that **Brett Walburn** will assume responsibility for BYK-Gardner Color and Appearance Instrumentation for the company in Northern Ohio, Western Pennsylvania, and West Virginia.

In other news, **Pete Marek** has joined the company as Sales Representative. Mr. Marek will represent raw materials, additives, and specialty chemicals in the Northern Ohio territory. He is a member of the Cleveland Society.

Wacker Silicones Corp., Adrian, MI, has promoted **Darryl W. Brixius** to Technical Manager for the company's Building, Sealants, and Coatings Business Unit. Mr. Brixius will be responsible for all technical service functions as well as research and development for Wacker's paint raw materials and masonry treatment products.

PPG Industries, Pittsburgh, PA, has announced the creation of the Office of the Chief Executive (OCE). Comprising the office are **Jerry E. Dempsey**, Board Chairman and Chief Executive Officer and **Robert D. Duncan** and **Raymond W. LeBoeuf**, both of whom were elected Executive Vice Presidents. In addition, four others were elected Senior Vice Presidents: **Russell L. Crane**—Human Resources and Administration; **Peter R. Heinze**—Chemicals; **John J. Horgan**—Fiber Glass; and **Guy A. Zoghby**—General Counsel. These four, as well as the members of the OCE, make up PPG's Management Committee.

Also, **Frank A. Archinaco** was elected Vice President, Glass.

Olin Corp., Stamford, CT, appointed **Steven T. Warshaw** to Vice President and General Manager, Performance Urethanes. Mr. Warshaw is responsible for the overall management of the company's performance urethanes business, including the Luxate® aliphatic diisocyantes product line.

Ted DelDonno assumed the title and responsibilities of Business Manager for the Polymers Division of Rohm Tech, Fitchburg, MA. Mr. DelDonno will manage sales, laboratory, production, and support for all aspects of the business. Prior to his five years with the company, Mr. DelDonno was with Industrial Coatings Research at the Rohm and Haas Central Research Laboratories, where he led exploratory research, product development, and technical service projects.

AlliedSignal, Morris Township, NJ, has announced the addition of **F.M. Ross Armbrecht Jr.** to its Performance Additives business unit as Director of Technology. In this capacity, Dr. Armbrecht will oversee the consolidation, support, and growth of technology assets. Prior to joining the company, Dr. Armbrecht served as President of Systech, Wilmington, DE.

Michael Tarwacki will represent Datacolor International, Lawrenceville, NJ, as Area Sales Manager for the company's Michigan/Ohio River Valley Region. This area encompasses the states of Indiana, Kentucky, Michigan, Ohio, and West Virginia. Mr. Tarwacki previously held the position of Technical Sales Representative for this area.

New York Society Presents Its Annual Awards

Donald E. Brody accepted the New York Society's PaVac Award "for outstanding devotion to the Society and his technical developments and educational efforts contributed to the advancement of the protective coatings industry."

Mr. Brody has been in the coatings industry for more than 40 years and is currently a Consultant. During this time, he has had experience in research, development, and technical services. In addition, Mr. Brody has published numerous papers and has been granted several patents. In 1971, he received the Roy H. Kienle Award while serving on many Society committees.

In recognition for his technical achievements and outstanding service to the New York Society's Technical Committee, **Lawrence Waelde**, of Troy Corp., East Hanover, NJ, received the 1994 Roy H. Kienle Award.

Mr. Waelde has been a member of the Society since 1980 and a member of the Technical Committee since 1984. He served as Chairman of the Committee from 1990-93 and Chairman of the 1993 Spring Symposium. He was Co-chairman of the Subcommittee that presented the Society's paper "Evaluation of Additives for High-Solids Coatings" at the 1989 FSCT Annual Meeting. Mr. Waelde also presented the Committee's paper "Silicone Additives of High-Solids Coatings" at last year's Annual Meeting where he was awarded second place in the Society Speakers Award Competition.

Richard J. Himics, of Daniel Products Co., Jersey City, NJ, was presented the President's Service Award for his long and faithful service to the New York Society and the protective coatings industry.

Dr. Himics began his coatings career 28 years ago. He has been President of Daniel Products Co., since 1982. Dr. Himics has served on the Program Committee and was Joint Coordinating Chairman of the Legislative Update and Society Representative. Formerly a member of both the New York and Federation Board of Directors, he has been on numerous FSCT Committees including Roon, Annual Meeting Program and Planning, and Professional Development. Dr. Himics served as a Trustee of the Coatings Industry Education Foundation.

L. Waelde

R.J. Himics

C.H. Mayne

The Industrial Coatings Unit of Akzo Nobel, Louisville, KY, has appointed **Charles H. Mayne** as Human Resources Manager. In this position, he will be a member of the Industrial Coatings Management Team reporting directly to **Robert J. Torba**, President, Industrial Coatings. Since joining the company in 1983, Mr. Mayne has held several senior management positions in sales, marketing, and operations.

United States Testing Co., Inc., Hoboken, NJ, has named **Robert Broughman** as Regional Marketing Representative, Biological and Chemical Services. Mr. Broughman's experience includes the business development, sales, and marketing of clinical and pharmaceutical products and analytical instruments. His most recent positions combined his technical and marketing background at a New York-based science products company and a Cincinnati-based research services firm.

Kline and Co., Inc., Fairfield, NJ, announced the addition of **Bardia Mesbah** as a Business Manager in the firm's Chemicals Practice. In this capacity, Mr. Mesbah will co-manage the practice with **Eric Vogelsberg** and will have overall management responsibility for the Adhesives, Sealants, and Coatings Practice. He will assist Mr. Vogelsberg in the marketing and management of the company's proprietary consulting services.

Richard Roberts has been named Business Manager for the Textile Business of ICI Surfactants, Wilmington, DE. Based in Bolton, United Kingdom, Mr. Roberts is charged with the company's textile operations throughout the world, except for Asia Pacific.

