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).

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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. At 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 refinish primer system (R-M® Flash Fill™ 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 10 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 biobased 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 bacteria retardant paint that is nontoxic and contains no VOCs. ECOSIL Technologies LLC is commercializing its one-step, low-VOC, chromate-free primer system for aluminum alloys and hot-dip galvanized steel. The formula-tion is based on water-dispersed epoxy-based bisphenol-A or epoxy-novolac resins, organofunctional silane, and selected pigments.

Halox's water-based organic corrosion inhibitor for direct-to-metal coating applications (HALOX® 510) is based on 1,3-propanediamine, *N,N* dimethyl-, monobenzoate and contains no heavy metals, nitrates or other toxic chemicals, eutrophication 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

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 Dearth. 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 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 Millicent W. Pitts, group vice president of BASF's

12 Principles of Green Chemistry

1. Prevent waste
2. Design safer chemicals and products
3. Design less hazardous chemical syntheses
4. Use renewable feedstocks
5. Use catalysts, not stoichiometric reagents
6. Avoid chemical derivatives
7. Maximize atom economy
8. Use safer solvents and reaction conditions
9. Increase energy efficiency
10. Design chemicals and products to degrade after use
11. Analyze in real time to prevent pollution
12. Minimize the potential for accidents

Performance Chemicals for Coatings, Plastics, and Specialties business in North America, the company defines green chemistry as innovation that improves the quality of life. "While 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 balances economic growth, environmental protection, and 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 Bendo, industry 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 that, "Companies that create products that meet consumer demand through sustainable operations will increase their market share, reduce the amount of waste produced, 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 a 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."

Regulatory pressures also remain an important factor in the further adoption of green chemistry practices. "There has been a marked acceleration of environmental regulations globally. Ensuring compliance with expanding regulations in each geographical area and the associated administration costs are driving both government and industry to look for better ways of achieving their environmental objectives," notes Jennifer A. Middleton, Dow Corning's building material protection market manager for the Americas. She adds that life-cycle-based policy initiatives like Europe's REACH (registration, authorization) legislation are tying together previously unconnected policy agendas on innovation, competitiveness, energy, and environment. Companies will need to address all aspects of the creation, use, and manufacture of their chemicals and products.

Biocides is one area where regulations are having a significant impact. As a result of the European Biocidal Product Directive and other regulations around the world, the number of allowable active ingredients is becoming limited, as more and more products are pulled from the market. "We must be able to provide effective products that perform at the high levels demanded by our customers while meeting increasingly stringent regulatory requirements and exhibiting appropriate safety profiles," states Ray Fahmy, North American marketing manager for biocides at International Specialty Products (ISP).

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 implemented 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, safety, 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, Cytec 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

approval for a shortened regulatory review process for certain new products. "The biggest advantage of Sustainable Futures for Cytec is that the program encourages pollution prevention and the development of inherently low-hazard chemicals from the very beginning of the process," says vice president of Safety, Health & Environment, Karen Koster. "It steers our product development toward success right from the start and ends with a quicker, but no less stringent, regulatory approval process."

BASF has developed its own eco-efficiency analysis method that looks at the entire lifecycle of a product, from the extraction of raw materials to product use to recycling or disposal after use. "This analysis allows both economic and environmental factors to be considered when developing and optimizing products and processes, and makes it possible to determine the most eco-efficient of the various alternatives," says Pitts. The objective is to offer the best possible cost-effective products with good environmental performance.

One of Dow Corning's strategic programs that supports the principles of green chemistry is the company's corporate environmental compatibility program. "The intent of this program is to integrate eco-design principles and philosophy into our business and decision-making processes," notes Wolak. The program involves two elements: developing eco-criteria to apply to products, processes, etc.; and phase out of environmentally unfriendly chemicals. It is implemented by working with both the business and functional units.

