Sustainable Coatings I:

The 'Greening' of Industry Products and Practices

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Since sustainability was first defined in 1987 by the Brundtland commission as "development that meets present needs without compromising the ability of future generations to meet their own needs," it has become increasingly apparent that society as a whole faces a significant challenge in managing consumption of resources. All facets of the coatings industry have accepted that challenge and are working to develop new products and processes that better utilize those resources. In doing so, new definitions of sustainability have emerged that fit the activities of the coatings industry and enable individual companies to set specific and attainable goals.

Many have determined that integrating sustainability initiatives throughout their operations is necessary for maintaining and potentially increasing their competitiveness. For example, striving to deliver unique solutions to pressing social and environmental challenges has become an increasingly important driver of profitable growth and the reputation of Air Products and Chemicals, according to Epoxy Additives market manager, Matthew Engel. "It's not just managing risk or protecting reputation, but also building community goodwill, improving employee morale, and attracting investment," he stresses. "Overall, sustainability is a strategic model for profitability and good citizenship."

For Cytec Industries, sustainability is defined as "living our values in a changing world." This approach is manifested in many different ways in the company. "Development of innovative and environmentally sustainable products that compete in a global economy; achieving the highest standards of safety, health, and environmental stewardship; and being responsible to our customers, our employees, and our shareholders and other stakeholders are fundamental activities at Cytec," says vice president of Safety, Health & Environment, Karen Koster.

This article is the first in an ongoing series focused on sustainability issues in the coatings industry.

Innovation, indeed, is central to the success of a sustainable company. For Cognis, innovation is at the heart of its sustainability initiatives. "Sustainability for us is defined in terms of little compromise in performance with innovations that encompass sensitivities to ecology and that enhance and enable good corporate citizenship," remarks Dr. Vasu Bala, technical director of Functional Products for Cognis' NAFTA Polymers, Coatings, Inks, Agrochemicals & Compounded Lubricants business.

Like others, Rohm and Haas has been committed to improving sustainability efforts for years, with initial efforts led by its Environmental, Health, and Safety Division and then its Manufacturing and Procurement groups. In 2008, the company decided to do more, and turned to The Natural Step, an international, not-for-profit research, education, and advisory organization that helps companies identify a science based approach to sustainability and provides tools to make decisions in a sustainable way.

"We worked closely with The Natural Step to define better what sustainability means for us—create more detailed definitions and to closely align business objectives and sustainability," explains Luis Fernandez, vice president and business group director for Rohm and Haas' Paint and Coatings Technology operations.

The company's overall objectives remain to slow the depletion of natural resources while at the same time increasing efficient use of the raw materials it does consume. "The end result improves the quality of life—and it also supports the need for a company to continue to make a profit, so that it can reinvest in products and services that are even more sustainable in the future," he notes.

"Sustainability is a core belief that balances the development of eco-efficient products, economic growth, environmental protection, and social responsibility," agrees Thierry Chevrier, director of BASF's Performance Chemicals–Coatings Pigments and Plastic Chemicals business in North America.

BASF has developed an eco-efficiency analysis 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, according to Chevrier. "The objective is to offer the best possible cost effective products with good environmental performance." The company's efforts have been noticed; BASF is the leading chemical company on the Dow Jones Sustainability Index.

For the coatings industry, many BASF products and manufacturing sites are focused on cost-effective alternatives to lead-based pigments, like its Paliotan® portfolio. The company has also been focused on specific solutions for needs such as low to zero VOC coatings such as its Xfast® dry stir-in pigments and ILJOptions® pigment dispersions that are APEO free and very low VOC. Another example is BASF's Lumogen® heat management technology, which includes both infrared (IR) reflective and IR transparent pigments.

Evonik Degussa also focuses on offering more sustainable colorant technology for the coatings industry. "One of the green initiatives of the PL Colorants business is to contribute to our customers' sustainability by providing environmentally-friendly, no-VOC colorants in sustainable plastic packaging," notes Britt Nordby, director of High Performance Colorants Marketing for Coatings and Additives.

The company recently introduced VOC- and APEO-free, low-odor Colortrend® 808 products specifically formulated for use in volumetric color dispensing for retail (point-of sale) applications. Like previous offerings, these colorants can be used in conjunction with custom-designed color systems that are currently matched with the company's traditional 888 colorants.

