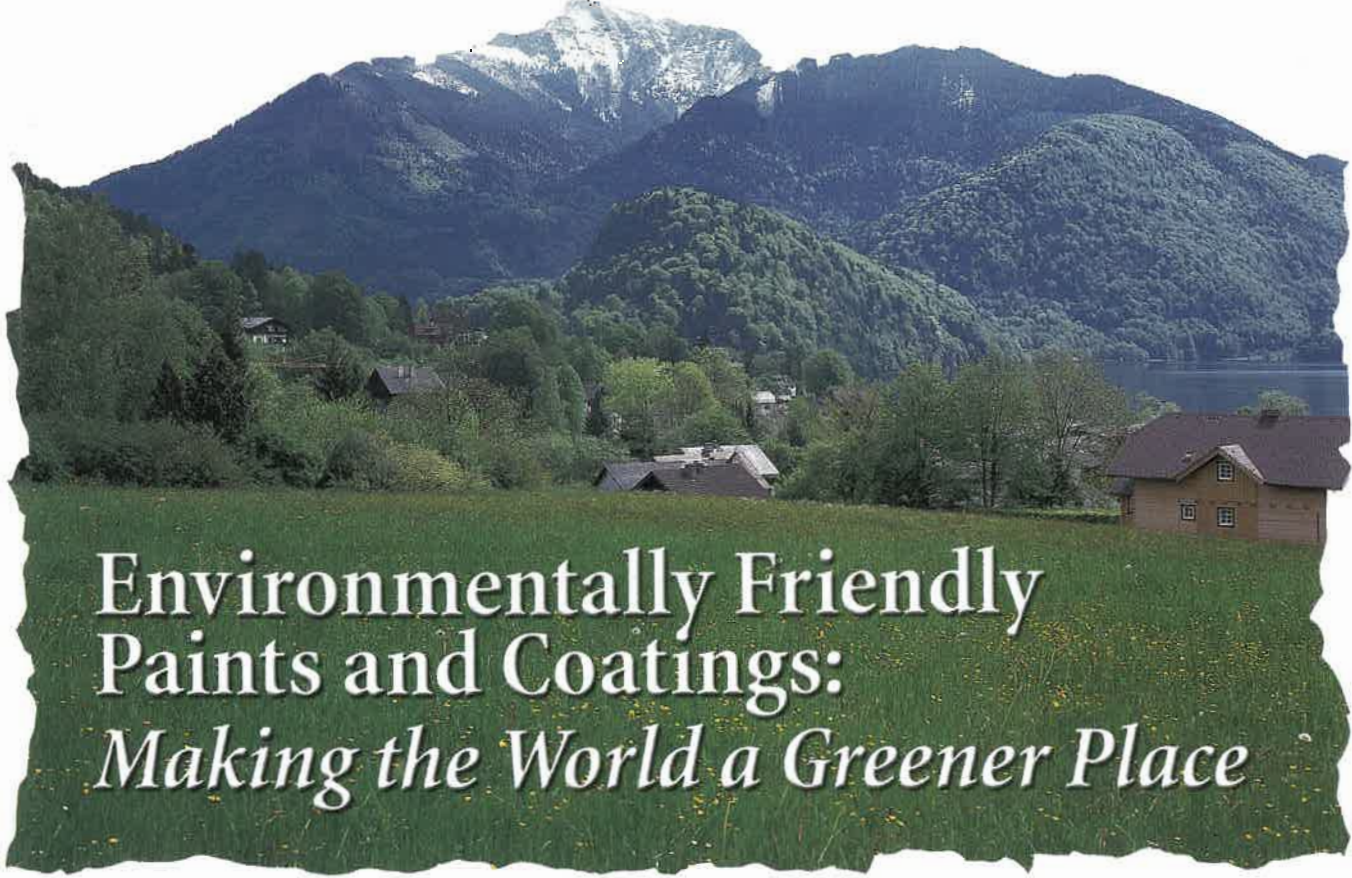




Environmentally Friendly Paints and Coatings: *Making the World a Greener Place*

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Demand for safer, healthier products has been growing in many industries, with the most marked gains observed in the food, dietary supplements, and personal care markets. In recent years the trend has expanded beyond these traditional sectors and has become a noticeable factor in the building construction and maintenance industry as well. The result has been a growing demand for "green" products and materials, including paints and coatings. While regulatory requirements have been a force behind initial research and development efforts targeted at reducing unwanted emissions and eliminating hazardous chemicals from paint and coating formulations, this increasing demand for more environmentally friendly products has become a significant driver for innovation today.

