Effects of Colorants on the Rheology of Tint Bases

Inside

Analytical Series: Fluorescence Decay Methods
Exterior Coatings for Wood
Antifriction Coatings
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The Effects of Color Concentrates on the Rheology of Tint Bases
Douglas J. Herrick, Jason W. Boke, Maung Y. Htet, and Raymond H. Fernando, California Polytechnic State University

The ability to control rheology is crucial in controlling the flow behavior of coatings. Rheological properties of coatings formulated with associative thickeners are sensitive to a number of formulation variables, and even small changes in these variables can have a profound effect. Few studies have focused on the large viscosity drop and related problems when predispersed colorants are added to tint bases formulated with associative thickeners. In this study, pastel and deep-tone tint bases were formulated with associative and nonassociative thickeners. The tint bases were tinted with different conventional colorant dispersions and low-VOC counterparts of the same colorants. The effect of the colorants, thickeners, and VOCs on viscosity profiles, dynamic viscoelastic properties, color development, and gloss are quantified.

Analytical Series: Fluorescence Decay Methods for the Characterization of Latex Film Formation
J.M.G. Martinho and J.P.S. Farinha, CQFM, Instituto Superior Tecnico

Fluorescence decay methods have been used extensively to characterize the formation of polymer films from latex dispersions. By measuring the polymer chain diffusion at the nanometer scale, the technique can be used to quantify the extent of mixing between polymer chains from different particles that ultimately leads to the formation of a coating with good mechanical properties.

Exterior Coatings for Vertical Wood Surfaces: Demand Grows for Long-Lasting, Easy-to-Apply Paints
Cynthia Challener, CoatingsTech Contributing Writer

The paint on the exterior walls of a building, particularly in residential construction, does much more than protect the wood surface beneath it. The expectations for the appearance and durability of exterior paints and coatings are high. Intensifying the pressures are increasingly strict VOC regulations and growing consumer demand for more sustainable solutions. As a result, close relationships throughout the value chain are necessary as formulators face the challenge of developing low-VOC, high-quality, longer-lasting exterior paints for a wide range of wood and mixed substrates.
CoatingsTech provides a forum for publication of industry and association news, highlighting new materials and technology in practice, regulatory and legislative updates, as well as essential business information related to the coatings and allied industries.

As the principal membership and industry publication of the American Coatings Association, CoatingsTech serves the global membership of ACA and others in the coatings industry, and showcases association news, programs, and activities.

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October ACSeries Conference Focuses On Coating Wood and Wood Composites

The American Coatings Association (ACA) will host a fall Advancements in Coatings Series (ACSeries) conference on Coating Wood and Wood Composites. To be held October 29–30, 2013, at the Omni Hotel & Resorts in Charlotte, NC, the program will offer a forum for professionals who design, build, or manufacture using wood substrates. The program is geared towards architects and specifiers; home builders; paint contractors and remodelers; laboratory and field testers; raw material suppliers; formulators of paints and/or stains; other R&D personnel; and furniture and cabinetry manufacturers.

In addition to exploring the business and regulatory issues that involve coatings for wood and wood composites, topics to be covered include sustainable coatings technology, understanding wood substrates, performance properties of sustainable coatings, and methods for preventing coatings failures.

Presentations to be offered include:

**Preliminary Program**

**Tuesday, October 29**

8:00 am–4:00 pm

*Registration*

8:00 am–9:00 am

*Continental Breakfast*

9:00 am–9:10 am

*Opening Remarks—Ronald Obie, Wood Coatings Research Group, Inc., Wood Coatings Conference Task Force Chair*

9:10 am–10:00 am

*Keynote Speaker—Wood Market Update—Dr. Urs Buehlmann, Department of Wood Science and Forest Products, Virginia Tech University*

10:00 am–10:15 am

*Refreshment Break*

10:15 am–10:45 am

*Progress Report: State of the Industry—Waterborne Deck Stains—Doug Mall, Arkema Coating Resins*

10:45 am–11:15 am

*Investigation Into Binders for the Best Deck Coating—Ivan Tyre, Alberdingk Boley*

11:15 am–11:45 pm

*The Effect of Primers on the Durability of Paint on Historic Exterior Wood—Carol Chin, National Center for Preservation Technology and Training*

12:00 pm–1:30 pm

*Networking Luncheon with Tabletop Exhibits*

1:30 pm–2:00 pm

*Biobased Nanocoating for Wood—Moajan Nejad, University of Toronto*

2:00 pm–2:30 pm

*Structured Nano-Acrylic Polymers: Technology to Support Low-VOC Paints with Excellent Block Resistance, Hardness, and Film Formation—Jeff Arendt, Arkema Coating Resins*

2:30 pm–3:00 pm

*Use of Core-Shell Hybrids for Greater Wood Protection—John Schierlmann, Specialty Polymers, Inc.*

3:00 pm–3:15 pm

*Refreshment Break*

3:15 pm–3:45 pm

*New High Performance, Ultra-Durable, All-Acrylic Latex for Wood Coatings and Other Applications—Eric Calhoun, BASF*

3:45 pm–4:15 pm

*Achieving Optimal Wood Coatings Through the Use of Superwetting Surfactants—Jeanine Snyder, Air Products and Chemicals*

4:15 pm–4:45 pm


5:00 pm–6:00 pm

*Networking Reception with Tabletop Exhibits*

**Wednesday, October 30**

8:00 am–11:00 am

*Registration*

8:00 am–9:00 am

*Continental Breakfast*

9:00 am–9:30 am

*Overcoming Wood Coatings Defects—Marian Adjei-Taiwah, Evonik Industries*

9:30 am–10:00 am

*Low-Monomer Isocyanate Hardeners for Safer Coatings—Mauro Usai, S.A.P.I.C.I. Spa*

10:00 am–10:15 am

*Refreshment Break*

10:15 am–10:45 am

*A Discussion of the Strengths and Weaknesses of 2K and UV-Cured Coatings Systems—David Folkman, Alberdingk Boley*

10:45 am–11:15 am

*The Impact of Application Temperature on Wood Coating Formulations and Performance—Michael Bonner, Saint Clair Systems, Inc.*

11:15 am–11:45 am

*Will a Waterborne 1K System Ever Meet the Performance Standard of a Solventborne Conversion Varnish?—Jon Cronin, DSM Coating Resins*

12:00 pm–1:00 pm

*Luncheon*

**Hotel Accommodations**

ACA has secured the discounted rate of $179.00 single/double at the Omni Hotel & Resort for attendees of the ACSeries program. Reservations must be made directly with the hotel’s reservations department. The cut-off date for reservations at the reduced rate is September 30, 2013. Mention ACA when making your reservation.

**General Information**

For additional information, contact Starsha Valentine, svalentine@paint.org, or call 202.719.3698. Complete details are available at www.paint.org/events/ac-series.html.

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Biobased Epoxy Resins Research Among Topics Presented in September Issue of JCTR

The September issue of Journal of Coatings Technology and Research (Vol. 10, No. 5, 2013) features a wide range of topics of interest to the coatings community. The issue begins with a report on biobased epoxy resins. According to the authors of the article, natural oils, such as soybean oils, are emerging as promising alternatives to petrochemicals in the coatings industry. As renewable resources, they increase the overall sustainability of the coating system and can be found in plentiful supply. Yet limitations in performance have prevented the widespread use of natural oils. Recent research on epoxy-anhydride thermosetting polymers, however, has shown that a renewable resource based on a 100% biobased sucrose ester of soybean oil (sucrose soyate) can give superior performance when compared to certain petrochemical-based systems.

This report, and additional articles in the issue, are:

- Catalyzed crosslinking of highly functional biobased epoxy resins—Thomas J. Nelson, Teluka P. Galhenage, and Dean C. Webster
- NMR-measurements for determination of local moisture content of coated wood—Jimmy Johansson, Åsa Blom, and Sergey Dvinskikh
- Development of moisture-cure polyurethane–urea coatings using 1,2,3-triazole core hyperbranched polyesters—Guang Zhu, Jian Hou, Hongfei Zhu, Ri Qiu, Jingkun Xu Raju
- Preparation and fluorine enrichment behavior of fluorinated polyester—Jinsu Xiong, Yunquan Jin, Baoqing Shentu, and Zhixue Weng
- Fractionation effect of polystyrene on acrylation reaction and their adhesive and corrosive properties—A. Okudan and F. Sinan
- Effect of surface wettability on transparency in different water conditions—Zhoukun He, Xiaorong Lan, Feng Chen, Ke Wang, Hua Deng, Qin Zhang, and Qiang Fu
- Methyl acrylate polymers as suitable materials for the conservation of stone: performance improvements—Barbara Sacchi, Laura Giannini, Marco Fedrani, Luca Rosi, and Piero Frediani
- Electrochemical synthesis of poly(3,4-ethylenedioxythiophene) on stainless steel and its corrosion inhibition performance—Guang Zhu, Jian Hou, Hongfei Zhu, Ri Qiu, and Jingkun Xu
- Nanosilver/hyperbranched polyester (HBPE): synthesis, characterization, and antibacterial activity—C. Kavitha and K. Priya Dasan
- Preparation and characterization of a novel conducting nanocomposite blended with epoxy coating for antifouling and antibacterial applications—Amir Mostafaei and Farzad Nasirpour
- Polycaprolactone coating with varying thicknesses for controlled corrosion of magnesium—Min Park, Ji Eun Lee, Chun Gwon Park, Seung Ho Lee, Hyun Kwang Seok, and Young Bin Choy
- Comparison of corrosion performance of various conversion coatings on magnesium alloy using electrochemical techniques—R. Uma Rani, V. Maria Shalini, Hari Krishna Thota, and A.K. Sharma
- Study on the preparation and properties of novel transparent fire-resistant coatings—Xiang Hu, Guojian Wang, and Yan Huang
- Study of the simultaneous effects of MMT nanoclay and hydrophobically modified ethoxylated urethane—Mohsen Sarrafi, Babak Kaffashi, and Mohammad Barmar
- An oxygenated rubber derivative as a compatibilizer for the preparation of polymer films—Colin V. Bonduelle, Matthew J. McEachran, Solmaz Karamdoust, and Elizabeth R. Gillies
- Brief Communication—The effect of silane layer drying temperature on epoxy coating adhesion on the silane pretreated Al substrate—A. Hatefi, S. Mohagheghi, and A. Kianvash
- Brief Communication—Hydrophobic properties of cardboard coated with polylactic acid and ethylene scavengers—Amaury Taboada-Rodríguez, Isabel García-Garcia, Rita Cava-Roda, Antonio López-Gómez, and Fulgencio Marín-Iniesta
ACA has announced its fall schedule of Virtual Learning Conferences (VLCs). Among the courses to be offered are “Waterborne Polyolefin Dispersions for Industrial Coating Applications” on September 26, and “Architectural and Industrial Maintenance (AIM) and Green Building Standards Update,” scheduled for October 3. Both programs will be held from 1:00–2:00 pm (ET) on their respective dates.

**WATERBORNE POLYOLEFIN DISPERSIONS**

This VLC will be led by Jay Romick, research leader in the Industrial Coatings R&D group within Dow Coating Materials. The program will focus on coatings based on waterborne polyolefin dispersions (PODs). The PODs, targeted for industrial coatings, are 40–50% solids, with mean particle sizes between 200–1500 nanometers, and viscosities between 300–3500 Centipoise. Coatings made from these dispersions are reported to have excellent chemical resistance, adhesion to metal, and flexibility when cured at temperatures between 100–240ºC. The dispersions can be used as clear coatings or fully pigmented coatings, at ultra-low VOC. This course will discuss how the dispersions’ characteristics, pigment type and loading, and cure conditions affect coating performance.

**AIM AND GREEN BUILDING STANDARDS UPDATE**

Local, state, and federal pressure to lower the VOC content of architectural and industrial maintenance (AIM) coatings are expected to continue unabated for the foreseeable future. In this one-hour program, instructors David Darling, P.E., and Tim Serie, Esq., of the American Coatings Association, will assist participants in better understanding of this important area. David Darling will give an update on recent AIM regulation changes and preview key AIM regulatory changes expected over the next five years.

In addition to government regulations, green building standards and codes have evolved from little-known voluntary building certification programs to fundamentally changing the new commercial and residential construction market in the United States over the past decade. Tim Serie will provide an overview and forecast of the green building landscape and the potential influence of these standards on the coatings industry.

**REGISTRATION**

Early registration rates are in effect through September 19 for the course on Waterborne Polyolefin Dispersions and through September 26 for the AIM and Green Building Standards VLC. The early bird discounted rate is $99 for ACA members and $199 for nonmembers. The regular registration fee is $149 for members and $249 for nonmembers.

For more details, or to register online, visit ACA’s website at www.paint.org/events/virtual-learning-conferences.html. For additional information, contact ACA’s Starsha Valentine, at svalentine@paint.org or call 202.719.3698.

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RAHN USA Corporation
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Shandong Wanda Organosilicon New Materials Co., Ltd.
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Tianjin Jiuri Chemical Co., Ltd.
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TRInternational, Inc.
Tronox LLC
Troy Corporation
Trust Chem USA
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Univar Process, Inc.
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Deadline Nears for Submissions of Abstracts For 2014 American Coatings Conference

Industry personnel who are interested in participating in the American Coatings Conference 2014 (ACC) are encouraged to submit abstracts of presentations by the deadline of September 27, 2013.

The ACC, to be held in conjunction with the American Coatings Show, is scheduled for April 7–9, 2014 at the Georgia World Congress Center in Atlanta, GA. The theme of the conference is “Designing the Future: Innovative Solutions for Coatings.” Geared to this theme, presentations will focus on the latest breakthroughs and scientific research in areas crucial to the advancement of the coatings industry. Leading international industry experts from paint companies, raw material suppliers, academia, and government will gather to support the global information exchange at this important scientific forum.

Presentations should detail previously unpublished high-level technical research results that will be made available for the conference. Topics may include advancements in all coatings categories and raw materials, novel formulations, laboratory and analytical methods, and processing technology and equipment, as well as environmental and/or sustainability benefits.

Conference organizers will select presentations based on the scientific significance, novelty, and potential value to the industry. As a result, prospective authors are strongly encouraged to clearly state the research’s unique contribution in their abstracts. Selection will be based solely on the content of the abstract submitted. Acceptance of an abstract will require the author(s) to submit a final paper for a designated session or forum.

To comply with the expectations of the conference audience, abstracts, presentations, and papers for the conference proceedings must be noncommercial in style and focus exclusively on technical/scientific content. The use of trade names must be avoided wherever possible. It is also important to note that papers will not be accepted if they have been previously presented or published.

All submissions will be treated with the strictest confidence, and will only be announced if selected for the final program. The oral presentation time will be 20–25 minutes in length, followed by 5–10 minutes for discussion.

Speakers from industry will be offered a full conference registration, including all materials, for a special reduced rate. There will be no charge for speakers from academia. Coauthors attending the conference must pay the full conference fees. Conference attendees registration will open in late 2013.

All abstracts must be submitted online at www.american-coatings-show.com/callforpapers. Deadlines which must be followed include:

- Submission of title and abstracts—September 27, 2013
- Notification of acceptance to speakers—October 14, 2013
- Submission of full technical papers for the conference proceedings—January 24, 2014

For additional information on the American Coatings Show and American Coatings Conference, visit www.american-coatings-show.com.

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The 31st Biennial Western Coatings Symposium & Show (WCS) will be held October 20–23, 2013 at the Paris Las Vegas Hotel and Casino, in Las Vegas, NV. The event will combine a robust technical program with tabletop exhibits and networking opportunities. The WCS is sponsored by the Arizona, Golden Gate, Pacific Northwest, and Los Angeles Societies for Coatings Technology.

