Composites Manufacturing
The Official Magazine of the American Composites Manufacturers Association

January/February 2016

Making Inroads In Infrastructure
Resilient Resins

ACMA Advocacy in 2016
3-D Printing in Space

www.compositesmanufacturingmagazine.com
Working with Composites One gives you access to a unique partnership that starts with our PEOPLE, from regional customer service reps and technical sales teams, to local support teams at over 35 distribution centers throughout North America. As your partner, we'll help you find everything you need, make sure you receive it when you need it and do what it takes to help grow your business including offering you emerging market expertise and process application know-how. And we'll provide you with the unmatched service and support that you should expect from the nation’s leading composites distributor.

That’s the power of Partnership. The Power of One – Composites One.
Features

Making Inroads in Infrastructure ............................................ 14
Companies targeting the infrastructure market face roadblocks, but are making headway providing everything from GFRP pile repairs to railway bridges. Industry veterans share their thoughts on the marketplace. Plus, an update on the FAST Act.
By Susan Keen Flynn

Annual State of the Composites Industry Report .......... 19
What's in store for your business – and the industry as a whole – this year? Lucintel’s leader shares insight on materials, manufacturing processes and markets in 2016 and beyond.
By Dr. Sanjay Mazumdar

Resilient Resins ................................................................. 24
From stack linings in coal-fired power plants to large tanks for chlorine bleach storage, composite applications can withstand some very harsh settings. The reason these structures are so tough? Their resins.
By Mary Lou Jay

About the Cover:
The Sandy Beach Bridge in Indian Lake, Ohio, was in disrepair and closed for 50 years before being renovated with a FiberSPAN bridge deck. Crowds crossed the bridge at the grand re-opening on August 23, 2014.
Photo courtesy of Composite Advantage
What’s the State of Your Company in 2016?

The new year is underway and looks promising for composites. Our industry had a great 2015 and is poised for that trend to continue. There are several positive signs. The global composites market anticipates a compound annual growth rate of more than 4 percent over the next five years. Our products are increasingly successful in replacing traditional materials in applications where the cost and performance of composites make us the best choice. In addition, designers, specifiers and architects continue to see and understand the benefits of using composites in a growing number of applications. Helping us gain traction is our industry association, ACMA, which continues to have an impact in the marketing and acceptance of composites across multiple industries. We see many new applications across aerospace, energy and utilities, infrastructure, transportation and other markets.

For an in-depth look at the composites industry and a forecast of the future, check out Composites Manufacturing magazine’s annual State of the Industry report on page 19. Just as the magazine checks the pulse of the industry each year, the start of 2016 presents a great opportunity for companies to conduct a “State of Your Company” review. It’s good business practice to periodically re-evaluate your business. Here are some questions to consider:

• Where do you stand?
• Are you focused in the right areas?
• Where should your employees spend their time to get the most return for your business in the short term and long term?
• What parts of your business have the best growth opportunities, and how do you accelerate performance in those markets?
• Which business segments need additional focus, or should you redeploy resources to other initiatives?

I find that carefully examining our company, Crane Composites, can be very challenging, but it’s a critical exercise to ensure the organization has the right priorities and focus to be successful. Making sure that your business is properly aligned for the future will have a positive effect on your business results.

I wish you good luck in 2016, and, as always, thank you for your support of ACMA. Together we are making a difference.

Jeff Craney
Crane Composites
ACMA Chairman of the Board
jcraney@crane.composites.com
Global Company with Regional Focus

Polynt Composites is a leading producer of unsaturated polyester resins, gel coats, vinyl esters and other derivatives for the composites industry.

Polynt Composites is present on five continents with regional manufacturing and specialized research and development centers. We provide our customers with innovative solutions, helping them make even lighter, stronger and more sustainable composite materials.

Wide-Ranging Distributor Network

Polynt is positioned to supply products and materials globally, allowing our valuable customers to meet their needs with one-stop shopping through our experienced, dedicated distributors.
Resin Selection

There are so many different factors that influence the selection of an appropriate resin. The main thing is to work with your resin supplier, whether it is a distributor or resin manufacturer, to select one that best suits your needs. Creating a list of critical parameters is key to the selection process. Here are some things to consider:

**Resin Quantities:** One of the first factors is the amount of resin you will purchase. Do you require one or several drums, truckloads or tankers per month? This will determine whether you need to purchase a resin stocked by a distributor in a regional warehouse or one made to order by a resin manufacturer. If you are purchasing a low volume you will likely be limited to resins that local distributors have in inventory for your process and application.

**Manufacturing Process:** Next, consider the manufacturing process. Will the product be manufactured by open molding spray-up, resin transfer molding, filament winding, infusion, pultrusion, centrifugal casting, open molding hand lay-up or another process? Each process has general properties like viscosity, gel and cure that resins are commonly set up to meet. If you do more than one process in your shop, select the dominant one or the most sensitive process.

**Application and End Use:** After process consideration, the application/end use is the next component to think about. A resin best suited for a heavy truck part will be different than one for a surfboard or shower stall. Suppliers have internal lists of key properties and requirements that resins for various applications are designed to meet, so knowing the end use will narrow the choices. Consider what attributes you might need, such as corrosion or fire resistance.

In addition, you may be guided by certification requirements from organizations such as UL, FM, Lloyds of London, ANSI Z124, CSA International and DNV. Required certifications will...
Even though you have [resin] requirements, make sure you keep an open mind. There may be a better product available. New resins and additives are being developed and current products are being expanded.

dramatically narrow the list of suitable resins further. For instance, having CSA approval on the resin so your product can be sold in Canada may be an important factor in resin selection.

Regulatory Standards: Some of the standards that affect resin selection may apply nationwide, such as the Environmental Protection Agency’s Title V operating permits and Maximum Achievable Control Technology (MACT) standards. Others may be regional, such as the South Coast Air Quality Management District’s Rules 1162 and 1132 in southern California. Be sure to know any applicable state and regional hazardous air pollutant (HAP) and volatile organic compound (VOC) requirements.

HAP and VOC regulatory requirements may dictate specified limits and carry financial penalties for amounts in excess of those limits. Other limits in HAP and VOC contents can arise as production increases, such as issues related to Title V operating permits for manufacturing sites. These can also limit HAPs and VOCs that can be processed at the site for continued production without obtaining a new operating permit.

Working Properties and Specifications: The next step in the resin selection process is to consider the working properties and specifications. Key working properties include gel time, viscosity, the ability to add various levels of fillers, the ability to make a thick part in a single step and mold/demold time. These affect how the resin works on the shop/production floor and productivity.

Selecting a resin that allows workers enough time to make the part with a small cushion to accommodate processing issues, but not too much extra time, will maximize productivity per shift. Being able to make a part in a single step rather than breaking it into several steps to control exotherm, cosmetics or other properties is another thing that factors into productivity. Some raw materials like peroxides and fillers have shipping limitations, so understanding what is available in the region is important.

