Green is the New Normal

An Open Book for Closed Molding

Composites Taking on Tradition

Styrene Watch: New Research on Styrene Safety
Green is the New Normal
Eco-friendly composites firms used to be novel. Today, they’re necessary as the marketplace seeks companies with green initiatives. That trend has made recycling a key strategy — and a head-scratching challenge — for the composites industry. By Darin Painter

An Open Book on Closed Molding
Composites manufacturers are switching from open to closed molding and discovering the benefits and challenges of the new process. Here, three companies across the market share their experiences, decision-making processes and opinions on open versus closed molding. By Jamie Hartford

Taking on Tradition
Despite the delay in government funding, which is pivotal in transportation infrastructure growth, and civil engineers’ resistance to step away from the usual suspects of concrete and steel, composites companies are making inroads across North America. By Susan Keen Flynn

Styrene Watch
At the recent meeting of the Society of Toxicology in Washington, D.C., toxicologists presented new styrene study results based on the latest research—relying on techniques that won the Nobel Prize in physiology and medicine in 2007—that uses genetically modified mice to test styrene’s potential carcinogenicity. By Richard Stewart

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Correction: In the March/April issue of CM, the University of Dayton Research Institute was incorrectly abbreviated as URDI in the article “Collaboration Brings Big Benefits to Aerospace”. The correct abbreviation should be UDRI.
Reevaluate and Reinvent Your Business

This is my last President’s Message before the July 1 leadership changeover, and I want to share with you my thoughts on the events and activities we have all experienced over the course of my presidency as well as on business opportunities and the challenges we face going forward.

Over the course of the past three years all of our businesses were adversely affected in one manner or another by the downturn in our economy. Although this Great Recession has been painful to our industry, it also served as a forcing function to reawaken us to focus on the essential elements of our businesses that make us successful—we had to do it to survive. At Alaglass Pools we, like many of you, significantly reduced the number of employees in our company to meet reductions in revenue. Along the way we re-focused our energy, time, and money on those critical success factors that would ensure our survival and position us for growth when the economy began to recover. As a result, today we get more meaningful work done in a shorter period of time with fewer folks. I think the lesson from these past few years is quite simple: we should never take for granted the successes we think we have, because they can disappear quickly. We should constantly reevaluate and reinvent our businesses so we are prepared to meet and overcome any future adverse changes in the business environment.

With the Great Recession slowly disappearing behind us, we can more fully look forward to a resurgence in our businesses and industry. COMPOSITES 2011 was a great success, with nearly 3,000 participants representing over 47 countries. Folks were upbeat about the future and excited about moving forward once again. With newer and better manufacturing technologies, we’re now able to provide higher quality, cost effective and environmentally compatible products. This is not only enhancing our presence in current markets but also opening new markets, thus providing significant opportunities and the challenges we face going forward.

As the composites industry evolves and matures, we will continually be tasked by both government and private environmental entities to be responsible industry participants in the way we manufacture our products. This creates a significant challenge for each of us, our industry, and our association. These challenges will not disappear. To be a viable business participant in current and new markets, we must strive to do what we do better, quicker, and cleaner.

As your association president for the past two years, I want to thank you for the trust and confidence you conveyed to me. It has been a great ride and any success can only be attributed to all of you who either individually helped me along the way, participated on committees, or served on the Board of Directors. Also, a particular note of thanks to Tom Dobbins and the ACMA staff, who continually provide all of us—and the industry—with the highest level of professional support and dedication.
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Eco-efficiency is the major driver for advances in automotive today. The problem: OEMs and suppliers each work on solutions in secrecy, rather than collaborating in the quest for lower emissions, a smaller carbon footprint over a car’s lifecycle and lower system cost. It’s not exactly a race either, up to 15 years can go by before a new material is commercialized. What’s pushing the ponderous automotive industry forward regardless are governmental regulations and legislations, impending eco taxes on the carbon footprint of a vehicle and shifting consumer preferences toward greener cars. Here is a look at one supplier and manufacturer’s latest solutions to cope with these pressures.

**Why every future advanced-technology vehicle will hinge on composites**

Weight is detrimental to high efficiency and metal is heavy. That’s why producing future cars aims at engine downsizing, but also making any auto part lighter. Apart from friction reduction and electrification of car components, the automotive industry currently focuses on weight reduction to save fuel and lower emissions, mainly through metal-to-composite conversions close to the engine or in body panels. Netherlands-based materials supplier DSM Engineering Plastics, for instance, attempts to outpace the automotive industry by offering manufacturers advanced bio-based resins that reduce production cost with reduced injection molding cycle times. “If it doesn’t also bring a cost advantage, the automotive industry doesn’t switch from metal to composites,” says Bert Havenith, business and innovation manager for automotive at DSM.

DSM is now commercializing a high-performance polyamide (PA) that is 100 percent carbon-neutral from cradle to gate. He foresees automakers will focus on using greener materials in their next generation of greener cars to keep the carbon footprint down. It’s also important not to compete with the food chain in making these bio-grade materials. “Small farmers in India and China grow the castor bean plant on very poor soil where no other plant could survive, making it a win-win for all manufacturers,” he says.

**CFRP: From the Lexus LFA to every car tomorrow**

Investing a decade of in-house R&D in building 500 supercars isn’t the most obvious way of proving to be an eco-conscious, productive automotive company. But that’s exactly what Toyota did. “With a total production run of 500 units, it’s not a big money-maker,” admits Paul Williamsen, national manager, Lexus College, who trains associates who will be selling Toyota’s $375,000 all-composite supercar. “The primary reason is simply for the sake of doing it. We challenged our engineers:

*Continues on page 31*
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Marine Composite Groundbreaker Says Future Bright for Composites

J. Frank Crane, of JFCI Composites Group, in Ft. Lauderdale, Fla., and his partner, Jim Gardiner, general manager of Compmillennia LLC, in Washington, N.C., made history in 2009 with the construction of one of the world’s biggest gigayachts: the Swift 141.

The two men are now moving forward with other innovative ideas. With the boat building industry floating on skinny margins, and the second Swift retrofit project -- the Swift 135 -- on hold for now, Crane and Gardiner are aiming to rise above the water by delving into composite-bridge manufacturing. Both are preparing to pitch municipalities, real estate developers, and even foreign governments on the benefits of low-maintenance composite bridges.

“A couple of realtors caught my ear when they said they could sell property if they could get across the ditch,” says Crane. “These bridges are light and easy to handle. You can build a composite bridge in a couple of weeks, drag it with a trailer on wheels, and use a small hydraulic crane that can lift 40x tons. They would last a hundred years.”

Although traditional bridge materials are still the norm, Crane thinks maintenance issues will tip the balance in favor of composites, particularly for small bridges. “By the fifth year, when they are doing repairs on bridges made from traditional materials you’re not doing repairs.” It’s also an ideal solution for bridging small streams and rivers in Central America, he says.

Crane also envisions working in architectural applications. “There are lots of old buildings all over the world – lovely things to be saved – and composites make strong, suitable materials for rebuilding and restoring structural integrity. You can build hurricane- and earthquake-proof homes with composites. Not to mention the fact that the International Building Code (IBC) recently added use of composites.”

For Crane, one of his biggest accomplishments is demonstrated in the unique perspective he brought to the job of constructing one of the

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world’s biggest gigayachts: the Swift 141. Completed for the United Arab Emirates (UAE), the retrofitting of a Royal Netherlands Navy frigate was commissioned to further the UAE’s aspirations of developing world-class yacht construction.

Before embarking on such a monumental task, Crane first viewed it in microcosm, developing a small-scale model of the project. “I’m a very methodical person, and I think things through completely. Then, I turn that concept into a schedule and the management of the program,” says Crane, who confidently took on a composite-based maritime project beyond what had ever been done before. He says his methodical nature is why “I could say ‘yes’ right away and figure out the problems later,” he says.

Rich in long-term industry associations, Crane has a knack for knowing and recruiting the best in the business. He credits his 35-year-long friendship with Johan Valentijn, who was the Swift 141 project manager, for his commission to lead that project. “My strength is that I know how to find the connections—the people to do the job,” Crane says. Valentijn’s yacht designs have been showcased in several America’s Cup race boats and many other successful large yacht projects.

Since Crane had worked for many years with Gardiner, he knew he would be up to the challenge of building heated molds up to 120-feet long for the project, and Gardiner soon developed an innovative approach. Working together, the two quickly improvised the technology to create the large molds needed for the project. Drawing inspiration from radiant floor heating, the two built a temperature-controlled mold table 20-feet wide by 80-feet long, with individually controlled heat settings for each 10-foot section.