Sybron Chemicals Inc., Birmingham, NJ, has announced the appointment of **David J. Drahos** to the position of Senior Research Scientist for the Biochemical Division. Prior to joining the company, Dr. Drahos served as Research Group Leader for the applied environmental microbiology program of Monsanto Co.

Dan Eberhart has joined the Instrument Society of America (ISA), Research Triangle Park, NC, as Director of Member and Customer Services. Mr. Eberhart is responsible for managing the processing and fulfillment of member records, catalog orders, magazine subscriptions, and training seminar registrations.

In addition, **Mary Ann Cohen** was named Manager, Marketing Services. In this position, Ms. Cohen will assist ISA's business units with the development of strategic business plans and will implement marketing campaigns throughout the year.

Vanessa French-Harris was promoted to Director of Graphics. Ms. French-Harris will be responsible for the quality of all graphics produced by or for ISA.

Carl L. Segraves has been named Vice President—Corporate Purchasing for Harcros Chemicals, Inc., Kansas City, KS. Formerly Director, Corporate Purchasing, Mr. Segraves will continue to have overall responsibility for corporate purchasing for the company's distribution centers located throughout the U.S. He has held various positions with Harcros, including Sales, Marketing Manager, Project Manager, and District Manager.

Call For Papers

22nd Annual Waterborne, Higher-Solids, and Powder Coatings Symposium

Sponsored by:
The Southern Society for Coatings Technology
and
The University of Southern Mississippi

February 22-24, 1995
New Orleans, LA

The Southern Society for Coatings Technology and the Department of Polymer Science at The University of Southern Mississippi invite all interested persons to submit papers for presentation at the 22nd Annual Waterborne, Higher-Solids, and Powder Coatings Symposium.

Papers relating to the chemistry, formulation, and marketing of waterborne, higher-solids, powder and other advanced coating systems are solicited. Papers relating to engineering aspects of coating systems or solvent abatement are also solicited.

Title, abstract, and author's name(s) (speaker's name underlined) should be submitted not later than August 15, 1994 to:

Dr. Robson F. Storey or Dr. Shelby F. Thames
Co-Organizers, WBHS & PC Symposium
Department of Polymer Science
The University of Southern Mississippi
Box 10076
Hattiesburg, MS 39406-0076

The completed paper should be submitted by December 2, 1994. The preliminary program will be developed based on the submitted abstracts. Manuscripts will be required for inclusion in the *Symposium Proceedings*.

It is required that all papers be original and of scientific value.

For additional information call (601) 266-5193, or 4475.

Book Review

PATTY'S INDUSTRIAL HYGIENE AND TECHNOLOGY: TOXICOLOGY, 4TH EDITION VOLUME II, PART A

Edited by
George D. Clayton and
Florence E. Clayton

Published by
John A. Wiley & Sons, Inc.
605 Third Ave.
New York, NY 10158-0012 (1993)
xvi + 944 pages, $195

Reviewed by
Paul R. Guevin Jr.
P.R. Guevin Associates
Westerville, OH

This book is an update of the third edition which dates back to 1981. It is faithful to Frank Patty's original idea of having a comprehensive and convenient reference that combines field experience with research.

The book is divided into 15 chapters written by industrial hygienists, toxicologists, and physicians who are leaders in their field. The coverage and treatment of each topic is directed primarily towards industry professionals wanting to keep abreast of the practical dangers of industrial toxins in their area. Much of the information contained in the book is an in-depth analysis of subjects such as tobacco smoke (a timely topic), solvents, occupational carcinogens, peroxides, epoxy resins, asbestos, etc. Numerous tables report topological characteristics of many compounds. Numerous references are presented at the end of each chapter. The index makes it easy to find technical discussions and properties of all of the chemicals.

The book is not a text book; it is a specialized, in-depth volume, one of what will be a total of six books containing 46 chapters. Each chapter in this volume covers the basic concepts and detailed descriptions of current topics of importance. It can be considered a welcomed addition to a reference library. It contains numerous references which help the reader find additional information. For example, the chapter "Epoxy Compounds," written by Drs. Thomas Gardiner, John M. Waechter, and Donald E. Stevenson, contains 100 pages of text and 450 references. This book, as well as others in the series, is a reference source to individuals seeking a quick fix for information, or persons needing a refresher and update on the specific topics covered.

Letters to the Editor

ISO Seeks U.S. Paint Industry Assistance

To the Editor:

Recently, I attended a meeting of Technical Committee 35 ("Paint") of the International Standard Organization, in Tokyo. It was unfortunate that no representatives from the U.S. were in attendance.

This is most regrettable as paints, exported by your members, are likely to be tested abroad by methods established by this ISO committee. Until now, these test methods have been developed without the benefit of the experience available in the U.S. in standardization.

We would like to obtain close cooperation with U.S. experts for development of ISO standards. Therefore, our Technical Committee hopes to hold one of its next meetings in the U.S., perhaps in conjunction with an ASTM meeting, in order to give your members an incentive to participate in our work.

R. Heiden Heimer
Tambour Ltd.
P.O. Box 2238
24 121 Akko, Isreal

Literature

Repeatability Software

A software program that tests the repeatability and reproducibility of quality assurance equipment is described in a product release. The program's features include compliance with automobile industry requirements, automatic entry of test data using a serial connection to the instrument being studied, and flexibility in test setup on the number of operations, trials, and samples. Information on the DeltaSoft/Gage R&R Software can be obtained from Fischer Technology, Inc., 750 Marshall Phelps Rd., Windsor, CT 06095.

Circle No. 30 on Reader Service Card

Capillary Columns

Capillary columns which reportedly allow GC analysis of alcohols and ketones to be done on a single column are introduced through literature. These columns feature simultaneous analyses as well as minimum theoretical plates, narrow retention indices, and reduced stationary phase bleed. Contact J&W Scientific, 91 Blue Ravine Rd., Folsom, CA 95630, for information on DB™-WAX and DB™-1 capillary columns.