Finished Properties: The final step in the resin selection process is determining which finished properties your application requires. Possible properties to consider include UV resistance, corrosion resistance, fatigue performance, fire resistance, surface cosmetics, stain resistance, stiffness, strength, toughness, blister resistance, thermo-shock and color/clarity. Some of these will be covered in the application/end use step, but there may be some property requirements outside of the basics ones. Let the resin supplier know you need a specific end property, such as a temperature capability that can be defined by the heat distortion or glass transition temperature or thermo-shock.

Overall, I recommend that you create your own set of requirements based on the above criteria and pass along that important information to the resin representative. Even though you have requirements, make sure you keep an open mind. There may be a better product available. New resins and additives are being developed and current products are being expanded. An alternate resin may offer you some processing and/or performance advantages even though they may have some different working properties and specifications.

The guest columnist for this issue’s “Best Practices” column is David Herzog, director of research and development for Interplastic Corporation in Minneapolis. Email comments to dherzog@interplastic.com.

Safe, Green Acetone Replacement

Approaching our sixth decade in the marketplace, U.S. Polychem Acrastrip is a safe, green alternative for all your cleaning needs within the composite industry.

U.S. Polychem has partnered with the EPA’s Design for the Environment (“DfE”) program to promote the use of products with improved environmental and human health characteristics.

Polychem Acrastrip is non-flammable, biodegradable, has no HAPs and is re-usable. Designed as a solvent and acetone replacement product, it will effectively clean, flush and strip uncured or cured polyester, vinyl ester, epoxy resins, as well as adhesives and coatings.

In addition to our Acrastrip line, Polychem has introduced “Bio-Lock” a revolutionary way to eliminate grinding and sanding for secondary bonding!

Feel free to contact us at www.uspoly.com or 1-800-431-2072
During his expedition to the International Space Station last year, Commander Barry Wilmore misplaced a torque wrench. Orbiting approximately 200 miles above earth made it seemingly impossible for Wilmore to easily replace the tool. But the astronaut did, indeed, have a new wrench within days. Employees at the Made In Space offices in California who were in contact with the astronauts overheard the commander complain about his lost wrench, designed a replacement and transmitted the design file to the space station. Within two hours, the space station created the wrench on a 3-D printer, and the commander had a useable tool.

Additive manufacturing in space may sound like a plot to a sci-fi movie, but it’s become reality thanks to Made In Space Inc., which has developed 3-D printing technology for use in zero-gravity. Founded in 2010, the company hopes that constructing materials, tools and structures in space, rather than on earth and then sending them into the galaxy, will accelerate space development.

“Our ultimate goal is to help people live permanently in space,” says Andrew Rush, president of Made In Space. “One of the principle ways we can realize that goal is by taking manufacturing off the planet, doing it in space and developing the tools that will help people work better in space.” Made In Space decided to focus its efforts on additive manufacturing because, as Rush says, “A 3-D printer is a meta tool; it’s a tool that makes other tools.”

The first Made In Space 3-D printer – the Zero-G Printer – uses an extrusion-based printing method to layer hot liquefied acrylonitrile butadiene styrene (ABS) thermoplastics. It was launched to the International Space Station in September 2014 under a partnership agreement between Made In Space and NASA’s Marshall Space Flight Center. The printer is being utilized to test the long-term effects of microgravity on 3-D printing and understand how the technology can enable future space exploration. In its initial run, 21 parts were printed on the space station, the first one being a faceplate for the printer itself.

Printing tools in space makes sense. Launching something into outer space costs $10,000 per kilogram or more, according to Made In Space. Building there is a more economical solution.
addition, items currently used at the International Space Station must get there on a rocket, so they’re designed to withstand the launch and voyage. Rush says that leads to over-engineered items, which also are expensive.

Another argument for printing in space concerns part redundancy. NASA sends many duplicate items to the International Space Station because astronauts can’t simply purchase misplaced or broken tools and equipment like the torque wrench.

“There are literally billions of dollars of spare parts on the International Space Station,” says Rush. “Instead, we can send up raw materials and replace some of those things through additive manufacturing.”

A study by NASA found that 82 percent of failed parts could be considered preliminary candidates for additive fabrication and repair technologies.

Prior to launching anything into space, Made In Space conducted parabolic flight testing on C9 aircraft through NASA’s Flight Opportunities Program, which facilitates payload testing for companies. During the flight tests, the 3-D printer onboard built a part while the aircraft went into a freefall about 400 times (20 seconds each time) to simulate a zero-gravity environment. Successful tests led to the 2014 launch into space. “On November 24, 2014, we manufactured the very first parts in space,” says Rush.

The 3-D items built on the International Space Station returned to earth last April and are now undergoing testing. “At the most basic level, the parts were visually inspected to reconfirm what we saw in orbit – that the parts, from a macroscopic level, printed as advertised like they did on the ground,” says Rush. Made In Space and NASA are currently performing a series of nondestructive and destructive testing, including X-ray analyses and compression and flexural testing.

Made In Space also is working on the next generation 3-D printer. “The Zero-G Printer was a technology demonstrator – the beating heart and brain of a 3-D printer,” says Rush. “But it wasn’t the full package.” The next version, called the additive manufacturing facility (AMF), will print on an expanded range of materials, including ABS, high-density polyethylene and polyetherimide/polycarbonate. It will feature an independent power system. The AMF also is designed to be very modular and simple to upgrade so astronauts can easily swap out parts, such as the extruder.

Made In Space’s goal is to partner with other companies to ultimately manufacture multimaterial, complex applications not just on the International Space Station, but throughout the galaxy and in a vacuum. In October, the company teamed with hardware retailer Lowe’s to launch the first commercial 3-D printer in space. Together they will bring tools and technology to astronauts on the International Space Station. So when crew members like Commander Wilmore lose a wrench, they can do what many people would in that situation – turn to Lowe’s for a replacement.

Susan Keen Flynn is managing editor of Composites Manufacturing magazine. Email comments to sflynn@keenconcepts.net.

For more stories like this, visit CompositesManufacturingMagazine.com and check out the Aerospace articles under the “Market Segments” tab.
A Racing Helmet

While some motorcycle racers might be leery of a helmet that’s thinner and lighter, helmet manufacturer Bell Powersports recognizes that using composites can better protect racers. The company’s new Pro Star helmet combines its Flex Impact Liner technology with a CFRP shell reinforced with TeXtreme® spread tow carbon fiber fabric. Integrating the ultra-thin carbon fiber fabric into the shell has reduced its weight by 21 percent.

Weight reduction is critical, says Dave Kolosek, North American sales manager for Oxeon, which manufactures TeXtreme. “First, races last approximately 45 minutes, and average speeds are in excess of 150 miles per hour so it is very demanding on the athlete’s body. Therefore, every gram that can be saved has a cumulative effect on reducing the neck fatigue of the rider over a race,” he says. “Secondly, reducing the weight of a helmet has very positive effects from a safety viewpoint. Should an accident occur, the reduced mass of the helmet can help in offsetting rotational forces.”