"The green building movement has moved beyond the fad stage and become an established trend," says Michael D. Brown, vice president of The ChemQuest Group, a management consulting firm located in Cincinnati, OH. Green building encompasses energy efficiency, renewable resources, reduced emissions, and even considers the manufacturing process for producing building materials. "Companies are no longer simply responding to upcoming environmental regulation requirements," he adds. "Both raw material suppliers and final formulators are developing products to meet a growing 'green' market need as well as to meet mandated limits."

Clean technologies accounted for 67-70% of the total U.S. paint and coatings market in 2005 and were valued at \$13.77 billion, according to Steven Nerli, a consultant with Kusumgar, Nerli & Growney. The remaining material is low-solids solvent-based. Waterborne coatings, with 2005 sales of \$8.3 billion, are by far the largest type of environmentally friendly coatings.

accounting for 60% of all sales. This is the dominant technology in architectural coatings. High-solids solvent-based coatings, or formulations with more than 60% solids, were second largest at \$2.6 billion in sales. Powder coatings were the third largest environmentally friendly coating type, with U.S. sales of \$1.4 billion in 2005. Other types include 100% solids formulations that are in liquid form, radiation-cured (UV and EB) coatings, and electrodeposition coatings. Powder and radcure coatings are growing the fastest, at between 4–5% per year. Waterborne paints and coatings are experiencing slightly slower growth of 2–3% annually.

The overall growth rate for paints and coatings is much higher in Asia at 8% per year. In addition, Asian growth continues to be strong for solvent-based products due to less stringent regulations. In fact, according to Mr. Nerli, solventborne paints and coatings are the largest type of coating product sold in Asia, accounting for 55–57% of the total market at \$12–13 billion. Waterborne technology, with sales of \$7 billion, has a 30% share. Powder coating sales in Asia in 2005 were \$2 billion and are growing at 12% per year—the highest rate in the region.

In North America, demand for green products is increasing in both the industrial and consumer segments of the market. "Growth has been sparked by a renewed social awareness and momentum within the construction industry," states to Zoe Voisey, marketing supervisor for Cloverdale Paint Inc. "More and more architects, specifiers, and builders are seeking environmentally friendly construction materials with the aim of benefiting both the users of products and the occupants of buildings upon completion," she continues. On the consumer side, Willem Maas, founder of GreenHomeGuide, points out that "the green home lifestyle appeals to people for many of the same reasons fueling the growth of organic foods: health and safety, environmental impact, aesthetics, comfort, and the pride of originality. These homeowners want to create homes that make them feel good."

"Evidence of this increased demand can be found by simply opening up any trade or consumer magazine and looking at the increasing number of ads from all of the major paint companies publicizing their 'green' products," notes Rocky Prior, vice president of Southern Diversified Products. "Both contractors and homeowners are becoming increasingly concerned about the impact of using paints that contain solvents or other potentially hazardous materials on their health. In addition, a growing number of people are worried about the environmental aspects associated with the use of solvents in paint. All of these end-user groups are converging simultaneously and demanding better performance with lower odor and toxicity," he adds.

This growing demand is coupled with continued regulatory legislation. In the U.S. a limit of 50 g/L of VOCs for non-flats was scheduled to take effect in the South Coast Air Region of California on July 1, 2006. Many expect that the rest of the state will adopt the same limits within a year, and similar regulations will be in place on the East Coast within two years. More than likely, the federal government will eventually adopt them as well.