“Initially, we met on the 1st of September, and by the end of October we were building the first molds at Vector-works Marine, which were 30 to 35-meters long. “We were very creative,” says Crane. “Comp-
Vectorworks built 13 large individual molds and parts, and individual molds for the support frames for their large sections, so they could be laminated concurrently.”

Crane credits the project’s team for the success of the monumental endeavor. In addition to Gardiner, team members included: Bill Kullengusky, the head of engineering at Vectorworks Marine, who assisted with the 3D model, and made the geometry machine ready; Kurt Hopf, general manager of Vectorworks Marine, which has one of the largest 5-axis milling machines in the world; and Mark Bishop and Brian Climenhaga, of Waterfront Composite Solutions LLC, in Fairfield, Calif., who were responsible for the composite engineering and coordinating the design effort.

Two companies built composite parts for the Swift 141, says Crane. Compmillennia made a large part of the internal and external structure. This was like an egg crate that supported the external shell parts, which were built by Vectorworks Marine, LLC, in Titusville, Fla., in large molds the company fabricated, utilizing a 5-axis router. These parts were individually much larger, up to 15x20x120 feet, but were post-cured in the mold over months at ambient temperature.

Compmillennia’s parts were fabricated in days, and required post-curing at 125 F for 15 hours so that their flat table mold and carbon beam molds could be cycled, often two or three times per week, says Crane. “Brian was fabulous. He completely understood the project, and turned it around quickly,” says Crane. “I also had a large-scale training program (for the fabrication crew) with Belle Blanding, a composite consultant, to ensure consistent results without problems.”

As the gigayacht and other recent projects demonstrate, Crane and Gardiner have great accomplishments and look forward to more. “I just like to help push forward some new ideas, and provide good quality jobs for a lot of people,” says Crane. “The future is bright.”

Jan Fletcher is a freelance writer based in Spokane, Washington.
Composites Buoy Up Renewable Energy

The world’s oceans hold the potential for producing at least 2 terawatts of electricity—a little over 10 percent of the world’s energy consumption. The Pacific coast of the U.S. is one the prime locations for wave-based power generation, which has led to several research efforts aimed at harnessing the potential. Columbia Power Technologies (CPT) teamed up with Oregon State University and Ershigs, Inc., a fiberglass-reinforced plastics manufacturer, to develop a buoy—a wave energy converter code-named Manta—that can generate an average of 400 kilowatts of electricity.

Once constructed to utility scale, the buoy will have two, 18-meter long wings, each attached to a central shaft within a single nacelle measuring 9 meters in diameter and 16 meters high. The wings react to the shape and amplitude of passing ocean swells and transfer rotational energy to each central shaft. The rotation of each central shaft drives dedicated rotary generators. As each wing moves up and down, it generates electricity, which is then transmitted to the electrical grid on shore.

The body components in the Manta are made out of fiber-reinforced plastic, which provides the strength and corrosion-resistance necessary for use in the ocean. “A composite approach to the Manta will have distinct corrosion advantages over metallic alternatives for long term seawater service,” says Steve Hettick, vice president of manufacturing at Ershigs.

Several manufacturing processes are to be used in making the Manta components, including filament winding, contact molding, and vacuum infusion methods. Ershigs specializes in the filament winding of large diameter cylindrical structures. According to Hettick, the company worked with Columbia Power to optimize various buoy components in order to reduce manufacturing complexity. Columbia Power then ran extensive wave modeling simulations to ensure power-generating capacity was maintained with the most efficient manufacturing configurations. The Manta is being designed to withstand waves associated with 100-year storm events, says
Hettick. When tested in the Oregon State University wave tank at scaled sizes, prototype wave energy converters survived the stresses created by such a storm event, and performed well.

Wave-generated power offers several advantages over other forms of renewable energy, according to experts at Columbia Power. Wave-power farms, can produce more power on smaller footprints than photovoltaic, solar thermal, or wind farms. Finally, the generating capacity of waves can be predicted several days in advance with a high degree of accuracy using satellite imagery and offshore weather buoys allowing wave farms to be scheduled like a base load.

A 1/7th-scale prototype, code named SeaRay, is currently being tested in the water near Seattle; the sea test should be complete by summer of 2011. According to Hettick, a full-scale design will be complete by the end of 2011 and the buoy will be tested and confirmed available for utility grid connection in 2012 and 2013, then available for sale.

According to Columbia Power, working with Ershigs was a natural choice since the firm is located in Bellingham, Washington, and capable of manufacturing large buoy components close to where they will be deployed. “We were very pleased Columbia Power chose to pursue a composite approach to this wave energy concept and we are excited to lend our composite design and large scale fabrication experience to help it succeed into commercialization,” says Hettick. In addition, the company’s scope was to provide mechanical engineering and marine design services as well as composite manufacturing expertise, Hettick notes.

Tom Pilcher, president of Ershigs, notes that collaborations like this one with Columbia Power are helping his company expand into new markets. “Ershigs has been very strong in the power market,” Pilcher says, “because we specialize in onsite fabrication of very large cylindrical components like chimney liners for smokestacks at coal-fired power plants.” But traditional power markets will likely dry up over time, says Pilcher, so the company has started investing in alternative energy projects and clean water technology.

Partnering with existing companies allows Ershigs to also expand its expertise. “We don’t pretend to have the marketing and sales presence to jump into markets that we don’t already have a presence in,” says Pilcher. “So we find partners in each new industry and invest in the company in exchange for the opportunity to apply composite solutions to their concepts.”

In addition to its work with CPT, Ershigs is producing micro-turbines designed to turn water flow in irrigation ditches into electricity. The key, says Pilcher, is to diversify. “We’re investing in a lot of different technologies.” The company is also working with researchers in Ohio to develop composite towers for large-scale wind turbines. As turbines have gotten larger, says Pilcher, transporting the metal towers that hold them from distant manufacturing facilities has gotten more difficult.

Allyson Wendt is a freelance writer based in Brattleboro, Vt.
University Advances Composites in Aircraft Manufacturing

In an era of outsourcing, one university says it’s seeing a return of some manufacturers who had previously moved manufacturing plants overseas because they want to take advantage of higher quality processes and expertise than what they can find overseas. This is especially the case in the use of high-level information technology and robotics in the manufacturing process.

Wichita State University (WSU) began planning its Center of Innovation and Enterprise Engagement three and a half years ago to assist firms gain access to research facilities and laboratories to bring improved products and processes to market.

The University’s aeronautical engineering department has a long research history with aircraft manufacturers in Wichita – dubbed the Air Capital City. A Workforce Innovation Regional Economic Development Grant from the U.S. Department of Labor funded the center which aims to show smaller area manufacturers how to transform their manufacturing process from legacy materials, such as aluminum for aircraft, to a variety of composites.

Composites are not new to the aviation industry; one of the first uses of composites in aircraft manufacturing dates to the 1980s with Beech Aircraft’s Starship 1. While the aircraft was not commercially successful, it showed the industry how lighter and stronger composites were an advance over traditional aviation materials.

The Nanocomposites and Biocomposites Laboratory, one of 12 research sectors in the aeronautical engineering department, employs 13 graduate students and one undergrad and works with such companies as Spirit AeroSystems, Hawker Beechcraft, Bombardier-Learjet, Boeing and Cessna, as well as NASA, the Office of Naval Research, the Air Force Office of Scientific Research, the Department of Energy and the state of Kansas.

Debra Franklin, who operates the center, says it takes a customized approach in working with firms and how each would like to integrate aramid, carbon and fiberglass composites into their products. “We are also experimenting with new composite materials,” Toro-Ramos said. “Depending upon the needs of some sectors that we have identified, we are trying to come up with new composite materials for different industries.”

Franklin said information about new materials is being closely held until research is further along.

Small and medium-size manufacturers often lack the research and development departments of the larger companies, said WSU Engineering Dean Zulma Toro-Ramos. These companies are part of the supply chain that the larger manufacturers rely on for parts and sub-assemblies.

“They come to us with a problem or with a goal of finding out if they can move toward these additional products from composites,” Toro-Ramos says. “Some of them do not have any idea as to what the requirements are to add composites to their product mix.”

WSU takes a customized approach in helping firms integrate composites into their products.
realistically, a seven to ten year time frame is more likely.