Colortrend 870 in-plant architectural colorants from Evonik Degussa allow color matching between in-plant tinted coatings and paints tinted at the retail store, enabling the paint manufacturer, and ultimately the paint dealer, to more easily provide consumers with truly environmentally friendly paint. "These innovations demonstrate our continued commitment to sustainability and to our customers by providing superior products that meet their market needs," assures Nordby.

AkzoNobel has also evaluated its product portfolio in terms of eco-efficiency, which it defines as creating more value with less environmental impact. Products were identified that are contributing to more eco-efficient solutions than commercially available alternatives that fulfill the same function and have a dominant market share. The eco-efficiency of a product can originate from any phase of the value chain: from extraction of natural resources to manufacturing, end-use, and waste management.

Currently, 18% of AkzoNobel's revenue is derived from products that it has classified as eco-efficient. By 2015, the company plans to have 30% of its revenue generated by eco-premium solutions. AkzoNobel is also introducing a carbon reduction program, increasing efforts to reduce the VOC content of its products, and working toward 100% sustainable water use and zero waste through operational efficiency.

To define opportunities and make recommendations on activities where it can have the greatest impact, Air Products recently founded a Sustainability Council made up of senior executives and subject matter experts and led by the vice president of Strategy Planning. Two

of Air Products' latest product offerings are good examples of sustainable innovations for the coatings industry.

Both are water based. Anquamine® 721 and 731 are zero-VOC, low-odor epoxy curing agents that allow formulators of flooring and concrete coatings to use less binder and more filler, thus providing cost savings while still offering excellent performance characteristics in terms of adhesion, rapid hardness development, and ease of handling. Also zero VOC, Air Products' Ancarez™ AR555 waterborne epoxy resin provides enhanced coalescing for uniform film formation and fast-dry properties for increased productivity. It also has anticorrosive attributes, and thus is good for protective coatings. The company also recommends its use in floor, institutional, and general OEM coating formulations.

Cognis has been practicing sustainability for many years. The company's major focus is on the development of innovations that use starting raw materials derived from sustainable sources such as vegetable oils. "We have been quite successful at commercializing polymer building blocks or reactive monomers, resins, and functional additives (surfactants, fatty acid esters, water-based epoxies, biobased polyols, rheology modifiers, and coalescents) that have found use in a variety of coating applications," says Bala.

Specific products from Cognis that are based on renewable resources, possess a low- to zero-VOC profile, and require the minimal use of harmful chemicals include Photomer® acrylate oligomers and monomers, Versamid® and Genamid® polyamide resins, Sovermol® biobased polyols, Waterpoxy® water-based epoxy systems, Disponil® surfactants, Loxanol® coalescents, Texaprint® fatty acid esters, and Rilanit® thickeners.

Cytec's sustainability strategy is linked with its business strategy, operations, and research programs. The company has both short- and long-term goals for improvement in its environmental performance, and has significantly reduced its environmental footprint over the years, according to Koster. More recently, Cytec has focused on designing more environmentally friendly products and has invested in technology for environmentally friendly resins for coatings. "It is our intent to be a leader in the development of environmentally friendly coatings," she asserts.

Specific products from Cytec designed for such applications include its new Resydrol® AY 588 and Resydrol AY 6150 low-VOC waterborne resins for trim and protective enamels; new UV curable Ebecryl® Bioligomer resins that are based on renewable content; and surfactants for APE-free emulsion polymers. The company has also made a commitment to reduce energy use, CO_2 emissions, and waste at its operating sites. For example, its Kalamazoo, MI, plant, where coatings resins are produced, achieved a reduction of over 1200 MT of CO_2 emissions.

Rohm and Haas has implemented extensive sustainability programs throughout its operations and has developed several new products as well. For European Union customers, its Hydrotech ™ technology offers a high-performance, environmentally advanced water based binder option for low-VOC decorative gloss coatings that is in compliance with REACH requirements and VOC regulations that take effect in 2010.

For the Chinese market, Rohm and Haas has introduced TianBa™ 2000 and Primal™ EZ-100. TianBa 2000 is a low-odor, low-VOC flexible acrylic co-polymer designed for China's building and construction market. Primal EZ-100 is a first generation stain beading technology designed for the growing premium interior wall paint segment in Asia.

Rhoplex™ VSR 2015 is an APEO-free, low-odor, low-VOC 100% acrylic solvent-free coating for interior and exterior flat to semi-gloss coatings that offers low-temperature film formation. Dirtshield™ 08 is a 100% acrylic binder that requires significantly reduced use of high cost coalescents. The proprietary surface crosslinking technology provides excellent dirt pick-up in exterior applications.

