The Grass Really CAN Be Greener...

Although the paint and coatings industry often touts its extensive capabilities in producing a large palette of shades and hues, one color in particular stands out more than others these days—green. The predominance of this green, however, does not reflect shifts in consumer demand for products of this actual color. Rather, the “green” in question refers to paints and coatings that are formulated to have minimal environmental impact throughout their full lifecycle.

Raw materials suppliers and paint manufacturers alike have made the commitment to develop green products that exhibit equal or improved performance capabilities compared to traditional products. The extent of industry interest in doing so was evident at the recent International Coatings Expo (ICE) event held in New Orleans in November of 2006. Responding to the “Green Chemistry—Global Ingenuity” theme of the event, many exhibitors showcased new products and technologies or highlighted existing materials specifically designed for use in greener paints and coatings.

The FutureCoat! Conference included four different sessions on green chemistry practices and technology, all of which were well attended. “The high interest level at the ICE show confirms that increasing numbers of people in the industry are both aware of, and interested in, learning more about green chemistry principles and how to implement them,” states Jennifer Young, senior program manager with the American Chemical Society’s Green Chemistry Institute (GCI).

by Cynthia Challener
JCT CoatingsTech Contributing Writer

GOVERNMENT INITIATIVES

The passage in September 2006 of the Green Chemistry Research and Development Act of 2005 (H.R. 1215) by the U.S. House of Representatives also reflects the growing recognition of the value that green chemistry practices can impart to the chemical and allied industries. The law calls for an interagency program involving the National Institute of Standards and Technology, the National Science Foundation, the Environmental Protection Agency (EPA), and the Department of Energy. The goal is for these groups to work together to enhance funding and coordination of green chemistry R&D, supporting merit-reviewed grants to individual researchers and university-industry partnerships; R&D and technology transfer at federal laboratories; and the education and training of undergraduate and graduate students in green chemistry science and engineering. The bill must now be approved by the U.S. Senate.

The EPA established its Green Chemistry Program, which has as its mission the promotion of “innovative chemical technologies that reduce or eliminate the use or generation of hazardous substances in the design, manufacture, and use of chemical products,” in response to the Pollution Prevention Act of 1990. Through the program, the EPA supports fundamental research in the areas of environmentally benign chemistry as well as a variety of educational activities, international activities, conferences and meetings, and development tools through voluntary partnerships with academia, industry, and other governmental and nongovernmental agencies and organizations.

As interest in green chemistry has grown and more companies are developing processes based on its principles, increased amounts of data have been flowing to the EPA. The agency is currently building an Internet-based Expert System, a database that will initially be text searchable but eventually structure searchable as well. “We get a lot of requests for examples of how to develop green chemistry processes,” says Tracy Williamson, chief of the EPA’s Industrial Chemistry Branch. “People want to know how to determine if their processes are indeed green. The best way to show them is with examples.” The database will include information taken from literature and examples provided directly to the EPA. Williamson expects the system to be launched sometime between June 2007 and the end of that year.

One of the main goals of the EPA is to demonstrate to the industry that green chemistry practices contribute to the bottom line as well as reducing environmental impacts. “We recognize fully that green chemistry must be commercially viable in order for it to be practical,” stresses Richard Engler, Ph.D., director of the EPA’s Green Chemistry Program. Williamson adds that, “the economic, scientific, and environmental impacts of chemical processes are deeply intertwined. As the EPA Green Chemistry Program, we have focused on this fact and worked hard to educate members of the industry about this basic truth.” GCI director Paul Anastas, Ph.D., who won the 2006 Heinz Award for the Environment, adds that, “People often believe environmental and economic prosperity are a balance or a trade off. Green chemistry is showing that you can simultaneously benefit the environment and the economy.” Based on the activity at ICE, 2006, it is safe to say that these agencies are getting this point across.