Circle No. 31 on Reader Service Card

Particle Separation Kit

Technical literature introduces a particle separation kit to separate traces of suspended solids from a liquid for direct analysis by reflection-absorption FTIR microscopy. The kit contains 13 mm diameter gold-coated filters, with a .8 micrometer pore size, to isolate particulates from a solution with a syringe filter holder. To obtain additional information on the Microscopic Particle Separation Kit, contact Spectra-Tech Inc., 652 Glenbrook Rd., Bldg. 8, P.O. Box 2190-G, Stamford, CT 06906.

Circle No. 32 on Reader Service Card

Specialty Additives

A brochure describes a company's specialty additives for applications of coatings, inks, adhesives, and dyes. The publication contains brief product and application descriptions as well as application grids detailing the functions these products perform. For a copy of the brochure, "Air Products' Specialty Additives—Versatile Performers for Diverse Applications," contact Air Products and Chemicals, Inc., Performance Chemicals Div., 7201 Hamilton Blvd., Allentown, PA 18195-1501.

Circle No. 33 on Reader Service Card

Extender Pigment

A calcined extender pigment designed to partially replace calcined kaolins, cellulosic thickeners, and flatting agents in coatings with high pigment volume concentrations has been introduced through literature. Further information on AL-SIL-ATE® 2000 Extender Pigment can be obtained from Engelhard Corp., Specialty Minerals and Colors Group, 101 Wood Ave., Iselin, NJ 08830-0770.

Circle No. 34 on Reader Service Card

Industry Newsletter

A company presents its fifth annual product/industry newsletter. This edition features information on defoamers, a new viscosity control agent, a new dispersant series, and a new anticorrosive agent, as well as a chart with defoamer recommendations for aqueous high-gloss coatings. For a copy of *Drew Perspectives*, Volume 5, contact Marketing Services, Drew Industrial Div., One Drew Plaza, Boonton, NJ 07005.

Circle No. 35 on Reader Service Card

Quality Assurance

A six-page brochure highlights a system designed to provide on-line management of quality assurance data for organizations associated with products manufactured by the batch or by the lot. The system aims to provide management of the definition, review, and disposition of product or material lots which are to be manufactured, tested, and released for distribution. For a free copy of the brochure, request form no. L-1659 from The Perkin-Elmer Corp., 761 Main Ave., Norwalk, CT 06859-0012.

Circle No. 36 on Reader Service Card

Surfactants

A brochure reviews the market for industrial surfactants and their typical applications. Topics covered include: additives for the polymer industry; surfactants that help paint manufacturers convert from solvents to water-based formulations; micro-emulsifiers that provide an alternative to chlorinated hydrocarbon solvents for industrial and institutional cleaning products; polymeric emulsifiers that allow water to replace expensive and hazardous hydrocarbons in metalworking and hydraulic fluids; and adjuvants to cut the levels of active ingredients in pesticides. For a copy of "Surfactants for Industry," write ICI Surfactants, Wilmington, DE 19897.

Circle No. 37 on Reader Service Card

Oligomers and Monomers

An oligomers and monomers reference wall chart is highlighted in a product release. This chart features the chemical structure of products for peroxide and amine cure applications, including information on the products' physical and chemical properties, features, applications, and performance properties. Major product groups highlighted are urethane and epoxy oligomers; scorch retarding monomers; water dispersible monomers; adhesion promoting monomers; and monofunctional, difunctional, trifunctional, and multifunctional monomers. "Sartomer's Monomers and Oligomers for Peroxide and Amine Curing" chart is available from Sartomer Co., 468 Thomas Jones Way, Exton, PA 19341.

Circle No. 38 on Reader Service Card

Company Profile Brochure

A 28-page, four-color brochure details a company's research and manufacturing operations, as well as its building block chemicals. Full-color photographs present the company's businesses, markets, and products, which include coatings and resins, polymer additives, phosphine chemicals, polyester molding compounds, engineered materials, and acrylic fibers. A copy of the brochure is available from CYTEC Industries Inc., Five Garrett Mountain Plaza, West Paterson, NJ 07424.

Circle No. 39 on Reader Service Card

Particle Size Analyzer

The availability of a modem and network-accessible particle size analyzer is announced in a product release. The data files are stored in Binary and ASCII text formats, and data can be exported into many industry standard formats. Write Horiba Instruments Inc., 17671 Armstrong Ave., Irvine, CA 92714, for details on the LA-900 Particle Size Analyzer.

Circle No. 40 on Reader Service Card

Polyurethane-Acrylic Dispersion

A company introduces its water-based polyurethane-acrylic dispersion through literature. This product is designed to provide a clear, nonyellowing, durable finish for use on wood and masonry, flooring, fabrics, inks, and paints. To obtain more information on WL-305, contact Upaco Adhesives Div., Worthen Industries, Inc., 3 E. Spit Brook Rd., Nashua, NH 03060.

Circle No. 41 on Reader Service Card

VOC Removal System

A brochure describing a VOC removal adsorption system has been printed. This system reportedly uses small amounts of proprietary adsorbents to remove VOCs from air streams. Desorption and adsorption take place simultaneously, and the VOCs are recovered in a condensed, ready-to-recycle liquid form. For a copy of the brochure, or for more information on The Purus A2000™, contact Purus Corp., 2713 N. First St., San Jose, CA 95134.

Circle No. 42 on Reader Service Card

Capabilities Brochure

A brochure highlights a company's products and services for industrial water treatment, coatings, plastics, and formulating companies. This 16-page, four-color publication presents the company's approach to productivity, problem solving, customer service, environmental safeguards, and quality standards. For a copy of the brochure "Accepting the Challenges," write Buckman Laboratories, 1256 N. McLean Blvd., Memphis, TN 38108-0305.