Besides aviation, the center also works with the biomedical and wind energy industries in their adoption of composite materials. Wind energy offers a large potential for composite growth, she said, especially with blade assemblies.

As wind generators age, changing a blade that has failed because of stress from flexing is difficult because the three-bladed assemblies need to be in balance to reduce stress on the structures, and changing all three blades is costly.

Ken Starcher, assistant director of Alternative Energy Institute at West Texas A&M University, said the conventional blade is fiberglass and balsa wood laminate with a honeycomb structure.

At the standard height for towers (105 meters) those blades sustain bends and twists that, in the worst circumstances, can cause delamination. Because carbon fiber composites are stronger and lighter, they offer the possibility of being more durable and longer, Starcher says. Lighter blades would also have the bonus of placing less stress on the tower structures and on the massive gearboxes that convert the wind energy to electricity, which would reduce their maintenance costs.

Adding just 2 percent to the length of a wind turbine blade is enough to increase the amount of power generated, Starcher said.

Public utilities are also looking into composites for certain structures, Toro-Ramos says, and economic development programs are urging the use of composites in the construction industry. And while Wichita State has not yet committed to research of composites in construction, the center is considering studying composites for use in walls and building infrastructure.

Over the next five to 10 years, Toro-Ramos says she expects to see additional integration of biomedical composites within the medical industry. Life-cycle analysis is part of the research to determine the useful life of composites.

“These are the big research questions,” Toro-Ramos said, “but underneath each one of these are additional research questions that have to do with different applications.”

Greg Rohloff is a freelance writer based in Amarillo, Texas.
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Julie Keith walks by several large containers that hold junk — carbon fiber composite scrap that was rejected during the start-up manufacturing process at Crane Composites. When she looks into the bins, however, she sees more than debris. She sees opportunity.

Last year, about 240,000 square feet of product produced by Crane Composites was lost due to start-up scrap and inefficiencies at the Channahon, Ill.-based company. That amounted to 84,000 pounds — 42 tons of a problem — headed for the landfill.

Like many other industry manufacturers aiming to become more “green,” Crane Composites faces a weighty challenge: How can it reduce waste and recycle it more effectively, engage employees to embrace eco-friendly objectives, and communicate the value of the firm’s green products and processes to clients and prospects?

Unlike some industry peers, Keith and her team have a plan. In 2008, they began tracking data needed to estimate how much money Crane Composites could save by becoming more energy-efficient and environmentally friendly. “We decided that to really make an impact on the environment as well as on our company, we needed to take green into account in every decision we made — it wouldn’t be enough to recycle more effectively or get rid of manufacturing scrap,” says Keith, the company’s vice president of customer care. “We needed a roadmap
that would affect every part of the business.”

To that end, the firm launched an ongoing, companywide training program called kaizen (pronounced “kai-zen” — Japanese for “improvement”). By improving standardized activities and processes, kaizen aims to eliminate waste through lean manufacturing. It also aims to humanize the workplace, nixing overly hard work and automating repetitive tasks that lead to unproductive time. Unlike Six Sigma or ISO quality training, which generally take a long time to complete, kaizen “events” are typically weeklong and address a particular issue.

“We move in small steps, aiming to fix one topic at a time,” Keith said. “It proved to us the value of progressing methodically instead of trying to solve all environmental footprint issues at once.”

For example, consider what Keith calls the “start-up reject scrap” problem. A team at Crane Composites organized an “impact/difficulty” matrix to determine what specific scrap problems it should tackle, and then spent a week analyzing ways to optimize scheduling and remove steps from the start-up process on a specific machine. That single kaizen event yielded a 25 percent improvement in efficiency, and will reduce the firm’s landfill waste by at least 10 tons this year, Keith says.

Crane Composites is proving that green practices are good for the pocketbook, not just the planet. By 2012, the manufacturer will have saved $1.8 million from its recycling and other environmental initiatives, Keith says. The company has already reduced VOC emissions by 95 percent and scrap by 36 percent since 2008. Keith says the company is also enjoying a byproduct of its green processes — better employee engagement. The firm recently created an intranet site to communicate its environmental activities to employees and gain their feedback, and all workers must sign an environmental commitment policy annually. Also, new and existing vendors are encouraged to commit to sustainable packaging procedures and other eco-friendly efforts. “There are plenty of practical ways for a company of any size to do what’s right for the environment while also saving money and building a better culture,” Keith says. “The key is to develop a roadmap, establish goals that can be measured, tackle projects and celebrate your success.”

**Not Just a Passing Fad**

Recycling continues to be an important issue worldwide among manufacturers, and the composites industry is no different. About 6.6 million pounds of carbon fiber composite scrap is generated annually in the United States and Europe, according to industry estimates. What can the industry do with all that so-called “black junk”?

Also, where will composite products such as wind blades go in about 20 years, when their life use ends? And what can industry firms say to architects and designers who want details — and data — about green practices? (See “5 Questions Your Next Prospect Might Ask” on p. 18)

“Many composite manufacturers believe that composites last forever. This is entirely true, and definitely part of the problem,” says Ed Pilpel, president of Polystrand, based in Montrose, Colo. “Boats, wind blades, automobile components, piping and many other composite products have defined lives. But then what do we do with them? We can’t just walk away.”

This is especially true today, when prospective clients are more apt than ever to shift their purchase decisions toward eco-friendly companies. According to a study of 5,600 consumers in nine countries recently released by Edelman, 85 percent of consumers are willing to change the brands they buy or their consumption habits to make tomorrow’s world a better place.

The European business community is ahead of the United States, as regulatory bodies enact regulations about the use and recycling of all manufacturing materials. In the United States, corporate stalwarts such as Wal-Mart, Procter & Gamble, Time Incorporated and NewsCorp are pressing their supply chains to reduce their carbon footprints and reconfigure their products and services to better measure, manage, report, verify and continuously improve their sustainability.

The recycle-now trend has become a stark reality for many composites firms. When bidding on jobs today, some companies are asked to explain their sustainability accomplishments, including reductions in natural gas and electricity use, use of organic and recycled materials, compliance with state and federal regulations, and certifications from environmental groups.

“There has been a notable increase in recycling awareness for both consumers and manufacturers,” says Bob Moffit, product manager at Ashland Performance Materials, Dublin, Ohio. While some segments of the
company’s client base has been interested in recycling for decades, he says, the turning point for Ashland occurred in late 2007 and through the first half of 2008. “We saw significant tightness and cost escalation in both the petroleum and food markets. Consumers and manufacturers increased awareness of the need for more sustainable practices, and the interest held relatively strong during the recession. The shift to more sustainable products and practices is not just a passing fad.”

With heightened interest in sustainability and LEED (Leadership in Energy and Environmental Design) certification from the U.S. Green Building Council, more builders are looking beyond traditional materials for green alternatives, Moffit says. That’s one reason Ashland developed CompositeBuild.com, a website where architects, designers and builders can learn about composite materials and connect with composite material fabricators and distributors.

Moffit and Keith agree that green composites manufacturers have a significant marketing and branding advantage, and that a sliver lining in the recycling challenge is that firms can save money and make money if they do it right. “It makes sense to take advantage of the monetary incentive to recycle, whether it is getting paid for your used packaging materials or for raw materials that can be reused by others,” says Keith.

Success on One Front, Snags on Another

Composites manufacturers are addressing the recycling challenge on two main fronts — recycling of product during manufacturing (the industry is making strides) and end-of-life recycling (the industry is scratching its head).

Firms such as Crane Composites, Polystrand, Ashland and others have found ways to reduce waste and become leaner. Polystrand produces thermoplastic materials that can be shredded, chopped and made into pellets which can then be compression molded, injection molded or extruded into composite components. “We are presently looking at several processes to implement this concept, and there are government-funded efforts studying the recycling of thermoplastic composites,” Pilpel says. Polystrand is working with several manufacturers, OEMs, molders, reprocessing firms and customers to develop a cost-effective method to recycle its thermoplastic composite materials. “Our overall goal is to see our materials gain a minimum of two or more lives before they are disposed,” he says.

To help communicate its recycling mission to employees, Polystrand recently joined forces with the University of Maine to produce a green video that details several issues associated with recycling. Polystrand is also conducting weekly teaching sessions for all employees about the importance of following green practices, among other topics.