Spread tow carbon fiber fabrics weave a high-count carbon fiber tow – in this case 12,000 filaments (12K) – into a lightweight fabric. This allows for thinner laminates and straighter fibers with reduced crimp, according to Oxeon. Fewer crimps, in turn, help to reduce weight as there are fewer places which need to be filled with resin.

Two composite products are taking advantage of the material’s strength and lightness to offer previously unseen levels of protection from head to toe – a motorcycle helmet and an advanced orthotics system.
Oxon tested many layup sequences to see which would provide the desired weight savings yet still pass the testing protocol. “The unexpected part was how thin we could make the shell and still have it perform,” says Kolosek. “This was due to having multiple thin plies of TeXtreme working together to deflect upon impact while not delaminating.”

The helmet shell, which is bladder molded, is not only lighter and thinner than previous versions, but it also is stiff and strong enough to pass Bell Powersports’ in-house cold and hot impact tests as well as all required third-party testing. “You would think a thinner helmet would not be durable enough, but that’s one of the big benefits of TeXtreme and thin ply construction,” says Kolosek.

“Multiple thinner plies are able to work better together under deflection than fewer thicker plies over the same total thickness, thereby significantly reducing interlaminar shear.”

Replacing the 3K carbon fiber with TeXtreme increased the stiffness of the helmet shell, which ultimately improved impact energy distribution. In addition, by shaving weight off of the shell, Bell’s engineers could add more foam to increase the interior padding thickness, further improving overall impact performance. “Even though we are talking about millimeters, anything they can do to increase the padding size is beneficial in terms of safety,” Kolosek says.

Dr. Steven King, managing member of Kinetics LLC and a former Army podiatrist, is focused on protecting feet from a range of hazards, including musculoskeletal injuries, punctures and improvised explosive device (IED) blasts. A breakthrough moment came after King suffered a stress fracture in his own foot. Rather than undergoing surgery to place a screw in his foot, King searched for orthotics with the necessary stiffness to limit the strain on the healing fracture site. But King discovered that most orthotics were made of blown foams, so he designed a new orthotic insole that combines a...
CFRP spring plate and lever.
The “simple machine” physics of the spring and lever offer not only comfort, but harvest potential energy as the heel hits the ground, turning that movement into kinetic energy that speeds movement and improves stability. “Spring steel plates have been used in the past for foot pathologies … but the makers of spring steel switched to carbon composites,” King says. “I found samples of both materials and discovered that steel was heavier and had less energy return, but it did last a little longer.”

With the help of design and manufacturing firm Rocket Composites Inc., King began modifying composite components to create the desired end result. The spring is a combination of woven and unidirectional carbon fibers, Kevlar® and epoxy resins, manufactured through compression molding. “The strength and design flexibility of the carbon fiber and the resistance of the Kevlar made composites an obvious choice,” says Paul Hewitt, owner of Rocket Composites.

King hopes his orthotic insole will someday protect soldiers in the field. Through a Small Business Initiative Research Grant sponsored by the Department of Defense (DOD) and Army Medical Research and Materials Command, King explored how composite-based orthotics could better protect soldiers than the polyurethane and ethyl vinyl acetate foam products currently used. Testing indicates that the Kingetics’ product can increase puncture resistance of the U.S. military’s current footwear by 300 to 1,000 percent while also offering additional material protection from IED debris.

King says that not only is the system stronger, but it’s also up to 30 percent lighter than the current DOD-procured combat boots. By reducing the weight of the footwear, the wearer requires less energy to stride – and the carbon fiber better reuses the energy generated from the foot hitting the ground, King explains.

King also notes that the orthotic insole provides a sturdy shock absorbing system that can decrease the risk of musculoskeletal injuries. “I’m running marathons and climbing in them,” says King. “If they didn’t work and weren’t more comfortable for me, I wouldn’t wear them.”

Megan Headley is a freelance writer based in Fredericksburg, Va. Email comments to rmheadley3@gmail.com.

For more stories like this, visit CompositesManufacturingMagazine.com and check out the Sports & Recreation articles under the “Market Segments” tab.
TAKE YOUR IDEAS TO NEW DIMENSIONS
SAERTEX 3D Fabrics

This new NCF incorporates reinforcing fibers not only in 0° and 90° directions but also through the thickness (Z).

- Reduced lay-up time for thick parts
- Infusion rates twice as fast as 2D woven fabrics
- Excellent delamination suppression and fracture toughness

Achieve more with another innovation from SAERTEX.

www.saertex.com
Someday that big rig you see on the highway will be greener – at least in environmental terms if not in actual hue. That’ll be thanks, in part, to composites.

A case in point comes from Volvo Group Trucks Technology. The company, which has its U.S. headquarters in Greensboro, N.C., is the research, engine development and product design arm for the Volvo Group, a leading manufacturer of trucks, busses and construction equipment. Trucks must get leaner for a variety of reasons, says Saeil Jeon, technical lead for materials for advanced technology and research. "The truck needs to lose weight in order to improve fuel efficiency as well as to increase load capacity for the next generation," he says.

Both customers and the government are pushing for this, Jeon adds. Class 8 tractor-trailers, such as the classic 18-wheeler, make up only five percent of the vehicles on the road but consume 20 percent of the fuel, according to the U.S. Department of Energy. That’s not surprising since such trucks averaged only 5.8 miles per gallon in 2014.

The U.S. Environmental Protection Agency has proposed that tractor-trailers cut fuel consumption by 24 percent by 2027. That would result in billions of dollars of savings in fuel costs. Hitting those targets will likely require a combination of engine improvements, weight reduction and better aerodynamics. Additional means to raise fuel efficiency could involve cutting idling time and other operational changes. What’s more, stronger materials allow for an increased load capacity. For the end users of 18-wheelers, the result will be more freight transported for less, a powerful reason for them to push truck manufacturers.

For its part, Volvo also is looking to use materials that provide added benefits. “We want to use materials that have better environmental durability," Jeon says. Another need, he notes, is for better and easier assembly. That's important because everything eventually has to be fastened together in an economical way to make the entire tractor-trailer combination. That can be difficult at those points where two very dissimilar materials come together.

Jeon has been working with resin manufacturer Arkema, which has its U.S. headquarters in King of Prussia, Pa., to develop and characterize composite solutions for eventual use in truck body panels. One solution involves recycled carbon fiber. Jeon says that virgin carbon fiber is currently too expensive for ground transportation, but recycled carbon fiber (rCF) has good mechanical properties and is cost effective.

Volvo’s research efforts have focused on a dry woven mat that includes a polypropylene resin system reinforced with rCF. Together with other materials and manufacturing changes, the result could be a 29 percent weight reduction.

In constructing demonstration truck parts, the research team used the rCF thermoplastic prepreg in a standard vacuum infusion process with some proprietary tweaks applied. They created a part and subjected it to heat and pressure to cure the material and ensure the finished part is the proper shape.