Circle No. 43 on Reader Service Card

Floor Coatings

Literature focuses on an addition to a line of floor coatings for industrial, commercial, and marine applications. The two-component, low VOC, water-based coating is designed to offer chemical resistance, abrasion resistance, and gloss retention under low to medium traffic conditions in moderate chemical exposures. For further details on ArmorSeal™ 700 HS (SWS-3924), write The Sherwin-Williams Co., c/o HKM Direct, 5501 Cass Ave., Cleveland, OH 44102.

Circle No. 44 on Reader Service Card

Interferometers

Information on a new line of interferometers has been issued. The line is designed for growth and upgrading potential, being configurable and compatible with many accessories and optics. Contact Zygo Corp., Laurel Brook Rd., P.O. Box 448, Middlefield, CT 06455-0448, for more details on the GPI family of interferometers.

Circle No. 45 on Reader Service Card

Water Treatment Systems

A brochure details water and wastewater treatment systems. The two-page, four-color bulletin emphasizes water purification processes, including reverse osmosis, continuous deionization, and ion exchange, as well as wastewater treatment, filtration, service deionization, consulting and testing, and recovery services. U.S. Filter Corp., P.O. Box 560, 4669 Shepherd Trail, Rockford, IL 61105-0560, can provide a free copy of the brochure, "Purely U.S. Filter."

Circle No. 46 on Reader Service Card

Bag Filters

Bag filters used at the product filling stage are discussed in a data sheet. These filters are made of continuous fibers and are available in a range of micron removal ratings and sizes. More information on Profile® bag filters can be obtained by requesting Brochure PAG 100 from Pall Corp., Fluid Processing Groups, 2200 Northern Blvd., East Hills, NY 11548.

Circle No. 47 on Reader Service Card

Japanese Paint Industry

A 150-page study on the Japanese paint industry has been published. This report provides an overview of the Japanese paint market, a market technology assessment, new advancements, demand forecasting, and environmental action programs. Contact Franco Busato, Irfab Chemical Consultants SCV, 24 J.B. Danayerstraat, 1560 Hoeilaart (Brussels), Belgium, for more information on "New Technology Products in Surface Coatings—Japan 1992-2000."

Circle No. 48 on Reader Service Card

Polyester Resin

A new high-solid polyester resin which can be used as a base resin or modifier in VOC compliant industrial coatings is introduced through literature. The product is designed to offer low VOC capability, flexibility, and adhesion to substrates, including hot dipped galvanized. Additional details on this new high-solid polyester resin are available from Etna Products, Inc., P.O. Box 630, Chagrin Falls, OH 44022.

Circle No. 49 on Reader Service Card

Allyl Alcohol Derivatives

A press release introduces three new allyl alcohol derivatives. One is a hard thermoplastic material and is used as a hard resin additive; the second is a dual functional intermediate with reportedly low flammability; the third is a low viscosity, difunctional liquid with a high boiling point and low shear point. For more information on the Arcal™ line (which includes SAA-100, AAP, and DAP), contact ARCO Chemical Co., 3801 West Chester Pike, Newtown Square, PA 19073.

Circle No. 50 on Reader Service Card

Clarifying Agents

A list of polypropylene resins containing a new clarifying agent is described in a product release. Polypropylene resins containing these clarifiers reportedly can be used in all fabrication processes without temperature limitations or plate-out. For more information on Millad® 3988 clarifying agent, write Milliken Chemical & Packaging Div., Milliken & Co., 920 Milliken Rd., P.O. Box 1927 M-400, Spartanburg, SC 29304.

Circle No. 51 on Reader Service Card

VOC Reduction

A press release presents a modified linseed oil that is designed to reduce VOCs in coatings. This substance can reportedly replace petroleum-based solvents while maintaining functional properties in a variety of coatings. More information is available from Cargill, Inc., P.O. Box 5625, Minneapolis, MN 55440.

Circle No. 52 on Reader Service Card

Silica Products

Two new white, neutral pH precipitated silica powders are highlighted in a product release. One is a wax-treated powder having a median agglomerate size of four micrometers and the other has a median agglomerate size of seven micrometers. Product bulletins for Lo-Vel 326 and 356 are available from Business Communications, PPG Industries, Inc., One PPG Place, Pittsburgh, PA 15272.

Circle No. 53 on Reader Service Card

Viscometers and Rheometers

A 36-page catalog describes a line of viscometers and rheometers. Product information on viscosity measuring instruments, systems, and accessories for liquids, slurries, and pastes is included. A copy of the 1994 catalog and user's guide is being offered by Brookfield Engineering Laboratories Inc., Dept. NR-102, 240 Cushing St., Stoughton, MA 02072.

Circle No. 54 on Reader Service Card

Dispersion Mill

A dispersion mill that has an operating capacity of 125 U.S. gallons batch (or design option for continuous operation with throughput rates of up to 120 GPM) has been detailed in technical literature. This mill is capable of mixing, dispersion, cooking, aeration, deaeration, and emulsion. More information is obtainable from Kady International, 127 Pleasant Hill Rd., P.O. Box 847, Scarborough, ME 04070.

Circle No. 55 on Reader Service Card

Defoamers

Three new general purpose defoamers for acrylic and latex systems are highlighted in a data sheet. Two are compatible with semi-gloss paints and coatings, and the third imparts leveling and flow control properties in high-gloss paints and adhesives. Technical information, product data, and sample kits on Foamacure® 170, 190, and 210 are available from Hüls America Inc., Coatings Additives & Biocides Group, 80 Centennial Ave., Piscataway, NJ 08855-0456.

Circle No. 56 on Reader Service Card

Steel Drum Packing

Information on construction and testing of containers used to package hazardous materials has been published. This 37-page publication illustrates new universal standards being used to enhance safety of transport, flexibility and technological innovation, and facilitated international commerce in the packaging field. Contact Trilla Steel Drum Corp., 2959 W. 47th St., Chicago, IL 60632, for a free copy of "Understanding HM-181 for Steel Drums."