Clariant has extensive environmental, health, and safety policies that in many cases emphasize and require implementation of green chemistry principles. "Clariant strives for continuous improvement of its environmental, safety, and health (ESH) performance by developing new and better products, processes, and services with efficient use of energy and resources, minimization of environmental impact and waste generation, and safe and responsible disposal of residual wastes," explains Tony Newell, marketing manager for Clariant's BU Coatings business.

Green chemistry is also embraced at Ciba Specialty Chemicals, says Bendo. "While we manufacture many ingredients used in coatings 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."

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 developing products 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, BC4200NP, 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 cationic electrocoat in 2001. The company's coatings plants in Oak Creek, WI, and Petaling Jaya, Malaysia, have been awarded Sony Corporation's "Green Partner" certification.

Also following the EPA's green chemistry principles, ISP has focused on developing environmentally benign alternatives for industrial applications and at the 2006 ICE show formally introduced its new Cleanguard™ family of "green" biocides, fungicides, and algaecides. Through the Cleanguard initiative, ISP 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 products," 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 chemical products are top priority, as is the introduction of innovative technologies that reduce the amount of energy consumed," he adds.

GREEN GOODS

The availability of green products on the market today strongly reflects the efforts of members of the paint and coatings industry to implement green practices and procedures throughout their organizations. 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 Syl-Off® SL 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 solvent that is released to the atmosphere, because local Chinese paper coaters typically don't have solvent recycling equipment."

New waterborne basecoats from PPG marketed in various countries under the Envirobase, Nexa Autocolor Aquabase Plus, and MaxMeyer Aquamax 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 coatings (Duranar SPF), and solar-control, low-e glass coatings (Solarban and Sungate coating series). Its Olympic Premium Interior Latex paint, sold exclusively at Lowe's, 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, which offer titanium dioxide efficiency. BASF also offers its Joncryl line of low-VOC systems for a variety of coating applications.

Pigments

Pigment suppliers have concentrated on offering low-VOC, APEO-free aqueous pigment dispersion. Ciba's EFKA® product line are pigment dispersants en-

*Envirobase, Nexa Autocolor Aquabase, MaxMeyer Aquamax, Pittsburgh Paints Pure Performance, Duranar SPF, Solarban, Sungate, and Olympic are all trademarks of PPG Industries, Inc.

Certification for Green Paints and Coatings

Different organizations now offer certification for products that meet specific "green" requirements. Consumers and other end-users interested in purchasing more environmentally friendly options look for products that have the approval of these organizations.

Green Seal is a nonprofit organization that develops science-based environmental leadership standards for more than 40 major product categories, two of which are for paints and coatings. Green Seal certifies a wide range of products and services ranging from cleaning and paper products to electric chillers for a diverse clientele, including government agencies, universities, and the private sector.

Environmental evaluations are conducted on standards using life-cycle assessment to ensure that all significant environmental impacts are considered, from raw materials extraction through manufacturing to use and end-of-life management. Wherever possible, Green Seal standards cite international test methods for evaluating product performance or environmental attributes. Green Seal also follows the Guiding Principles and Procedures for Type I Environmental Labeling adopted by the International Organization for Standardization (ISO 14024).

The two standards for paints and coatings are GS-03 for anticorrosive paints and GS-11 for general paints. These standards establish environmental and performance criteria such as setting limits on VOC levels and aromatic compounds, and restricting the use of certain toxic substances in the paint as well as in packaging materials. There are currently over 10 companies with Green Seal-certified paint products.

The U.S. Green Building Council (USGBC) developed the Leadership in Energy and Environmental Design (LEED®) Green Building Rating System™ as a "national consensus-based, market-driven building rating system designed to accelerate the development and implementation of green building practices," according to the organization. LEED is comprised of six performance areas: siting, water conservation, energy, materials, indoor environmental quality, and innovation and design. A certain number of points must be earned in each category by obtaining credits. Different levels of certification can be achieved (LEED Certified, LEED Silver, LEED Gold, and LEED Platinum) depending upon the number of points earned. Manufacturers of LEED-qualified products including paints and coatings use this approval as a marketing tool for architects and builders interested in the LEED program. Selecting paints and coatings that meet or exceed the VOC and chemical component requirements of Green Seal requirements will earn one point in the LEED rating system.