At Ashland, a team is continuing to identify “quality recycle streams” that enable the company to incorporate recycled materials into its Envirez line of polyester resins, Moffit says. “The resins are used by composite fabricators trying to reduce their products’ impact. The inclusion of recycled content in our fabricated product is also valuable to our customers’ end users, including architects, designers and building owners who are interested in sustainable building initiatives such as the LEED program.”

Those are examples of good news.

Green Composites Committee Formed

What can your company say about composites having a low carbon footprint? Any answer today is likely anecdotal or an educated guess.

The ACMA Green Composites Committee (GCC) wants to change that, realizing the marketplace wants data, not hunches. The mission of the GCC is to nurture and expand the role of composites in sustainable development, including initiatives that enable member composite manufacturers to understand what sustainability means to their customers, understand the aspects of their products that affect sustainability, credibly promote sustainable composites to the market and more.

To that end, the GCC aims to develop credible data for the U.S. Life Cycle Inventory (LCI) database, which is a collection of relevant inputs and outputs for a given system throughout its life cycle. Composites have known advantages (durability, lightweight, etc.), and life cycle analysis is a data-driven way to tell the market about those advantages. Competing industries, including cement, steel and aluminum, widely distribute LCI data.

The GCC includes five subcommittees that address LCI, outreach, education, recycling and bio-composites. For more information, visit www.acmanet.org.
End-of-life recycling of composites is complicated mainly because high-performance engineered materials are just that — well-engineered. The industry’s greatest advantage is also its Achilles’ heel when it comes to recycling.

The bad news is the composites industry lacks a sustainable answer to end-of-life recycling. Neither landfill nor incineration of composites scrap is optimal, and environmental regulations may eventually lead to a ban on both.

The chemical structure of polymers, and the fiber and filler content of composites scrap, make recycling complex. The first problem with composites scrap recycling is the use of thermoset resins. Unlike thermoplastics, the scrap can’t be melted down and remolded, as is often done in plastic recycling. The second complicating factor is the filler and fiber content of the scrap. The resin-fiber matrix is difficult to breakdown in an economical and sustainable way. Any reduction in fiber length or introduction of surface defects by a recycling system will reduce the value of the recycled material. Finally, any system that solves both the technical and logistic challenges presented by composites scrap recycling must also have a market use for the recycled material of enough value to cover processing costs and compete with alternate waste disposal options.

The irony: End-of-life recycling of composites is complicated mainly because high-performance

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<th>4 Current Options for End-of-Life Recycling</th>
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<td>Will Darracott, principal engineer for the Composites Innovation Centre, Winnipeg, Manitoba, Canada, says the composites industry has four end-of-life recycling options. Here are his explanations of those options:</td>
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1. **Mechanical.** This method involves shredding and grinding of the scrap FRP material with subsequent use of the ground material in a new product. Previous attempts at mechanical recycling have focused on two size classes. The first size class is coarse “chips” that are one-quarter inch to one inch square. These chips are used as filler and/or structural enhancements in a new plastic product such as a polyurethane foam board. The second size class is a finer ground product that could be used as a filler material to reduce the resin content of a part. Some FRP fabricators already use mineral fillers like calcium carbonate for this purpose. Mechanical recycling is simple and technically proven, but drawbacks include potential safety hazards and low value of the end product.

2. **Incineration.** Combustion of FRP scrap with energy recovery is an option, but whether incineration qualifies as a “recycling” technique is debatable. Incineration does recover the energy content of the scrap materials, but air pollution resulting from FRP scrap incineration is a drawback.

3. **Thermal.** Thermal recycling of FRP scrap, also known as “pyrolysis,” involves heating the material in an inert atmosphere to recover the polymer material as an oil. The inert atmosphere doesn’t allow combustion, so the air pollution effects are lower for this process than incineration. The fiber is also recoverable using pyrolysis, but thermal stresses introduce surface defects reducing the strength of the recovered fibers. The recovered oil can be used as fuel or it can be refined to regenerate resin feedstock chemicals.

4. **Chemical.** This method uses chemicals to dissolve the resin away from the fibers. The fibers retain most of their original strength using this method due to the absence of thermal stresses as in pyrolysis. But this method typically requires granulating the scrap, which reduces the fiber length, and use of potentially hazardous solvents. Similar to pyrolysis, a chemical recycling plant would be capital intensive.

**Potential End Uses for Recycled FRP**
- Countertops
- Noise absorption material
- Viscosity modification of polymer mixes
- Blast medium for removing paint
- Wall/floor coverings
- Plastic wood products
- Roofing shingles
- Roofing asphalt additive
- Parking stall curbs
- Construction barricades
- Temporary traffic barriers
- Vinyl siding additive
- Tooling material additive
- Insulation material
- Flow medium
- Aerating material
- Patio stones
- Garden ornaments
engineered materials are just that — well-engineered. The industry’s greatest advantage is also its Achilles’ heel when it comes to recycling.

Another issue is ensuring a reliable upstream supply, Moffit says. “Our chemists can formulate the materials, and our manufacturing plants can put processes in place to ensure high-quality finished products, but if we can’t find consistent supply of the materials, we will not be able to meet our customers’ expectations. This limits Ashland’s and our customers’ ability to promote the use of recycled materials more aggressively.”

A few years ago, the R. J. Marshall Company developed a pilot plant in Detroit that could mechanically process composite scrap, but the project was dismantled due to lack of demand from automotive companies. The composites scrap would have been thermally cured in compression molding tools, eliminating the problem of excess catalyst and promoters encountered in room-temperature processed material. The company’s experience indicated that the economics of mechanical composites recycling was marginal at best.

Today, materials experts are identifying potential solutions to the end-of-life recycling problem. (See “4 Current Options for End-of-Life Recycling” on p. 17.) “Grinding composites into small particulates looks promising, but there are challenges with this option, including the expense to implement it,” Keith says.

The Future Starts Now

“The composites industry is a collection of innovative people who develop solutions,” Keith says. “Even though we still have questions to answer about how to best recycle composites, we all have a huge opportunity to address the issue at our own facilities. Small, incremental steps can make a huge difference.”

Certification Can Enhance Green Marketing

It’s one thing for a composite manufacturer to simply say it’s “green.” It’s more effective, however, to prove it through third-party certification and to promote it through effective marketing.

“The key is for companies in the industry to prove their commitment — doing so can bring more value to your businesses and your products,” says Brian Englert, manager of science and standards at GREENGUARD Environmental Institute.

Englert, who oversees development of standards, scientific processes and technical programs related to GREENGUARD certification programs, said the programs can help composites manufacturers create more value and credibility for their environmentally safe products.

GREENGUARD-certified products must meet stringent requirements for chemical emissions and toxicity, such as being screened for more than 10,000 different chemicals, including irritants, carcinogens and reproductive toxins, Englert says. Products undergo both annual recertification and quarterly quality monitoring tests to maintain this credential. The sound science and independent third-party status that back GREENGUARD certification programs are internationally recognized, he says.

“Certified products are referenced and preferred by many retailers, companies, institutions and government agencies around the world, and they’re stipulated in many standards and specifications,” Englert says. Low-emitting products that are GREENGUARD-certified can satisfy code or ordinance criteria, or meet indoor air quality-specific requirements that are part of requests for proposal (RFPs).

“Instead of just making a claim that your products are environmentally friendly, you can have that claim tested and verified with an entity that is unbiased,” Englert says. This is important because more consumers are looking for products that are certified as green, with no strings attached.”
An Open Book On Closed Molding

Manufacturers discuss the pros and cons of adopting closed molding

By Jamie Hartford

Composites manufacturers are switching from open to closed molding and discovering the benefits and challenges of the new process.

Many tout closed molding as offering a variety of benefits—from reducing styrene emissions and cost to improving quality and increasing production volume—but open molding remains the norm within the composites industry. Brad Walter, engineering supervisor for FRP and plural component equipment, with ITW Finishing Equipment Americas, a supplier of pumping and spray equipment to the composites manufacturing industry estimated that only around 10 to 15 percent of his company’s customers have converted, and even those who have don’t use closed molding for every part.

Given its many benefits, many manufacturers are considering closed molding. But what are the exact costs and benefits of making the switch? Here, three companies across the market share their experiences, decision-making processes and opinions on open versus closed molding.

Infrastructure

Orenco Systems

Why make the switch

Oregon-based Orenco Systems was an early adopter of closed molding. The company, which specializes in wastewater solutions, first started using the process to make fiberglass access lids in 1988. In Orenco’s case, the process was less a conversion and more a matter of adopting closed molding as the company expanded.