Circle No. 57 on Reader Service Card

Adhesives and Sealants

A directory for both manufacturers and users of adhesives and sealants has been published. This publication includes trade and research associations, adhesive and sealant manufacturers, trade names, adhesives and sealant suppliers listed by both type and end use. To order the *European Adhesives and Sealants Yearbook* write FMJ International Publications Ltd., Queensway House, 2 Queensway, Redhill, Surrey RH1 1QS.

Circle No. 58 on Reader Service Card

Weatherability Testing

Information is now available on an instrument for testing weatherability and material durability. Typical weathering tests are reportedly capable of shortening test times without distorting the quality of UV light. Features include a high irradiance xenon arc system for higher irradiance ranges. Atlas Electric Devices Co., 4114 N. Ravenswood Ave., Chicago, IL 60613, will provide further details on the 3SUN high irradiance xenon Weather-Ometer®.

Circle No. 59 on Reader Service Card

Crystalline Structures

A new software program for the calculation and representation of crystalline structures is the topic of a product release. This program performs 3D visualization and calculations on crystal structures and allows for building, viewing, and analysis of complex cells and structures of several hundred atoms. Contact ARSoftware, 8201 Corporate Dr., Ste. 1110, Landover, MD 20785, for information on CAD Crystallography.

Circle No. 60 on Reader Service Card

Metal Surface Preparation

A line of cleaning and processing equipment is detailed in a product release. This equipment is designed to simplify metal surface preparation, clean parts, and reduce production rejects by utilizing pneumatic powered mechanical agitation. Contact Man-Gill Chemical, 23000 St. Clair Ave., Cleveland, OH 44117, for more information on Magnus® Magna Lif® cleaning and processing equipment.

Circle No. 61 on Reader Service Card

Check Valves

Diaphragm check valves have been introduced through literature. These valves reportedly are not dependent upon gravity, mounting position, or reverse flow, and feature a diaphragm which automatically positions itself against the valve seat in the same location every time used. Contact Plast-O-Matic Valves, Inc., 430 Route 46, Totowa, NJ 07512, for more information on Series CKM valves.

Circle No. 62 on Reader Service Card

Lined Container

A lined bin for handling hazardous liquids, either corrosive or combustible, has been detailed in technical literature. This bin is based on a standard carbon steel or stainless steel handling bin and features a teflon lining for the lid and a teflon-dipped EDPM multiseal gasket. More information on the poly lined jumbo bin is obtainable from Clawson Container Corp., 4545 Clawson Tank Dr., Clarkston, MI 48346.

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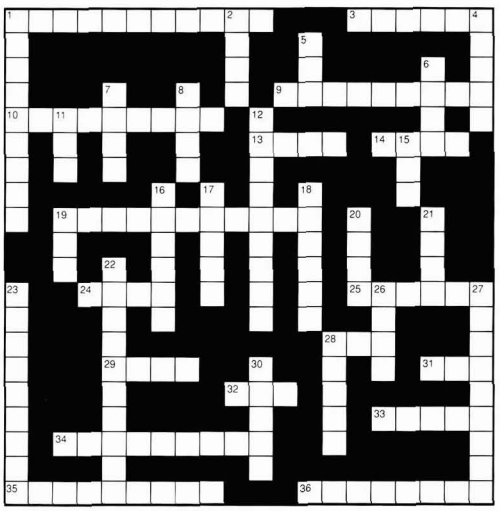
CrossLinks

Natural Products III
by Earl Hill



No. 60

Solution to be Published in July Issue

H. Earl Hill is a retired Coatings Chemist with an interest in mathematics, statistical quality control, and his home computers. He is a resident of Erie, PA, and has been a member of the FSCT for over 25 years.

ACROSS

1. What mineral curls and expands upon heating?
3. Turpene hydrocarbon found in, what else, turpentine? C_____
9. Clay mixture from volcanic ash, B_____
10. A solvent plasticizer from the class of 3 Across
13. Hydrocolloid from algae plants
14. What is a metallic salt of a fatty acid called?
19. Latex source of an elastomer similar to natural rubber (2 words) G_____
24. Burlap (Syn.)
25. Monobasic acid found in nature, now made synthetically
28. Kind of spray
29. What protein comes from maize?
31. Word is in 9 Across clue
32. Heat sensitive substance used to contribute slip or mar resistance in coatings
33. Soluble salts of a polymeric acid found in seaweed
34. What are the corrosion products on zinc called? (2 words) W_____
35. Type of asphalt, mined in Argentina
36. Aromatic acid; basis of Japanese lacquer, U_____

DOWN

1. Word with oil, V_____
2. Nonfibrous magnesium silicate
4. Common type of gum, rosin derived
5. Organic colorant, commonly found in nature
6. Ground Muscovite
7. Aquatic oil
8. Kind of natural alcohol; poisonous; CH_3OH
11. Dry
12. As a polymer, it is 13 Across, G_____
15. Where we get minerals
16. Nut shells yield this natural oil (ends with W)
17. Fragrant oil, used to mask odors
18. Another oil from nuts; used by artists
19. Jellylike solid
20. Having to do with water
21. A defect in 8 Down; Wayne's favorite expression
22. A type of asphaltic pyrobitumen, W_____
23. A variety of pure gypsum, A_____
26. The bark from a type of oak tree
27. Dye derived from female insects
28. A brick made from clay in the S.W.
30. Where many natural products come from

Coming Events

FEDERATION MEETINGS

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

1994

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

1995

(Oct. 9-11)—73rd Annual Meeting and 60th Paint Industries' Show. Cervantes Convention Center, St. Louis, MO.

(May 17-22)—FSCT Spring Week. Cancun, Mexico.

1996

(Oct. 23-25)—74th Annual Meeting and 61st Paint Industries' Show. McCormick Place North, Chicago, IL.