Using recycling carbon fiber in the process pays multiple dividends, Jeon notes. For instance, in comparing this approach to glass thermoset sheet molding compounds (SMCs), the greater strength of the carbon fiber means that less of it must be used. In studies where a minimum tensile strength of 5000 psi is required, only 2.5 pounds of rCF is needed. In comparison, 11.25 pounds of glass thermoset material must be used.

Using less material saves 8.75 pounds. Even though the recycled carbon fiber is 2.5 times more expensive, using it also saves money – $30 a part in one study. Both positives result from the fact that carbon fiber used as a reinforcing material yields parts that are 4.5 times stronger.

The recycled carbon fiber-based approach also produces other benefits. For one thing, it diverts what would potentially otherwise be a scrap material into new uses. In addition, the resulting parts are end-of-life recyclable. Finally, it lowers storage costs because no refrigeration is required for rCF prepreg as is the case with virgin carbon fiber prepreg, according to Jeon.

Because these parts are ultimately intended to be assembled into a truck body, the researchers also looked into the ability to paint the material and achieve a Class A finish. At a presentation at CAMX 2015, Jeon said, “Initial adhesion testing of the top coat painted recycled carbon fiber shows that the substrate can provide that level of required quality for exterior outer body panels.”

While initial results are promising, there are several hurdles that still have to be overcome before the material can go in to
production. One is that presently it’s not known how to do mass manufacturing of large components, Jeon says. Secondly, the complete aspects of paint adhesion are yet to be determined. Third, the full environmental impact and durability of the new material is also unknown. A fourth and final parameter that hasn’t been completely characterized yet is the impact of fatigue on the material.

The current goals of the project, therefore, are complete material characterization, development of the process technology, proper sizing of the fiber to the matrix and application of the material to an exterior component. After that will come a road test, something that Jeon hopes to be ready for within a few years. Ultimately, the rCF thermoplastic prepreg could replace current thermoset SMCs for manufacturing components via compression molding for the next generation of trucks.

Hank Hogan is a freelance writer based in Albuquerque, N.M. Email comments to hank@hankhogan.com.
Making Inroads in Infrastructure
Selling in the infrastructure segment isn’t easy, but there’s light at the end of the tunnel.
By Susan Keen Flynn

When Canadian Pacific Railway needed to renovate an old, decaying steel bridge in Fernie, British Columbia, it turned to HCB Inc. In late October 2014, Canadian Pacific crews replaced the original bridge with two parallel prefabricated bridge modules utilizing Hillman Composite Beams (HCB®).

“When in its simplest embodiment, the HCB is an FRP box with a steel tension tie in the bottom flange resisting the thrust from a concrete arch inside the box,” says John Hillman, CEO and president of HCB Inc. The FRP outer shell provides shear strength, the concrete arch offers compressive strength and the steel reinforcement running longitudinally provides tension capacity.
The composite solution is ideal for railroad bridges, which are typically installed with rail-mounted locomotive cranes, often in remote locations. “Canadian Pacific decided that a concrete span would be too heavy for the cranes and steel is too expensive,” says Hillman. “So HCB became Goldilocks on that project. It fit just right.”

The 33-foot long, single span bridge was installed in under 10 hours. This was critical to the customer because railway traffic must be stopped during construction. “The HCB span was installed in even less time than anticipated, providing us the ability to ‘give back the track’ and resume train operations quickly and effectively,” says John F. Unsworth, deputy chief of engineer structures for Canadian Pacific Railway. “The installation was a resounding success.”

The railroad bridge in Fernie is one of nearly 20 HCB installations in North America since 2007, when the company first introduced the product. Structural beams like the HCB are among a handful of FRP products making headway in the infrastructure market. Others include bridge decks, rebar, strengthening structures and pilings.

“Infrastructure is a promising area, but it’s going to take time to work our way forward,” says Scott Reeve, president of Composite Advantage, a Dayton, Ohio-based company that supplies FRP products for bridges, waterfront infrastructure and rail platforms.

Overcoming Roadblocks

Companies committed to advancing composites in the infrastructure market face some roadblocks. “It’s the FUD factor – fear, uncertainty and doubt,” says Doug Gremel, director of nonmetallic reinforcing for Hughes Brothers Inc. in Seward, Neb. His company began bridge work more than 20 years ago. “Government bureaucrats are usually the owners or specifiers of bridge materials, and they aren’t typically open to change because there’s high risk. So while we may have a great solution that’s becoming more proven, they’re not going to be among the first to adopt something new.”

One of the ways Hughes Brothers alleviates customer concerns is by examining bridge materials it installed 15 years ago to prove their reliability. Last summer, the company began partnering with two universities, Owens Corning and state Departments of Transportation to core and extract GFRP rebar samples from bridges in Missouri and Texas. They use a scanning electron microscope and energy dispersive X-rays to look for chemical traces of degradation. “We’re not finding anything,” says Gremel. “That’s very reassuring.” Hughes Brothers and its partners foot the bill for these bridge examinations, hoping they will reassure prospective clients, too.

HCB Inc. also invests in testing to persuade clients of the advantages of composite solutions. “We’ve done various types of testing with our technology – either in the laboratory or in situ – including 13 research projects conducted by eight different institutes to the tune of about $3 million,” says Hillman. The company conducted full-size prototype testing on the first four bridges it fabricated with its proprietary beams. It examined fatigue, ultimate strength, skewed effects, lateral impact and other factors. “The challenge we have with highway projects is that despite all the testing, when we go to a state that hasn’t deployed FRP in a bridge they often want to start from scratch,” says Hillman.

Another challenge is getting in front of the right customer. “In the transportation industry, you really cater to three different clients,” says Hillman. “You’ve got to make the owners interested in using your technology in their infrastructure assets, convince the designers that it’s as good or better a solution as the existing technologies and persuade the contractor it’s simple to install.”

He adds that most of the time the owner and designer will specify materials, but the end client is the contractor who buys them. “Contractors are the definitive voice because they are ultimately responsible for installing your technology,” he says. “If they perceive a benefit, then composites will be attractive to them.”

Despite the benefits, the biggest hurdle to selling GFRP products is often cost. “The price of our product is higher than the price of the traditional product,” says Reeve. “We offer many benefits over traditional materials – corrosion resistance, low...
FAST Act: Not so fast, but worth the wait

By MJ Carrabba

In late 2015, Congress approved and President Obama signed the Fixing America’s Surface Transportation (FAST) Act, the long-awaited highway bill. After many years of short-term extensions of federal authorization of new construction of roads and bridges, House and Senate leaders advanced the overwhelmingly bipartisan legislation that funds infrastructure and transit projects through 2020 to the tune of $305 billion.

The legislation includes a significant victory for the composites industry. Under previous legislation, a U.S. Department of Transportation (DOT) program called the Innovative Bridge Research and Construction program (IBRC) funded the construction of more than 300 bridges throughout the country using innovative materials and technologies. Over half of these bridges featured composite reinforcing components like FRP rebar, deck, girders and more. Between composites and the other innovative materials used in this program, this set of bridges represents arguably the best unified sample of the use of innovative materials in bridge construction.