Rohm and Haas has also been active in reducing the energy intensity and water use of its global coatings manufacturing operations. Energy intensity has declined by 29% as measured in BTUs per pound of prod-

net, saving the company $22 million and resulting in 250,000 fewer tons of greenhouse gas emissions. In 2008 alone, the company lowered its water consumption (measured per pound of emulsion produced) by 2%. Specific activities include replacing water scrubbers with natural gas thermal oxidizers and finding innovative ways to recapture and recycle product left in tanks and lines rather than flushing with water.

Dow Corning has a similar approach to improving the sustainability of its manufacturing operations. Throughout its various plant sites, the company has focused on recycling and reuse of materials combined with implementation of more efficient systems. At its Midland, MI, site, it invested $50 million in a thermal oxidizer (designed by Dow Corning) and a plasma based waste processing system from Integrated Environmental Technologies that separates manufacturing waste into two parts that are then recycled into a raw material and a synthetic gas. Steam produced by the thermal oxidizer will be used as process heat, therefore decreasing consumption of natural gas.

The company has eliminated or reduced waste production at various sites as well. For example, at its Seneffe, Belgium, plant, the ratio of process scraps to finished goods for the emulsions and antifoams production units in Seneffe was successfully reduced from 4.2% to 0.8%, which represents a decrease of 650 tons of waste volume per year.

As can be seen in the activities of Rohm and Haas and Dow Corning, it is apparent that sustainability programs are taking place across the globe. Australia is no exception. Dulux Powder Coatings and CSIRO (Commonwealth Scientific and Industrial Research Organization) have developed a VOC-free, very low waste powder coating system for heat-sensitive materials such as plastics, composites, and MDF as a replacement for wet paints.

CSIRO achieved surface conductivity by coating the plastic components with a nano-thin layer of specialty multifunctional molecules that provide surface conductivity, and which simultaneously promote the ability of the powder coating to stick well to plastic components. Dulux Powder Coatings developed new generation powder coatings that could be cured at much lower temperatures and for much shorter times than traditional powders.

"We are very pleased with this new system," says Dulux's technical manager, Siew Fong Cheong. "The technology generates minimal waste, minimizes the release of harmful chemicals to the environment, and delivers significant cost savings in terms of electricity consumption and greenhouse gas emissions."

The new powder coating system has been successfully trialed in the Australian state of Victoria, and is now being customized for coating automotive plastics. Dulux Powder Coatings and CSIRO won the 2008 Banksia Eco Innovation Award from the Banksia Environmental Foundation. The Banksia Awards are considered the most prestigious environmental awards in Australia. They recognize outstanding environmental achievements by businesses, government, and individuals.

The examples discussed here clearly demonstrate that the coatings sector has made significant progress on its journey to becoming a truly sustainable industry. There is much to be done yet, though. "As an industry, we are only beginning to embrace sustainability," Bala notes. Governments and retailers are beginning to provide guidelines and mandates, which can both offer incentives and create challenges.

"The coatings industry is already well on the path to improving sustainability, but this is a complex, multifaceted, and evolving journey we are on," Fernandez comments. "Just consider the complexities of different regulations and governing bodies in place around the world—all are attempting to do what's best for their people, and all with slightly different points of emphasis and regulatory policies. Each requires special attention and adaptation of our processes or information sharing in order to ensure compliance."

The current financial crisis and economic slowdown must also be addressed. "The coatings industry, like most industries linked to the demand for durable goods, will be facing challenges associated with reduced demand and competition from developing markets," states Koster. "Companies that are offering sustainable products will be challenged to sell the 'value add' associated with the products. Customers do not always want to pay a premium for products that offer improved environmental health and safety benefits. Therefore, the industry must offer sustainable products that also provide a competitive advantage to their customers."

"We are at a tipping point," Fernandez believes. "Chemists and chemistry are the key to finding the new formulations for new paints. The alignment across consumer demand, the industry's technical capabilities, and the ability to profitably make environmentally advanced paint ingredients is nearly in place."

Ultimately, taking a sustainable approach to business is necessary for the future survival of the coatings industry. "Meeting business needs and helping protect the environment are not mutually exclusive," claims Chevrier. "BASF and other suppliers to the coatings sector, as well as coatings formulators themselves, must offer the ingredients, chemistry, and know-how to develop new, sustainable products that help our customers to be more successful." CT