gineered for higher loadings in waterborne systems, yielding higher loadings and lower solvent needs, according to Bendo. "These improved durability additives position waterborne as a more attractive option," he notes. Clariant's Colanyl 500 series of very low-VOC and APEO-free aqueous pigment dispersions include highly defined color shades that exhibit good flowability, pumpability, and stability against sedimentation and drying out. "These aqueous preparations are free of binding agents and solvents and have high pigment content, and are ideally suited for use with automated dosing and mixing equipment," says Newell. BASF offers H2Option* high pigment loading pigment dispersions for aqueous paint systems that are APEO-free and very low VOC.

BASF has also developed Xfast* stir-in pigments that are APEO-free. These free-flowing, low dusting granules can be stirred directly into aqueous coating formulations. When used in combination with the XFast Dispenser, the pigments can be directly dispersed into a base paint and shaken, eliminating several steps in the process of tinting paints at retail locations. Pitts states that, "Xfast is not only a green product but also addresses the challenges of liquid-based colorants such as shelf life and product consistency."

Both Clariant and BASF have recently launched organic-based alternatives to heavy metal pigments. Clariant's 70 series pigments represent a full range of yellow, orange, and red that, according to Newell, offer superior purity of shade, opacity, and flow characteristics versus conventional organic pigments. In addition to its Synergy® and Paliotan® alternative pigments, BASF is currently developing a primrose shade for coatings. "This new product will be economical and have excellent weathering properties, excellent solvent resistance, and good opacity and rheological properties," Pitts says.

To address temperature issues associated with pigment use, BASF has developed CoolSim, a software program designed to address the challenges of keeping a dark colored coated surface from absorbing too much energy from the sun. The program calculates total solar reflectance (TSR) of pigment combinations to save time and energy in the lab. In addition to TSR calculations, CoolSim can adjust pigment loading and film build to maximize pigment usage and the amount of paint that is required to coat a surface.

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, Ascinin® AntiSkin antiskinning agents serve as methylethyl ketoxime alternatives and Borchers® Dry driers find use as replacements for cobalt-based products. Borchi® Kat 0234, 0241, 0245, 22, and 24 are tin-free catalysts. Baysilone® silicone-based substrate wetting additives serve as alternatives for fluorinated surfactants, and Borchi 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 demand, EFKA® 3000 series slip and leveling agents at 100% solids were developed with the intent to give the desired coating property without VOC impact, according to Bendo. Other new Tinuvin® 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 no corrosive gas formation when exposed to fire and are suitable for many different application segments, such as steel coatings, sealants, adhesives, wood, textiles, thermosets, thermoplastics, polyurethane foams, and wood plastic composites.

TF Ceridust* 3921 F is a micronized polytetrafluoroethylene (PTFE) wax mixture from Clariant that improves scratch resistance, enhances slip resistance, and imparts antiblocking characteristics, according to Newell. The company's Hostavin® disp. XP range of light stabilizers for water-based coatings are easy to handle and incorporate while providing significantly longer shelf life than other competitive light stabilizer dispersions through the use of proprietary biocide and humectant blends.

Degussa has introduced Dynasylan® Hydrosil® multifunctional silanes that reduce VOCs as well as exhibit other positive properties and replace toxic chromium substances in metal pretreatment systems. The products are based on completely hydrolyzed polysiloxanes in water. They are excellent adhesion promoters for water-based resins in coatings applications and are produced by a special patented Degussa process, according to Ioannou. "Hydrosil silanes are ideal for adhesion and wettability of resins in the paper industry and can also be used as primers for metal pre-treatment to improve adhesion of aqueous acrylic coatings." The company is

currently developing a new line of multifunctional silanes that will be marketed under the name Dynasylan® SIVO. Other environmentally friendly product lines developed by Degussa Silanes include sol gel waterborne technology and neat low-VOC water repellents sold under the Protectosil® trademark.