The performance of these bridges could shed serious light on the technologies that need to be deployed to build the highest quality 21st century infrastructure. However, DOT had failed to do any follow-up examination since the last bridge was installed over a decade ago. ACMA worked closely with leaders in the House and Senate to include language in the FAST Act that directs DOT to contract with the Transportation Research Board to undertake a comprehensive review of the bridges built under the IBRC and assess the performance of innovative materials compared to traditional construction technologies. This authoritative third-party assessment of composite infrastructure components will provide our industry with crucially needed performance data that can help companies compete against steel and other metals.

The legislation also significantly increases the amount of money allocated for road and bridge construction beyond current levels. It achieves funding certainty for five years through a combination of financing mechanisms, including liquidation of over $19 billion from the Federal Reserve’s “rainy day fund.” It also streamlines the environmental review and permitting process, accelerating project approvals but not sacrificing important environmental protections. Another important hallmark is the inclusion of language that substantially increases transparency by requiring the Federal Highway Administration to provide project-level information to Congress on all major federally funded infrastructure projects. The same information must also be made available to the public through a new online database.

These are just a few key aspects of the 1,300-page legislation, which also includes major reforms to the passenger rail system, reauthorization of the Export-Important Bank and a slew of other policies. The legislation isn’t perfect and could go a little farther toward refocusing our national infrastructure paradigm and providing permanent funding solutions. But for once in this highly polarized political climate, Congress didn’t let perfectionism be the enemy of a good bill. And for that we have much to be happy about.

MJ Carrabba manages legislative affairs for ACMA. Email comments to mcarrabba@acmanet.org.

maintenance and life cycle savings. However, if the customer doesn’t value those benefits, it doesn’t matter.”

Reeve says one strategy that makes Composite Advantage successful is selling complete solutions – GRFP bridge decks with curbs, railings, drainage troughs and other elements in place. “When I work with designers and contractors, what sells best is a product that comes to the construction site ready to drop in and bolt down,” he says.

In November, Composite Advantage installed a vehicle bridge deck in Ottawa, Canada. The prefabricated FiberSPAN™ sandwich deck replaced a deteriorating concrete deck on a historic steel truss bridge. The company supplied 14 panels, measuring 18.6 x 9.67 feet, that were molded with accompanying crowns and drainage scuppers. It also pre-applied the wear surface. The installation took place during three very cold days, with tight access on the old steel truss bridge. “FRP costs more, but when owners, designers and contractors understand what we can save them in construction costs and installation time, then more of them are willing to consider our products,” says Reeve.

Sometimes, however, even customers’ hands are tied by governmental regulations. For example, Title 23 of the Code of Federal Regulations (CFR) contains rules issued by federal agencies regarding highways. Subsection 635.411 of the CFR states that federal money can’t be used to purchase proprietary items for implementation in a national highway infrastructure. “The very existence of that provision for decades now has created
this culture of aversion to patented technology in our nation’s infrastructure,” says Hillman. “And it’s that kind of stigma that creates an enormous disincentive for people to either create innovative technologies, invest in those technologies or specify or deploy them.”

The provision hits home with HCB Inc. because of its patented beam technology. Luckily, there are a few caveats that allow for implementation of the Hillman Composite Beam. Companies can use proprietary items on national highway projects if they are required for synchronization in an existing system, are part of a demonstration project or are cheaper than non-proprietary items.

The last is difficult to do if you’ve got a new technology in a young industry, says Hillman. But HCB is working on modifications to the manufacturing process and materials of its structural beams that Hillman hopes will reduce costs by 15 to 20 percent. “If we can do that, we are rapidly converging on the cost of conventional bridge technology,” says Hillman. “Once it’s less expensive, anyone can use the product. So that’s kind of the Holy Grail for us.”

Expanding the Market

Companies can’t simply sit back and wait for the infrastructure market to explode. They need to actively make it happen. Here are a few tips on ways to penetrate and expand the niche market:

Educate end users. In addition to meeting one-on-one with customers, Hillman hosts webinars and gives presentations. He led a workshop entitled “Emerging Technologies” at the 2015 National Accelerated Bridge Construction Conference in December in Miami.

Talk about price early. “The discussion of price has to come up in either the first or second conversation,” says Reeve. “Having lots of conversations on the wonderful technical merits of our products is very nice, but price is going to be a major factor.” He would rather not spend lots of time on prospective projects that aren’t going to pan out because of cost concerns.

Fit the system. “We try to make our technology interchangeable with conventional bridges so you don’t need any special equipment or knowledge to install it,” says Hillman. FRP products also have to work with other materials and components in the structure. “Just because you can make an FRP panel and it tests well in the lab doesn’t mean that’s the right thing to put on a bridge deck,” says Reeve. “There are a number of considerations around the connections [to other parts], wear surface and temperature fluctuations.”

Consider common applications. While big vehicle bridges and eye-catching pedestrian bridges get all the attention, there are other composite applications where companies can make an impact. “Structural strengthening is a growing field because there’s a bigger installed base of bridges and things that need remediation to keep going,” says Gremel. “FRP plays a really important role there.” Other applications include GFRP dowel bars for load transfer between joints in concrete slabs and GFRP pile repairs to support piers, roadways, buildings and bridges.

Take a hybrid approach. “The first bridge decks we did were
just FRP composites,” admits Reeve. “Now all of our bridge decks make some use of steel to handle those concentrated loads and impact points.”

Most importantly, says Hillman, it will take a concerted effort by the entire industry – manufacturers, suppliers and ACMA – to gain significant penetration in the transportation segment of the infrastructure market. “There needs to be a very high level of commitment to assisting companies in developing and deploying these technologies,” he says. “When you add up all the other barriers to increasing market share of composites, it’s easy for people to give up. It takes a certain level of support to gain critical mass, where composites can be as ubiquitous as conventional technology.”

But Hillman remains optimistic. So do Reeve and Gremel. FRP products can become part of the mainstream in infrastructure. They can take over Main Street.

Susan Keen Flynn is managing editor of Composites Manufacturing magazine. Email comments to sflynn@keenconcepts.net.

Attend ACMA’s Infrastructure Day
Join fellow ACMA members in Washington on February 10 to meet members of Congress and agency leadership and educate them on composites in key infrastructure applications, including highway bridges, utility poles and cross arms, pipes, tank, locks, levies and more. For more information, contact MJ Carrabba, ACMA’s manager of government and industry affairs, at (703) 682-1668 or mcarrabba@acmanet.org.

Delivering the Future of Composite Solutions

With engineering and sales offices in the US, Europe, and Asia/Pacific, as well as production sites in North America, Europe and Asia, Gurit is ideally positioned to serve its local customers with truly global resources.

Gurit ensures the success of any project through its extensive experience across a variety of markets, combined with unrivalled engineering support and design services, the industry’s best kit designs and production, and customer-focused local sales support.

Contact us today to learn how Gurit can help you.