In Canada, the government is expected to implement new regulations in 2008 that will also lower VOC limits below current levels. "It is largely the government that sets the trends in terms of environmentally friendly products," says Edith Lalanne, brand manager with Sico Inc. "The consumer will always say that it is better to use environmentally friendly products, but they are not necessarily ready to pay the extra to purchase them. Architects are also pushing to get environmentally friendly products because they want to build buildings that are LEED certified (see below). LEED is the buzzword."

Worker safety has become an issue as well. "Growing global awareness of the need to protect our environment and continually strive to ensure the health and well-being of those in the industry and consumers creates the demand for environmentally friendly coatings," says Tony Newell, marketing segment manager of Decorative Coatings for Clariant's Pigments & Additives Division. Carl J. Sullivan, coatings technology director with Reichhold, adds that there is growing activity by legislative bodies to address worker safety, increasing pressure to change from solvent-based coatings, particularly those that use flammable solvents, to waterborne and powder technologies.

Whether the drivers are regulatory based or market driven, the challenge is to provide equivalent or improved performance in "green" products as compared to traditional technologies. "Our customers are looking for the same performance as conventional resins but at a lower cost, or higher performance at the equivalent cost," states Hexion Specialty Chemicals Americas market development manager David S. Woodcock. "We want to be able to supply resins, curing agents, or other products that enable our customers to meet the most stringent regulatory requirements, or, better yet, help them prepare for future compliance."

Many paint and coatings companies and their raw material suppliers have successfully responded to the increasing regulatory requirements and the growing market demand for environmentally friendly products. "Development of cleaner technologies can expand markets," asserts Sally Ramsey, chief chemist for Ecology Coatings. "Powder was developed for this market and improvements in that technology continue to be made. Research to advance high-solids and waterborne coat-

FOR MORE INFORMATION

The topic of environmentally friendly coatings will be the focus of ICE 2006, to be held November 1-3, 2006 in New Orleans, LA. Exhibit displays and educational programs will be geared to the theme of "Green Chemistry—Global Ingenuity."

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ings technologies continues. Radiation-curable coatings, especially those that are 100% solids, also continue to be developed and improved to minimize or eliminate emissions. The overall result with lower emissions is savings in time and money." Companies are also addressing the issue of toxic metals in anticorrosion paint formulations.

According to Jeffrey T. Spillane, senior marketing manager for Benjamin Moore & Co., the main issue has been finding "green" replacements for raw materials like glycol and various coalescing solvents. "Glycol provides flow, leveling, and open time properties while coalescing solvents aid in curing. Companies have invested significant research efforts in finding alternatives and reformulating to achieve equivalent performance."

Investigation of cutting edge technologies is underway as well. "There have been significant advances in many areas, including nanotechnology and new twists on using bio-based products," notes Mr. Prior. He also points out that many universities, like The University of Southern Mississippi, have active programs to develop new technologies based on renewable resources. "The coatings industry is remarkably adaptive and will adjust," Dr. Sullivan comments. "In some cases, technology advances occur in advance of adoption of legislative proposals. The bigger challenge to the paint and coatings industry will be the continued rise in raw material costs—or even the facing of shortages—as a result of crude oil and petrochemical feedstock pricing," he continues.

The increase in crude oil has actually had a positive effect, though. "Solvent costs are rising along with oil prices. As this occurs, waterborne technology doesn't carry such a premium any more," Mr. Woodcock says. "Coatings formulators can now develop compliant products that possess the desired level of performance without much additional cost. Because of this situation, many companies are taking a second look at environmentally friendly technologies and considering the benefits and advantages they provide."

The desire of architects and builders to receive certification of compliance with voluntary "green" standards has increased dramatically in the last 10 years. Various organizations have become recognized as leading the way in establishing these standards. Green Seal, The Green Building Council (both in the U.S. and Canada), The Master Painters Institute, and The Green Guard Environmental Institute are the main groups forging the way.

Green Seal is a non-profit 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 variety of products and services, ranging from the lodging industry to 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, and 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 standard 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.