**WESTERN COATINGS SYMPOSIUM**

The WCS will begin on Sunday, October 20, with a Welcome Reception. Educational tracks will be featured over the course of the next three days. The papers scheduled for presentation include:

- **A Formulator’s Toolbox For Optimized TiO₂ Use**—Doug Mall, Arkema Coating Resins
- **A New Way to Ensure Metal Protection with Waterborne Dispersion**—Mike Kaufman, Arkema Coating Resins
- **Advancements in Military Coatings**—Beth Ann Pearson, Sherwin-Williams
- **Advances in the Direct Determination of VOCs in Coatings**—Dane Jones, Cal Poly San Luis Obispo
- **Advantages of AMMETM Dry-Film Biocides in U.S. Exterior Coatings**—Rodney T. Rees, THOR Specialties, Inc.
- **Application of a Non-Chrome, Rare Earth Coating System on a C-130 Hercules at Robins Air Force Base**—Kathy Kim, Deft Incorporated
- **Application Testing of an Experimental Dispersant Agent by DOE Methodology**—Arne Rick, BASF Corporation
- **Balancing the Conflicting Demands of an Interior Paint-and-Primer-in-One Binder**—Nicholas Foley, BASF Corporation
- **Beyond Chemistry: Dispensing and Mixing Are Critical Steps to Deliver Paint Solutions to Retail Customers**—Tim Hogan, Fluid Management
- **Biocide Optimization: An Assessment of Rapid Kill Preservatives and Two Novel Chemistries**—Beth Ann Browne, The Dow Chemical Company
- **Colored Pigments: Chemistry and Performance**—Dr. Romesh Kumar, Clarilant Corporation
- **Combining Solubility Parameters and Particle Size Distribution of Anti-Corrosive Pigments to Achieve Optimal Coating Performance**—Nathan Kofira, HALOX
- **Development of New Water-Soluble Organometallic Catalysts for CASE Applications**—Lenny Venham, Reaxis Inc.
- **Dispersed Nanoparticles: Their Positive Influence on Corrosion and UV Protection**—Michael Coppola, BYK USA
- **Dispersing Agents Aiding in TiO₂ Performance in Water-based Architectural Paints**—Beth Lowe, Clarilant Corporation
- **Effects of Predispersed Colorants on Rheology of Waterborne Tint Bases**—Raymond H. Fernando, California Polytechnic State University, San Luis Obispo
- **Environmental Considerations in the Development of Novel Dry Film Biocides**—Scott A. Grown, Lonza
- **High Hide Yellow with Superior Durability for Architectural Coatings**—Nilanjan Chakrabarti, BASF Corporation
- **High Performance Epoxy System for Ultra-Low-VOC Waterborne Concrete Coatings**—Derek Crawford, Momentive Specialty Chemicals
- **High Performance Masonry Latexes**—Elizabeth Bell, Organik Kimya US
- **High Performance Wetting Agents**—Joel Schwartz, Munzing US
- **Improved Exterior Architectural Paint and Primer Coatings: Benefits of Polymeric Hiding Technologies and Preferred Selection of Formulation Ingredients**—Tom Tepe, The Dow Chemical Company
- **Improvements in Dispersants for Multimedia Colorants**—Jeff Buchman, Lubrizol Corporation
- **Incorporation of Reactive Silicones into Various Coatings Films and the Resulting Properties**—Bob Ruckel, Siltech Corp.

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Latest Advances In Additives and Reflective Effect Pigments for Improved Weathering of Exterior Paints and Coatings—Timothy Chen, BYK USA

Liquid Crystal Coatings/Printings Toward High Efficiency Flexible Electronics—Shanju Zhang, California Polytechnic State University, San Luis Obispo

Low-VOC Tri-dibenzoate Blend in Exterior Coatings and Interior Paint Based on Harder Acrylic Polymers—Marianne Conner, Emerald Kalama Chemical

Maintaining Sag Resistance During the Entire Cure Time or Pot-Life of Two-Component, Low-VOC, High-Solids Epoxy Systems—Wes Huff, Southern Clay Products

Making Sustainability Happen: the Technologies and Options for the Next Decade—Wilhelm Wessels, BYK USA

Molecular Design, 2013—John Du, BYK USA

Nanoadditives for Waterborne Cool Roof Coatings—Steffen Pilotek, Buhler

Nano-Structured Particles to Enhance Primer Performance Properties—Maria Nargiello, Evonik Degussa Corporation

New Developments in Core Shell Chemistry—John Schierlmann, Specialty Polymers Inc.


New HMV Polymers for Optimizing Dispersion of Difficult Pigments—Larry Keyede, Patcham USA

New Paint Additives Aid in Performance of Waterborne Formulations—Jose P. Ruiz, Solvay


Next Generation of High Performance Additives for Zero-VOC Paint Formulations—Homer Jamasbi, Elementis Specialties, Inc.

Novel Additives for Maximizing the Dispersion of Transparent Iron Oxide Pigments in Waterbased Systems—Richard Najdusak, OM Group


Novel Application of Fluorosurfactant in Easy-Clean Architectural Paint—Jean Meng, DuPont Chemicals & Fluoroproducts

Novel Deaerator Technology for Modern High-Solids Coatings—Christopher Howard, Evonik Industries

Novel Developments in Self-Crosslinking Acrylic Resins—Rick Cole, Dianal America, Inc.

Novel Functional Additives for Zero-VOC Coating Formulations—Ayaz Khan, Solvay

Novel Matting Agents for Low-VOC Coatings—Matthew Linares, Evonik Degussa Corporation

Optimizing Performance of Interior Architectural Coatings Using Polymeric Hiding Technologies—Heather Eckerede, The Dow Chemical Company

Organically Modified Silicone Additives for Low- and Zero-VOC Coatings—Bruce A. Berglund, Emerald Performance Materials

Perfectly Tailoring the Performance of Water-based, Premium Quality Decorative Paints—Jaime Harris, Ashland Specialty Ingredients

Polyester Diols—Richard Shain, King Industries, Inc.


REACH: Impact on Global Coatings Industry—Naser Pourahmady, Lubrizol Advanced Materials

Significant Improvements in Paint Performance, Stability, and Color Acceptance Through the Use of New, Bio-Based Dispersant Technology—Bill Leightner, Archer Daniels Midland

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Cardolite
Buhler, Inc. (Nanotechnology)
DSM
KH Neochem Americas, Inc.
BASF
Conn and Company LLC
Elements Specialties, Inc.
Alberdingk Boley, Inc.
SOLVAY
Excaliber Minerals
Reaxis, Inc.
Pan Technology
Thor Specialties, Inc.
Lintech International
Organik Kimya US, Inc.
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Chromaflo Technologies
Akzo Nobel
Chemical Distributors, Inc.
Patcham USA LLC
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Custom Milling & Consulting, Inc.
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PQ Corporation
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BYK USA
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3M
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EPS
Worlee Chemie GmbH
EMD Chemicals
Ethox Chemicals, Inc.
Dominion Color Corp.
King Industries, Inc.
Halox, ICL Performance
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Successful Safety Integration in a Laboratory Environment—Timothy J. Selby, DuPont Titanium Technologies

Super Sticky Waterborne Primer—Peter Schmitt, Bayer MaterialScience LLC

Surface Tension/Surface Energy: Selecting the Correct Wetting Additive—Robert Miller, Troy

Surfactants for Use as Codispersants in Architectural Coatings—Jamie Harris, Ashland Specialty Ingredients

Tailored Coating Surface Properties with Polysiloxane Based Additives—Marc Hans, BYK-Chemie GmbH

Tailor-Made Hyper-Branched Nonionic Associative Thickener for Zero-VOC Paints—Brandon Achord, BASF Corporation

Take Back Control: Designing, Formulating, and Possibly Producing Your Own 0-VOC Tinting System—Hersjeel Wehrens, Elementis Specialties

The Challenges of Increasing the Accuracy of Measurements with Decreasing VOC Levels—Jeremy Powers, Chromaflo Technologies

The Changing Landscape of Alkyd Emulsions for Architectural Coatings in North America—Neal Rogers, Arkema Coating Resins

The Influence of Pigmentation on the Performance of Alkyd Latex Direct-to-Metal Primers—Jeffrey H. Danneman, Reichhold

The Role of Molecular Defoaming Actives in Low-VOC Paint Defoamer Design—John Mangano, BASF Corporation

There’s No Crying In Research! Making Innovation Succeed Even When Your Project Doesn’t—Jason Woods, Sherwin-Williams

Three Dimensional Interfacial Barrier Provides Stabilization of Water-In-Water Dispersions—Shannon A. Morrison, Southern Clay Products Inc.

TiO₂ and Extender Effects on Acrylic Latex Paint Optical Properties and Color Development—William J. Rosano, BASF Corporation

TiO₂ Scattering Optimization and Not-In-Kind Opacity Alternatives—Thomas R. Hanna, DuPont Titanium Technologies

TiO₂: Optimization or Alternatives?—Beth Howard, Cristal, USA Inc.

Titanium Solutions in Architectural and Industrial Coatings—Richard P.E. Bordeleau, Huntsman Pigments Division

UV-Curing, Water-Dilutable Urethane Acrylate—Raymond S. Stewart, Bayer MaterialScience LLC

Ways to Maximize Applied Hide, and Performance of Architectural Coatings via the Use of Additives—Tara Lyn Conley, The Dow Chemical Company

Zero-VOC Colorants: A to Z High Hiding, High Performance, High Strength, IR Reflective—David White, Heucotech Ltd.

GENERAL INFORMATION

Hotel rooms have been blocked at Paris and its sister hotel, Bally’s. Discounted rates, in effect until September 22, are $149 at Paris, and $109 at Bally’s. For hotel accommodations, call 800.499.6311 and reference the WCS Symposium. For additional WCS information, visit www.westerncoatings.org.

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ACA’s indispensable guide to the coatings industry — the *U.S. Paint & Coatings Industry Market Analysis: 2010-2015* — has recently been updated by the ChemQuest Group to include authoritative figures for value and volume of each coatings segment through 2012, estimates for 2013, and a five-year forecast for the industry to 2017.

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Allnex to Acquire Bayer’s Radiation-Curing Resin Business

Allnex has signed an agreement to acquire the nonwaterborne, radiation-curing resins business currently belonging to Bayer MaterialScience. Marketed under the Desmolux™ brand, the line represents a specialized portfolio of radiation-curing oligomers suitable for higher-performance uses, including nonwaterborne, radiation-curing acrylated resins and radiation-curing unsaturated polyesters in acrylated diluents. The deal is expected to be closed in the second half of 2013.

For Allnex, the acquired products will complement the company’s line of Ebecryl® UV/EB radiation-curing products, as well as provide opportunities to increase Allnex’s presence in new applications, develop new markets for radcure, and globalize the Desmolux business.

“This transaction will extend our portfolio of products and add new revenue streams, enabling Allnex to further leverage its strong customer relationships and partner network to expand distribution worldwide,” said Allnex’s CEO, Frank Aranzana.

Aranzana added, “We are excited about combining Bayer’s Desmolux business with Allnex’s existing Radcure product portfolio. The divestiture of the Coating Resins business of Cytec into Allnex was only completed on April 3, 2013, and we are already taking another step towards establishing the company’s new identity.”

Rust-Oleum Acquires Assets Of XIM Products

Rust-Oleum Corporation has acquired certain assets of XIM Products, Inc. The company, based in Westlake, Ohio, produces and markets specialty primers and coatings. Their brands, including Peel Bond, UMA, and Tile Doc, are marketed for difficult-to-paint surfaces.

“XIM brands and products broaden our portfolio of specialty coatings, enabling us to offer more solutions to customers seeking to solve difficult painting problems,” said Tom Reed, president and chief operating officer of Rust-Oleum.

Valspar Completes Purchase Of Inver Holding S.r.l.

The Valspar Corporation has completed its previously announced acquisition of Inver Holding S.r.l. (Inver Group). The company specializes in liquid and powder coatings and resin products used in several kinds of industrial applications, such as off-road equipment, automotive parts, architectural aluminum windows, railways, and trams. Inver reported 2012 sales of approximately €160 million ($200 million).

Gary Hendrickson, Valspar’s chairman and chief executive officer, commented, “We’re excited to welcome the Inver team into the Valspar family, and look forward to accelerating our growth in the large European industrial coatings market. Our customers will benefit from the combined resources of both companies, giving them access to expanded technologies, a broader product portfolio, and superior service.” Hendrickson added, “I am also pleased that Giovanni Domenichini, Inver’s chief executive officer, will now lead Valspar’s combined industrial business in Europe.”

Bureau of Labor Statistics
Producer Price Index

<table>
<thead>
<tr>
<th>Month</th>
<th>Prepared Paint 0621</th>
<th>Paint Materials 0623</th>
</tr>
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<tbody>
<tr>
<td>2012</td>
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<tr>
<td>February</td>
<td>267.3 (R)</td>
<td>218.6 (R)</td>
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<tr>
<td>March</td>
<td>269.2 (R)</td>
<td>226.8 (R)</td>
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<tr>
<td>April</td>
<td>270.1 (R)</td>
<td>227.1 (R)</td>
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<tr>
<td>May</td>
<td>270.5 (R)</td>
<td>224.7 (R)</td>
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<tr>
<td>June</td>
<td>270.0 (R)</td>
<td>213.8 (R)</td>
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<tr>
<td>July</td>
<td>271.2 (R)</td>
<td>211.8 (R)</td>
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<td>August</td>
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SOURCE: 1U.S. Dept. of Labor, Bureau of Labor Statistics; 2Not seasonally adjusted; 3ACA Management Information Committee; (R) = revised.
Emerald Kalama Chemical Expands Facility in Washington State

Emerald Kalama Chemical has announced plans to further increase capacity for its K-Flex® products in Kalama, WA. The company, a business group of Emerald Performance Materials, held a two-day ribbon-cutting event to inaugurate its newly expanded facility. Since 2011, the company has already doubled capacity for its line of nonphthalate plasticizers and coalescents at the Kalama site. Emerald Kalama also intends to dedicate an additional reactor for production and R&D in fall of 2013 to accommodate needs for increased manufacturing and product development.

More than 100 customers, employees, family members, and representatives of federal, state, and local government attended the ribbon-cutting event. Guests attended a luncheon program, formal ribbon cutting, and tours of the expanded facilities. Shamsi Gravel, K-Flex product line director for the Americas, conducted the event, which also included guest speakers Mark Wilson, executive director of the Port of Kalama, and James Griffing, 2012–2013 president of the Society of Plastics Engineers (SPE).

Wilson, a longtime resident of Kalama, asserted that Emerald’s Kalama Chemical business is a vital part of the fabric of the community, affecting economic development, drawing capital, increasing the tax base, and providing jobs.

Griffing discussed the benefits of technical organizations, such as SPE, and the value of active participation and networking. According to Griffing, continuous exposure to a broad range of problems, products, and solutions through participation in several events and committees might lead to the generation of new ideas for innovative products.

“Product innovation has been a key part of the K-Flex growth strategy,” added Gravel. “It was just one year ago that the company gathered to celebrate its 50th anniversary and dedicate its new expanded Technical Center. As a result, we have accelerated our efforts to develop creative, environmentally friendly solutions that deliver performance to targeted applications. We are looking forward to the next phase of our growth.”

“This business has completed a major project or acquisition every year since the company was formed in 2006,” said Edward Gotch, president of Emerald Kalama Chemical. “With 10 new product concepts active in our R&D pipeline, the new large, semi-works reactor will support product and customer scale-up. It will also provide an additional 10 million pounds of capacity to support production needs. Future expansions are planned in the United States, Europe, and Asia.”

AkzoNobel to Divest Building Adhesives Business

AkzoNobel has received a binding offer from Sika AG for the purchase of its Building Adhesives business. For €260 million, Sika AG will take ownership of the business, which in 2012 generated annual revenues of €185 million. The transaction is expected to be completed in the fourth quarter of 2013, with the proceeds used to repay short-term debt and improve liquidity.

Following the sale, all 550 employees of Building Adhesives will transfer to Sika AG. Additionally, the two Building Adhesives manufacturing facilities, in Rosendahl, Germany, and Damville, France, as well as all products and brands, will belong to the Swiss-based company.

The intended sale follows a strategic review of its place within AkzoNobel’s overall portfolio. As a stand-alone business within AkzoNobel’s Decorative Paints business area, Building Adhesives primarily serves the professional market in Northwestern Europe with a portfolio of products including floor and wall leveling compounds, floor adhesives, tile setting, sealants, and floor finishes. Its brands include Schönox, Casco, Cégécol, Synteko, and EriKeeper. The company’s Wood Finishes and Adhesives business (which also operates under the Casco brand) is not the subject of this offer.

“We want to focus our Decorative Paints business at AkzoNobel on the strong strategic paint positions we have in Europe and the growth markets of Asia and South America,” commented Ton Büchner, AkzoNobel CEO. “The intended sale of Building Adhesives is in line with this strategy. In Sika, with its portfolio of businesses in this industry, we are pleased to have found a good future home for this business.”

Rockwood Sells Clay-Based Additives Business to ALTANA

Rockwood Holdings, Inc. has entered into a definitive agreement to sell its Clay Based Additives business to ALTANA Group. The transaction, involving a purchase price of $635 million, is expected to close in the fourth quarter of 2013.