“We just never liked the variability and the lousy working conditions associated with open molding,” says Eric Ball, Orenco’s vice president of product development. The company also wanted better quality parts that it could churn out at a higher volume.

“We’re not a custom molder,” Ball says. “For the most part we’re making parts for our own processes and equipment. We needed to make tens of thousands of these a year, and we needed to make nicer looking parts. Spray up just wasn’t getting us there.”

The benefits

Ball says closed molding has resulted in better quality parts for Orenco Systems. Parts made with a closed mold are more consistent and can more easily incorporate high-strength fabrics and achieve higher glass contents (regu-
larly 40 to 50 percent and even higher, depending on what type of reinforcement glass is used) than chopped manual parts.

Orenco has also seen success in using closed molding for large tank parts, which must be watertight. According to Ball, using an open mold often resulted in pinhole leaks because of the inaccuracy of the manual lamination process. “When you do a closed molding process, you’re forcing resin through a fixed cavity, so every last air void is full of resin, and the part is the same weight every time,” Ball says. “It’s a much more exact process.”

The company has also seen quicker cycle times—less than five minutes for small, seven-pound parts that would typically take an hour or more with open molds. Large, 400-pound parts that used to take four hours in open molding are cycled in 90 minutes. Closed molding has also reduced styrene emissions from approximately 10 percent to less than 2 percent as well as improved conditions for workers. Ball says most employees don’t wear masks, and because resin isn’t being sprayed, the floor and other surfaces stay cleaner. “When you’re trying to attract high quality workers, having a nice working environment can be a huge benefit,” he says.

The challenges

While the company knew there would be a learning curve associated with closed molding, they didn’t realize how steep it would be. Mistakes were made, Ball says, and they still occur today. Early on, Orenco had to scrap a large mold they tried to make by vacuum bagging. “We tried to shoot it all at once and ended up with resin-rich areas, which then shrank, creating an inaccurate mold,” he says. “The lesson learned was that if you’re trying something new, try it on a smaller part first.” Still, he says the company was turning out good quality parts within a year of its first foray into closed mold technology.

Ball also says getting fiberglass into a closed mold is the Achilles heel of the process. Instead of using a chopper gun, as with open molds, closed molds require rolls of fiberglass that must be cut to shape. Fiberglass in that form costs more and increases waste. As a solution, Orenco has automated the process so that robots spray fiberglass onto a preform, but that, of course, required additional investment.

Another drawback is mold cost and time to implementation. Building a sophisticated closed mold system can take months and costs many times more than an open mold for the same part. “There really is a lot to consider when determining how and when to move forward with closed molding,” Ball says. “To be successful at closed molding takes far more planning and engineering than open molding. You can’t jump into it half-heartedly. You really have to be committed to understanding the process.”

Recreation

WhiteWater Composites

Why make the switch

WhiteWater Composites, a British Columbia-based manufacturer of equipment for water parks, switched to open molding for some of its parts in 2002. Tim Boothman, the company’s vice president and general manager, says there were several factors behind the decision: “We switched for three reasons,” Boothman says. “First was the cost. We estimated it would be cheaper for the volume. Second was the volume itself. We calculated that we could build faster than we could with open mold. And third, closed molding gave a gel coat molded surface on both sides, which is important in the waterslide industry. It’s smooth on both sides, and that made it a sexier looking product.”

The benefits

Boothman says WhiteWater has seen output improve since switching to closed molding. “We certainly have the ability to churn out more parts than we could before,” he says.

The company has also seen a 10 percent total savings (productions, material and labor costs), and styrene emissions have been reduced to 1 percent, versus 6 to 13 percent with open molding. “It’s a far cleaner environment for our workforce,” Boothman says. “The only time they have to wear a mask is during the gel coat at the beginning of the process, which makes them much happier.”

The challenges

WhiteWater has seen some savings, Boothman says, but less than what they had initially hoped—mostly because materials such as fiberglass mats are more expensive. Currently the business is 60 percent closed mold and 40 percent open, a fact largely driven by the cost of the tools. Boothman says open molding is a labor-intensive process but admits that RTM is a technology-intensive process. “If you don’t have the resin chemistry right or you don’t have your mold design correct, you’re going to make a lot of bad parts,” he says. “With an open mold, you can fix a bad part whereas with closed, you often have to throw it out.”
Similar to Ball, Boothman points out the steep learning curve associated with the switch. He says it took about six months to get the hang of the process, and mistakes are still made. “If you get a new operator and they forget one step or do one step incorrectly, you can potentially produce a bad part. That one step that might seem inconsequential, but in fact it is not,” Boothman says.

Transportation

Molded Fiber Glass

Why make the switch

MFG, Union City, Pennsylvania, began using closed molding for heavy truck components, rail transportation components and water treatment products back in 2005, says Dennis Vorse, general manager for MFG Union City, construction products and water treatment products. The business is currently around 75 percent open molding and 25 percent closed molding. They began making the switch because they wanted a cleaner work environment, consistency in product and part thickness, two smooth sides and better physical properties.

The benefits

Vorse says MFG gets more tool turns per day with light RTM than with open mold. Emissions are also lower, resulting in a healthier work environment, which he says can help gain and retain talent. He also says closed molding can increase part strength by 50 percent, depending on the part (glass configurations can have a positive or negative impact.)

For clients, the benefit comes from having two smooth sides, which Vorse says results in better thickness control and a more attractive looking product.

The challenges

Vorse says closed molding isn’t as quick to production as open molding, where tooling is much faster and prototypes can be developed in less time. He says closed molding can also be a tough sell to customers because of the additional up-front cost associated with tooling.

“I usually get a customer face to face and show them the texture of the back side of a part made with a closed mold versus a part made with an open mold and try to explain the benefits they would get. If they don’t care if the back is coarse, it’s going to be a real tough sell to get them to double their tooling.” Two smooth sides matter more to some industries than others. Rail transport, heavy truck, automotive and marine are becoming more and more interested in that benefit, Vorse says. For products such as a bathtubs or shower stalls, where the rough side is hidden between the studwork of the home, having two smooth sides isn’t as important.

Vorse also notes that there is a modification that occurs for each closed molder. “You have to teach yourself,” he says. “You can have someone come in and talk to you about how to do it, but if you talk to five different people at five different companies, they all do it differently because they’ve all evolved their process from the basic.”

In the end, manufacturers will have to decide for themselves if open or closed molding is right for their company, sometimes on a per-part basis. The investment is significant—Vorse estimates it costs twice as much to get started as it would with open mold. There are also significant challenges. “One of the biggest things we’ve learned is that if something can be done improperly during a molding process, it eventually will,” Ball says. “The key is, every time something goes wrong, create a control that doesn’t allow it to happen again. Needless to say, we have a lot of controls in our process.”

Still, says Boothman, to him it’s worth the trouble. “Despite its challenges closed mold is still the way to go,” he says. “The level of quality and consistency we get is far superior and outweighs the issues you can have in your production.”

WhiteWater Composites has also seen a 10 percent total savings (productions, material and labor costs), and **styrene emissions have been reduced to 1 percent**, versus 6 to 13 percent with open molding.
When the Broadway Bridge opened over the Willamette River in Portland, Ore., nearly 100 years ago, the 1,742-foot bridge with a concrete deck was state of the art. But time and traffic caused inevitable decline, and the bascule bridge has undergone numerous repairs to the structure and mechanics. ZellComp Inc., based in Durham, N.C., completed a partial deck replacement for this historic bridge last summer.

The city is immersed in the Portland Streetcar Loop Project to extend its streetcar service and link neighborhoods with a convenient transportation alternative. The 3.3-mile extension travels over the Broadway Bridge, requiring rail installation for the streetcars on the movable spans of the bridge. ZellComp was selected to install a composite bridge deck between the new rail lines.

“It’s essential to preserve this historic landmark, and that includes ensuring its structural integrity,” says Dan Richards, president and CEO of ZellComp. “An FRP bridge deck meets desired goals of using green construction materials as well as ensuring that bridges we build and rehabilitate today will last for future generations.” ZellComp uses a proprietary two-part open system, relying on mechanical fasteners. It doesn’t require on-site mixing of adhesives and bonding with adhesives.

Richards says this made the ZellComp Decking System ideal for the Broadway Bridge, where there is significant moisture and temperature fluctuations.

The Broadway Bridge is just one of more than 600,000 bridges across the United States. Many of them need repairs, and long-lasting composite materials are a great solution. According to Better Roads Magazine’s 2010 Annual Bridge Inventory, published last November, 23.3 percent of America’s bridges are structurally deficient or functionally obsolete.