At the present time, Green Seal is working on a recycled latex paint standard with the Product Stewardship Institute (PSI), the National Paint and Coatings Association (NPCA), The Master Painters Institute (MPI), and others. The period for submitting public comments on the proposed standard ended on May 31, 2006, with the final standard expected to be issued by the end of August. The goal in developing the standard is to alleviate concerns over recycled paint performance and environmental quality, thereby increasing the use of recycled paint and reducing waste. The proposed standard takes into account the quality, performance, and safety of recycled paint, as well as environmental attributes.

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 (each credit has a point value). 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 paint and coating producers, 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 limits of the Green Seal requirements earn one point in the LEED rating system.

The Master Painters Institute has also developed Green Performance Standards for paints and coatings. "MPI has as its vision a paint and coatings industry that develops and uses paints and coatings with balanced performance, safely and appropriately every time." To achieve this goal, the Institute developed the MPI Green Performance Standard and a "green" Approved Products List that takes into consideration not only VOC emissions, but product performance as well. Manufacturers choose an environmental performance level based on VOC quantity. Different ranges have been established for different product categories. Durability and other physical performance characteristics are assessed as well.

The Greenguard Environmental Institute is a separate group that certifies materials for interior use. Standards set by an independent scientific board address limits for VOCs, formaldehyde, and other emissions. Products that earn Greenguard certification can receive credit toward the LEED Commercial Interiors rating.

Several other groups have identified the need for supplying information and resources on green building materials as a business opportunity. BuildingGreen, Inc. created GreenSpec, a subscription based online directory of environmentally friendly building products and materials. The company uses 27 criteria to evaluate products, but does not require performance testing or independent verification. BuildingGreen Suite is a more comprehensive online resource that includes the GreenSpec directory, articles, reviews, and news from Environmental Building News (EBN), and is

integrated with the product listings and project case studies from Building Green's High-Performance Buildings Database.

GreenHomeGuide is a community-based online resource that provides information on "green" alternatives to conventional building, cleaning, pest control, and landscaping products through tips, case studies, expert Q&A articles, and regional directories of products and services. "By using environmentally friendly alternatives, we can have more, not less. Our homes can be better designed and more attractive; warmer and brighter in the winter and cooler in the summer. They can also offer us more of the well-being and comfort that we need and seek. And with better homes, we move one step closer to creating a better planet," asserts Mr. Willem Maas, founder of GreenHomeGuide.

The Environmental Home Center (EHC), located in Seattle, WA, was founded by Matthew Freeman-Gleason in 1992 to increase access to sustainable environmental building materials. The company carefully evaluates products and only sells those that meet its high standards for "greenness" and excellent performance. EHC has expanded rapidly and has garnered interest from investors and the public alike. Demand for environmentally friendly paints and coatings is generated by people with chemical sensitivities or parents looking to avoid potential chemical exposures for their children, according to Ryan Ceurvorst, marketing coordinator with EHC.

The company only carries paints that are zero VOC and offer equivalent performance to traditional paints. Its current products include AFM Safecoat, American Pride, and Yolo Colorhouse. "Yolo is the latest addition for the store, and is an exciting new product for us," says Mr. Ceurvorst. "This waterborne paint offers excel-



Photo courtesy of U.S. Green Building Council.

lent coverage and is very durable, yet has no formaldehyde, no hazardous metals, no chlorine, no fragrance, and no VOCs. It is also formulated with natural ingredients and exceeds Green Seal certification standards," he explains.

GREEN FORMULATORS

Several paint and coatings companies have developed products specifically designed to meet the standards of these various organizations and to make them more attractive to customers—both commercial and consumer—that are interested in environmentally friendly products. Dunn Edwards Paints offers a *Green Building Guide* as well as an environmentally friendly focus on its Architect/Design Center on www.dunnedwards.com. Benjamin Moore, Cloverdale Paint Inc., Ecology Coatings, Sico Inc., and Southern Diversified Products are highlighted below.