As a portion of Rockwood’s Performance Additives business, Clay Based Additives garnered sales of $191.4 million in 2012. The segment develops and manufactures a range of specialty rheology modifiers and additives used in a wide variety of applications to modify viscosity, thickness, and flow characteristics and to keep solids in suspension. The products are used in industrial and architectural coatings, oil and gas drilling fluids, consumer and household care products, inks, paper, and composites.

“The sale of Clay Based Additives is another step forward in the implementation of our long-term business strategy to maximize shareholder value,” said Seifi Ghasemi, chairman and chief executive officer of Rockwood.

Clariant Oil Services Plans Center of Excellence Lab in Malaysia

Clariant plans to open a new Center of Excellence laboratory for its Oil Services business in Kuala Lumpur, Malaysia. Located in the hub of oil and gas operations in Southeast Asia, the lab will include state-of-the-art equipment. Also, it will feature standard and manual testing processes modeled on Clariant Oil Services labs in North America and the United Kingdom.

The Malaysia facility will be Clariant’s fourth in the region, but it will be the first Center of Excellence located there. In line with the company’s goal of product innovation, the lab will house formula simulation and performance testing in emulsion, flow assurance, corrosion, and scale control technologies.
Eastman Chemical Company has been named a 2013 Responsible Care® Company of the Year by the American Chemistry Council (ACC). The award recognizes “superior health, safety, environmental and security (HSE&S) performance.” This title is ACC’s top honor, given to member companies that have increased and embraced ACC’s Responsible Care ethic throughout their organizations.

To be eligible for the Responsible Care Company of the Year award, companies must demonstrate they have surpassed specific Responsible Care performance criteria, including having a safety performance rating in the top 10% of companies in their size category; no significant process incidents in the previous year; positive performance measures in the areas of transportation safety, process safety, and emissions reduction; and demonstrated improvements in HSE&S performance, product stewardship, distribution safety, and emergency preparedness.

“It is an honor to be recognized among our peers for excellence in a program and philosophy that is foundational to our health, safety, environmental, and security program,” said Jim Rogers, chairman and CEO for Eastman. “This award is an affirmation of our commitment to Responsible Care and the work of Eastman team members to imbue its principles into the day-to-day conduct of our business.”

According to the company, Eastman has incorporated Responsible Care principles into its business for almost 25 years. Some of the company’s key accomplishments during 2012 include reaching the lowest recordable injury rate in the company’s history; implementing a corporate safety brand, “All In for Safety”; and sponsoring three other companies to become Responsible Care-certified.

Eastman’s ongoing efforts toward sustainability, in accordance with Responsible Care principles, include life cycle analysis conducted on various products; significant improvements in managing energy, improving energy efficiency, and reducing greenhouse gases (resulting in being named 2012 and 2013 Energy Star® Partner of the Year and receiving ACC Energy Efficiency awards for 20 consecutive years); having Community Advisory Panels active at 11 sites; and giving Responsible Care Management System certifications at corporate headquarters and six sites in the United States. The company has also participated in many global Responsible Care activities at sites around the world.

Each year, ACC names three Responsible Care Company of the Year recipients, one for each size of company (small, medium, and large). Eastman received the award for a large company, Solvay North America and Niacet Corporation also received Company of the Year awards.

KODA Expands Distribution of Lonza Materials Protection Products; Represents U.S. Zinc on Streamlining Zinc Oxide Distribution

Lonza Materials Protection has announced that, as a result of an acquisition by KODA Group, Lonza’s customers in the United States will benefit from a broader distribution arrangement. A long-time distribution partner of Lonza, KODA Group recently completed the acquisition of E.W. Kaufmann, a provider to the coatings, adhesives, sealants, and elastomers (CASE) markets. Under the newly expanded scope of the KODA Group, E.W. Kaufmann will represent Lonza in the CASE market in the Northeast, while another KODA company, Monson, will only represent Lonza in the metalworking fluid markets throughout the U.S. Monson was scheduled to transition their Lonza CASE accounts to E.W. Kaufmann as of September 1, 2013.

Lonza Materials Protection provides antimicrobials and preservatives to help protect CASE products as well as lubricants and metalworking fluids (MWF) from fungi, bacteria, and other contaminants. Key Lonza brands sold into these markets include: Densill® Antimicrobials, Triadine® Antimicrobials, Omacide® Fungicides, Sodium Omadine® Antimicrobials, Proxel® Preservatives, Dantogard® Preservatives, Reputan® Preservatives.

Julie Gallucci, head of NAFTA for Lonza Materials Protection, commented on the change, “We are pleased that KODA has expanded its distribution network to encompass E.W. Kaufmann. All five companies within the KODA Group offer our shared customers’ deep technical expertise and market knowledge, making them an excellent partner.”

The five member companies of the KODA Distribution Group and their respective markets and territories include the following: P.T. Hutchins—CASE West Coast; Ribelin—CASE Southwest and Southeast; GMZ—CASE Ohio Valley/Midwest; Monson—MWF, all of U.S.; and E.W. Kaufmann—CASE Northeast.

In related news, KODA Distribution Group will represent U.S. Zinc in its new national distribution strategy for zinc oxides. According to U.S. Zinc, the strategy, which will go into effect as soon as contracts permit, will streamline points of contact for customers across the United States. The alliance is intended to utilize KODA’s regional distribution companies, creating logistical efficiencies and an optimized supply chain. Previously, U.S. Zinc worked with over 15 zinc oxide distributors to cover the same territories.

“Our main priority is providing our customers with the highest quality products and services,” said Tracy Baugh, U.S. Zinc vice president of Commercial. “To deliver upon that commitment, we realized we could secure greater efficiencies by consolidating our zinc oxide distribution network within the United States. We will work closely with our customers, KODA and its distribution companies, and our existing distributors to ensure a seamless transition over the next few months.”

“We are thrilled to partner with U.S. Zinc, whom we believe to be a premier provider of zinc oxide. We have the experience, the national footprint via our regional companies, and the technically trained team to ensure the transition and qualification process is smooth for our customers,” said KODA Distribution group president and CEO Frank Bergonzzi. “We are excited about this new opportunity and look forward to working with U.S. Zinc and the customer base.”
Clariant Expands Pigment Plant Capacity in India by 50%

Clariant is expanding by 50% the capacity of its Azo pigments and pigment preparations plants in Roha, India. The investment is aligned with the company’s commitment to provide high-quality products specifically tailored to the needs of its customers in the region. The expansion is also designed to enhance the capabilities and output at the site in a sustainable manner by reducing energy consumption and expanding the range of low-VOC-containing pigments preparations offered to the market.

According to the company, these latest investments are meant to support the strong market growth in India. Clariant is also using the efforts to enhance its on-the-ground presence and offer more intimate customer service in the emerging Indian and Asian markets. Throughout 2013, Clariant is involved in the process of doubling its marketing and sales organization in India, China, and Indonesia.

“Our ongoing efforts to strengthen our presence in India are part of a broader commitment to meet growing demand here and in the rest of the region, and to give customers access to high-quality, sustainable products and technical support tailored to their local product development needs,” said Marco Cenisi, senior vice president & general manager Business Unit Pigments at Clariant.

PPG Plant in Tianjin Begins Operations

PPG Industries has started production at a new manufacturing plant in Tianjin, China. The site, which will produce heavy-duty equipment coatings, also has equipment installed to help reduce VOC emissions.

Nearly 100 guests attended the opening ceremony, including PPG executives and representatives from heavy-duty equipment manufacturers in the industry. Afterward, PPG held an industrial coatings seminar, involving a discussion with attendees regarding the company’s products and future market trends.

RadTech Issues Call for Papers On UV and EB Technology

RadTech International N.A. is inviting companies to submit abstracts for the 12th biennial RadTech UV & EB Technology Expo & Conference 2014, taking place May 12–14, 2014 at the Hyatt Regency O’Hare in Rosemont, IL.

According to RadTech, fast-emerging ultraviolet (UV) and electron beam (EB) technologies are enabling manufacturers to develop new products, enhance process control, increase throughput, lower material and energy use, and enhance sustainability efforts.

RadTech estimates attendance at over 1,000 industry participants, and offers a well-established Conference Proceedings. Sessions at the conference will include Additive Manufacturing/3D Printing, LED Formulation & Equipment Advances, Advanced Materials, Corrosion Resistance, Sustainability, Nanomaterials, and Food Packaging. The event will also feature a session on Touch Screens & Displays, covering high refractive index materials, low refractive index materials, sealants, and scratch-resistant coatings.

For a complete list of topics and to submit an abstract online, visit www.radtech2014.com.

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PPG Industries has made several new executive appointments, effective August 1. Frank S. Sklarsky, executive vice president, finance, has been appointed executive vice president and chief financial officer, as previously announced. Sklarsky also serves on PPG’s executive and operating committees and reports to chairman and CEO Charles E. Bunch.

David B. Navikas, formerly senior vice president, finance and chief financial officer, has taken on the role of senior vice president, strategic planning and corporate development. Navikas also continues to serve on the executive and operating committees and to report to Bunch.

Kevin D. Braun, previously general manager, silica products, is now vice president, global raw materials and Americas purchasing, a role in which he is responsible for global raw material purchases and related transportation costs. Braun reports to Stephen T. Lampe, vice president, purchasing and logistics. The North American general purchasing group and the South American purchasing organization based in Sumaré, Brazil, report directly to Braun.

The new vice president, silica products, is Anup Jain, who previously performed the duties of vice president, strategic planning and corporate development. In his new role, Jain will be responsible for growing the core silica products and Teslin® products groups, as well as exploring different applications and innovations to add to these businesses. Jain reports to Richard C. Elias, senior vice president, optical and specialty materials.

Jeffrey C. Davies, managing director, corporate development, has been appointed vice president, corporate development. In this position, he will report to Navikas. Davies has been instrumental in several strategic portfolio-transformation initiatives, including the acquisition of AkzoNobel’s North American architectural coatings business, the separation of PPG’s commodity chemicals business, and the divestiture of the automotive glass and services businesses.

Thomas E. Maziarz, general manager, stores and dealers, architectural coatings, has been named vice president, stores and dealers, architectural coatings, North America. Maziarz continues to lead the store and dealer channels of the architectural coatings business in North America, which recently expanded with the acquisition of AkzoNobel’s North American architectural coatings business. He reports to Scott Sinetar, vice president, architectural coatings, North America.

Dr. Vinay Mishra has joined Royce International as director of technology and business development. He formerly worked for Sika Corporation as a director of research and development for polyurethanes, where he led projects for automotive and construction markets. Prior to that, Mishra held senior R&D positions at ITW Devcon for 13 years. As a scientist in the field of epoxy and polyurethane formulations and applications, Mishra holds four patents and has received honors from both academia and industry organizations. He served as the president of the Thermoset Resin Formulators Association in 2009 and 2010, as well as serving on the board and as president or chairman of several industry organizations.

Emerald Kalama Chemical, a business group of Emerald Performance Materials, has promoted Shamsi P. Gravel to product line director of its K-Flex® platform for the Americas. Gravel joined Emerald in 2009 as product line manager and since then has shaped strategy and driven growth for the platform. Previously, Gravel was a senior consultant with The ChemQuest Group, specializing in the coatings, adhesives, resins, and polymer industries. Additionally, she is involved in several industry organizations, including the Society of Plastics Engineers, ASTM, and the Adhesives and Sealants Council, where she currently serves as membership committee chair.

Wagner Industrial Solutions has appointed Jennifer Bochenek as purchasing agent. Bringing over 15 years of experience in purchasing and procurement with both national and international suppliers, Bochenek will assist Wagner with reducing costs, managing inventory levels, and expediting delivery of goods.

Tom Hmiel has joined fluoropolymer coatings company Whitford as regulatory manager covering all markets. Hmiel brings to his new position more than 25 years of experience in regulatory affairs in the chemical industry. Most recently, as a chief product steward for Cytec’s engineered materials and formulated resins businesses,
Hmiel coordinated compliance with global product regulatory requirements, supporting manufacturing in the United States, Europe, and Asia. Prior to that, Hmiel worked with BASF Corporation within the NAFTA region. He was also the former industry leader of the American Chemistry Council Air Issue team.

The D.B. Becker Co., Inc. has appointed Brian Morris as its New England sales representative. Morris will cover portions of New Jersey, New York, Connecticut, Maine, New Hampshire, and Vermont for the distributor. For the past two years, he has worked in Marketing and Business Development at D.B. Becker, along with having account responsibility in the New Jersey territory. Before joining the company, he was the market manager for Perstorp Aliphatic Isocyanates, where he managed marketing, pricing, profitability, and business analysis for North and South America.

Evans Analytical Group (EAG), an independent laboratory network, has announced the appointment of Dr. Luis Ruzo as the general manager of its Environmental Fate, Chemistry and Ecotoxicology (EFCE) division. The three general managers of Wildlife, PTRL West, and PTRL Europe will also report to Ruzo. In his new position, a major priority for Ruzo will be integrating and aligning the Wildlife and PTRL business strategies. Also, he will continue to explore new client relationships, together with the division’s business development unit. Ruzo was previously managing director and CEO of PTRL West from 1988 until 2012, when PTRL was acquired by EAG. Earlier in his career, he worked as a professional research chemist and codirector of the Pesticide Chemistry and Toxicology Laboratory at the University of California, Berkeley. Ruzo has served on numerous editorial and advisory boards, including the Canadian National Research Council and EPA’s Peer Review Board.
President Signs Executive Order on Improving Chemical Facility Safety and Security

On August 1, President Obama signed an executive order to improve the safety and security of chemical facilities and reduce the risks of hazardous chemicals to workers and neighboring communities. The impetus for the executive order was the explosion at the fertilizer plant in West, Texas in April; in particular, the apparent failure of the West Fertilizer Co. to comply with a number of chemical safety and security regulations, including the Chemical Facility Anti-Terrorism Standards (CFATS). The Executive Order on Improving Chemical Facility Safety and Security directs federal agencies to improve operational coordination with state and local partners; enhance federal agency coordination and information sharing; modernize policies, regulations and standards; and work with stakeholders to identify “best practices.”

The executive order not only implicates the CFATS program, but also other existing federal regulatory programs addressing chemical safety that apply to coatings and chemical manufacturing and distribution, such as the U.S. Environmental Protection Agency’s (EPA) Risk Management Program (RMP) and Occupational Health & Safety Administration’s (OSHA) Process Safety Management Standards (PSM).

Possible outcomes of the executive order may be inclusion of additional chemicals in existing programs (e.g., adding “poisons and reactive substances” to the list of chemicals of concern under CFATS), as well as potentially broader dissemination of plant-specific information. The order will also set in motion an “independent, high-level assessment of the overall U.S. approach to chemical facility risk management to identify additional recommendations for all levels of government and industry to reduce the risk of catastrophic chemical incidents in the future.” This will be accomplished through the creation of the Chemical Facility Safety and Security Working Group, co-chaired by the Secretary of Homeland Security, the EPA Administrator, and the Secretary of Labor. DHS Assistant Secretary for Infrastructure Protection Caitlin Durkevich will likely serve as the DHS representative for the working group.

Federal, state, local, and tribal governments have different responsibilities in addressing risks associated with chemical facilities, including response planning for potential emergencies. To improve the effectiveness and efficiency of risk management and response measures, the executive order directs federal agencies to improve coordination and information sharing with state and local governments. For example, the executive order requires federal agencies to develop a plan within 90 days that identifies ways to ensure that state homeland security advisors, State Emergency Response Commissions (SERCs), Tribal Emergency Response Commissions (TERCs), Local Emergency Planning Committees (LEPCs), Tribal Emergency Planning Committees (TEPCs), state regulators, and first responders have ready access to key information in a useful format to prevent, prepare for, and respond to chemical incidents.

Currently, multiple federal agencies, including EPA, DHS, the Department of Labor (DOL), and the Department of Justice (DOJ), manage programs designed to improve the safety and security of chemical facilities through regulations, information reporting requirements, site inspections, and voluntary partnerships. To improve the collective performance of these federal programs, the executive order calls upon federal agencies to initiate innovative approaches for working together on a broad range of activities, such as identification of high-risk facilities, inspections, enforcement, and incident investigation and follow-up. For instance, the executive order requires that affected federal agencies deploy a regional pilot program that will validate best practices and test innovative new methods for federal interagency collaboration on chemical facility safety and security. Additionally, federal agencies are specifically directed to modernize the collection and sharing of chemical facility information to maximize the effectiveness of risk reduction efforts and to reduce duplicative efforts.