As part of the EPA’s Green Chemistry Program, the Presidential Green Chemistry Challenge awards recognize the industry for successful green chemistry initiatives. The first awards were given out in 1996 and have encompassed all types of products and processes in the chemical and allied industries. Awards in five categories are distributed each year: alternative synthetic pathways, alternative solvents and reaction conditions; designing safer chemicals; academics; and small business.

COATINGS COMPANIES RESPOND

Over the years several companies have won environmental awards for products with applications in paints and coatings. Most recently, in 2005, BASF Corporation won the Green Reaction Conditions category for its UV-curable, one-component, low-VOC refining primer system (R+® Flash Fix® VP126 and Glasurit® 151-70). This new urethane acrylate oligomer primer system contains only 1.7 pounds of VOCs per gallon. The crosslinked nature of the film produced using radical initiators provides improved adhesion, water resistance, solvent resistance, hardness, flexibility, and cure speed. Compared to traditional primers, the new technology requires no bake ovens for curing, cures 30 times faster, requires fewer preparation steps, has a lower application rate, is more durable, controls corrosion better, and has an unlimited shelf life.

Also in 2005, Archer Daniels Midland won the award in the Designing Greener Chemicals category for its non-volatile, reactive coalescent Archer RC™. The bio-based coalescent, prepared from the reaction of corn and sunflower oil fatty acid esters with propylene glycol, rather than evaporating, oxidizes and crosslinks into the coating offering the further advantages of lower odor, increased scrub resistance, and better opacity.

Several companies supplying the paint and coatings industry, while not receiving an award in 2006, did submit products for evaluation. Innovative Formulation’s Ecological Paint Antimicrobial Clear Coat is a self-curing water-based antimicrobial mold, and...
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THINKING GREEN

These examples effectively highlight the key green chemistry approaches. Most companies incorporate the well-established 12 “Principles of Green Chemistry” with their own sustainability and environmental, health, and safety programs. “At LANXESS, we strive to minimize waste and emissions, maximize the ecological compatibility of our products, and meet the highest standards of quality and product stewardship,” says LANXESS Corporation president and CEO Randy Dethlefs. The ultimate goal at Troy Corporation is to make products that require less energy to manufacture, use renewable feedstocks, do not accumulate in the environment, and are safer to use, according to vice president of marketing David E. Faherty.

Placing an emphasis on the use of natural raw materials in combination with low energy requirements, recycling, and minimum environmental impact is the approach taken by Degussa. The company is committed to Responsible Care® as well. "The Degussa Silanes business is entrenched in green chemistry efforts that focus on balancing the various economic, environmental, and social considerations of our chemical processes," asserts business director Dr. Tom Ioannou. "Green silanes chemistry is viewed in a risk-based decision making context, along with product efficacy, performance, and economics. We believe that no single principle should take precedence and are also keenly cognizant that it is not technically feasible to apply all of the principles in all circumstances."

Dow Corning takes a life cycle approach to green chemistry, eco-design, and eco-innovation, which involves developing solutions that place less burden on the environment, are safer for humans and animals, and provide the performance attributes required by customers. “We look at all aspects of the development, manufacturing, distribution, and use of materials, and divide our criteria into four categories: synthesis and production, packaging and transportation, use phase, and end-of-life (re-use, recycling, and, conversion). Specific activities range from minimizing waste and using renewable resources, to minimizing energy consumption to enabling resource conservation, and to creating value from materials that would otherwise be considered waste,” explains Laura A. Wolak, Dow Corning Americas marketing manager for coatings.

In taking the EPA definition of green chemistry one step further, PPG offers products that reduce waste for its customers as well. “Our definition of green chemistry includes the design of products that enable our customers to capture additional benefits such as minimizing adverse environmental impacts and increasing the energy efficiency of their downstream products and processes,” notes Chuck Kahle, PPG director of research for coatings and resins.