Several new green biocides have been introduced to the global paint and coatings market as well. As part of its new Cleanguard™ initiative, ISP has launched two new products: Fungitrol® 920 fungicide and Nuosept® 498 in-can preservative. Fungitrol 920 fungicide is a water-based, formaldehyde-free dispersion of 3-iodo-2-propynyl butylcarbamate (IPBC), which offers highly effective, broad-spectrum protection against degradation, discoloration, and defacement caused by mold, mildew, and algae. Nuosept 498 preservative is an aqueous dispersion of 1,2-benzisothiazolin-3-one (BIT), a nonmetallic, nonchlorinated, formaldehyde-free biocide. Both Fungitrol 920 and Nuosept 498 come in water-based carrier systems, are color stable and effective at very low dosage rates, and are close to neutral pH, eliminating issues with skin corrosiveness, according to Fahmy.

Troy Corporation initiated a program designed to improve the environmental safety of their products several years ago, according to director of microbiology, Gary Horacek. "This effort recently led to the launch of our water-based zero-VOC Polyphase® 710S and 728S dry film preservatives in Europe and Asia." These products reportedly provide broad spectrum dry film protection for coatings with minimal impact to aquatic organisms.

In the Americas, Troy Corporation has launched several zero-VOC products including the dry film preservatives Polyphase 678, Polyphase 662, and Polyphase 663; the in can preservatives Mergal K10N and Mergal 399; and the substrate wetting additive Troysol ZLAC.

GREEN INNOVATION

The green movement, like other changes in the paint and coatings industry, offers both opportunities and challenges. The key to success lies in the ability of producers to develop new technologies and processes that are sustainable yet provide equal or better performance when compared to less environmentally attractive existing materials. The examples listed above clearly demonstrate that the industry is equal to the task.

"Clariant is committed to sustainable growth springing from its own innovative strength," stresses Newell. "Our success is based on the know-how of our people and their ability to identify new customer needs at an early stage and to work together with customers to develop innovative, efficient solutions," he continues. At Dow Corning, the company vision centers around innovation, and its effort to develop eco-innovative solutions supports that vision and the company's values, according to Wolak.

No matter what the elected strategy may be, all agree that green chemistry must become an integrated aspect of the operations of paint and coatings companies if they want to not only survive but be successful in the extremely competitive market environment that exists today. "Green chemistry is a long-term approach to doing business, and it is only in the earliest stages of adoption," stresses Fahmy. "There is tremendous growing interest in the use of more environmentally friendly materials and products across the entire supply chain and customer segments. Forward looking companies are responding eagerly to the challenge of developing innovative technologies, products, processes, and services to advance the sustainability of all aspects of the paint and coatings industry."

Green Resources

- EPA Green Chemistry Program
  www.epa.gov/greenchemistry
- ACS Green Chemistry Institute
  http://chemistry.org/greenchemistryinstitute
- ACS Education Division, Green Chemistry web page
  www.chemistry.org/portal/a/c/s/1/acsdisplay.html?DOC=education%5Cgreenchem%5Cindex.html
- Green Chemistry Network (UK)
  www.chemsoc.org/networks/gcn
- Centre for Green Chemistry (Australia)
  http://web.chem.monash.edu.au/greenchem
- Canadian Green Chemistry Network
  www.greenchemistry.ca/
- Green & Sustainable Chemistry Network (Japan)
  www.gscn.net
- Green Chemistry (Journal)
  www.rsc.org/is/journals/current/green/greenpub.htm
- The Green Business Letter
  www.greenbizletter.com/
- List of "Green Chemistry Organizations"
  www.nsfstc.unc.edu/green.htm
- Green Seal
  www.greenseal.org
- U.S. Green Building Council (USGBC)
  www.usgbc.org
- World Green Building Council
  www.worldgbc.org
- Master Painters Institute Green Performance Standards
  www.specifygreen.com
- Greenguard Environmental Institute
  www.greenguard.org
- GreenHomeGuide
  www.greenhomeguide.com
- BuildingGreen, Inc.
  www.buildinggreen.com