1994

(July 18-21)—"94...Proyección de la Technologia." Annual Technical Symposium. Sponsored by the Mexico Society. Cuernavaca, Morelos, Mexico. (César Fuentes, ANAFAYPT, Gabriel Mancera 309, Col. Del Valle, 03100 Mexico, D.F. Apartado Postal 44-099; 543-64-88).

(Sept. 22-25)—20th Annual Meeting of the Mexico Society. Ixtapa, Zihuatanejo, Mexico. (César Fuentes, ANAFAYPT, Gabriel Mancera 309, Col. Del Valle, 03100 Mexico, D.F. Apartado Postal 44-099; 543-64-88).

1995

(Feb. 20-22)—Western Coatings Societies' 22nd Biennial Symposium and Show. Sponsored by the Golden Gate, Los Angeles, Pacific Northwest, and Rocky Mountain Societies. Hilton Hotel and Towers, San Francisco, CA. (Gordon Pioch, WCSSS Chairman, Eureka Chemical Co., P.O. Box 2205, S. San Francisco, CA 94083; (415) 761-3536).

(Feb. 22-24)—22nd Annual Waterborne, Higher-Solids, and Powder Coatings Symposium. Sponsored by the Southern Society and The University of Mississippi (USM). New Orleans, LA. (Robson F. Storey or Shelby Thames, Co-Organizers, WBHS&PC Symposium, Dept. of Polymer Science, USM, P.O. Box 10076, Hattiesburg, MS 39406-0076).

OTHER ORGANIZATIONS

1994

North America

(June 20-22)— "Introduction to Plastics." Short course sponsored by The University of Akron (UA), Akron, OH. (Nancy Clem, UA, Akron, OH 44325-3109).

(June 21-25)—"Basic Polymer and Coatings Chemistry." Short course sponsored by California Polytechnic State University, San Luis Obispo, CA. (James Westover, Chemisty Dept., California Polytechnic State University, San Luis Obispo, CA 93407).

(June 23-24)—"Introduction to Compounding." Short course sponsored by The University of Akron (UA), Akron, OH. (Nancy Clem, UA, Akron, OH 44325-3109).

(June 23-25)—"Extrusion Processing." Short course sponsored by The University of Akron (UA), Akron, OH. (Nancy Clem, UA, Akron, OH 44325-3109).

(June 27-28)—"Introduction to Injection Molding." Short course sponsored by The University of Akron (UA), Akron, OH. (Nancy Clem, UA, Akron, OH 44325-3109).

(June 27-29)—"Principles of Color Technologies." Short course sponsored by The University of Akron (UA), Akron, OH. (Nancy Clem, UA, Akron, OH 44325-3109).

(June 27-29)—"Coating Process Fundamentals." Short course sponsored by the University of Minnesota. Minneapolis, MN. (Jackie O'Brien, Dept. of Chemical Engineering and Materials Science, University of Minnesota, 421 Washington Ave., S.E., Minneapolis, MN 55455).

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

(July 12-14)—Dialogue '94. Symposium cosponsored by National Association of Corrosion Engineers, Johns Hopkins University, National Institute for Conservation of Cultural Property, and the National Park Service. Johns Hopkins University, Baltimore, MD (NACE, P.O. Box 218340, Houston, TX).

(July 18-20)—"Basic Coatings for Sales and Marketing Personnel." Short course sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (Cynthia N. Campbell, UMR Coatings Institute, Dept. of Chemistry, 142 Schrenk Hall, Rolla, MO 65401-0249).

(July 28-29)—1994 FLC/TTC Government Laboratory/Industry Technology Transfer Conference. Sponsored by Technology Transfer Conferences, Inc. The Ritz Carlton—Pentagon City, Washington, D.C. (Lucy W. Malone, Technology Transfer Conferences, Inc., 325 Plus Park Blvd, #108, Nashville, TN 37217).

(Aug. 17-19)—1994 Weather-Ometer® Workshop. Sponsored by Atlas Electric Devices Co. Holiday Inn O'Hare, Chicago, IL. (Margaret MacBeth, Atlas Electric Devices Co., 4114 N. Ravenswood Ave., Chicago, IL 60613).

(Aug. 29-30)—1994 Midwest University/Industry Technology Transfer Conference. Sponsored by Technology Transfer Conferences, Inc. Westin Hotel—O'Hare, Chicago, IL. (Lucy W. Malone, Technology Transfer Conferences, Inc., 325 Plus Park Blvd, #108, Nashville, TN 37217).

(Sept. 26-30)—"Introduction to Paint Formulation." Short course sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (Cynthia N. Campbell, UMR Coatings Institute, Dept. of Chemistry, 142 Schrenk Hall, Rolla, MO 65401-0249).

(Sept. 28-30)—"Accelerated and Natural Weathering Techniques." Short course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Director, Cooperative & Continuing Education—Chemistry, Kent State University, P.O. Box 5190, Kent, OH 44242-0001).

(Oct. 3-4)—1994 Canadian University/Crown Laboratories/Industry Technology Transfer Conference. Sponsored by Technology Transfer Conferences, Inc. Holiday Inn Crown Plaza Airport Hotel, Toronto, Ont., Canada. (Lucy W. Malone, Technology Transfer Conferences, Inc., 325 Plus Park Blvd, #108, Nashville, TN 37217).

(Oct. 4-5)—"Advanced Radiation (UV/EB) Curing Marketing/Technology." Seminar sponsored by Armbruster Associates Inc. Marriott Hotel, Newark Airport, Newark, NJ. (David Armbruster, Armbruster Associates Inc., 43 Stockton Rd., Summit, NJ 07901).

(Oct. 4-7)—"Introduction to Coatings Technology." Short course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Director, Cooperative & Continuing Education—Chemistry, Kent State University, P.O. Box 5190, Kent, OH 44242-0001).