At BASF, green chemistry has been woven into the company’s strategy for innovation. According to Milliecent W. Pitts, group vice president of BASF’s Performance Chemicals for Coatings, Plastics, and Specialties business in North America, the company defines green chemistry as innovation that improves the quality of life by improving the development of eco-efficient products is part of this, we recognize that green chemistry is not about what we do, but how we do it. BASF embraces sustainable development as a core belief because it recognizes environmental protection, social responsibility.”

GREEN GROWTH

In fact, maintaining sustainable operations for the future figures prominently among a large set of market drivers sweeping the green chemistry movement forward. "Green chemistry is a matter of both social responsibility and good business sense. Regulatory mandates and end-user need for low environmental-impact products are key drivers, but successful organizations look not only at short-term rewards, but the long-term impact of their actions," says Pitts. Andre Bento, Industries manager of Ciba Specialty Chemicals’ Industrial Coatings business, adds that, "Marketing a product range in concert with green chemistry is critical for continued success/existence in the marketplace.” Kahle agrees, "Green chemistry is key to PPG staying competitive. It’s as simple as that.

The demand for sustainable products, in part, originates with consumers, who are becoming increasingly aware of the environmental issues associated with materials they purchase. “Consumers and manufacturing customers want energy efficient products that are safer for the environment,” adds Kahle. This trend is occurring around the world. "Consumers in all countries are much more aware of the environmental impact of the products they use, and how they can make a positive contribution to a safer environment based on the products they purchase," comments Don Shaw, vice president of development with Troy Corporation. He also notes, "Companies that create products that meet consumer demand through sustainable operations will increase their market share, reduce the amount of waste products, and lower costs to improve slim margins in a very competitive global market."

Dow Corning believes that in order to maintain its leadership position in the silicone industry, the company must go beyond environmental performance to keep pace with the marketplace and stakeholder expectations, which are increasingly focused on more sustainable processes and products, according to Wolak. Kahle adds that, “Typically, there is cost and value penalty if a new product doesn’t consider the 12 Green Principles. Not only is pursuing green chemistry environmentally responsible, it just makes great business sense.”
nized steel. The formula-water-dispersed epoxy-based epoxy-novolac resins, organofunctional silicone, and selected inorganic materials.

Halcon's water-based organic corrosion inhibitor for direct-to-metal coating applications (HALCON 510) is based on 1,3-propanediolamine, N,N-dimethyl-, monobenzoxazone and contains no heavy metals, nitrates or other toxic chemicals, electrophilic chemicals, or marine pollutants. Flexible NORYL® poly(arylene ether) resins from GE Plastics eliminate halogenated compounds, heavy metal stabilizers, pigments, and phthalates from wire coatings while offering improved heat performance, increased flame retardant properties, and lower costs due to reduced weight. Sierra Performance Coatings by Rust-Oleum are zero-VOC, zero-HAP, no odor industrial coatings based on single component (1K) acrylic and acrylic urethanes and two-component (2K) epoxies and acrylic epoxies.

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GREEN STRATEGIES

The ways in which companies respond to these drivers and develop strategies for incorporating green chemistry practices into their operations vary broadly. Those companies that have made continuous improvement programs like Responsible Care® often incorporate green chemistry practices into these existing initiatives. LANXESS, for example, does not have a formal green chemistry program, but utilizes green chemistry practices within its product stewardship program. "We focus on identifying and developing ways to reduce adverse impacts on health and the environment, beginning at the initial development stage of a product and carrying through research and development, production, packaging and distribution, handling and storage, and recycling and disposal," notes LANXESS Corporation vice president of technical services, Sharon Feng.

Participation in voluntary regulatory programs is another approach. In April 2006, BASF became the first company to qualify for the EPA's Sustainable Futures Program, which encourages pollution prevention in new chemical development through the transfer of chemical risk screening methodologies and includes...
Virtually all coatings R&D projects at PPG have a green component, according to Kahle. "Our product and process development for customers around the world typically considers the 12 Principles of Green Chemistry. We have taken numerous steps to reformulate our raw material chemistry to provide a safer product," he says. "PPG has a long history of anticipating environmental regulation and green product developments that reduce their burden on the environment, decrease waste for our customers, and increase their energy efficiency," he adds.