For more information on Gurit’s full composite offering and expertise:

www.gurit.com
In the composites industry, one of the best ways to judge success is to look at end product demand. The demand for composite end products – ranging from utilitarian underground pipes to high-performance aircraft – reached $21.2 billion in 2014 and stayed the course in 2015, reaching $22.2 billion.

The U.S. composite materials industry grew 5.6 percent in 2015 in terms of dollars shipped and reached $7.5 billion overall. Looking ahead, the key economic indicators and market dynamics suggest 2016 growth at approximately 5.4 percent to reach $7.9 billion. Approximately 5.7 billion pounds of composite materials were shipped in the U.S. in 2015 and that number is forecast to grow to 6.9 billion pounds in 2021 at a compound annual growth rate (CAGR) of 3.2 percent.

Raw Materials Outlook

Any examination of the industry requires a closer look at the status of reinforcements and resins. This year, Lucintel expects increased innovation in the development of low-cost carbon fibers across a wide variety of mass volume applications. Carbon fiber is significantly more expensive than glass fiber, so it is mainly used for high-performance applications where weight
saving requirements are critical. There are a growing number of research projects around the use of lignin or other precursors to reduce the price of carbon fiber. Specific applications are driving carbon fiber demand in the U.S., including the rising use of carbon fiber in next-generation aircraft, electric and sports cars, and wind turbine blades, which are getting increasingly longer.

While carbon fiber is making inroads in the industry, glass fiber remains in high demand. Over the last 70 years, glass fiber has been used in thousands of applications and has thus demonstrated an excellent track history. Lucintel anticipates increased development of high-performance glass fibers to meet higher mechanical and chemical requirements, as well as development of high-strength natural fibers to increase penetration in automotive, construction and other industries.

In the resin market, four trends will continue for next year: shorter cure times for mass volume applications, development of resins with optimum gel times for long wind blades, development of low-cost and high-strength nano resins, and development of bio resins for various applications. Despite these advances, in many industries – such as construction, marine and automotive – polyester resin continues to be the workhorse because of its low cost and high corrosion resistance.

One issue in the composites industry remains the lack of standardized grades of raw materials, which hinders widespread use of CFRP and GFRP.

**A Shift in Manufacturing Processes**

In the U.S. composites industry, fabrication processes have long included hand lay-up, spray-up and filament winding. Currently, there is big shift taking place as many manufacturers are transitioning from these open molding processes to closed molding, such as resin transfer molding (RTM), compression molding and vacuum infusion processing.

The fabrication method is typically dictated by volume or the shape and size of the composite part. Compression molding, injection molding and RTM are the preferred manufacturing processes for mass volume applications, whereas hand lay-up and vacuum assisted RTM are preferred for applications requiring less than 1,000 parts annually. Filament winding, roll wrapping and centrifugal casting are ideal for making tubular parts.

The graph on the left shows how fiber length, cycle time and part complexity also converge to affect selection of a fabrication process.

**Market Segment Trends**

Transportation, construction and aerospace were the largest market segments within the composites industry in 2015, representing 62 percent of its total value. The growth of composite materials in newer airplanes, such as the Boeing 787 and Airbus 350 and 380, has played a part in aerospace overtaking the pipe and tank market in the top three last year. The chart below provides forecasts for several composites market segments from 2015 to 2021 in terms of billions of dollars shipped. Out of all markets listed, aerospace has the highest potential for growth, with a CAGR of 9.5 percent over the next six years.

Now let’s take a closer look at five markets.

**Automotive:** The automotive sector continues to be the largest market for composite materials, with annual growth of 4.1 percent in 2015 in terms of volume of shipments. OEMs are continuously looking for innovative materials to curb vehicle weight and achieve fuel efficiency and carbon emission targets.

Perhaps the biggest trend in the automotive industry is the development of technologies for making carbon fiber parts for mass volume vehicles. Automotive OEMs continue to

**U.S. Composite Materials Demand Forecast ($Billion)**

<table>
<thead>
<tr>
<th>Applications</th>
<th>2015</th>
<th>2021</th>
<th>CAGR (2015-2021)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation</td>
<td>2.4</td>
<td>3.3</td>
<td>5.2%</td>
</tr>
<tr>
<td>Marine</td>
<td>0.4</td>
<td>0.5</td>
<td>3.2%</td>
</tr>
<tr>
<td>Wind Energy</td>
<td>0.2</td>
<td>0.4</td>
<td>8.0%</td>
</tr>
<tr>
<td>Aerospace</td>
<td>0.8</td>
<td>1.4</td>
<td>9.5%</td>
</tr>
<tr>
<td>Pipe &amp; Tank</td>
<td>0.7</td>
<td>0.9</td>
<td>3.0%</td>
</tr>
<tr>
<td>Construction</td>
<td>1.4</td>
<td>1.8</td>
<td>4.1%</td>
</tr>
<tr>
<td>Electrical &amp; Electronics</td>
<td>0.7</td>
<td>0.9</td>
<td>3.8%</td>
</tr>
<tr>
<td>Consumer Goods</td>
<td>0.4</td>
<td>0.5</td>
<td>3.6%</td>
</tr>
<tr>
<td>Others</td>
<td>0.4</td>
<td>0.5</td>
<td>5.7%</td>
</tr>
<tr>
<td><strong>Total ($B)</strong></td>
<td><strong>7.5</strong></td>
<td><strong>10.2</strong></td>
<td><strong>5.1%</strong></td>
</tr>
</tbody>
</table>

*Source: Lucintel*
form strategic alliances with carbon fiber suppliers, composite part manufacturers, machine suppliers, research institutes and universities to address various challenges, such as cycle time, raw material cost, tooling, repair and recycling.

U.S. production of light vehicles increased from 7.6 million in 2010 to 11.7 million vehicles in 2015, representing a 54 percent growth. Light vehicle sales also have grown by 50 percent since 2010, rising from 11.6 million to 17.4 million vehicles in 2015. Light vehicle production will continue growing next year but may plateau in 2017. A variety of factors influence the growth in automotive demand, including lower fuel prices, job gains, easy availability of credit and increasing consumer confidence.

Currently, prepreg lay-up and resin infusion process are the primary manufacturing methods for making CFRP parts for mass volume applications in the automotive industry. But both automotive OEMs and carbon fiber stakeholders are heavily betting on technologies such as high pressure RTM, prepreg lay-up and continuous fiber reinforced thermoplastics, as the figure above indicates.

Construction: Composites demand within the construction segment registered 6.2 percent growth from 2014 to 2015 in terms of the volume of shipments. Construction continues to be the second largest market for composite materials after transportation. The growth in housing starts is driving the demand of FRP bathtubs, doors, windows, panels and other applications.

Overall, U.S. housing starts grew for the sixth consecutive year, reaching approximately 1.14 million units in 2015. The growth was propelled by a continuous increase in employment, low mortgage rates and slowing house price inflation. Other major drivers for the market are the easing of lending standards and increasing funding support from state and local construction measures.

Aerospace: The aerospace industry is one of the largest and most important segments within composites. Lucintel estimates that composite materials demand in the U.S. aerospace industry grew by 9 percent in 2015 in terms of the volume of shipments and is likely to experience similar growth in the next five years.