And bridges are only one component of the nation’s transportation infrastructure in dire need of attention. In a 2009 report, the American Society of Civil Engineers evaluated our infrastructure, which includes bridges, roads, energy, solid waste, transit, rail and other areas. The ASCE gave our infrastructure an unacceptable D grade, estimating a five-year investment of $2.2 trillion to fix the problems.

There’s great opportunity for the composites industry. “The thing that keeps us interested in the infrastructure field is the enormous potential,” says Ray MacNeil, owner of Ray MacNeil Composites Consulting in Wexford, Pa. “What motivates people is the hope that we’ll achieve some breakthroughs.” He sites rebar as an exam-
ple. FRP rebar is widely accepted, but still used far less than its steel counterpart. “If we could gain even five percent of that market, we’d be set,” says MacNeil. “It is staggering how much steel rebar is used.”

Louis N. Triandafilou, P.E. is a team leader with the Bridge and Foundation Engineering Team for the Federal Highway Administration. He sees several composite applications already in use in the transportation infrastructure segment, including decks, full-length slabs, girders, pedestrian bridges, inspection walkways and wrapping welded connections of overhead aluminum sign trusses. Plus there are numerous composite applications on the horizon, adds Triandafilou, such as prestressing strands for strengthening, rigidified tubular arches, hybrid composite beams and decks and thermoplastic bridge elements.

“My crystal ball would say it’s going to be a slow, but hopefully steady growth,” says MacNeil. “The infrastructure market is not going to just explode. It’s going to take a lot more missionary work to convince the authorities and traditional voices in the field to adopt composites.”

**Competing Against Convention**

Doug Gremel knows about challenging the status quo within transportation infrastructure. “Part of the problem is you have this industry that’s built up around the way it does business now,” says Gremel of Hughes Brothers in Seward, Neb. “You have to fit what you’re doing into what they do now.”

Hughes Brothers manufactures glass fiber reinforced plastic (GFRP) rebar, carbon for structural strengthening, GFRP dowel bars and other composite products. “We’re hitting a lot of different concrete-related products,” says Gremel. Hughes Brothers has worked on highway bridges, waterfront construction, light rail, port rehabilitations and structural strengthening projects.

Last summer, the company completed work on a bridge in Brandon, Manitoba, Canada. It provided composite rebar for two parallel bridges with seven 150-foot spans. “I think you have to be very discerning when you talk about composites in infrastructure because there are a lot of things that just make no sense at all,” says Hughes. “FRP rebar is not that big of a stretch.”

Bridge engineers are accustomed to designing reinforced concrete structures, says Hughes. FRP rebar is only marginally different than traditional materials, so the principles of reinforced concrete design remain the same. “It’s a lot easier to sell something they’re familiar with than if you come at them with a whole new FRP superstructure,” says Hughes.

As the next generation of civil engineers enter the workforce, replacing those who only learned the basics of concrete and steel in school, there will be a push for composites. “It is difficult to shift the thinking in the civil engineering world,” says Richards. “But composite decks and other structural composites have been around for a while now—and we are starting to see greater acceptance.”

Comfort with composites isn’t the only barrier: The longstanding problem of cost often presents hurdles, too. “Price is the number one issue,” says Scott Reeve, president of Composite Advantage, a Dayton, Ohio, manufacturer of prefabricated FRP products for infrastructure. “The only way we sell against traditional materials is when we’re offering some immediate value. It’s got to be a situation that requires lightweight materials or accelerated construction.”

Bridge decks are Composite Advantage’s main—and most visible—product line. The company is currently working on four installations, including an 11,000-square-foot pedestrian bridge in Washington, D.C. The city is creating parks with biking and hiking trails on both sides of the Anacostia River. Composite Advantage is supplying decks for pedestrian bridges that cross over railroad tracks in two spots. One bridge will be installed this summer and another in 2012. Because the bridges use the same design and the panels are replicated, the cost of the project was reduced.

Other features of composites attracted the city and the contractor. The lightweight deck meant they could use a lower cost substructure. In addition, the deck features built-in curbs, scuppers for water drainage and junction boxes for electrical systems.

Composite Advantage has overcome objections to higher upfront costs of composites by focusing on a handful of projects like the one in Washington, D.C. “Whether it’s bridges or utility poles or other composite applications out there, we find one or two situations where we can make a difference and sell into that,” says Reeve. But finding those projects takes time and patience, particularly in a sluggish economy. “Infrastructure repairs have suffered—along with everything else—during the downturn economy,” says Richards. “Funding is a key issue.”

**Bolstering the Transportation Bill**

Funding is also pivotal in governmental policymaking that affects the transportation infrastructure industry. The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), which had guaranteed funding for highways, highway safety, and public transportation totaling $244.1 billion, expired in 2009. Congress has passed a bill to extend SAFETEA-LU until September 30, 2011. However, the uncertainty of the transportation bill has affected the industry.

“All construction related to transportation infrastructure is nearly at a halt,” says John Busel, director of the American Composites Manufacturers Association’s Composites Growth Initiative (ACMA-CGI). “The state DOT’s don’t know where the funds are going to come from to build any project, whether it’s steel, concrete, composites or other materials.”

Part of the delay in passing a new transportation bill, says Busel, is finding the funds to support it. Currently, monies are generated from the gas tax. But the federal portion has stood at only 17 cents for decades. And with more fuel-
According to Better Roads Magazine’s 2010 Annual Bridge Inventory, published last November, 23.3 percent of America’s bridges are structurally deficient or functionally obsolete.

efficient cars on the road, less taxes are being collected.

As the U.S. House of Representatives’ Transportation and Infrastructure Committee considers how to reenact the bill, ACMA is working to insert language stressing the importance of life cycle costs in transportation projects. ACMA officials and member companies have met with members of Congress to discuss the benefits of composites. They also held a briefing for the Congressional Composites Caucus in late 2009.

“We’re pushing for the transportation bill to provide incentives for the highway community to look at composites,” says Tom Dobbins, CAE, chief staff executive of ACMA. “We see an opportunity for the composites industry to make a valuable and lasting contribution to America’s infrastructure.”

Passing a new transportation bill would open the gates for construction projects and create jobs, says Busel. Manufacturers such as Composite Advantage aren’t currently feeling the pinch: It’s installing bridges using funds allocated five to 10 years ago. But Reeve says design work has slowed and his company will be impacted in a few years from the ripple effect that causes. “When the bill is finally passed, there will still be years before any related construction gets done,” he says.

Dobbins hopes that a sense of urgency about repairing the nation’s decaying infrastructure, coupled with the fact that transportation bills have been historically bipartisan, will propel Congress to vote on a bill soon. “If we are successful in working with members of Congress to make changes in the current law to level the playing field for composites, it could open up a huge market for companies in the industry,” says Dobbins. “And, ultimately, it would give the American people a better, longer-lasting transportation infrastructure.”

Strategies for Success

While a composites-friendly transportation bill would move the industry forward, there are other ways to gain market share in the transportation infrastructure arena. It starts with education. Triandafilou encourages companies and organizations such as ACMA to teach engineers and designers about composites through webinars, conferences, tutorials and other avenues. Richards adds that it’s important to educate elected officials and the taxpaying public, too.

Marshall Composite Technologies partnered with the Civil Engineering Department at Widener University in Chester, Pa., on a student FRP rebar competition. The Salem, Ore., manufacturer mailed approximately 60 rebar kits to students, who then designed a structure that will be evaluated at an American Concrete Institute meeting.

“It’s a grassroots approach to educate upcoming engineers,” says Cameron Crawford, managing partner for Marshall. His company has supplied FRP rebar for seawalls in southern Florida and bridge decks throughout the Midwest and Canada.

Gremel, who chairs ACMA’s FRP Rebar Manufacturers Council, says companies must work together. “Composites are not a great mystery. We all have access to the same suppliers of raw materials,” he says. “If you think about your business as a closed proprietary process you’re never going to tell anybody about, then engineers won’t embrace it. We have to get organized as an industry.”

Like other manufacturers, ZellComp takes a multifaceted approach to growing business and the industry. “We believe it is important to better advertise our successes, work to lower costs and continue to focus on life cycle and value engineering through Congressional fly-ins, speaking engagements, etc.,” says Richards.

Change in the transportation infrastructure community will take time. “The people in the field need to be patient and have a couple irons in the fire,” says MacNeil. “This could be a field that takes many years to blossom.”