PPG's efforts have been recognized through several awards. Including the 2005 Environmental Achievement Award from the Environmental Management Association for the company's environmentally minded paint denaturant, BC-24000NP, which uses a natural byproduct of food processing as a primary ingredient. A U.S. EPA Green Challenge Award was given to PPG for its lead-free ceramic ecocat in 2001. The company's coatings plants in Ozl Creek, Vel, and Petaling Jaya, Malaysia, have been awarded Sony Corporation's "Green Partner" certification.

Also following the EPAs green chemistry principles, SFS has focused on developing environmentally benign alternatives for industrial applications and at the 2006 IGE show formally introduced its new Cleanguard family of "green" biocides, fungicides, and algicides. Through the Cleanguard initiative, SFS formulates green protective ingredients by taking potentially hazardous elements out of the mix, while working with active ingredients that are well accepted in the industry. "We appreciate, for example, that while paint has many components, incorporating biocides with greener profiles will give a paint manufacturer less to be concerned about when it comes time to qualify his product," states Fahmy.

Degussa strives to promote the research, development, and implementation of leading edge chemical technologies that protect the environment and also provide performance products to the market, according to Ioannou. "Improved processes that help reduce volumes of hazardous materials resulting from the production of chemicals, products, processes, and services with efficient use of energy and resources, minimization of environmental impact and waste generation, and sale and responsible disposal of residual wastes," explains Tony Newell, senior marketing manager for Degussa's BCI Coatings business.

Green chemistry is also embraced at Ciba Specialty Chemicals, says Bendo. "While we manufacture many ingredients used in coatings products from pigments to dispersants to light stabilizers, we are also final users of coatings. Minimizing the environmental impact of the chemical industry as a whole is vital to our present and our future."
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GREEN GOODS

The availability of green products on the market to-day strongly reflects the efforts of members of the paint and coatings industry to implement green practices and procedures throughout their businesses. An ever-widening selection of much more environmentally friendly paints, resins, pigments, additives, raw materials, and other reactants can be found on the market to-day, with many of these products produced via processes designed to minimize environmental impact. A few products are highlighted in the following section.

Paint and Coatings Formulations

Dow Corning has introduced Sil-OBP S-7688, a new paper release coating, to the Chinese market. It is the first 100% solids product that targets solvent-based applications, according to Norm Kanar, Americas market manager, Pressure Sensitive Solutions. This product lowers energy requirements because it cures quickly at low temperature, and it reduces solvent usage by 70%. The ultimate result is a significant reduction of the amount of solvents that is released to the atmosphere, because local Chinese paper converters typically don't have solvent recycling equipment.

New waterborne basecoats from PPG marketed in various countries under Envirobase, Netta Autocolor Aqueable Plus, and MaxMeyer Aquamix brands meet environmental regulations in Europe. "It's only a matter of time until other parts of the world enact environmental legislation similar to that in Europe. And we'll be ready," asserts Kahle. Other green products from PPG include low-VOC and zero-VOC paints (Pittsburgh Paints Pure Performance Interior Latex paint), heat-reflecting exterior metal finishes (Duranol SPF), and so-lar-control, low-e glass coatings (Solarban and Sungate coating series). Its Olympic Premium Interior Latex paint, sold in Canada (Olympic Spec. II), is zero-VOC and is Green Seal-Class A certified.

Resins

In addition to the UV-curable primer for automotive refinish applications that won BASF a 2005 Presidential Green Chemistry Challenge Award, the company has launched a new non-isocyanate system for industrial solventborne coatings. The Acronal Optive line of low-to-zero VOC acrylic resins for formulation of architectural coatings includes Acronal Optive 350, a new high-gloss multiphase latex with freeze/thaw resistance at 50 g/l VOC; Acronal Optive 130 and Acronal Optive 230, 50 g/l VOC capable latexes; and Acronal Optive 130 and Acronal Optive 230, each offer titanium dioxide efficiency. BASF also offers its Ioncryl line of low-VOC systems for a variety of coating applications.