Composite materials consumption has increased significantly in the commercial aerospace sector. In the 1990s, aircraft contained 5 to 6 percent composite materials, whereas today's advanced aircraft programs utilize more than 50 percent composites content. Major OEMs, such as Boeing, Airbus and Bombardier, have robust plans to increase the monthly production rate of their major platforms. Boeing, the largest U.S. composite consumer in the aerospace industry, is expected to experience a 6.5 percent increase in annual commercial aircraft deliveries to 770 units in 2016.

Pipe & Tank: Demand for composite materials in the pipe and tank market declined by 5.5 percent in 2015 due to a huge drop in oil and gas activities. U.S. oil and gas companies decommissioned more than half their rigs and sharply cut
investments in exploration and production. One main cause is the plunging price of oil, which decreased by more than 40 percent per barrel in 2015. According to Baker Hughes Inc., the rig count has fallen by more than 45 percent to an average of 1,026 during the first nine months of 2015.

Wind Energy: In the U.S., the total composites market in wind energy grew by 24.2 percent in 2015. Last year, the Department of Energy funded $1.8 million for the support of research and development to improve the manufacturing, transportation and assembly of wind turbine blades larger than 60 meters. This initiative shows the United States’ commitment to the development of renewable energy. The U.S. wind energy growth is predominantly dependent on the Production Tax Credit (PTC). Approximately 6,500 megawatts (MW) of new wind capacity was anticipated to be installed by the end of 2015, which is a 34 percent increase from 2014, but still short of the record 13,124 MW installed in 2012. However, the industry witnessed strong federal and state incentives to invest in new wind facilities in 2015 and 2016. There are uncertainties in a PTC extension beyond 2016, which could lead to a boom and bust cycle in the market.

The [employee] skill set required in the future will not be the same as 20 years ago, when composite parts were made using manual chopped guns, buckets and brushes.

Opportunities and Challenges

In the next 50 years, there will be significant innovations in the composites industry as demand picks up across all market segments. Many of the innovations will be aimed at increasing performance, reducing cost and process time, and making applications more environmentally friendly.

The anticipated growth of the composites industry is likely to create a huge demand for well-trained composite technicians, engineers and designers. The skill set required today and in the future will not be the same as 20 years ago, when composite parts were made using manual chopped guns, buckets and brushes. The composites industry is continuously moving toward automated manufacturing processes, such as HP-RTM, automated tape lay-up and automated fiber placement. There’s also an influx of better design and simulation tools. These techniques and tools necessitate that composite designers and engineers have a deep understanding of composite materials to identify solutions for current and future challenges.

However, the composites industry struggles to attract and educate new talent. There’s a huge need for universities to create undergraduate degree programs focused on the design,
testing, manufacturing and repair of composites. The challenge for companies is not only to attract young graduates but also to retain existing skilled technicians and designers. Lucintel envisions an emergence of training institutes in the next five years to develop skilled laborers for the composites industry.

Another challenge for the composites industry has been its inability to leverage its potential. Composites account for only about 1 percent of the total structural materials market by volume. This provides ample opportunity to grow in various industries by replacing traditional materials, such as steel and aluminum. The industry needs to work on four areas to drive growth and thus gain a competitive edge over traditional materials:

- **Education to engineers and designers** about the benefits and use of composites for mass volume markets. Most engineers are unaware of the advantages of composites and still rely on black metal for structural applications. Educating engineers is the first step toward designing innovative parts in new applications.
- **Development of a cradle-to-grave infrastructure**, thereby addressing composites repair and recycling issues.
- **Development of a mature advanced manufacturing process** targeting one to two minutes cycle time for mass volume markets where high cycle time is critical. Most current composite part manufacturing processes are either completely manual or partially automated and don’t meet the required cycle times.
- **Reduction in the price of advanced fibers and parts** to make them competitive with steel and aluminum parts. Most of the major markets for composites are highly cost sensitive.

The high price of composites, especially carbon fibers, restricts potential leverage in many applications. For example, automotive OEMs demand carbon fiber within the range of $5 per pound, whereas the current price is approximately $10 to $15 per pound for automotive applications. Industry leaders are working on alternative precursors and advancements in manufacturing processes to curb material costs and reduce the overall energy cost with the ultimate goal of producing low-cost carbon fiber.

Overall, Lucintel is optimistic about the composites industry for 2016 and beyond. If all major players in the industry work together – researchers, suppliers and manufacturers – the future is bright.

Dr. Sanjay Mazumdar is CEO of Lucintel, a global market research and management consulting firm. Email comments to sanjay.mazumdar@lucintel.com.

---

**Receive Monthly Industry Reports**

Did you find this insight useful? ACMA members can receive monthly reports from Lucintel, one of the association’s affinity partners. For more information, contact Paul Hirsh at phirsh@acmanet.org.
From stack linings in coal-fired power plants to large tanks for chlorine bleach storage, composite applications can withstand some very harsh industrial settings. The reason these structures are so tough? Their resins. Resilient resins are the workhorses of the composites industry. Used in industrial, transportation and building applications, resins can imbue a composite material with properties to resist corrosion caused by alkaline and acidic environments, to withstand high heat and to retard the spread of flame, smoke and toxic gases.

Corrosion and heat-resistant resins generally fall into one of these chemical classes:

- Isophthalic polyester resins
- Epoxy vinyl ester resins
- Epoxy novolac vinyl esters
- Urethane-modified vinyl ester
- Bisphenol A fumurate polyester resins
- Bisphenol epoxy vinyl ester resins
- Chlorendic polyester resins

The selection of a specific polymer for a resin formulation depends on the environment where the composite material will be used. Isophthalic polyesters, for example, are used primarily for light to moderate duty service, like piping in seawater environments. Epoxy vinyl ester resins, on the other hand, can handle moderate to heavy duty corrosives, making them a good choice for mineral and chemical processing. Epoxy novolac vinyl esters can withstand higher temperature conditions than many other resins, while bisphenol A epoxy vinyl ester offers both anti-corrosive and fire retardant properties. Flexibilized epoxy vinyl ester resins make a good anti-corrosive lining for metal tanks because they can stretch enough to accommodate the different rate at which metals and composites expand.

Resin producers offer their corrosion-resistant and heat-resistant products in different formulations. Ashland has been evolving its Derakane™ line of high-performance, thermoset epoxy vinyl ester resins for 50 years; it now has 15 different formulations designed for specific purposes and geographic areas. The variety enables fabricators to find the right epoxy for everything from chemical storage tanks, process piping, scrubbers, stacks and cooling towers to cladding, siding and roofing for buildings in corrosive and high-temperature environments.