ZellComp is prepared for slow adoption of composites. Richards says the company currently focuses on public projects where there’s a recognized need for lightweight, corrosion-free bridge decks and commercial projects where net present value and life analyses are a key consideration. Composite Advantage takes a similar approach. “We sell in situations where we can solve a problem,” says Reeve. His customers often require lightweight options, a fast installation or maintenance-free materials.

Market acceleration is not likely to start in the United States, says Crawford. “I think the early adopters will be overseas, then it will catch on here in North America,” he says. “When it does, we’re not going to be able to expand our production and capacity fast enough.” Marshall’s business model is to license its technology, build production plants for licensees and provide turnkey operations. Crawford speculates that the first licensee will be in the Middle East because that region is generally more willing to spend extra money to ensure structures last longer.

“There is plenty of room for growth for all of us,” says Crawford. “A rising tide raises all boats, and that’s the case in the composites industry, particularly for infrastructure materials.”

Susan Keen Flynn is a freelance writer based in Cleveland
Stories about the development of tumors in mice caused by styrene exposure concerned many in the composites industry when they first appeared. Since humans, like mice, are mammals, people started to worry that styrene might have a similar affect on industry employees and community members. At the March 2011 annual meeting of the Society of Toxicology in Washington, D.C., toxicologists presented new styrene study results based on the latest research, which uses genetically modified mice to test styrene’s potential carcinogenicity. This work—relying on techniques that won the Nobel Prize in physiology and medicine in 2007—belys fears that there is a link between styrene and tumors in humans.

Styrene, a component used to produce polyester resins for composites, polystyrene and many other common materials, has been the subject of scientific examination to determine human health affects, including cancer risk, from exposure to the chemical for over 20 years. Researchers have concluded from extensive data that a link to cancer in humans is not scientifically supportable, according to the Styrene Information and Research Center (SIRC), an industry group of styrene manufacturers and users, which has a long-standing commitment to health-effects research.

SIRC has commissioned more than $20 million in scientific research since its founding in 1987 to understand styrene’s potential health effects. Two recent expert weight-of-the-evidence reviews of the extensive styrene health effects database have shown that styrene is not likely to cause cancer in humans. Yet government regulators in the U.S. National Toxicology Program (NTP) have expressed concern that styrene exposure might be a cancer risk and have proposed to officially list it as “reasonably anticipated” to be a human carcinogen.

The American Composites Manufacturers Association (ACMA) has been working closely with SIRC, receiving the latest research findings and scientific information from the organization and putting it before government policy makers to ensure that it gets heard, according to John Schweitzer, ACMA senior director of government affairs. A key mission of the ACMA is public sector advocacy, representing the composites industry before government regulators and legislators and before non-government organizations that promulgate codes and standards.

SIRC spokesman Joe Walker believes that a cancer listing could have a devastating effect, particularly in the composites industry, where it has the potential to create fear among workers and the communities where composites manufacturing facilities using styrene resins are located. It also has the potential to have profound effects on other industries, in particular on the use of expanded...
poly styrene food service products, which have been used for 50 years without a single adverse health effect attributed to them, Walker observes.

He relates that the question concerning styrene’s carcinogenicity has been researched in studies using rats and mice and epidemiology studies on people working in styrene-related industries since SIRC was founded. “The bottomline of all of that work is that styrene is not a cause of human cancer,” he adds, noting that the evolving research continues to point away from a human cancer concern for styrene.

During the 1990s, researchers using laboratory rats and mice in styrene inhalation studies found lung tumors in exposed mice, but none in rats that had been exposed to much higher levels, recounts George Cruzan, a toxicologist working with SIRC. Scientists over the ensuing years continued to study styrene’s cancer-causing potential.

In late 2009, the peer-reviewed Journal of Occupational and Environmental Medicine published a SIRC-commissioned review by a panel of internationally recognized scientists who found that the available epidemiologic (human) evidence does not support a causal relationship between styrene exposure and any type of human cancer.

At the recent Society of Toxicology meeting, Cruzan and other toxicologists presented a poster based on the latest research with genetically modified mice. “This work—relying on techniques that won the Nobel Prize in physiology and medicine in 2007—showed no toxicity from styrene whatsoever,” reports Cruzan.

“Overall, eight cancer studies have been done with rats and mice exposed to styrene. In mice, three of five studies have shown either increased lung tumors or the suggestion of increased lung tumors, but none in rats,” he continues. “So we were left with the questions: Is there something about mice that’s causing these tumors, and are humans more like rats or more like mice?”

That work led researchers to identify an enzyme, CYP2F2, prevalent in mouse lungs but not found at the same levels in rat lungs, and even less so in human lungs. Experiments were conducted to examine the metabolism of styrene by that enzyme, finding that styrene is metabolized in the mouse lung by the enzyme.

**This work—relying on techniques that won the Nobel Prize in physiology and medicine in 2007—showed no toxicity from styrene whatsoever.**

- George Cruzan, toxicologist Styrene Information and Research Center, Arlington, Va.

SIRC is the primary group spearheading the new work with modified mice, notes Cruzan. “We worked with a researcher at New York-based University of Albany to genetically modify a mouse in which the CYP2F2 gene was made inactive, so that the enzyme is not produced,” Cruzan explains. These genetically modified mice are now more like humans, since they lack the mouse-specific enzyme. “We found that when those modified mice are exposed to styrene, there is no toxicity— it completely eliminates the lung toxicity. We are quite certain that the CYP2F2 is causing the toxicity, so we are pursuing that now.”

Pathology slides of mouse lungs under high magnification are quite remarkable. “Lung sections from the normal, unmodified mice are full of abnormal growth following styrene exposure,” says Cruzan. “But the lungs of the genetically modified mice look completely normal following styrene exposure. Not like it’s a 50 percent reduction; it’s a 100 percent reduction in toxicity. So it’s pretty exciting for scientists,” he adds.

According to ACMA’s Schweitzer, the preliminary data from that study supports the hypothesis that styrene-induced mouse lung tumors are a species-specific effect and do not indicate a potential risk to humans. He notes that the research currently underway involves adding a different gene that will cause mice to metabolize styrene like humans. He points to the latest findings in support of the ACMA’s position that the government does not have a sound basis to proceed with a cancer listing for styrene.

“The preponderance of styrene-exposure data supports a conclusion of no concern. That was the recent decision in a European Union risk assessment report on styrene which looked at all the data and concluded that there is no evidence for a causal link between cancer and exposure to styrene,” Schweitzer reports. He adds that under the EU REACH program, no further risk management activity is required relating to carcinogenicity.

Schweitzer met with Kathleen Sebelius, Secretary of the U.S. Department of Health & Human Services, in December. “The NTP’s proposal to list styrene as a reasonably anticipated carcinogen had just arrived on her desk for her review and approval,” recounts Schweitzer. He was there to make the ACMA’s case against the proposal. He maintained that NTP styrene reviews and listings should be based on a full consideration of all the available science.

“Secretary Sebelius said that she would look into it carefully. I think that they understand the scientific issues and the impact on jobs that this would have, so they are proceeding carefully,” Schweitzer says. “Apart from immediate OSHA labeling requirements, the listing would have only limited direct regulatory consequences, but it may lead to increased regulatory or legal burdens at the state and local level,” he adds.

“More importantly, the listing is likely to result in widespread, unnecessary concern among composites industry workers and plant neighbors. We hope that can be avoided.”

Richard Stewart is a freelance writer based in Tampa, Fla.
ACMA Well Received at SPE TopCon Conference

At the SPE Thermoset Division TopCon Conference, Chicago, John Busel, ACMA’s director of the Composites Growth Initiative, delivered a presentation titled ACMA’s Vision to Drive Market Development Through Green Composites to nearly 100 attendees. Busel educated the compression molders and thermoset compounders on the intricacies of life cycle assessment for composites with a challenge to the compression molding industry to participate in ACMA’s Green Composites Committee project to develop life cycle inventory data. Later, ACMA’s Chief Staff Executive Tom Dobbins delivered a presentation titled Styrene Legislation: A Time for Action that updated thermoset molders on important industry regulatory issues.