Pigments

Pigment suppliers have concentrated on offering low-VOC APREO and/or aqueous pigment dispersion. PPG's EPAX® product line are pigment dispersions en-

"Envirobase Netta Autocolor Aqueable, MaxMeyer Aquamix, Pittsburgh Paints Pure Performance, Duranol SPF, Solarban, Sungate, and Olympic are all trademarks of PPG Industries Inc."
Additives

Borchers GmbH, a subsidiary of LANXESS, offers several additive solutions for coatings and paints, many of which can be used as alternatives for products that potentially raise environmental concerns. Largely in Europe, Ascinol AntiSkin antiiskinning agents serve as methylethyl ketozone alternaties and Borchers® Dry driers find use as replacements for cobalt-based products. Borchers® Kan 0234, 0244, 0245, 22, and 24 are iron-free catalysts, Baysilone® silicone-based substrate wetting additives serve as alternatives for fluorinated surfactants, and Bocchi Gen and Emulsifier wetting and dispersing agents are high performing substitutes for nonylphenols.

Ciba offers a range of zero-or low-VOC additives that provide formulators with flexibility to improve their coatings while meeting VOC requirements. Addressing the market demands, EFKA® 3000 series slip and leveling agents at 100% solids were developed with the intent to give the desired coating properties without VOC impact, according to Benco. Other new Titanum® and Efka additives allow for improved performance in traditionally low VOC systems: waterborne, powder, and UV curing applications.

One of the newest products from Clariant is its Exolit® line of ammonium polyphosphate-based, non-halogenated flame retardants. These products exhibit low smoke density and create non-convective gas densities, according to Benco. Exolit® is its new raw material for coating applications, such as steel coatings, sealants, adhesives, wood, textiles, thermosets, thermoplastics, polyurethane foams, and wood plastic composites.

ISP has GONE GREEN!

International Specialty Products, new, CleanGuard™ family of green biocides fungicides and algaecides is a green generation of superior IPBC-level protection.

Fungitrol® 920 provides low- or no-VOC, low-odor, broad-spectrum protection against degradation, discoloration and defacement caused by mold, mildew and algae. In addition to paints and coatings, Fungitrol® 920 can be used as an additive to prevent fungal growth in non-medical, non-food-use natural and synthetic adhesive formulations and caulks, both in wet state and in the dry film of the finished product. It can also protect aquatic-based ink solutions from fungal attack and is effective as a dry-film anti-mildew protector for waterborne paints, coatings and stains. Other applications include paper coatings and above-ground wood preservation.

Nuosept® 498 preservative with in-can protection applies to the proven, broad-spectrum antimicrobial activity of BIT to emulsion paints/crane joint compounds, water-based adhesives, grouts, caulks, sealants, ready-mixed cements, and many other building and construction products. EPA-registered Nuosept® 498 is an odorless, no-VOC, off-white dispersion that is broadly compatible with aqueous systems and is specially formulated to provide environmentally hazard-free protection. Unlike other BIT formulations, Nuosept® 498 preservative is non-settling and freeze-thaw stable, and may be incorporated into a product during any step of the manufacturing process. In addition, it is stable and effective over a wide pH range (4-12). Additional applications include textile spin finish solutions, pesticide formulations, laminates, and leather processing formulations.