The executive order also directs federal agencies to work with stakeholders to improve chemical safety and security through agency programs, private sector initiatives, federal guidance, standards, and regulations. To reduce risks associated with ammonium nitrate, for example, agencies will examine new options to address the safe and secure storage, handling, and sale of this explosive chemical. These agencies will also determine if existing federal regulatory programs, such as EPA’s RMP, DHS’s CFATS, and OSHA’s PSM, should apply to additional chemicals not currently subject to coverage. In addition, agencies will consider whether to pursue an independent, high-level assessment of the nation’s approach to chemical facility risk management to identify additional recommendations for action by government at all levels, as well as by industry, that could reduce the risk of catastrophic chemical incidents in the future.

Finally, the executive order directs key federal agencies to consult with a wide range of interested stakeholders, including representatives from industry, state, local, and tribal governments; nongovernmental organizations; and the first responder community. This process will identify best practices to reduce safety and security risks in the production and storage of potentially harmful chemicals and share successes to date. There are likely to be opportunities for industry participation in this process, including through the CSCC.

Contact ACA’s Allen Irish (airish@paint.org) for more information.
U.S. Green Building Council Formally Adopts LEED v4

On July 1, the U.S. Green Building Council (USGBC) announced that 86% of its voting membership voted to approve the fourth version of the Leadership in Energy and Environmental Design rating system, or LEED v4. USGBC originally intended to ballot the newest version of LEED in the summer of 2012, but ultimately decided to slow the development process for the fourth iteration amid controversy over a number of new provisions. Diverse stakeholders—from LEED practitioners to product manufacturers (including ACA)—expressed strong reservations about many of the updates and the complexity of the most recent version.

The LEED v4 rating system will be launched at USGBC’s Greenbuild conference in Philadelphia, PA, scheduled to be held from November 20–22, 2013. Projects will be able to register for LEED v4 certification soon thereafter. Given concerns regarding the changes and complexity of the new system, USGBC has stated that projects will still be able to register for LEED 2009 certification until June 1, 2015 in order to give the market time to adapt to the changes. ACA will keep its membership informed as LEED v4 and the associated reference materials are finalized.

ACA submitted multiple sets of comments on each draft of the updated LEED rating system while it was under development, expressing its concern with some of the new credit language in LEED v4. In particular, the Low emitting interiors credit requires 90% of architectural coatings (applied to walls, floors, and ceilings), adhesives, and sealants to undergo chamber testing emissions evaluations. LEED v4 also still rewards projects for disclosing product ingredients and avoiding certain chemicals under the Building product disclosure and optimization—material ingredients credit. This credit offers one point for projects that contain products from manufacturers that publish a content inventory using Chemical Abstract Service registration numbers, the Health Product Declaration, Cradle to Cradle v2 Silver Level, or another USGBC-approved program. This credit also rewards projects one point for installing at least 25% of its building materials with products that do not contain certain chemicals of concern, according to the GreenScreen v1.2 Benchmark, Cradle to Cradle v2 certification, REACH (European Union’s Registration, Evaluation, Authorization, and Restriction of Chemical Substances) criteria for substances of very high concern, or another USGBC-approved program.

Green building standards and certification systems have evolved from little-known, voluntary programs 10 years ago to a range of standards and codes that are fundamentally changing the residential and commercial building market in the United States. In 2012, green building was estimated to represent 44% of all commercial and institutional construction, and this number is expected to grow to 55% by 2016.

Green building standards aim at producing more energy-efficient buildings and reducing the environmental footprint of building construction by providing guidelines and criteria for the construction industry in the areas of building design, site location and planning, energy efficiency, construction materials and resources, water efficiency, and indoor environmental quality. ACA supports the underlying goals of the green building movement and engages in the process to develop these rating systems and codes. The association recognizes the industry’s role in green building as providing sustainable products that contribute to energy efficiency, materials and resources, and indoor air quality goals.

Contact ACA’s Tim Serie (tserie@paint.org) or Dave Darling (ddarling@paint.org) for more information.
U.S. District Court Sides with SEC in Conflict Mineral Case, Appeal Expected

On July 23, the U.S. District Court for the District of Columbia rejected all of the plaintiffs’ objections to the U.S. Securities and Exchange Commission’s (SEC) conflict minerals rule in National Assoc. of Manufacturers v. SEC, and granted summary judgment to the SEC. The court’s ruling appears to have turned largely on its determination that none of the SEC’s decisions were arbitrary and capricious. ACA, along with six other trade associations, on January 23 filed an amicus brief in support of an October 2012 lawsuit filed by the National Association of Manufacturers (NAM), the U.S. Chamber of Commerce, and the Business Roundtable (BRT) against the SEC. The suit asked that the SEC’s Conflict Minerals Rule be set aside.

The decision will almost certainly be appealed by petitioners, and if so, the case will be heard de novo, as though it had not been tried in the district court, and will be decided in the U.S. Court of Appeals, where petitioners first filed their objections to the rule.

On August 22, 2012, the SEC voted 3–2 to adopt the Conflict Minerals Rule, pursuant to section 1502 of the Dodd-Frank Wall Street Reform and Consumer Act. The rule requires that U.S. publicly traded companies disclose certain conflict minerals or derivatives used in their production processes. Congress included this provision in the Dodd-Frank Act in an effort to further the humanitarian goal of ending conflict in the Democratic Republic of the Congo (DRC) and the adjoining region. This conflict has been partially financed by the trade of certain minerals, known as “conflict minerals,” which currently include tin, tungsten, tantalum, and gold. The rule took effect on January 1, 2013 and requires annual reporting, the first of which is due May 31, 2014. Annual compliance with the rule—which impacts some 6,000 SEC-reporting issuers and many more of their suppliers—is expected to cost billions of dollars.

In granting summary judgment to the SEC, Judge Robert Wilkins found that “the Commission’s choice not to include a de minimis exception in the Final Rule was the product of reasoned decision-making, and the Court finds no basis under the [Administrative Procedure Act] to subjugate the Commission’s prerogative on this point.”

While emphasizing support for the goal of the legislative measure—that is, to help end the humanitarian crisis in and around the Democratic Republic of the Congo—ACA’s amicus brief argued that, in drafting particular provisions in the rule governing, for example, de minimis uses of conflict mineral derivatives, the SEC failed to apprise itself of the economic consequences of its action, either with respect to U.S. industry or the situation in the Congo. As such, it violates the SEC’s foremost statutory mandate to determine the economic implications of its rules. ACA’s brief supported petitioners and argues that the court should send the rule back to SEC for revised rulemaking conducted in accordance with SEC’s statutory obligations.

Specifically, ACA’s brief highlighted the dire consequences and unnecessary burdens on manufacturers imposed by “failing to adopt a sensible de minimis exception for those whose products may (or may not) contain mere trace elements of conflict metals (e.g., tin) as a result of manufacturing processes (e.g., the use of catalysts) employed by third-party suppliers of ingredient materials at one stage, or more, in long upstream supply chains.” The brief also pointed out that by failing to adequately define what it means to be a “derivative” of a conflict mineral, the SEC has potentially expanded the economic scope of the regulation to markets with only the most tenuous connection, if any, to the Congo and the purpose of its statutory authority. ACA’s amicus maintained that the SEC rule is arbitrary and capricious, and it should be set aside.

On May 30, the SEC issued a set of frequently asked questions about its contentious conflict minerals rule. The set of 12 questions and answers is available at www.sec.gov/divisions/corpfin/guidance/conflictminerals-faq.htm.

One of ACA’s goals in preparing the amicus brief was to secure “clarifications” from the SEC in its reply brief that might benefit industry, even if the full challenge to the conflict minerals rule is not successful. The most notable SEC response is with respect to packaging, which the SEC states is not covered by the conflict minerals rule: “Moreover, amici’s concerns that the rule ‘could be read to include a product’s packaging’ are overstated, as nothing in the release states that packaging is included.” This is a helpful clarification, since ACA members were unsure, based on the vague language of the rule, if the packaging of a product was subject to the rule.

Of note, the packaging question raised in ACA’s amicus is directly addressed in the SEC’s new set of questions and answers: “Only a conflict mineral that is contained in the product would be considered ‘necessary to the functionality or production’ of the product. The packaging or container sold with a product is not considered to be part of the product.”

ACA enlisted as fellow amici the American Chemistry Council, Can Manufacturers Institute, Consumer Specialty Products Association, National Retail Federation, Precision Machined Products Association, and Society of the Plastics Industry, Inc.

The industry coalition also challenged provisions of the rule requiring companies to undertake an onerous “reason- able country of origin inquiry,” expanding the rule’s scope to nonmanufacturers, and providing for an irrational transition period. Lastly, the industry associations assert that the rule violates the First Amendment by requiring companies to report on their website and to the SEC if any of their products are “not DRC conflict-free.” The industry coalition said requiring this disclosure is “as unfounded as it is politically charged.”

The court summarily dismissed the First Amendment allegation stating that it found “a reasonable fit,” between the rule’s financial reform requirement and the congressional intent in “promoting peace and security.”

ACA has put together a guidance document to assist its membership in understanding the rule and supporting compliance efforts.

Contact ACA’s Marie Hobson (mhobson@paint.org) or Thomas Graves (tgraves@paint.org) for more information.
ACA, though its Transportation and Distribution Committee and the International Paint and Printing Inks Council (IPPIC), is proactively engaged in efforts to harmonize shipping requirements for the United States and other international codes to eliminate lost time and added costs in cross-border and multi-modal shipments of paint and allied products. As such, IPPIC participated in the latest meeting of the United Nations Subcommittee of Experts on the Transport of Dangerous Goods (UN SCE TDG) held in late June in Geneva, Switzerland. IPPIC submitted four informational papers to streamline the UN Model Regulations, which govern the shipment of products across country borders.

The UN SCE TDG works on a biennium schedule: four meetings over the course of two years. The last meeting of the biennium occurred in December 2012; the first meeting of the 2013–2014 biennium was held in June 2013. The last meeting of the biennium is very important because it is the last opportunity to have proposals adopted into the UN Model Regulations before the next revision, and all decisions that were made in previous meetings during the biennium remain “on the table” until the meeting is adjourned. During the 2011–2012 biennium, approximately 150 formal proposals and 240 informational papers were submitted and considered by the Subcommittee of Experts.

IPPIC submitted the four informational papers to the UN SCE TDG in December, including a proposal to reinstate exemption from requirement for closed cargo transport units; a proposal to adopt a single multi-modal description for pollutants (Class 9); a proposal for Class 9 Proper Shipping Names for Environmentally Hazardous Paints, Printing Inks, and Adhesives; and a proposal to allow some packaging flexibility for these Class 9 Paints, Printing Inks, and Adhesives. These proposals were all informational papers and were discussed briefly by the subcommittee. While no decisions were made on these proposals, the discussion was helpful in formulating strategy for submitting formal proposals in the next biennium.

An Intercessional Working Group paper aimed at developing an exception for small quantities of environmentally hazardous substances in transportation was thoroughly discussed. The subcommittee voted on paper 2012/93, the Correspondence Working Group’s proposal to deregulate small quantities of environmentally hazardous substances in containers of five liters or less. While this issue of environmentally hazardous substances remains a difficult subject for the subcommittee, the proposal was adopted by a very close vote. Despite the work of the Correspondence Group, there was a fair amount of objection to the proposal. In fact, comments from the experts indicate that there are some competent authorities who would increase the threshold above five liters, but there are also some who would vote against the proposal completely. IPPIC supported this proposal and was hopeful that it would serve as a springboard for its own proposals on the Class 9 commodities.

For the first meeting of the 2013–2014 biennium, IPPIC submitted two formal proposals and one informational paper. The first paper, 2013/29, was seeking authorization to use marks and labels smaller than the required size of 100 m by 100 m, if the packaging size and other required marks made it impossible to accommodate a full-size label. The subcommittee was not very receptive to the language of the proposal, although its members are cognizant of the plight of smaller-sized packages and all of the required markings. After some discussion, IPPIC agreed to review the comments received and formulate a more tailored proposal for the December 2013 meeting.

IPPIC’s other formal proposal, 2013/28, requested Class 9 UN numbers for environmentally hazardous paint, printing inks, adhesives, and resin solutions. This same proposal had been submitted during the 2011–2012 biennium, but no decision had been made. While the discussion was very informative and supportive of IPPIC’s proposal, there were also some negative comments that provided constructive assistance. Considering all of the comments raised during the discussion, IPPIC agreed to refine this proposal and resubmit it for the December meeting as well.

IPPIC’s informational paper, which introduced a discussion about harmonizing some packaging requirements for these newly created Class 9 UN entries, was withdrawn as well, since the subcommittee had not yet made a decision on the Class 9 entries. During the June meeting, the discussion on Class 9 issues was very robust, and the representative of International Civil Aviation Organization (ICAO) made a proposal to completely rewrite Chapter 2.9 of the UN Model continued on page 30
ACA Urges Congress to Enact Meaningful Immigration, Tort Reform

In a letter dated July 30 and directed to U.S. Speaker of the House Rep. John Boehner (R-OH) and House Minority Leader Rep. Nancy Pelosi (D-CA), ACA urged Congressional leaders to act swiftly to enact immigration legislation that would bring meaningful reforms to critical components of the U.S. system.

As one of more than 400 signatories representing businesses and organizations of a broad cross-section of industries with a combined presence in every state in the United States, ACA stated that “reform of an outdated, broken immigration system is essential if we are to achieve a fully revitalized economy that provides rewarding and lasting jobs and opportunities for all Americans.”

Leaders from across the ideological spectrum agree that enacting immigration reform now will accelerate U.S. economic growth at a critical time when it has struggled to recover, and will help to enable sustained growth for decades to come. Done right, ACA argues, reform will also serve to protect and complement our U.S. workforce, generating greater productivity and economic activity that will lead to new innovations, products, businesses, and jobs in communities across the United States.

“Irage and costs resulting from the frivolous claim. A lawsuit abuse victim’s only practical option for attorneys to avoid frivolous filings. Given the expense of fighting such claims with no reasonable chance of recovering defense costs, a lawsuit abuse victim’s only practical option is to meet the demand of a plaintiffs’ attorney and to settle at the case’s nuisance value to “make it go away.”

Separately, on August 2, ACA signed on to a letter to Congressional representatives supporting H.R. 2655, the Lawsuit Abuse Reduction Act of 2013. The legislation will help to reduce the number of frivolous lawsuits and the exorbitant costs that can drive many businesses to financial ruin.

In 1993, the federal courts lost the disincentive for filing frivolous lawsuits. As a result, resources used to fight or settle baseless claims are diverted from investments that will lead to new innovations, products, businesses, and jobs in communities across the United States.

IPPIC Participates in UN Subcommittee Meeting

Regulation, the chapter devoted to Class 9 commodities. The subcommittee agreed that this would be a beneficial activity, and the representative from ICAO agreed to provide a draft for the December meeting. IPPIC has agreed to work with ICAO to develop this new revised chapter.

Other important decisions and discussions at the June 2013 meeting in Geneva included the development of a new GHS chapter and related test method for “Desensitized Explosives.” This has been a long-running discussion at the UN SCE TDG, as there were proposals in the early stages that would have classified these substances as Class 1 Explosives. This new chapter devoted to desensitized explosives is an effort to capture the current industry practices in a more reasonable fashion. In addition, there was a change to the packaging instructions for aerosols that was adopted. This amendment indicates that “large packagings shall be designed and constructed to prevent movement and inadvertent discharge during normal conditions of transport.”

The deadline for submitting papers to the UN SCE TDG for the second meeting of the biennium in December 2013 was August 30, 2013. IPPIC is working on the revised proposals discussed above. In addition, IPPIC will continue to monitor other papers submitted by other delegations and NGOs.

Contact ACA’s Heidi McAuliffe (hmcauliffe@paint.org) for more information.
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Friction between components can lead to significant issues, including wear, reduced performance, and increased noise. There are many types of lubricants—greases, oils, pastes, compounds, dispersions, and yes, coatings. Each type of lubricant is appropriate for certain applications. There is, however, growing interest in antifriction coatings, also referred to as dry film lubricants, due to their physical properties and long-term performance. Such lubricants find use in various industrial and automotive applications.

Antifriction coatings are lubricating paints that, when applied to a substrate (commonly metal or plastic), cure to form a dry, solid lubricant film that is bonded to the surface, according to Volker Oehl, automotive industry marketing manager with Dow Corning GmbH. The film helps cover the surface roughness and reduce surface-to-surface friction as parts (metal on metal, metal on plastic, plastic on plastic) move against each other, often under extreme pressures and temperatures.