(Oct. 10-12)—107th National Meeting of the National Paint and Coatings Association (NPCA). Hilton Hotel, New Orleans, LA. (NPCA, 1500 Rhode Island Ave., N.W., Washington, D.C. 20005).

(Oct. 11-13)—Powder Coating '94. Technical conference sponsored by The Powder Coating Institute. Cincinnati Convention Center, Cincinnati, OH. (Andy Goyer or Vicky Thatcher, Goyer Management International, Inc., P.O. Box 54464, Cincinnati, OH 45254).,

(Nov. 13-17)—Third North American Research Conference on Organic Coatings Science and Technology. Sponsored by the American Chemical Society, PMSE Division. Hilton Head, SC. (A.V. Patsis, Institute of Materials Science, State University of New York, New Paltz, NY 12561).

(Nov. 15-18)—"Second Color Imaging Conference: Color Science Systems and Applications." Sponsored by the Society for Imaging Science and Technology (IS&T), Springfield, VA, and the Society for Information Display (SID), Playa del Rey, CA. (Pam Forness, IS&T, 7003 Kilworth Ln., Springfield, VA 22151).

(Nov. 16-18)—1994 Weather-Ometer® Workshop. Sponsored by Atlas Electric Devices Co. Holiday Inn O'Hare, Chicago, IL. (Margaret MacBeth, Atlas Electric Devices Co., 4114 N. Ravenswood Ave., Chicago, IL 60613).

(Dec. 1-2)—1994 Southwest University/Industry Technology Transfer Conference. Sponsored by Technology Transfer Conferences, Inc. Dallas Airport Marriott Hotel, Dallas/Ft. Worth International Airport. (Lucy W. Malone, Technology Transfer Conferences, Inc., 325 Plus Park Blvd, #108, Nashville, TN 37217).

Asia

(Nov. 17-19)—"IndChem '94." World Trade Center, Bombay, India. (R. Rajagopal, Colour Publications Pvt. Ltd., 126-A, Dhuruwadi, A.V. Nagwekar Marg, Prabhadevi, Bombay 400 025, India).

Europe

(June 20-22)—16th International Conference on Advances in the Stabilization and Controlled Degradation of Polymers. Luzern, Switzerland. (A.V. Patsis, State University of New York, New Paltz, NY 12561).

(June 21-22)—Surfex '94. Exhibition organized by Surfex Ltd., a wholly owned subsidiary of the Oil & Colour Chemists' Association. Harrogate, North Yorkshire. (H. Pooley, Surfex Ltd., Priory House, 967 Harrow Rd., Wembley HAO 2SF, England).

(July 4-8)—20th International Conference on Organic Coatings Science & Technology. Athens, Greece. (A.V. Patsis, State University of New York, New Paltz, NY 12561).

(Aug. 22-26)—"Advances in Emulsion Polymerization and Latex Technology." Davos, Switzerland. (G.W. Poehlein, OIP/CRB, Georgia Institute of Technology, Atlanta, GA 30332-0370).

(Sept. 14-15)—"Waterborne Coatings and Additives." Symposium sponsored by the Royal Society of Chemistry and the Society of Chemical Industry. Manchester Conference Centre, UMIST, UK. (Carol L. Sharp, Conference Secretary,The Royal Society of Chemistry, 41 Exeter Rd., Davyhulme, Manchester, UK, M41 ORF).

(Sept. 28-30)—"Fluorine in Coatings." Conference organized by the Paint Research Association in conjunction with Chemical-Polymer and Chemserve (UMIST). Salford, England. (Conference Secretary, Paint Research Association, 8 Waldegrave Rd., Teddington, Middlesex TW11 8LD, UK).

(Oct. 4-5)—"Polypropylene '94." Conference sponsored by Maack Business Services. Swissôtel, Zürich, Switzerland. (Maack Business Services, Moosacherstrasse 14, CH-8804 AU/Zürich, Switzerland).

(Oct. 24-28)—"Surfactants and Polymers in Aqueous Solution." Course sponsored by the Institute for Surface Chemistry. Athens, Greece. (K. Môller, Institute for Surface Chemistry—YKI, P.O. Box 5607, S-114 86, Stockholm, Sweden).

(Oct. 24-26)—"Speciality Plastics '94." Conference sponsored by Maack Business Services. Swissôtel, Zürich, Switzerland. (Maack Business Services, Moosacherstrasse 14, CH-8804 AU/Zürich, Switzerland).

(Oct. 31-Nov. 3)—"U.K. Corrosion '94" and "Eurocorr '94." Sponsored by The Institute of Corrosion. Bournemouth International Centre, Bournemouth, United Kingdom. (Turret Group plc., 171 High St., Rickmansworth, Hertford, WD3 1SN United Kingdom).

(Nov. 16-17)—"Resins and Pigments '94." Exhibition sponsored by The Paint and Chemical Division of FMJ International Publications Ltd. Bella Center, Copenhagen, Denmark. (Jane Malcolm-Coe, PR & Publicity Manager, FMJ International Publications Ltd., Queensway House, 2 Queensway, Redhill, Surrey RH1 1QS, United Kingdom).

(Dec. 6-7)—"Styrenics '94." Conference sponsored by Maack Business Services. Swissôtel, Zürich, Switzerland. (Maack Business Services, Moosacherstrasse 14, CH-8804 AU/Zürich, Switzerland).

Pacific Rim

(Nov. 6-10)—International Adhesion Symposium. Sponsored by The Adhesion Society of Japan. Tokyo, Japan. (Hiroshi Mizumachi, Professor, Chemistry of Polymeric Materials, The University of Tokyo, Yayoi 1-1-1, Bunkyo-ko, Tokyo 113, Japan).

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1995

North America

(Jan. 14-18)—RCMA 1995 Annual Conference & EXPO. Sponsored by the Roof Coatings Manufacturers Association (RCMA). The Ritz-Carlton Laguna Niguel, Dana Point, CA. (Sally Choquette, RCMA Meetings Coordinator, RCMA, 6000 Executive Blvd., Ste. 201, Rockville, MD 20852-3803).