EcoSpec® latex paint by Benjamin Moore is a professional quality, premium interior 100% acrylic paint



system designed for both residential and commercial spaces where environmental concerns about air quality during application are a priority. The product contains no solvents that release VOCs, exhibits virtually no odor during application, has a very short open time, and dries rapidly. This rapid dry allows for a space to be painted and put back into use within two hours after the job is completed. "The quality performance of EcoSpec® paints and its competitive price make it the ideal choice for jobs where environmental concerns exist about conventional paint odor and VOC emissions, and when there is a desire to reduce job site downtime," notes Mr. Spillane. EcoSpec® paints are the first

to meet Green Seal and Greenguard Indoor Air Quality standards, which are based on requirements used by the State of Washington and the U.S. Environmental Protection Agency (EPA).

Additionally, Benjamin Moore has a new line of paint that contains <50 g/l. of VOCs (LEEDS level) that is currently in beta test. The tinting system is also environmentally friendly, according to Mr. Spillane. The company expects to launch the line on the West Coast later this summer.

Cloverdale Paint Inc., British Columbia, Canada, specifically designed its HORIZON brand to meet environmental standards for new construction and major renovations as defined by Green Seal and the LEED "Green Building" rating systems. It includes a full range of interior and exterior primers, sealers, and topcoats in a variety of sheens. The paints also meet Canada's Master Painters Institute Green Performance Standards. Cloverdale is one of the first companies in North America to receive Green Seal certification for both interior and exterior products. The paints have minimum odor and no residual after-smell, are low VOC, and, according to Ms. Voisey, are ideally suited for residential, institutional, and other public buildings where architects and design specifics require products that have less impact on occupants and the environment.

UV-curable, 100% solids, nanoparticle-based technology from Ecology Coatings offers a high performing, environmentally friendly alternative to traditional waterborne and powder coating formulations. Since it was founded in 1990 by Sally Ramsey, the company has developed 200 unique clear and pigmented coating formulations for use on metals, plastics, composites, wood, glass, and paper. "Beyond pioneering an economically viable, market-ready coating technology that drives 99% reductions in time, 75% energy efficiency, minimizes waste, and enables new coatings applications, our initial aim of environmental sustainability remains a key focus," notes Ms. Ramsey.

According to the company, Ecology Coatings formulations offer abrasion-resistance, moisture-resistance, and durability equal or better than that of conventional waterborne, solvent-based, or powder coatings, and superior to any other UV curable coatings available for testing. They can also achieve high degrees of opacity, a characteristic difficult to achieve in a coating that requires light to cure. Emphasis is placed on developing new applications that maximize the potential of the technology. "While presenting clear economic and environmental advantages to the spectrum of conventional

industrial coatings markets, it is the enabling characteristics for emerging technologies that cements the technology's innovative nature," stresses Ms. Ramsey. "For example, Ecology Coatings can be used to apply and carry other nanotechnologies that otherwise agglomerate when suspended in traditional coatings. As a result, we are helping to fulfill the emerging promise of nanotechnology," she adds.

Leading paint companies including DuPont and Red Spot have licensed Ecology Coatings' technology for specific metals applications in North America. The company has also received extensive award recognition for its efforts, including a *Wall Street Journal* Technology Innovator Award,

TIME Magazine's Best Inventions, *Red Herring's* Top 10 Clean Tech Companies to Watch, and was one of five finalists in *Small Times Magazine's* Best of *Small Tech* Innovator Awards—all of which happened in 2005. Most recently, the company was recognized by The World Economic Forum as a 2006 Technology Pioneer.

Currently, Ecology Coatings is developing 100% solids coatings that will cure with visible light. These products have very low emissions and qualify for the de minimis rules from the South Coast Air Quality Management District in California.

Sico, another leading paint manufacturer in Canada, launched its environmentally friendly product Ecosource, a 100% acrylic interior latex paint with zero VOC for commercial and institutional applications, in mid-2005. The virtually odorless product is Green Seal-certified, meets the requirements of the Canada Green Building Council for LEED project certification, offers excellent adherence, provides a highly resistant finish with good hiding power, and is unaffected by freeze/thaw cycles. Ecosource received the 2005 award for "sustainable development innovative product" at the Contech exhibition held in November 2005. The company expects to launch a derivative zero-VOC product for the consumer market before the end of 2006.