The coating formulations vary depending on the intended applications. In general, antifriction coatings are composed of submicron-sized solid lubricant particles, typically molybdenum disulfide (MoS₂), tungsten disulfide (WS₂), graphite, or polytetrafluoroethylene (PTFE). All these exhibit high ductile shear under an applied tangential force, making them ideal as lubricating compounds. The particles are formulated into binder resins, which can range from acrylics, epoxies, and phenolics to amide/imide systems or even ceramics. Both solvent-based and waterborne systems are available.

The particular solid film lubricant formulation is selected depending on the end-use application conditions, desired performance, the type of part being coated (plastics, metal, etc.), and the desired application method. Some formulations cure in air rapidly, while others require high heat—250 °C for up to an hour. In addition, there are coatings formulated to withstand very high or very low temperature conditions, and others that are suitable for only modest temperature applications. Furthermore, the performance of some dry film lubricants is enhanced by spray application, while screen printing or dip spinning (dipping following by centrifuging) is more appropriate for other systems.

Dry film lubricants are designed to reduce friction and wear, extend lubrication time, and reduce the amount of maintenance needed compared to that required for conventional oils and greases. Some are formulated to provide both corrosion and wear protection. “Antifriction coatings are ideal for use in dirty and dusty environments where grease and oils would be contaminated, and in chemically harsh environments and where extreme temperatures and speeds are involved. They are also ideal for protecting metal components during storage,” Volker notes. He points to several advantages of antifriction coatings. They provide long-lasting, dry, and clean lubrication that is not affected by dust and dirt and is localized to the desired area. In addition, because they are dry films, they are nonflammable and undergo minimal evaporation and oxidation and, as coatings, they provide good corrosion protection and their thickness can be controlled.

The coatings can be applied to one or both of the surfaces that are moving against each other. On softer substrates, the use of a dry film lubricant will extend the life of the surface, while on harder substrates, the performance of the antifriction coating will be improved. However, when coating both surfaces in a system, there is often a trade-off. Although the friction can be higher with both surfaces coated, the wear life will be increased to a greater extent than if just one surface were coated.

As with any other coating, surface preparation is critical to the performance of dry film lubricants. “To ensure maximum performance and long-term durability of antifriction coatings, it is necessary to use the appropriate surface pretreatment process for the selected dry film lubricant formulation,” Volker asserts. Pretreatment steps can include degreasing, sandblasting, phosphating, anodizing, acid washing, or other processes. Once this step is completed, the substrate must be dried before application of the coating. The actual application process will depend on the desired film thickness and sliding surface requirements, as well as the size, shape, weight, and quantity of the parts being coated. The choice of
Possible techniques include hand or drum spraying, dipping, centrifuging, brushing, roll coating, and printing.

In the automotive industry, antifriction coatings are used to improve driving comfort by reducing noise and vibration, performance through long-term lubrication of key engine parts, safety by keeping inaccessible parts working, and reliability by providing consistent lubrication under harsh operating conditions, according to Volker. Dry film lubricants are used on the pistons in car engines, on door lock components, on the interior parts of door and side panels, and in brake systems. Antifriction coatings on pistons ensure that there is lubrication during cold engine starts and when the engine oil is low. They also reduce noise and scuffing and increase combustion efficiency and fuel economy, according to Volker. For door locks, dry film lubrication is preferred due to its ability to lubricate the components for the lifetime of the lock and provide additional corrosion protection, which it does much more cleanly than greases. Antifriction coatings are typically applied to lock-catching plates and locking levers using dip-spinning.

The use of antifriction coatings in door and side panels is designed to reduce noise, particularly the undesired squeaks and creaks that can be heard as a car ages and those that naturally occur as the car rides over the road. “The need to reduce noise has increased in recent years as the numbers of electric vehicles on the market have increased. Electric engines are very quiet, and thus other noises common in automobiles that used to go unnoticed are now audible and unappreciated by car owners. The use of dry film lubricants addresses this issue and does so for the lifetime of the vehicle,” Volker explains.

In industrial applications, antifriction coatings are used most often in harsh environments where oils and greases would be degraded, such as applications involving high temperature and pressure. As a result, antifriction coatings are used for machinery lubrication, general metal lubrication in cutting tools, dies, and forming tools, and for gears operating under high contact stresses or pressures. In some of these applications, the lubricant may be applied as a pure film without any binder.

Dry film lubricants also find use on metal connectors and fasteners, and even on very large parts used in the construction of bridges and other major assets. On threaded connectors and fasteners, antifriction coatings provide a constant coefficient of friction and corrosion protection in a long-term solution (with no need to reapply grease). The use of this type of coating also makes parts removable. “In some construction projects, there can be very large components that must be well-secured, but also need to be removable. Dry film lubricants are very useful for these applications,” Volker observes.

Recent developments in dry film lubricant technology have been driven largely by the need to meet changing environmental regulatory requirements. “Much effort has gone into reformulating antifriction coatings to reduce VOCs and potentially hazardous substances. Thus, several new water-based alternatives and systems in non-solvents have been developed,” Volker comments. “As with other coating types, it can be very challenging to maintain performance and application properties and keep costs low when reformulating into water,” he adds. The growing use of dry film lubricants on plastic parts in automobiles also presents challenges. “With so many different types of plastics used in different interior car parts, and even as blends in a single part, adhesion can be an issue. Thus, this area is one that is also receiving attention,” says Volker.

Another exciting area of innovation in dry film lubricants relates to their expanded use on engine components. “We have extensive research projects under way to explore the use of dry film lubricants for several other engine components beyond pistons. The coatings, sold under the Molykote® brand name, are showing a lot of promise, and developing innovative dry film lubricants is a priority for Dow Corning. We are very excited about the opportunities for these systems, and particular more environmentally sustainable solutions, in new automotive applications,” Volker states. He also notes that the future looks bright for antifriction coatings in emerging economies. These lubricants have been accepted in Western Europe, the United States, and Japan for some time, but only recently has their adoption increased in Eastern Europe and many parts of Asia.
Rheological properties of coatings formulated with associative thickeners are quite sensitive to a number of formulation variables. Small changes in these variables, which include the latex, thickener, and surfactant components of the coating, can have a profound effect. Many previous studies have focused on understanding and controlling these sensitivities. However, few studies have focused on the relatively large viscosity drop and related problems when predispersed colorants are added to tint bases formulated with associative thickeners. In this study, pastel and deep-tone tint bases were formulated with associative and nonassociative thickeners. The tint bases were then tinted with six different conventional colorant dispersions and six low-VOC counterparts of the same colorants. Effects of the colorants, thickeners, and VOCs on viscosity profiles, dynamic viscoelastic properties, color development, and gloss were determined and results are presented.


INTRODUCTION

The ability to control rheology is crucial in controlling the flow behavior of coatings during mixing and storage to application and flow out, leading to film formation. In general, viscosities in the range of several hundred mPa·s at application-related shear rates (10^3 s^-1 and higher) are needed to achieve desired film thicknesses. Lower viscosities can cause the coating film to spread too thin. Preventing sagging of the applied films, on the other hand, requires viscosities in the range of 10–100 Pa·s at shear rates relevant to the sag-related flow (10^-1 s^-1 and lower). However, viscosities that are too high at low shear rates can prevent leveling flow that is required to achieve a uniform film. To meet these and other similar flow requirements, a typical waterborne coating must have a shear-thinning viscosity profile. Control of viscosity behavior and other rheological properties (yield stress, thixotropy, viscoelasticity, etc.) allow a formulator additional flexibility in designing the flow properties of the coating.
A typical, fully formulated coating without rheology modifiers is virtually Newtonian, with a viscosity of less than about 100 mPa-s. Therefore, addition of rheology modifiers to a coating formulation is essential in imparting the rheological properties discussed above. Until the late 1970s, several types of water-soluble polymers were commonly used as rheology modifiers for latex-based waterborne coatings. These polymers included cellulose derivatives (e.g., HEC-hydroxyethyl cellulose) and alkali-swellable acrylic emulsions. Common issues associated with these thickeners include poor leveling (due to higher than desirable low-shear-rate viscosities), flocculation of dispersed particles, and water sensitivity of the dry films.

Introduction of associative thickeners in the late 1970s allowed formulators to control rheology while minimizing the problems outlined above. Associative thickeners are amphiphilic polymers containing both hydrophilic and hydrophobic groups in their structure, and can be either non-ionic or anionic. Non-ionic associative thickeners available in the market today include hydrophobically modified, ethoxylated urethanes (HEUR), hydrophobically modified, aminoplast ethers (HEAT), and hydrophobically modified cellulose derivatives (e.g., HMHEC—hydrophobically modified, hydroxyethyl cellulose). Hydrophobically modified, alkali-swellable emulsions (HASE) represent a common example of an anionic associative thickener. The thickening mechanisms of associative thickeners are different and more complex compared to the mechanisms of the thickeners, such as cellulose derivatives that preceded them. Understanding these mechanisms in somewhat simplified systems (i.e., in aqueous media with few components, such as surfactants) has been the focus of numerous studies. Several studies on fully formulated coatings have also been published. These studies have clearly established that despite the many advantages associative thickeners offer, they are much more sensitive to formulation variables. These variables include the type of latex, surfactants, dispersants, and coalescing solvents.

One of the most difficult problems with the early-generation associative thickeners has been the high viscosity drop when predispersed colorants are added to tint bases at the point of sale. This is due to the fact that predispersed colorants contain large amounts of surface active additives used to stabilize the finely dispersed colorant particles. Typical waterborne coatings are formulated to have viscosities in the neighborhood of 100 Krebs units of Stormer viscosity before colorant addition. Upon the addition of colorant, the viscosity of the coating can decrease by as much as 30–35 Krebs units. In recent years, associative thickener suppliers have introduced a new generation of products to minimize the viscosity drop upon tinting. However, only a few reported studies have focused on rheological analysis of this problem. The purpose of this study was to quantify the effects of colorant addition on the rheological properties, using commercially viable tint bases, colorants, and early generation associative thickeners.

**EXPERIMENTAL MATERIALS AND METHODS**

**Pastel Base Formulations**

The pastel base formulations used in this study are shown in Tables 1 and 2. This is a formulation designed for use in high performance low- and zero-VOC paints. Both pastel bases were formulated to be as similar as possible, with the exception of the thickener. The formulation in Table 1 contained two hydroxyethyl cellulose (HEC) thickeners, one a low-molecular-weight

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Solids (wt%)</th>
<th>Weight in Formulation (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grind</td>
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<td></td>
</tr>
<tr>
<td>Water</td>
<td>0.00</td>
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</tr>
<tr>
<td>Natrosol 250GR</td>
<td>4.00</td>
<td>50.00</td>
</tr>
<tr>
<td>Tamol 850</td>
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<td>4.70</td>
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<tr>
<td>BYK-348</td>
<td>96.00</td>
<td>2.00</td>
</tr>
<tr>
<td>BYK-023</td>
<td>18.50</td>
<td>4.00</td>
</tr>
<tr>
<td>Nuosept 95</td>
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<td>3.00</td>
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<td>Minex 10</td>
<td>100.00</td>
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<td>TiPure R902</td>
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<tr>
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<tr>
<td>%Non-Volatiles by Weight (%NVW)</td>
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<td>%Non-Volatiles by Volume (%NVV)</td>
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<td>Pigment Volume Concentration (PVC)</td>
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<table>
<thead>
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<th>Ingredient</th>
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<th>Weight in Formulation (g)</th>
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<td>Tamol 850</td>
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</tr>
<tr>
<td>BYK-348</td>
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<td>2.00</td>
</tr>
<tr>
<td>BYK-023</td>
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<td>4.00</td>
</tr>
<tr>
<td>Nuosept 95</td>
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<td>3.00</td>
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<tr>
<td>Minex 10</td>
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<td>TiPure R902</td>
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<td>%Non-Volatiles by Weight (%NVW)</td>
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<td>%Non-Volatiles by Volume (%NVV)</td>
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<td>Pigment Volume Concentration (PVC)</td>
<td>22.08</td>
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</table>
Stormer Viscosities and Solids (% by Weight) in Tint Bases

### Table 3—Deep-tone Base with HEC Thickeners

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Solids (wt%)</th>
<th>Weight in Formulation (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grind</td>
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<td></td>
</tr>
<tr>
<td>Water</td>
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<td>61.30</td>
</tr>
<tr>
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<tr>
<td>Tamol 850</td>
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<td>BYK-348</td>
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</tr>
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<td>BYK-023</td>
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<td>8.30</td>
</tr>
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<td>Nuosept 95</td>
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<td>Texanol</td>
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<td>BYK-023</td>
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<tr>
<td>Ammonium Hydroxide</td>
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<td>Natrosol 250GR</td>
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<td>Total Weight</td>
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| %Non-Volatiles by Weight (%NVW) | 32.47 |
| %Non-Volatiles by Volume (%NVV) | 30.80 |
| Pigment Volume Concentration (PVC) | 1.73 |

### Table 4—Deep-tone Base with HEUR Thickeners

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Solids (wt%)</th>
<th>Weight in Formulation (g)</th>
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<tbody>
<tr>
<td>Grind</td>
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<td></td>
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<tr>
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<td>Tamol 850</td>
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<tr>
<td>BYK-023</td>
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<td>9.30</td>
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<td>Nuosept 95</td>
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<td>4.30</td>
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<td>Minex-10</td>
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<td>Let-Down</td>
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<tr>
<td>EPS-2757</td>
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<td>628.30</td>
</tr>
<tr>
<td>Propylene Glycol</td>
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<tr>
<td>Texanol</td>
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<td>7.50</td>
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<td>Acrysol SCT-275</td>
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<td>Total Weight</td>
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</table>

| %Non-Volatiles by Weight (%NVW) | 33.43 |
| %Non-Volatiles by Volume (%NVV) | 31.03 |
| Pigment Volume Concentration (PVC) | 1.75 |

### Table 5—List of Colorants and Corresponding CI Pigments Used in This Study

<table>
<thead>
<tr>
<th>Colorant (Low-VO/Zero-VO)</th>
<th>CI Pigment Name (Pigment)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1921/8821 Phthal Green</td>
<td>PG7 (Phthalocyanine Green)</td>
</tr>
<tr>
<td>1982/8828 Magenta</td>
<td>PR122 (Quinacridone)</td>
</tr>
<tr>
<td>1977/8878 Yellow Oxide</td>
<td>PY42 (Yellow Iron Oxide)</td>
</tr>
<tr>
<td>1935/8835 Red Oxide</td>
<td>PR101 (Red Iron Oxide)</td>
</tr>
<tr>
<td>1913/8813 Yellow</td>
<td>PY74 (Monaarylde Yellow)</td>
</tr>
<tr>
<td>1991/8891 Lamp Black</td>
<td>PBK7 (Carbon Black)</td>
</tr>
<tr>
<td>1932/8832 Phthalo Blue</td>
<td>PB15:2 (Phthalocyanine Blue)</td>
</tr>
</tbody>
</table>

### Table 6—Stormer Viscosities and Solids (% by Weight) in Tint Bases

<table>
<thead>
<tr>
<th>Sample</th>
<th>% Solids by weight</th>
<th>LSV Thickener</th>
<th>HSV Thickener</th>
<th>Total Thickener</th>
<th>Initial Viscosity (KU)</th>
<th>72-Hr Viscosity (KU)</th>
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</thead>
<tbody>
<tr>
<td>Pastel Base with HEC</td>
<td>44.22</td>
<td>0.26</td>
<td>0.64</td>
<td>0.90</td>
<td>85.0</td>
<td>86.7</td>
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<tr>
<td>Pastel Base with HEUR</td>
<td>44.84</td>
<td>0.13</td>
<td>0.40</td>
<td>0.53</td>
<td>95.4</td>
<td>98.7</td>
</tr>
<tr>
<td>Deep-tone Base with HEC</td>
<td>33.23</td>
<td>0.27</td>
<td>0.65</td>
<td>0.94</td>
<td>77.8</td>
<td>78.0</td>
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<tr>
<td>Deep-tone Base with HEUR</td>
<td>33.56</td>
<td>0.30</td>
<td>0.54</td>
<td>0.84</td>
<td>94.6</td>
<td>106.0</td>
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</tbody>
</table>

Colorant Addition

Two sets of seven colorants, supplied by EPS Color Corporation, were used for the study (Table 5). The CCA 1900 series represents conventional Universal colorants, and the 8800 series represents Zero-VO colorants. The chemical compositions of the colorants are not available, but the main pigments used in each of the samples are included in Table 5. Forty grams of the premixed tint base were weighed into a plastic mixing cup, followed by addition of 5.0 g of colorant. The samples were mixed in a Thinky AR100 speed mixer for 60 sec, stirred vigorously with a spatula for an additional 20 sec, and then transferred to a 4-oz glass jar. The viscosity profile of each sample was obtained approximately 24 hr following colorant addition.