(Feb. 1-3)—"Bridging the Environment." The Fourth World Congress on Coating Systems for Bridges and Steel Structures. Sponsored by the University of Missouri—Rolla (UMR). Marriott Airport Hotel, St. Louis, MO. (Michael R. Van De Mark or Norma Fleming, 119 ME Annex, UMR, Rolla, MO 65401).

(Feb. 24-26)—"Spring Decor 1995." Sponsored by the National Decorating Products Association (NDPA). Atlanta, GA. (Teri Flotron, NDPA, 1050 N. Lindbergh Blvd., St. Louis, MO 63132-2994).

(Mar. 26-31)—"Corrosion '95." Annual Conference sponsored by National Association of Corrosion Engineers (NACE) International. Orlando, FL. (NACE International, P.O. Box 218340, Houston, TX 77218-8340).

(Sept. 29-Oct. 1)—"Fall Decor 1995" Sponsored by the National Decorating Products Association (NDPA). Atlanta, GA. (Teri Flotron, NDPA, 1050 N. Lindbergh Blvd., St. Louis, MO 63132-2994).

Asia

(Jan. 16-18)—"Paintindia '95." Nehru Centre, Bombay, India. (R. Rajagopal, Colour Publications Pvt. Ltd., 126-A, Dhuruwadi, A.V. Nagwekar Marg, Prabhadevi, Bombay 400 025 India).

Europe

(May 15-18)—"Recycle '95." Forum and Exposition. Sponsored by Maack Business Services. Swissôtel, Zürich, Switzerland. (Maack Business Services, Moosacherstrasse 14, CH-8804 AU/Zürich, Switzerland).

Advertisers Index

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'Humbug' from Hillman

Impatiently waiting since last December, in my "Publish at Once" file, are "Ten Pretty Good Rules" contributed by our friendly Technical Editor Bob Brady. Was it worth the wait?

1—Never wrestle with a pig; you both get dirty and the pig likes it.

2—Never argue with an idiot; people watching may not be able to tell the difference.

3—Observe everything; admire nothing.

4—It's easier to obtain forgiveness than it is permission.

5—Rarely resist the opportunity to keep your mouth shut!

6—Don't ask the question if you cannot live with the answer.

7—If you want a new idea, read an old book!

8—If you don't know where you're going, any road will get you there.

9—Never have a philosophy which supports a lack of courage.

10—Never look back unless you intend to go that way.

—Fellows-Strategic Studies Group
Naval War College, Newport, RI

I was pleased to get a note from Frank Meyers, a years ago resident of Milan, Italy, and now living in San Jacinto. Frank included a 1967 clipping from *The Milan Daily American* which is appropriate for Humbug's Medical Research Department.

MILAN, Sept. 30–An attempt to remove a corn led to three operations and two broken bones for an unnamed Argentinean, the Buenos Aires correspondent of the Milan newspaper, *Il Giorno,* reported today.

Suffering from a corn on his left foot, the Argentinean went to the hospital to have it removed. Afraid of the thought of more pain, he requested an anesthetic.

Once the anesthetic was applied the patient's heart stopped. Frantic doctors immediately operated and conducted a heart massage to revive the patient.

Though the regular heartbeat was soon restored, the patient had been given such an overdose of oxygen that additional surgery was required to relieve stomach swelling. Two operations later, the patient was being returned to the recovery ward when the elevator and the interns had to place him on a stretcher.

During this maneuver, an intern slipped and the patient crashed to the floor breaking his arm and collarbone.

This would have been enough to cap anyone's day but this patient suddenly began gasping for air. He was rushed to the operating room for his third operation of the day–a tracheotomy.

And in all the confusion, the doctors forgot about his corn.

And you think that you've got problems!

For those who may have been wondering, Frank Borrelle, retired Executive Vice President of the Federation, much beloved by all and frequently maligned by Humbug, is alive, well, and avidly reads his church bulletin, where he found this:

Tact: the poise that refreshes.

Teen-ager: a bathroom fixture.

Vegetarian: a salad citizen.

Winter: the age of shovelry.

Supermarket: shopping a la cart.

Geneologist: a clan digger.

Neurotic: a self-taut person.

Nostalgia: yesterdaze.

Water Bed: a vinyl resting place.

Friend: one who knocks before entering, but never after leaving.

Tomorrow: the busiest day of the year.

Neighbors: the only people who listen to both sides of a family fight.

Pedestrians: the quick or the dead.

Prayer: a ground-to-air missal.

Inflation: when the buck doesn't stop anywhere.

Optimist: somebody who believes a housefly is looking for a way out.

Pessimist: somebody who looks at the world through woes-colored glasses.

Jeff Sturm thoughtfully keeps my files active with his contributions of the *Yetter Letter,* which yields stuff like:

—All decisions should be made as low as possible in the organization. The Charge of the Light Brigade was ordered by an officer who wasn't there looking at the territory.

—Bill collectors meet many men of promise.

—We know a stockbroker who was led astray by false profits.

—The person who never makes a mistake takes orders from one who does.

—Balancing the budget is like going to heaven. Everybody wants to do it. They just don't want to do what you have to do to make the trip.

—Delightful examples of euphemisms are these translations of what Andrew Harper, writing in Forbes Magazine, calls, in his wide-roving Hideaway Report, "Hotel Brochure-isms":

Charming ambience	Not newly renovated
Old World charm	Never renovated
Historic	Dilapidated
Evokes another era	Shared bath
Cosmopolitan	Little English spoken
Private	An hour from where you want to be
Warm hospitality	No air conditioning
Cozy atmosphere	No lobby
Overlooks ocean	Long walk down to the beach
Climate controlled room	The window opens

—In times like these it's helpful to remember there have always been times like these.

—Herb Hillman
Humbug's Nest
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