Sico shareholders recently accepted an offer by Akzo Nobel to acquire the company for approximately \$209 million (CAN \$295 million, EURO \$267

million). The acquisition will be Akzo Nobel's first entrée into the North American architectural coatings market.

Southern Diversified Products is working closely with The University of Southern Mississippi and key raw material suppliers to develop solvent-free paints with performance that meets or exceeds conventional solvent-containing competitive products. The company's line of American Pride® paints is solvent-free and certified by both Green Seal and The Master

Painters Institute. These products have minimal odor, are completely free of known or suspected carcinogens, and offer outstanding application properties and dried film performance, according to Mr. Prior.

GREEN SUPPLIERS

Several raw material suppliers have made the development of "green" products a key initiative of their R&D groups. Clariant, Hexion Specialty Chemicals, and Reichhold are three such companies.

Clariant Pigments & Additives has launched a variety of products aimed specifically at meeting the growing need for environmentally friendly products. Colaryl® 500 is a low-VOC line of aqueous color dispersions that provides formulators with a whole color range to meet new and developing regulatory requirements in an easy-to-use form, and also helps paint companies improve their production processes, according to Mr. Newell. The company has also developed a large range of "70" series high-opacity organic pigments and further forms of easy-to-disperse pigment preparations. "Clariant is acutely aware of the need to constantly develop new products and services to meet the needs of the paint and coatings industry with respect to environmentally friendly products and has and will continue to respond by providing a multitude of 'green' options and choices," Mr. Newell states.

Hexion's epoxy business is marketing its high-solids and waterborne resin and curing agent technologies to meet the needs of the "green" segment of the coatings market. "Our environmental friendly products under the EPOX™, EPI-REZ™, and EPIKURE™ brand names offer the formulator options to replace their existing systems with compliant resin systems and maintain equivalent performance," says Mr. Woodcock. He adds that Hexion takes a systems approach to developing new products, and is always looking to develop new curing agents and surfactants that will work with the company's broad line of epoxy resins to create new formulas that offer both compliance and performance. Hexion expects to announce shortly a new curing agent using proprietary surfactant technology that can be used directly with liquid epoxy resin to meet the 0-50 g/L VOC limits.

Reichhold's CEO and executive management team have made a firm commitment to reinvest in R&D and technology innovations that provide product advances needed for years to come, according to Dr. Sullivan. These technologies therefore, by definition, include

"green" resins. Examples include URTUF® F97, a waterborne oil-modified urethane that can be formulated to less than 275 g/L VOC for high performance gym floor coatings. This product meets or exceeds the performance of Reichhold's own standard and high-solids solvent-borne urethanes.

Reichhold will soon be launching a new waterborne epoxy curative product based upon the company's patented microgel technology. "Unlike previous waterborne curative technologies, this system offers ease of formulation and excellent corrosion resistance in primer applications," Dr. Sullivan notes. He adds that applied costs can be lower than conventional high solids primers because thinner films can be applied.

The company is also continuing to advance its specialty polyester powder coatings line with high-performance rheology modifiers designed to reduce melt viscosity without reducing glass transition temperature and storage stability.

HOW GREEN WILL THE FUTURE BE?

It appears that the future of paint and coatings will be bright green. "As the market continues to grow and recognize the increasing importance to protect and optimize resources, employees, and consumers, so the demands on the coatings industry continue to grow—that's always the challenge but, at the same time, our future opportunity," notes Mr. Newell. Mr. Woodcock cautions, though, that while there is a positive trend in the future, the brightness may be tempered by the fact that users will still demand equivalent performance at the same price.

Ms. Ramsey agrees that "environmentally friendly paints and coatings are unlikely to sell on that basis alone, with the exception of some areas in California. They must provide enhanced performance and energy savings as well. They will sell when they provide a suitable economic incentive for manufacturers to make the switch." She does add, though, that "if environmentally friendly coatings can stand on their own as superior technology, the future will be very bright."

"I am excited about the future of our industry," Mr. Prior emphasizes. "We are still in the infancy of this movement so there are still many significant advances and breakthroughs ahead. Companies that remain nimble and aggressively seek out new technologies have a tremendous opportunity to maintain and grow market share. ☐"