Rheology Characterization

The viscosity profile of each sample was obtained at 25°C with a TA Instruments AR2000 rheometer equipped with a 40 mm, 2° cone. The rheometer was run in a steady-state flow mode from 0.02–200 s⁻¹ shear rate.
Each sample was stirred gently for about 15 sec with a spatula before analysis. HEC-containing samples were designated by the letter “N,” the HEUR-thickened samples by the letter “A.” For example, N-1921 would be the sample formulated with HEC and 1921 green colorant and A-8882N would be the sample formulated with HEUR and 8882N magenta colorant. Dynamic viscoelastic properties were determined under sinusoidal oscillatory conditions as a function of the shear strain (0.01–100% at 1 Hz frequency) and oscillatory frequency (0.1–100 Hz at 0.1% strain, unless indicated otherwise in the Results and Discussion section).

**Gloss and Tint Strength Measurements**

Immediately following the rheology analysis, drawdowns of each sample were prepared alongside their parent bases at a wet film thickness of 6 mils (1 mil = 0.001 in. = 25.4 microns). At least 24 hr of drying time were allowed for all drawdowns. Color measurements were made with a Datacolor Mercury spectrophotometer using a D65 standard illuminant. The contrast ratios were also determined from these measurements. Tint strengths were calculated according to the procedure outlined in ASTM D4838-88, using drawdowns of untinted bases as standards for each set of samples. Due to the lack of hiding power resulting from the absence of TiO₂, the only deep-tone base samples to achieve a contrast ratio sufficient to measure the tint strength (contrast ratios of 0.98 are required by ASTM D4838-88) were those with red oxide, yellow oxide, and black colorants.

**RESULTS AND DISCUSSION**

**Viscosity Behavior of Tint Bases without Colorants**

The solids content by weight and Stormer viscosities of all untinted formulations are shown in Table 6. The solids contents by weight are very close to the expected values in Tables 1–4. It should be noted that all of these coatings are formulated to have a nearly constant 32% solids by volume. The Stormer viscosities of HEUR-thickened bases are much closer to the target value of 100 KU; however, the HEC-thickened formulations’ Stormer viscosities are significantly lower than the target value. Achieving high KU viscosities with HEC thickeners is always a challenge due to the fact that they were delivered to the formulation mix as very low-concentration aqueous solutions (2% and 4% by weight for HMW HEC and LMW HEC, respectively). These solutions are highly viscous, and increasing the HEC concentration in aqueous solution results in gels that are...
Figure 4—Effects of Zero-VOC colorants on viscosity behavior of HEC-thickened pastel bases.

Figure 5—Effects of Zero-VOC colorants on viscosity behavior of HEUR-thickened pastel bases.

Figure 6—Dependence of storage and loss moduli (G' and G'') on % strain at 1 Hz frequency.

Figure 7—Dependence of storage and loss moduli (G' and G'') on % strain at 1 Hz frequency.
difficult to incorporate. While industry practices may be adjusted (e.g., preparation of a highly concentrated aqueous slurry immediately before incorporation to the mix) to accommodate higher levels of incorporation to achieve a high KU viscosity, we chose to prepare solutions ahead of time to achieve complete solubilization of HEC. Table 6 includes the weight percentage of each of the two thickeners and the total thickener concentrations in the two pastel bases and the two deep-tone bases.

The viscosity dependence on shear rate for the two pastel bases thickened with HEUR and HEC thickeners is shown in Figure 1. Although the Stormer viscosity is low for the HEC-thickened base, its viscosity at the low-shear-rate end is higher than that of the HEUR-thickened base. Associative thickeners are more effective (at a lower total dosage) at increasing the viscosity at higher shear rates. This result is consistent with what has been reported in literature.

**Effect of Colorants on Viscosity Behavior of Tint Bases**

Viscosity profiles of pastel bases tinted with Universal colorants (1900 series) are shown in Figure 2 (HEC-thickened bases) and Figure 3 (HEUR-thickened bases). Viscosity profiles of untinted bases are also included for comparison. The virtual lack of sensitivity of the viscosity profile of the HEC-thickened formulation to colorants can be clearly seen in Figure 2. On the other hand, all colorants decrease the viscosities of HEUR-thickened base throughout the shear rate range of 0.02–200 s⁻¹. In addition, the viscosity profile of each of the tinted formulations is different. The highest viscosity drop is observed with the inorganic red oxide 1935. The viscosity profile of the sample containing 1913 yellow is erratic in the low-shear-rate region. This is often an indication of the presence of large aggregates of particles. Similar viscosity drop results were observed when the bases were tinted with Zero-VOC colorants (Figures 4 and 5). Viscosity drop caused by a given colorant between the Universal colorant series and Zero-VOC series is not consistent in several cases. For example, whereas the viscosity drop caused by 1932 blue (Figure 3) is modest, it is severe with 8832N blue (Figure 5). Results of deep-tone bases indicated similar trends.

**Effect of Colorants on Dynamic Viscoelastic Properties of Tint Bases**

Storage and loss moduli of the HEC- and HEUR-thickened pastel bases as a function of dynamic oscillatory strain (strain sweep experiment at 1 Hz frequency)
are shown in Figure 6. The results are typical, with HEC-thickened formulations having high moduli at low % strains and decreasing at higher strains. The decrease in moduli is primarily due to disruption of intermolecular, interparticle, and particle-molecule interaction in the system. These interactions break up at higher strains to a point where the formulation’s storage modulus is impacted more than its loss modulus. The HEUR-thickened formulation that shows evidence of a Newtonian plateau at low shear rates in Figure 1 exhibits near-linear viscoelastic behavior up to 100% strain.

Figures 7–9 show the effect of the 1900 series Universal colorants on the moduli of HEC- and HEUR-thickened pastel bases. Although there are significant differences in both G’ and G” values for the HEC-thickened tint base when tinted with different colorants (Figure 7), they are not close to the differences seen in Figure 8 (G’) and Figure 9 (G”) for the HEUR-thickened tint base. Each colorant appears to disrupt the rheological mechanisms of the HEUR-thickened tint base differently.

Effect of Colorants on Other Properties of Tint Bases

The effects of colorants and thickeners on the gloss and tint strength were also determined. For untinted bases, HEUR-thickened films were higher in gloss than those thickened with HEC. This result is consistent with known effects of HEC and HEUR thickeners on gloss. HEUR-thickened formulations in this study have lower low-shear-rate viscosities that help leveling, and thus assist in improving gloss. HEC thickeners can lower gloss by flocculating the dispersed components as well. In general, tinting strengths of colorants were shown to be slightly higher with HEUR thickeners.

SUMMARY AND FUTURE WORK

The effects of Universal and Zero-VOC colorants on the rheology of HEC- and HEUR-thickened tint bases were examined. Viscosity profiles of HEC-thickened tint bases were virtually unaffected by the colorants. However, the viscosity of the HEUR-thickened formulation was lowered by all colorants. The level of effect was widely varied among colorants and between the two series of colorants. Current studies are focused on new generation commercial associative thickeners designed to minimize the viscosity drop upon addition of colorants. It is expected that the results of these studies will form the foundation for understanding complex interactions involved in effects of colorants on rheology of tinted formulations.

ACKNOWLEDGMENTS

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References


AUTHORS

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Find your solution at:

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Fluorescence decay methods have been used extensively to characterize the formation of polymer films from latex dispersions, a process widely used in the coatings industry. By measuring the polymer chain diffusion at the nanometer scale, this technique enables the quantification of the amount of mixing between polymer particles that ultimately contributes to the formation of a polymer coating with good mechanical properties. This article provides an introduction to fluorescence decay methods, with a strong emphasis on their application to the characterization of latex film formation. Examples are also provided, demonstrating how this technique has been used to help in the understanding of this process in different latex coatings.

INTRODUCTION TO THE PROBLEM

Latex Film Formation

The different stages involved in the formation of a film from a water dispersion of polymer nanoparticles, or latex, are schematically shown in Figure 1.1-4 After water evaporation and drying, the polymer particles form a densely close-packed arrangement. At temperatures above the “minimum film formation temperature” (MFFT, which is close to the glass transition temperature of the polymer in the presence of water), a transparent film is formed by deformation of the particles, through a combination of capillary, osmotic, and surface forces that overcome the elastic modulus of the particles.1 To form a mechanically strong film, the polymer chains have to further diffuse across the interfaces between adjacent particles, in a process driven by the increase in entropy associated with the healing of these interfaces. This last stage is of utmost importance to the final properties of the film. Therefore, to modify coating formulations and design more efficient coatings, it is necessary to understand the characteristics of polymer diffusion for the particular formulation of interest.

Measuring Polymer Diffusion During Film Formation

The most commonly used techniques for studying polymer interdiffusion across the interface in latex film formation are small angle neutron scattering (SANS) and Förster resonance energy transfer (FRET). SANS experiments, first used by Hahn5,6 to study the relation between polymer interdiffusion and film tensile strength,7
require the preparation of deuterated and nondeuterated polymer particles to achieve contrast. The use of FRET to analyze polymer mixing, an approach pioneered by Morawetz\textsuperscript{8}\textsuperscript{10} and extensively used by Winnik to study latex film formation,\textsuperscript{11,12} requires the preparation of polymer particles labeled with a small amount (typically less than 1 mol\%) of two different dyes: a fluorescent energy donor dye and an energy acceptor dye.\textsuperscript{13} These dyes are usually incorporated into the latex particles via dye comonomers with appropriate polymerizable groups, such as methacrylate or vinyl substituents. FRET has been used to study the effects of different factors on latex film formation: temperature,\textsuperscript{14} composition,\textsuperscript{15} moisture,\textsuperscript{16} coalescing aids,\textsuperscript{3,17-19} polar groups at the latex surface,\textsuperscript{20} the presence of filler particles, etc.\textsuperscript{21-24}

The films are prepared from a blend of FRET donor- and acceptor-labeled latex particles, for which the fluorescence spectra of the donor overlaps the absorption spectra of the acceptor. Since the molar fraction of the dyes is very low, one can assume that the donor and acceptor dyes serve only as traces for the location of the polymer. The donor- and acceptor-labeled particles should, in principle, have similar size, as well as similar molecular weight and molecular weight distribution of their constituent polymers. This can be achieved by synthesizing both particles from a common unlabeled seed latex with a size much smaller than the final latex particles. To measure the fluorescence decay curve of the donor in the films, a pulse of light with a wavelength selectively absorbed by the donor dye is used. The donor decay is affected by nonradiative energy transfer to the acceptor dyes in proximity (typically a few nanometers to tens of nanometers, depending on the dyes), and this effect can be used as a “molecular ruler” to evaluate the donor-acceptor separation.

If donor and acceptor dyes are located in different particles, FRET measurements can be used to evaluate the extent of mixing during the formation of the polymer film. In the nascent film (obtained upon drying the latex dispersion), the dyes are confined to separate particles, and the efficiency of FRET is limited because it occurs only across the interface between adjacent particles. Subsequent curing of the film leads to polymer diffusion across the interface between particles, mixing of donor- and acceptor-labeled polymer chains, and a resultant increase in the efficiency of energy transfer. Although this effect can also be evaluated by following the decrease in fluorescence intensity of the donor spectra, this is subject to numerous artifacts, and therefore it is typical to measure instead the fluorescence decay of the donor. These experimental artifacts are related to geometrical and light scattering effects, as well as to the difficulty in assuring that the excitation energy is exclusively absorbed by the donor in the donor/acceptor-mixed films.

**FÖRSTER RESONANCE ENERGY TRANSFER IN POLYMER COATINGS**

Since the pioneering work of Morawetz,\textsuperscript{8} the formalism of FRET has been developed to accommodate increasingly complex geometries\textsuperscript{25,27} and dye distributions,\textsuperscript{19,28-32} allowing the experimental determination of dye concentration profiles in complex nanostructured materials.\textsuperscript{33}

To use FRET in the characterization of latex film formation, one mixes polymer particles labeled with a small amount (typically less than 1 mol\%) of a fluorescent energy donor dye (D) with polymer particles labeled with an acceptor dye (A). After casting the film, this is irradiated with visible or UV radiation that should be mainly absorbed by D, and electronic energy can then be transferred to a nearby A by a resonance dipole–dipole coupling mechanism. The efficiency of FRET depends on the inverse sixth power of the D–A distance, in a length scale of a few nanometers (depending on the D–A pair used). The typical length scale of FRET matches the size of interparticle domains in latex films, and is small enough to avoid interference by capillary waves at the interface. In a typical experiment, two latex dispersions (one labeled with an energy donor and the other with an acceptor) are mixed. If the film is dried at about the glass transition temperature ($T_g$) of the polymers, FRET occurs only across the interfaces between D- and A-labeled neighboring particles. Annealing of the film above the $T_g$ of the polymers leads to colocalization of the dyes in the interparticle regions, and one observes an increase in the quantum efficiency of energy transfer. Since the dye distribution mimics the distribution of the polymer components, these experiments can provide detailed information on the distribution of the labeled polymer components and the morphology of the nanostructure.\textsuperscript{33}

**EXPERIMENTAL SETUPs FOR FLUORESCENCE DECAY MEASUREMENT BY SINGLE-PHOTON TIMING**

The most commonly used technique to record fluorescence decay curves is time-correlated single-photon counting (TCSPC), better designated as single-photon timing (SPT). Figure 2 shows a diagram of the modules that compose typical SPT equipment.\textsuperscript{34}
The heart of this technique is the time-to-amplitude converter (TAC) that translates the difference in time between two pulses to a voltage. The sample can be electronically excited using a pulsed lamp (nanosecond pulse width) or a pulsed laser (picosecond pulse width). An electric signal associated with the excitation pulse is generated (e.g., from the electronics of the excitation source or from a fast photodiode that detects a small fraction of the excitation light) and routed through a discriminator to initiate the TAC (start pulse). The stop signal is generated by the fluorescence of the sample, which is detected by a photomultiplier (preferably, a microchannel plate, which has faster response times and practically no “color effect”). The interval between the start and the stop signals is converted in an analog output pulse proportional to the time between these signals.

As the probability of detecting a single photon at time \( t \) after excitation is proportional to the fluorescence intensity, the histogram of the number of counts versus voltage reproduces the fluorescence decay curve. The TAC and the associated analog to digital converter (ADC) must guarantee a very good linearity in the full range of operating voltages. The TAC signals corresponding to valid start–stop cycles are stored in a multichannel analyzer (MCA) according to their voltage. The voltage is then converted in time by the calibration of the TAC, and the fluorescence decay curve is recorded.

The popularity and preeminence of the SPT technique stems from its high sensitivity, excellent dynamic range and linearity, and well-defined Poisson statistics. To ensure that a probability of detecting two fluorescence photons per excitation pulse is low, the number of fluorescence pulses have to be much smaller (ca. < 2%) than that of excitation pulses. To obtain the decay curve with good statistics, the number of counts at the maximum channel should be high (~20,000 counts).

This requires excitation sources delivering light pulses at high repetition rates. Thanks to pulsed lasers delivering pulses in the MHz range, fluorescence decays can be acquired in minutes. For high repetition rate sources, it is recommended to use a reverse start–stop mode (inverted configuration) to circumvent high but inefficient conversion rates, because many start-stop cycles never complete while maintaining the time measurement electronics busy. In the reverse mode, the conversion rates are much smaller because they are only as high as the actual photon rates generated by the fluorescence signal. Instrumental response functions of \(~25\) ps duration can be achieved by using pulsed ps lasers and fast detectors and electronics. The stability of the laser systems and fast and linear response of the electronics permits the recording of very accurate fluorescence decays with a high dynamic range, allowing the determination of lifetimes of the order of \(5\) ps by using deconvolution (reconvolution) procedures for decay curve analysis:

\[
I(t) = \int_0^t L(\theta) \delta(t - \theta) \, d\theta
\]

where the experimental fluorescence decay curve \(I(t)\) is a convolution of the instrumental response function (or excitation pulse profile) \(L(t)\) with the fluorescence decay \(P(t)\) that would be obtained for a \(\delta\)-pulse of excitation light.