For more info, go to: www.ispscorp.com/green

International Specialty Products

USA Regional Sales Offices
USA Reginal Sales Office
Central Region: 1-800-424-4789
Eastern Region: 1-800-58-3863
Western Region: 1-805-980-8901

Canada: 1-800-465-5984
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ISP Coatings Tech

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The Coatings Research Institute (CRI) at Eastern Michigan University, Ypsilanti, MI, has announced that the Smart Coatings 2007 conference will be held February 21-23, 2006, at the Grovesnor Resort at Disney World in Lake Buena Vista, Florida. The three-day conference will focus on bioactive coatings, nanotechnology-based coatings, self-assembled intelligent layers, and stimulus and response coatings. The conference is organized into five sessions over the three days. It also includes a Poster Session. The preliminary schedule is as follows:

**Wednesday, February 21**

**Session I**

Self-Healing Polymer Coatings — S.-R. White, University of Illinois at Urbana Champaign

**Multi-Functional Thin Film Coatings Containing Layer-by-Layer Assembled Nano-particles** — M. Rubner, Massachusetts Institute of Technology

**Bioinspired Polymer Coatings** — J. West, University of California (San Diego)

**Thursday, February 22**

**Session III**


**Memory Effects and Device Performance of Functional Polymer Thin Film and Coatings** — Q.-D. Jing, National University of Singapore

**Biocidal Coatings for the Military** — John La Scala, Army Research Lab

**Increasing Coating Functionality Using Nano-Dimensional Materials** — R. Taylor, University of Mississippi

**Silica/Antimicrobial Hybrid Coating Materials** — Paul Pope, The Dow Chemical Company

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**Session II**

**Designer Biomaterial Engineering BioInterfaces with Controlled Properties** — J. Llabres, University of Michigan

**Scalable Micropatterning and Self-Haling Behavior of Nanocomposite Polyethylene Clear Coatings** — R. Fernandez, California Polytechnic State University

**Remote Cure—A Novel Approach to Polymerize Coating Formulations** — A. Dey, A. Fershtolin, Bowling Green State University

**Dependence of Switching Properties of Magnetic Micelles on the Thickness of Fullullam Overlayer and Substrate Temperatures** — Yi Ming Yang, Hong Kong Polytechnic University

**Reversibly Peeling Coatings** — John Tewer, Eastern Michigan University

**Polypropylene/Aluminum Flake Hybrids as Corrosion Inhibitors for Aluminum** 2024-T3** — Victoria Johnston Gelling, North Dakota State University

**Session IV**

**Hydrophilic Nanosol-Gel Coating Systems** — R. H. B伛chok, The Boeing Company

**A Smart Coating for the Early Detection and Inhibition of Coronary Lesions** — C. F. Kelleher, Kennedy Space Center

**Application of the Epoxy Layed-Silica Nanocomposite in Coating** — Chui Ping Chau, University of Dayton and Wright-Patterson ABF

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**Session V**

**Nature-Inspired Superhydrophobic Coatings** — W. Ming, Emory University

**An Evaluation of the Concept of Thinning Organic Biofilms as a Silicon Matrice to Create Novel, Environmentally-Friendly, Anti-fouling Coatings** — R. J. Chisholm, North Dakota State University

**Polymer Chameleons: Smart Materials with Built-In Deformation and Temperature Sensors** — Christoph Weder, Case Western Reserve University

**Characterization of Multifunctional Aircraft Coatings with Hydrophilic Additives** — N. Voorhees, University of Dayton and Wright-Patterson AF

**Registration**

Registration for the entire conference is $800 for industry professionals ($700 before January 21), $400 for academic educators, and $150 for students. To attend just one day of the conference, the cost is $300. In addition, a separately priced symposium dinner will be held at 7:00 pm on Thursday, February 22. The cost is $60 and should be paid with conference registration.

Additional information can be found at coatingtech.org/public/coatings, research/smartcoatings. Technical questions should be directed to Janet Baghlah, Dean of Coatings and Grading Materials Program Coordinator for CII at 734.487.3192 or janet.baghlah@ emich.edu.

For general conference questions, contact Sandy Tanner, CII Administrative Associate, at 734.487.2203 or sandy.tanner@emich.edu.