Thermoset Molders Committee Newest CGI Group

The new Thermoset Molders Committee, part of the Composites Growth Initiative (CGI), met in Chicago last week with over 20 companies represented in person and by phone. The newest CGI committee, co-chaired by Thomas J. Meola, president and CEO of Premix, Inc., North Kingsville, Ohio, and Kevin L. Barnett, president and CEO of Core Molding Technologies, Inc., Columbus, Ohio, will allow thermoset molders to work together with their suppliers and through ACMA to grow their markets by focusing on marketing, codes and standards, and political advocacy. The Thermoset Molders Committee will reconvene in the near future to develop strategies as a result of a SWOT (strengths, weaknesses, opportunities, threats) analysis completed at the Chicago meeting. If you are a compression molder, SMC/BMC, injection molder or supplier for that industry and would like more information on how you can participate, please contact ACMA’s Mike Dunn at mdunn@acmanet.org.

FRP Rebar Manufacturers Council Announces New Leadership

On April 6, the ACMA FRP Rebar Manufacturers Council conducted a business meeting to discuss industry needs and challenges and establish a new strategic direction for continued on page 29
Call for Participation: Manufacturers, We Need Your Help
The ACMA Green Composites Committee (GCC) is undertaking an important industry project to develop life cycle inventory (LCI) data that could be used to perform life cycle assessments (LCAs) of composites products. Currently, LCI data does not exist for composites, but it does for steel, wood, aluminum and concrete. For composites to compete in the world of “green” and “sustainability,” the industry needs to develop this data so individual LCA product assessments can be done. During Phase 1 of this project, an investigation will be performed on constituent materials, specifically key resin and fiber reinforcements that are used in open molding, vacuum infusion, compression molding, casting-closed mold and secondary bonding. In order to develop industry averaged LCI data, the LCI consultant needs at least three companies to ensure the industry data is valid and credible. We need companies that perform the five selected processes and that are willing to confidentially collaborate with the LCI consultant. For more information about LCI Project, contact ACMA’s John Busel at jbusel@acmanet.org.

Green Composites Workshop Program Available Online
The programming for the Green Composites Workshop, June 21-22, Rosemont, Ill., is now online. When you attend the Green Composites Workshop, you will learn what an LCA is and why it is important to your company and the industry, understand what LCI data is and how it can be collected, see examples of LCAs performed on various products in key markets and learn about ACMA’s strategy to develop composites LCI data. Go online to www.acmashow.org/GreenWorkshop to view the schedule and to register.
the FRP concrete market. During the meeting, members elected the following Council Leadership: Chairman: Cam Crawford, Marshall Composite Technologies, LLC; Vice-Chairman: Bernard Drouin, Pultrall, Inc.; and Treasurer: Sam Steere, Pultrall, Inc. The Council plans to focus on end-user education, legislation and industry certification. For more information about this Council, contact ACMA’s Mike Dunn at mdunn@acmanet.org.

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**Renew Your Support to Your Industry**

As ACMA finishes its fiscal year and begins focuses on the renewal cycle and the year ahead, I began listing some key reasons why ACMA remains beneficial to the industry and its members. When you receive your membership invoice in the mail, here are key reasons to renew:

*There is one organization that has done more than any other to make sure the Secretary of Health and Human Services does not sign a Report on Carcinogens with styrene in it—ACMA.*

If you’re using a styrene-based resin system, the future of your business rests in the hands of the Secretary Sebelius. If she signs the Report on Carcinogens and styrene is included in that report, your business will never be the same. Your relationship with your employees will be different, your liability and therefore your insurance will be change, competing materials will have a new marketing angle against your products, and the relationship with your communities and plant neighbors will change.

Renewing your membership and contributing to the Composites Advocacy Fund assures that ACMA will have the resources to make the strongest case possible to the Secretary and to engage allies on Capitol Hill. Renewing means we will have the resources for this important work.

**ACMA provides its members with the resources necessary to avoid OSHA fines.**

Has OSHA visited your plant recently for a dust inspection? Trust me, they will. The question is, will you be ready?

**ACMA is paving the way to greener composites and market development.**

We all hear about the green economy but do you know how it will impact you and are you prepared to take advantage of the growing market opportunities? ACMA is paving the way by developing data that you need to show your customers that composites are “greener” than competing materials. The project, estimated to cost half a million dollars, can only be done by companies working together through ACMA.

There are additional market development projects being conducted through the ACMA, such as codes changes and development, which will impact your bottom line. But we can’t do this without support—renew today and keep your association strong. If you had to let your membership lapse during the recession, now is the time to renew your support of your industry and your association. ACMA struggles to serve the industry because of a lack of resources. If everyone does their fair share, we would be on par with the resources that the steel, concrete, wood, and aluminum industries are spending to take away your current market share.

We look forward to hearing from you and welcoming you back for another year of achievement.

**Tom Dobbins, CAE**
New Members

Composites Consult. Grp Desoto, Texas

Honolulu Comm. College Honolulu, Hawaii


MacMillan & Donnelly Inc. Falmouth, Maine

Mirolin Industries, Inc. Etobicoke, Ontario, Canada

Wm. T. Burnett & Co. Jessup, Md.

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Build the apex of the automaker’s art,” says Williamsen. Setting these kinds of goals is how Toyota became the world’s first mass-producer of hybrid vehicles. And the Lexus LFA supercar is the flagship car that led the Japanese company on a pursuit of a stronger, lighter carbon fiber. Though the original concept of the LFA was for an aluminum body over an aluminum chassis, nearly halfway through their decade-long development of the LFA supercar, Toyota switched to a CFRP structure and body because its engineering team wasn’t happy with the handling feel of the aluminum mules. As a result, two-thirds of the LFA’s structure by weight is a carbon fiber composite. “Aluminum doesn’t communicate the same information to the driver about what’s happening between the tires and the road surface as a stiffer, higher resonant frequency structure, like one made of carbon fiber-reinforced plastic (CFRP),” Williamsen explains.

But it wasn’t the jump that caused the stir so much as the material breakthrough—the A-pillar and roof side rails in particular that created the automotive industry buzz. Toyota invented a special loom, a circular weaving machine, to weave a tubular carbon fiber fabric for hollow CFRP components with a varying cross-section that are then filled with resin.

The payoff for spending ten years on advanced engineering technology to build one car, according to Williamsen, will come down the road when supercar design engineering and production engineering merge. The lessons learned will eventually trickle down and help the progress of composite adoption in conventional mass-market cars, making them lighter and stronger.

Roadblock: Automotive industry can’t afford to do the right thing
In Bert Havenith’s mind, the perfect car would be an electric vehicle made out of bio-based materials - “because that would be the most optimal for our planet.” However, there are no economies of scale for these new sustainable engineering materials yet. “That’s why the whole industry is struggling,” Havenith says. “Everyone knows it’s the right way to go, but bio-based materials are always more expensive and therefore difficult to get approved.” So who still has the stamina for developing new materials? “OEMs rely on part suppliers or even the materials suppliers to pay for the innovation,” says the business expert. Today, composites are mostly seen in luxury cars. “And even there, there is tremendous price pressure,” so Havenith.

Sandra Henderson is a freelance writer based in Lafayette, Colo.

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Online Exclusives
Straight From the Source: Industry Leaders Speak Out

Composites Industry Reaching Historical Shift

Edoardo Depase is the engineered materials applications research and engineering manager for Cytec Engineered Materials (CEM), a global provider of technologically advanced materials for designers and engineers in commercial aerospace, civil and military rotorcraft, business and regional jets and automotive.

Can U.S. Composites Gain Advantage Over Imports?

Richard O’Meara is president of Core Composites, Inc., a division of ROM Development Corporation, located in Newport, R.I. He has worked in the distribution and sales of composite materials since 1978. He is the Charperson for Marine Products for SAMPE and serves on the curriculum board for The International Yacht Restoration School (IYRS), launched a first-of-its-kind, fulltime Composites Technology Program in 2010.

Composites Thrive Among Traditional Energy Sources

With a background in sales and marketing, strategic planning and business analysis, Ray MacNeil does market research and development for a variety of companies within the composites industry. This experience also allows MacNeil to look ahead and forecast the economic future of the composites industry.

Can Small Companies Have Big Advantages in Manufacturing

Pete Wagner is the CEO and Founder of Wagner Custom Skis. Pete received a BS in mechanical engineering focusing on composite materials and computer-aided design at UC San Diego before entering the golf industry as a product designer. After receiving an MBA in entrepreneurship, Pete opened Wagner Custom’s solar and wind-powered ski factory outside of Telluride, Colorado.

To read the interviews with these and other leading members of the composites industry, visit www.compositesmanufacturingblog.com and click on “Q&A Interviews.”