**DECAY DATA ANALYSIS**

After the latex film containing donor- and acceptor-labeled particles has been annealed at temperatures above \(T_g\) for a period of time \(t_{diff}\), one measures the donor fluorescence decay curve, \(I_{DA}(t)\). One of two different strategies can then be followed. For an in-depth characterization of the film morphology, a detailed FRET model has to be used to analyze the donor fluorescence decay curve.\(^{33}\) Here, we describe a less complex strategy that can be used to evaluate the evolution of interdiffusion as the latex film is formed. In this case, one calculates the quantum efficiency of energy transfer:

\[
\Phi_{ET}(t_{diff}) = 1 - \frac{\int_0^\infty I_{DA}(t) \, dt}{\int_0^\infty I_D(t) \, dt}
\]

where the integrals correspond to the areas under the donor decay curve of a latex film containing mixed donor- and acceptor-labeled particles, \(I_{DA}(t)\), and of a latex film containing only donor-labeled particles, \(I_D(t)\). This methodology circumvents many disadvantages of the determination of FRET.
efficiencies from the fluorescence spectra. Indeed, in this case it is not required that only the donors absorb the excitation light, because the donor decay is invariant to the presence or absence of excited acceptors. Furthermore, since the decays are normalized, the films containing only donors or a mixture of donors and acceptors do not need to have exactly the same optical density. Additionally, geometric effects that are important in steady state fluorescence measurements do not affect the decay curves, and light scattering can be easily removed from the decay curve (although not from the fluorescence spectra).

Although the integral of the donor decay curve of a latex film containing only donor-labeled particles can be easily calculated (it corresponds to the donor decay lifetime, τ\textsubscript{D}), to calculate the integral of the donor decay curve measured for the latex film containing mixed donor- and acceptor-labeled particles, it is better to fit the experimental decay using the empirical equation\textsuperscript{3,15,36}:

\[ I_{\text{D}}(t) = A \exp(-t/\tau_D) + \exp(-t/\tau_D) \]  \hspace{1cm} (3)

where the term with pre-exponential factor \( A \) accounts for the donors that are involved in the energy transfer process, and \( A \) is proportional to the amount of donors isolated from acceptors, which decay with the intrinsic lifetime \( \tau_D \).

The evolution of the extent of mixing in the latex film as it anneals can then be approximately calculated as the increase in the quantum efficiency of energy transfer, normalized with the values obtained for the film before annealing (\( t_{\text{diff}} = 0 \)) and for the fully mixed film (\( t_{\text{diff}} = \infty \))\textsuperscript{28}:

\[ f_m(t_{\text{diff}}) \approx \frac{\Phi_{\text{ET}}(t_{\text{diff}}) - \Phi_{\text{ET}}(0)}{\Phi_{\text{ET}}(\infty) - \Phi_{\text{ET}}(0)} \]  \hspace{1cm} (4)

The quantum efficiency of energy transfer for the fully mixed film (\( t_{\text{diff}} = \infty \)) can usually be determined by casting a film from a good solvent for the polymer (usually, THF). In cases where the particles are partially crosslinked and complete mixing is not experimentally accessible, it is necessary to estimate this value\textsuperscript{24,37}.

The value obtained from equation (4) is a reasonable approximation of the real extent of mixing in the latex film up to about 70% mixing\textsuperscript{28}; however, it can generally be used to evaluate the evolution of the extent of mixing. If one needs a more accurate estimate of the extent of mixing, a more complex procedure must be used which details the morphology of the evolving interparticle boundary during film formation\textsuperscript{19,28,30,31,33}.

Ideally, the parameter to measure the polymer diffusion rate would be the center-of-mass diffusion coefficient, \( D_{\text{cm}} \). For a system as complex as a latex film in which the polymers are initially confined in the deformed particles and have a broad distribution of molecular weights, calculating the distribution of \( D_{\text{cm}} \) values that characterize the system would be impractical. Instead, it is usual to calculate a single mean diffusion coefficient to describe the diffusion of a polymer characterized by a distribution of diffusivities. The concentration profile of the polymer in a particle can be described as a function of the extent of mixing between the polymer chains from neighboring particles, assuming that the general shape of the polymer segment distribution can be described by Fickian diffusion profile for spherical geometry\textsuperscript{38} for which the donor concentration profiles, \( g_D(r) \), is:

\[ g_D(r) = \frac{1}{2} \left( \text{erf}(\frac{r + r_s}{\theta}) + \text{erf}(\frac{r - r_s}{\theta}) \right) \]  \hspace{1cm} (5)

where \( \theta = 2\sqrt{\langle D \rangle t_{\text{diff}}} \) is a parameter measuring the extent of diffusion during a period of time \( t_{\text{diff}} \), with average diffusion coefficient \( \langle D \rangle \), \( R_s \) is the radius of the particle, and \( \text{erf}(z) \) is the error function. From the distribution profile we can calculate the volume fraction of polymer mixing \( f_s^* \):

\[ f_s^* = 1 - \frac{3}{4\pi R_s^3} \int_0^R 4\pi r^2 g_D(r) dr \]  \hspace{1cm} (6)

To calculate the polymer diffusion coefficient during film formation, one then assumes that the normalized increase in the quantum efficiency of energy transfer \( f_m(t_{\text{diff}}) \) is a good estimate of the mass that diffuses across the interparticle boundary \( f_s^*(t_{\text{diff}}) \).

**APPLICATION EXAMPLES**

**Latex Film Formation**

In this example, we monitor the polymer diffusion in poly(butyl methacrylate) latex films with a polymer molar mass of \( Mw = 125,000 \) (MW/Mn = 2.5), using polymer nanoparticles labeled with phenantrone (Phe), a RET donor, and others labeled with 4-dimethylamino-benzophenone (NBen), a nonfluorescent FRET acceptor (Figure 3).\textsuperscript{14} The dyes were incorporated as (9-phenanthyl)-methyl methacrylate (PheMMA) and 4’-Dimethylamino-2-acryloxy-5-methyl-benzophenone (NBen)\textsuperscript{39,40} into a PBMA latex by a two-step seeded emulsion polymerization.
The latex dispersions were prepared by seeded semicontinuous emulsion polymerization. Latex films were prepared from dispersion mixtures of 1:1 weight ratio of Phe- and NBen-labeled particles. The dispersions were first cleaned with an ion-exchange resin (AG-501-X8 mixed-bed-resin, Bio-Rad) to remove the ionic surfactant and other ionic species before film formation. A few drops of a latex dispersion (containing 1:1 ratio of mixed Phe- and NBen-labeled particle, 6 wt% solids) were spread on a small quartz plate. The film was allowed to dry at room temperature in the open air for one night before annealing. Films were dry and transparent.

The fluorescence decay profiles were measured by the single photon timing technique at room temperature. Phenanthrene was excited at 300 nm, and its emission was recorded over the range 350–400 nm. A band-pass filter (310–400 nm) and a cut-off filter (335 nm) were mounted in the front of the photomultiplier tube detector to minimize the interference due to scattered light. For fluorescence decay measurements, each sample was placed in a small quartz tube and degassed with flowing N\textsubscript{2} for 5 min before each measurement. In Phe(1%)-PBMA latex films (no NBen energy transfer acceptor), Phe decay profiles were fitted with an exponential function, with lifetime $\tau = 46.1$ ns.

Polymer diffusion in latex films annealed at 56, 74, 90, and 107°C was evaluated from the energy transfer quantum efficiency, by approximating the fractional mass that diffused across the particle boundary $f_m$ by the normalized energy transfer quantum efficiency $f_m$, and calculating the mean apparent diffusion coefficient, $D_{app}$.

In Figure 4, examples of Phe fluorescence decay curves in films prepared from mixed dispersions of Phe(1%)-PBMA and NBen(0.3%)-PBMA are presented. The top curve (1) is the exponential decay from a film prepared from the Phe-PBMA latex only; the curve below (2) shows the small degree of curvature associated with a freshly prepared film obtained from a 1:1 mixture of donor- and acceptor-labeled latex; the next curve (3) corresponds to the same film after it was annealed for 60 min at 90°C; and the bottom curve (4) was obtained for a solvent-cast film, representing full mixing of the donor- and acceptor-labeled polymer.

From the decay curves in Figure 4, we calculate energy transfer quantum efficiencies of $\Phi_{ET} = 0.07$ for the newly formed film and $\Phi_{ET} = 0.37$ for the solvent-cast film, using equation (2). Values of $f_m$ calculated from equation (4) are presented in Figure 5 for a film annealed at four different temperatures. One can see that the annealing temperature has a large effect on the rate of polymer diffusion, with $f_m$ increasing to 1.
in only a few minutes at 107°C, but reaching only 0.4 after annealing 15 hr at 56°C.

\(D_{app}\) values calculated in this way for the data in Figure 5 are plotted against \(f_m\) in Figure 6. These values increase markedly with increasing temperature. There is also a tendency for these values to decrease with increasing \(f_m\), which we attribute to the molecular weight polydispersity of our latex samples.

In Figure 7, the \(D_{app}\) values obtained at different temperatures are plotted in an Arrhenius fashion. In making these plots, we compare \(D_{app}\) values at similar extents of mixing. For three different values of \(f_m\), these data can be fitted with an apparent activation energy \(E_a = 34 \pm 3\) kcal/mol. To emphasize the fact that this value pertains to all the data, we use this value to calculate a shift factor to create a master curve of \(D_{app}\) values at 56°C (Figure 6).

**Reactive Latex Blends**

In this example, FRET is used to evaluate a reactive blend in which the two components have initially limited miscibility, but become miscible as the reaction proceeds.\(^{41}\) In this type of system, the growth in the quantum efficiency of energy transfer \(f_m\) allows one to monitor both the rate of polymer diffusion across the interparticle boundary and how this rate is affected by the chemical reaction.

Poly(ethylhexyl methacrylate) (PEHMA) latex particles containing reactive functional groups, either 11 mol% methacrylic acid (MAA) or 5 mol% t-butylcarbodiimidoethyl methacrylate (tBCEMA),\(^{42}\) and labeled with either 9-phenanthrylmethyl methacrylate or 9-anthryl methacrylate,\(^{43}\) were prepared by a two-stage emulsion polymerization from a common seed under monomer-starved conditions. Phenanthrene-labeled PEHMA latex (Phe-PEHMA), phenanthrene-labeled carboxylic acid-containing PEHMA latex (Phe-PEHMA-MAA), anthracene-labeled PEHMA latex (Ant-PEHMA) and anthracene-
Films prepared from a 1:1 mixture of Phe-PEHMA and Ant-PEHMA—one cast directly from the latex dispersion at 4°C, and the other cast from a THF solution prepared from the freeze-dried latex mixture—yield $\Phi_{ET} = 0.06$ and $\Phi_{ET} = 0.52$, respectively. When the same films are annealed at 60°C, $\Phi_{ET}$ remains at 0.52 ± 0.01 for the THF-cast film and increases to 0.49 (in 12 min) for the dispersion-cast film. In the last case, the polymers diffuse across the interparticle boundary, bringing the Phe and An groups into proximity and increasing $\Phi_{ET}$ (Figure 8a). The fact that the maximum value of $\Phi_{ET}$ obtained for the dispersion-cast film corresponds to that obtained for (homogeneous) films cast from THF indicates that the polymers are fully miscible.

For dispersion-cast and THF-cast films prepared from a blend of Phe-PEHMA-MAA/Ant-PEHMA-tBCEMA, $\Phi_{ET}$ behaves in a similar way to the blend of Phe-PEHMA and Ant-PEHMA (Figure 8a), yielding $\Phi_{ET} = 0.52$ for the THF-cast films, and $\Phi_{ET}$ increasing to 0.52 upon annealing for the dispersion-cast films. This indicates that Ant-PEHMA-tBCEMA and Phe-PEHMA are also miscible.

However, the presence of 11 mol% MAA units in the PEHMA-MAA latex is sufficient to induce phase separation when this polymer is blended with PEHMA (Figure 8c). The limited miscibility of these polymers would not be apparent by traditional methods since the blends of PEHMA with PEHMA-MAA are transparent, and the $T_g$ of the two components are too close for the presence of separate phases to be detected by differential scanning calorimetry or dynamic mechanical measurements. In this blend, $\Phi_{ET}$ increases much slower and only to 0.24 in dispersion-cast films annealed at 60°C, while for solvent-cast films, $\Phi_{ET}$ decreases from 0.40 (less than full mixing) to 0.23, upon annealing at 60°C. This indicates that further demixing takes place, leading to increased separation of the Phe- and An-labeled polymers.

The mixture of PEHMA lattices containing 11 mol% MAA and 5 mol% tBCEMA, Phe-PEHMA-MAA and Ant-PEHMA-tBCEMA yields a reactive blend in which the two polymers contain functional groups that can combine to produce a graft copolymer, eventually evolving to a crosslinked network. The extent of polymer interdiffusion can be followed by FRET, while the extent of chemical reaction is traced by Fourier transform infrared spectroscopy (FTIR), taking advantage of the carbodiimide band at 2128 cm$^{-1}$.44

In the newly formed THF-cast film, $\Phi_{ET} = 0.42$, a value that indicates some segregation. By annealing at 60°C, $\Phi_{ET}$ decreases to 0.40 over the first 20 min due to demixing of the polymers. However, for longer annealing times, $\Phi_{ET}$ increases due to mixing promoted by the reaction between -N=C=N- and -COOH groups, with $\Phi_{ET}$ reaching 0.52 (fully mixed film). The state of mixing (from...
\( \Phi_E \) correlates very well with the extent of carbodi-imide reaction monitored by the decrease in the FTIR intensity at 2128 cm\(^{-1} \) (Figure 9b).

The combined action of polymer diffusion and anchoring by the N-acyl urea overcomes the miscibility problem of the two blend components and results in a film with good mechanical properties.

**CONCLUSION**

Fluorescence decay methods allow very precise evaluation of FRET efficiency in polymer films labeled with appropriate donor and acceptor dyes. This technique has been extensively used in the characterization of latex film formation in different systems, such as thermosets, blends, reactive blends, etc. By allowing the measurement of polymer chain diffusion in the films at the nanometer scale, FRET can be used to quantify the extent of mixing between polymer chains from different particles, which ultimately leads to the formation of a coating with good mechanical properties.

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The paint on the exterior walls of a building, particularly in residential construction, does much more than protect the wood surface beneath it. As with cars, the paint on a house is generally seen as a reflection of the owner. Selection of an exterior paint and paint color are thus fraught with considerations that go beyond the basic performance of the coating. As a result, the expectations for the appearance and durability of exterior paints and coatings designed for use on vertical wood surfaces are fairly high. Increasingly strict VOC regulations and growing consumer demand for more sustainable solutions place additional pressures on coating manufacturers and their suppliers. Close relationships throughout the value chain are necessary today as formulators face the challenge of developing very low-VOC, high-quality, longer-lasting exterior paints for a wider range of wood and mixed substrates.

SUBSTRATE ISSUES

Wood remains the dominant substrate in architectural construction, but there is growing use of composites and other materials. Often wood is used in conjunction with these different materials, according to Steve Revnew, vice president of Product Innovation with Sherwin-Williams. In addition, there is a wider range of wood types finding their way into building construction, with growing desire for ash and elm and less interest in red oak and walnut, according to Dunn-Edwards color expert Sara McLean. “We are also seeing more people use reclaimed or alternative wood sources, such as torzo, keiri, coco, palm, and wheat, and placing more emphasis on textures, like saw-cut, distressed, wire-brushed, sand-blasted, scraped, edge-rasping, and carved 3D effects,” she adds.

RESIN CHOICES

There are many resin types available for the formulation of coatings for exterior, vertical wood surfaces, ranging from vinyl acrylics, acrylic copolymers, and acrylic blends to 100% acrylic resins, and each has varied qualities, according to Dave Heiligenthal, product marketing manager for Dunn-Edwards. “Of these systems,” says Todd Wirdzek, vice president of Product Development for Kelly-Moore, “One hundred percent acrylic resins are used in most of the best exterior paints, because they offer the best exterior durability and resistance to the elements at low VOC levels.” In addition to providing superior
resistance to premature fade and gloss loss, Heiligenthal adds, acrylic resins also offer more flexibility to resist grain cracking, which is important because wood is very susceptible to moisture and temperature changes.

Even though acrylic emulsions have almost completely replaced oil-based exterior paints, Stan Cook, North America marketing manager—Architectural Binders for Dow Coating Materials (DCM), notes that as more is learned about the effects of weathering on film formation and longevity through real-time tracking, further advances are being made with respect to adhesion properties and UV protection. “Recent developments include improvements in primer, direct-to-substrate, and paint-and-primer properties,” he says. As examples, Cook notes the expansion of the product portfolio based on DCM’s Evoque™ Pre-Composite Polymer Technology, which offers equal hide with less TiO₂, and formulation-specific performance improvements such as increased tannin stain blocking, corrosion resistance, and nail head rust resistance.

Work is being done on other resin technologies as well, including polyurethane dispersions (PUDs) and acrylic alkyd hybrids, according to Revnew. “These systems provide penetration into the wood, rather than film formation. As a result, particularly PUDs are used in semi-transparent formulations, where they give good color and gloss retention. With the growing use of cedar and other woods for building construction, we are seeing a rising interest in semi-transparent products for exterior applications as a way to display more of the wood grain. Because these formulations have fewer pigments, however, they do not provide the same level of protection as solid-color paints, and thus the penetrating resins offer a way to increase their durability.”

THE IMPORTANCE OF TIME

In addition to great color appearance, what consumers want these days is paint that goes on easy and lasts longer than conventional systems, according to Debbie Zimmer, director of the Paint Quality Institute (PQI). “There is continued interest in time-saving paints that is driving continued development of properties that extend the repaint cycle, as well as properties that translate into more immediate time savings, such as improvements to direct-to-substrate paints and higher adhesion paints that don’t require as much surface preparation,” she explains. She also notes that both contractors and do-it-yourselfers (DIYers) want to extend the paint application season, which is leading to a focus on technologies that allow painting with retained performance even in marginal weather conditions. “We find that contractors are increasingly interested in these types of products as the economy improves and housing starts and resales increase,” Zimmer adds.

Heiligenthal agrees that the marketing of paint-and-primer-in-one products has targeted DIY customers looking to make painting easier. He cautions, though, that “the reality is that each substrate has unique issues that must be addressed. Substrate-specific primers deal with those unique issues much more effectively than a topcoat, and will help to make the painting project last longer,” he notes. “For instance,” Heiligenthal continues, “woods such as redwood and cedar have high amounts of tannins that can bleed through a topcoat, causing severe staining. Specialized primers that can block the tannins are the best choice as the first coat for these types of substrates.”

On the other hand, Cook finds that there is indeed notable consumer value to be gained with paints that maintain a fresh painted look over a longer period of time. “We see as a key trend the growing interest in exterior paints that don’t just last longer, but also ‘look good’ longer. Dow Coating Materials is thus focusing R&D efforts on improving performance properties like tint and gloss retention and dirt pick-up resistance,” Cook adds.

COLOR TRENDS

The expectation of increased longevity has arisen from the growing focus on sustainability, which is also influencing color and appearance trends for exterior wood to some degree. There is growing interest in emphasizing wood grain effects and the natural look of wood, which includes a move to lighter, warmer colors and the use of green-influenced browns at the expense of redder browns, according to McLean.

OVERCOMING CHALLENGES

Maintaining performance at lower VOC levels in both paint and colorant formulations is the main challenge that formulators face when developing new paints and coatings for exterior, vertical wood surfaces, according to Wirdzek. The softer resins that must be used to formulate exterior paints at low-, ultra-low, or zero-VOC can present challenges, especially in the higher sheens where block
resistance is important, explains Heiligenthal. “Latex paints with poor block resistance stick to themselves. This is particularly critical on exterior surfaces, because all latex paints are thermoplastic. Since they can soften when exposed to UV light, block resistance can become an issue.”

The wood substrate can present challenges as well. There is a greater variety of wood species used in construction today, and the different species have varying properties that can affect paint performance. For example, as mentioned above, some wood species contain higher quantities of tannins and other compounds that can bleed through coatings if appropriate stain-blocking technology is not used. A more general concern is the use of younger wood in construction today. “Greener wood has a much higher moisture content, which can have a direct impact on paint adhesion. It is much preferable to paint on dry, seasoned wood,” Revnew observes. The cause for this problem, Revnew believes, is the recovery of the housing sector following the extended slow period when little lumber was produced. Due to a shortage of supply, wood is now going from the forest to the mill to the construction lot in a much shorter period of time.

FINING THE OPPORTUNITIES

These challenges and trends in the marketplace also present opportunities to both resin and coatings manufacturers. For Dunn-Edwards, eco-efficiency involves not just making paint without harmful ingredients, but also producing a product that lasts and protects longer so that valuable material resources are used at the highest efficiency, according to Heiligenthal. Sherwin-Williams, meanwhile, sees the use of a wider variety of wood species and mixed substrate types, such as wood, composites, and vinyl put together, as an opportunity to develop new paints and coatings with excellent adhesion to multiple surfaces. “The preference to use just one type of paint for all different surfaces fits in with the desire of consumers for easier and reduced-time paint application,” Revnew observes.

In recognition of the need for a high-performing paint that is easy to apply, in October 2012 Sherwin-Williams introduced its self-priming Emerald™ Exterior Acrylic Latex Paint that, according to Revnew, offers exceptional durability and delivers extreme resistance to blistering, peeling, and color fade. The company is so confident in the durability of the product that it offers a lifetime limited warranty. In the same month, Dunn-Edwards introduced its new Ultrasheild, high-performance product line of zero-VOC, very low-odor coatings, including an exterior acrylic urethane paint and a multi-surface primer with adhesion to a wide range of different substrates.

With respect to new resin developments, Dow Coating Materials has recently launched Rhoplex™ 585 100% Acrylic Binder, also designed for use on a wide variety of substrates to provide increased formulation flexibility, according to Cook. The company is also adding products to its Evoque Pre-Composite Polymers line that allow for TiO₂ reduction and provide improved performance characteristics, including tannin stain blocking, nail head rust resistance, and corrosion resistance.

THE VALUE OF RELATIONSHIPS

Many of the product innovations that are being achieved today take place within the context of extended relationships across the value chain, and even outside of it. “A strong formulator/supplier relationship helps to facilitate an earlier look at new technology that is coming in the future, which is particularly important for exterior paint products that require exposure testing prior to commercialization,” states Wirdzek. Cook agrees. “There are very few products that can be developed in a vacuum. Many of our innovations come from direct dialogue with our customers, people in the industry, contractors, and DIYers,” he remarks.

Heiligenthal notes that customers add value as well, because they help formulators understand their needs and challenges, thus enabling the development of products that perform appropriately. He also adds that manufacturers collaborate through organizations such as The Coatings Research Group, Inc., in which technical directors from various paint manufacturers work with scientists dedicated to formulating products that meet certain performance and “green” standards. Dow Coating Materials also uses participation in various industry organizations and PQI to keep abreast of the latest industry and consumer trends.

Sherwin-Williams places strong emphasis on innovation efforts, looking for partners in adjacent markets, such as academia, that can help achieve performance advances with new and innovative technologies, according to Revnew. Zimmer expands that thought: “Relationships are critical to staying not just current, but ‘relevant.’ New product development must be viewed in terms of its relevancy to the actual end-user. Along with the traditional DCM/customer relationships forged over time, the PQI alliance partnerships allow us to have touch points across the entire paint value chain. It is through this sharing and learning with the people picking up a brush or roller that we often receive our most insightful view of the ‘paint world.’”
Wetting Agent

The new Hydropalat® WE 3111 by BASF is a non-APEO pigment wetting agent formulated to provide excellent color acceptance. It can also be used as a dispersing agent in base paints. Hydropalat WE 3111 demonstrates good performance across multiple paint formulations, improves tint strength development over key APEO benchmarks, and maintains freeze-thaw stability in paints. Additionally, it has low odor and contains less than 1% VOC according to EPA Method 24. More information can be found at www.basf.com/formulation-additives.

Specialty Fluoroelastomer

AGC Chemicals Americas Inc. has introduced Aflas® 200P, a peroxide-curable, specialty FKM-type fluoroelastomer. The FKM is intended for applications that need to withstand aggressive oils containing anti-oxidants, solvents, ozone, acids, and bases. Classified as Type 4 FKM’s by ASTM standards, AFLAS 200P fluoroelastomers work for oil seals, shaft seals, O-rings, gaskets, and a variety of other parts and fittings. For details, visit www.agcchem.com.

Reinforced Polycarbonates

Bayer MaterialScience has released details on a new reinforced polycarbonate for laptop casings. To make casings lighter and thinner while maintaining durability, the company formulated these polycarbonates to save up to 100 g in weight and to reduce profile thickness by 45%. The new material also comes in a broad range of color choices and allows the laptop housings to achieve complex geometric structures (3D) and innovative surface textures (2D). Learn more at www.materialscience.bayer.com.

Agricultural Seed Pigment

Clariant has announced the launch of its new Agrocer® pigments for seed coloration. Designed to offer easy color choice and purchasing for seed companies and manufacturers of seed treatment products who are looking to differentiate their brand, this is reported to be the first dedicated range of colorants for the agricultural industry. The Agrocer range currently covers five powdered pigments used to color-treat seeds: Agrocer Red 482, Agrocer Red 112, Agrocer Blue 153, Agrocer Green 007, and Agrocer Violet 023. For more details, visit www.clariant.com.

Corrosion-Resistant Coating

Intech Services, Inc. has released a new DuPont™ Teflon® industrial coating, Water-based and low-VOC, the coating provides corrosion resistance of up to 3,000 salt spray hours. Specifically engineered for coating offshore, chemical processing, and water treatment fasteners, the new coating is targeted toward single-coat applications requiring strong corrosion resistance, antigalling, and dry lubrication. The coatings can be applied to thicknesses of 1–4.5 mils and are currently available in blue and red, with yellow and black to be added to the line in the near future. For information, contact Intech Services at 302.366.8530 or visit www.intechservices.com/fastener-coatings.

UV LED Technology eBook

An eBook recently released by RadTech International, NA, discusses technology and market opportunities for UV LED technology. Subjects covered include market developments, operation and output measurement, diode evolution and manufacturing, and the chemistry of UV-curable materials. The eBook may be downloaded free of charge at www.uvebeast.com. To view a video developed to support the publication, go to http://vimeo.com/71025295.

Water-Repellent Coating

Michelman has developed a new water-repellent coating, HydraBan® 420. This coating is intended to provide paper and corrugated converters a versatile solution to minimize or eliminate foaming and separation issues. HydraBan 420 can be applied in-line on the corrugator from the wet or dry end, with a rod or blade coater, or offline. It is also FDA-compliant for direct food contact, repulpable, and recyclable. For more details, see www.michelman.com.

Additive for Alkyd Coatings

BYK Additives and Instruments has introduced Nanobyk®-3630, a nano-additive for alkyd coatings. Based on nanosized boehmite particles, the Nanobyk-3630 additive is formulated to improve scratch resistance, gloss, and transparency for solvent-borne and high-solids architectural coatings. The additive can be used with all kinds of nonpolar alkyd systems: nonpigmented and pigmented, medium- to long-oil alkyds, and high-solids alkyds. For more information, visit www.byk.com.
Meetings and Events

2013

October

14-16 Rheology Fundamentals and Applications for Synthetic Latices and Associated Coatings
Sponsored by Emulsion Polymers Consulting and Education, LLC
MicroTek Training Center
Denver, CO
info@epced.com

21-23 Western Coatings Symposium
Sponsored by Western Coatings Societies
Paris Hotel
Las Vegas, NV
www.westerancoatings.org/content/wcs2013

2014

January

20 AC Series: Coatings for Concrete Conference
Sponsored by ACA
Las Vegas, NV
www.paint.org/events/ac-series.html

February

24-28 41st Annual International Waterborne High-Solids and Powder Coatings Symposium
Sponsored by University of Southern Mississippi’s School of Polymers and High Performance Materials
Sheraton New Orleans
New Orleans, LA
www.usm.edu/waterborne

March

6-8 PaintIndia 2014
Bombay Exhibition Center
Goregaon, Mumbai, India
www.paintindia.in

April

7-10 American Coatings Show and American Coatings Conference
Sponsored by ACA and Vincentz Network
Atlanta, GA
www.american-coatings-show.com

May

18-21 Annual Technical Meeting
Sponsored by Southern Society for Coatings Technology
Marriott Hilton Head Resort & Spa
Hilton Head, SC
www.sscct.org

November

20-22 CHINACOAT 2013
Shanghai New International Expo Center (SNIEC)
Shanghai, P.R. China
www.chinacoat.net/2013/exh_en.htm
Electrodeposition of Coatings, Part VI: Additional Surface Defects

As I pointed out in last month’s article [CoatingsTech, 10 (8) 44 (August 2013)], electrodeposition (ED) coatings suffer less from surface defects than do most coatings, but they do have some. In addition to the cratering and gassing problems that were covered, I have run into additional defects, including horizontal settling, mapping, hash marking, frosting, run-out, and difficult-to-rinse drag-out in ED coatings.

**Horizontal Settling:** In this defect, pigment settles on horizontal surfaces in the form of small clumps or granules, giving a gritty surface like sandpaper that often is easier to identify by touch than by eye. The surface must then be sanded before it can be topcoated. The settling is due to insufficient agitation and/or pigment flocculation, the latter of which can be a result of high bath temperature or aging of an unstable bath. It may be possible to control the settling by increasing agitation, but often that is not sufficient. Pigment flocculation is the likely culprit. The degree of flocculation can be evaluated via optical microscopy of bath specimens. Ideally that evaluation should be done periodically, starting when the tank is first filled. If flocculation is the problem, a solution may be filtration and feeding in new paste. Unless the flocculation was caused by a temperature spike, however, changes in the dispersion process or reformulation of the paste probably will be required to stop the settling.

**Mapping:** ED coatings normally are smooth and homogeneous, but sometimes there are peculiar streaks, drip lines, and/or patterns that may be in or under the coating. Examination of the substrate before it is e-coated usually will show that these same elements appear on the surface of the pretreatment. Pretreatment defects are telegraphing through to the e-coat. So, now a pretreatment problem needs to be solved. The defect could be caused by poor rinsing (clogged nozzles?) or even by a metal cleaning process that is leaving detergent residues. Faint mapping often is topcoated without problems, but I have seen very obvious mapping that had to be sanded before being topcoated. Better control of the cleaning and pretreatment process was needed in the latter case.

**Hash Marks:** This defect consists of stripes that form on ware as it is lowered into the ED bath. The defects form parallel to the surface of the bath. Entry into a bath never is completely smooth, and sometimes is even quite jerky. The current density at the leading edge of the paint film is very high, and this produces a band of relatively heavy deposition with each hesitation. There is less deposition during subsequent movement. The final effect is one of clearly noticeable alternating bands or stripes. Coatings that wet and flow well are less apt to suffer from hash marking. Raising the solvent level in the bath or prewetting the substrate with ultrafiltrate has been known to help as they tend to improve substrate wetting. Operating at a lower voltage in the first zone has helped in several cases in which I have been involved. Hash marks also have been associated with foam wetting at entry.

**Frosting:** This is a defect in which water and/or solvent are trapped in the e-coat, resulting in bubbles and pops. This can occur where the coating is overly thick or when the ware heats up rapidly due to an especially hot oven or a hot spot in the oven. Often, the coating just looks rough or bumpy, but sanding or a cross-section will reveal the bubbles. After topcoating, the defects may show up as pops, bumps, or roughness. Sometimes they look like solvent pops or galvanized gassing. This defect is rare and can be prevented by using a staged bake, lowering film thickness, and avoiding excessive overbakes.

**Run-out (or boil-out, as it is sometimes called):** Paint that is trapped in seams, flanges, and inner areas may boil and run out on baking and produce drips or thick spots. The latter may contain bubbles and pops and resemble frosting on a small scale. The defects must be sanded out before topcoating. Run-out can be reduced by better rinsing and/or a staged or ramped bake that allows flow before cure occurs.

**Drag-out:** The portion of the paint that comes along with the coated part as it exits the bath is called drag-out. Usually, it easily is rinsed back into the tank. However, under certain circumstances, drag-out includes gummy, elastic material that is difficult or impossible to rinse off and results in defects on baking. In my experience, such material has turned out to be resin that has had its molecular weight (MW) increased due to high bath temperatures, resin instability, or both. A simple way of identifying whether there is high MW material present is to compare the melt viscosities of an air-dried deposition of the problem coating and a similar specimen of a control. High MW gives high melt viscosity. Foam at the bath exit also can be picked up and dragged out. It may be difficult to remove by rinsing, leaving residues that harm appearance when they are baked in.
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