In Alberta, Canada, AOC LLC provided Chemposite Inc. two different formulations of its Vipel® resin for a facility that moves hydrochloric acid from trains to transport trucks. The Vipel F010 resin, included in the structural layer of four fiberglass surge capacity tanks, is a premium bisphenol A epoxy vinyl ester. It offers a good balance of corrosion resistance and processability, according to AOC. For the tank liners, Chemposite chose Vipel F085, an epoxy novolac vinyl ester resin, because of its organic solvent resistance and high-temperature properties.
Belco Manufacturing Co. Inc. employed another AOC Vipel resin, K022-C vinyl ester, for the manufacture of carbon adsorption vessels for a wastewater treatment plant in Birmingham, Ala. The adsorbers are part of the plant’s odor abatement system, which removes hydrogen sulfide from select points throughout the system. With the corrosion-resistant resin, the composite vessels are able to resist long-term exposure to the moisture-laden hydrogen sulfide environment. The vessels and ducting also had to meet E84 Class 1 flame spread requirements.

**Fire-retardant Technology**

There are fewer polymer categories for flame and smoke-inhibiting resins. Most come from vinyl esters (including brominated epoxy vinyl ester); polyesters (including brominated polyesters); and modified acrylics (non-brominated).

Bromine was one of the first fire-retardant technologies in the composites industry. Fabricators initially used brominated polyester resins but eventually moved to brominated epoxy vinyl ester resins because of their better mechanical properties.

While bromines limit the spread of fire, they can also give off a lot of deadly smoke. This is a problem in areas where there are a large number of people but limited exit options (movie theaters, railway cars, etc.). In response to these concerns, resin companies have developed non-brominated fire-retardant products.

Ashland offers non-brominated, modified acrylic resins under the Modar™ label. Mass transit vehicles and rail cars throughout Europe include interiors made with Modar resins. Composite Panel Systems also used a next-generation Modar resin in its innovative Epitome composite foundation wall system.

“The chemistry was specifically designed to replace poured concrete in residential foundations,” says Thom Johnson, Ashland’s market manager for specialty resins. “The structure is a foam-filled sandwich panel that gives three times the tensile strength of concrete walls and has really good fire retardant properties.” Built offsite, the Epitome panels are shipped to a job site and dropped onto concrete footers in the foundation hole. A poured concrete foundation typically takes seven to 10 days to complete; with Epitome, it takes just a few hours to finish a fire-retardant foundation. The wall system passed the National Fire Protection Association’s 286 room corner burn test and therefore doesn’t require a thermal barrier, such as drywall, prior to occupancy.

Polyn Composites USA Inc. introduced its own version of a halogen-free, unsaturated polyester resin in 2011, winning a JEC Innovation award for resin and gel coat meeting the highest fire railway standard. FireBlock™ uses intumescence to prevent a fire from spreading, according to Steve Voeks, research and development director at the company.

Bombardier Transportation included FireBlock in parts manufactured for the new monorail system in São Paulo. Carlson Engineered Composites Inc. uses FireBlock gel coat and laminating resin in interior parts and wheel wells for New Flyer city buses. These city buses are in full production for use across North America. At Stanford University, custom fabrication firm Kreysler & Associates chose FireBlock for the interior acoustic surfaces of the Bing Concert Hall, citing its good acoustic qualities and easy fabrication qualities. Kreysler also used FireBlock in the San Francisco Museum of Modern Art, creating 700 individual FRP cladding panels up to 1.5 meters wide and 9 meters long for the 10-story building. This was the first time a composite panel passed the rigorous fire-testing that allows a material to be used above the fourth story.

**Purposeful Formulations**

Determining the right resin for a demanding environment is a complex process. “There are different physical properties, such as heat distortion temperature, styrene content and tensile elongation,” says Mike Diehl, business manager for AOC. “It also depends on what chemicals the material is going to be exposed to; some perform well in acidic environments, some perform better in more alkaline environments.”

Many customers also request unique properties. “They might be making changes in their process that require us to develop new resins specifically for their manufacturing environment. Or we may have to develop a product that has less volatile content in order for a customer to meet their air permitting requirements,” Diehl says.

Developing resins for these environments is a matter of balancing cost with performance, according to Johnson. “The chemistries that you find in the aerospace market might be a little bit expensive for products used in chemical processing or wastewater treatment,” he says. “From a material science standpoint you have a wide range of things that you can employ in your solution set, but if you want to be successful commercially it has to be competitive with other construction materials.”

Formulation challenges include ease of fabrication, cost, health and safety considerations, and creation of a resin that maintains consistent performance over time. “The market forces will dictate that you form the best tradeoff on those four vectors and probably a few more,” Johnson says.

**Resin Advancements**

Resin producers continue to develop new chemistries to meet the evolving needs of their customers. AOC, for example, is conducting research into resins that can withstand very high temperatures.

“We’re looking at new resins that can operate at much higher temperatures than existing technologies – resins that can exceed 500 degrees Fahrenheit. It’s a quantum leap above the traditional chemistries that we’ve used in the past,” says Diehl. The development of such a resin would allow AOC to pursue opportunities in markets where process temperatures are currently too high for existing composites.

Companies that make corrosion-resistant resins must monitor developments in the industries they already serve. New fuel additives, for example, may require them to rework resin developments in the industries they already serve. New fuel additives, for example, may require them to rework resin
formulas used for gasoline tanks and piping applications to ensure that the composite will withstand the chemicals in the revised formula.

In addition, with increased emphasis on sustainable manufacturing processes, resin producers are looking at ways to incorporate more green products into all their offerings – including corrosion-resistant resins. Developing new sources of raw material is one way to accomplish that. To go greener, a company like Ashland, which can make a number of resins from either natural resources or recycled materials, might decide to incorporate at least some corn-derived ethanol into a resin instead of using only petroleum sources. The science has reached the point where a lot of these green alternatives are not significantly more expensive than the virgin materials.

In the years ahead, the toughest challenges faced by all types of resins, including those with anti-corrosive and heat-resistant properties, may come not from the industrial sector but from government regulatory agencies.

“There is a lot of pending regulation on VOC emissions, and certainly the workhorse monomer of our resins is styrene,” says Bill Schramm, vice president, commercial, North American composites at Reichhold. In anticipation of a push to limit styrene use, the company has developed a new technology called Advalite™, a vinyl hybrid resin made without styrene or other VOC materials. Advalite is temperature resistant up to 300 F.

Schramm says Reichhold has been able to take Advalite into the market now served by epoxy prepregs, which have a relatively short shelf life and must be refrigerated. Advalite, by contrast, has a shelf life of a year when stored at ambient temperature and requires no post cure.

Advalite has achieved excellent results in tests for GM’s Corvette. “GM tested the cabin exposures [for VOCs] and repeated the test because they couldn’t believe that they were unable to detect anything,” Schramm says. Chevrolet used Advalite for the battery housing in its Spark electric car. “It was the only thing that they found that didn’t have the VOC emissions and that could withstand all of the rear and side impacts necessary for a vehicle,” he says.

A Growing Field

Although composite manufacturers and their resin suppliers have made progress in the corrosive industrial chemicals market, there is still plenty of room for growth. “We have to keep in mind that we are typically competing with metals or metal alloys, concrete and other building materials,” Johnson says. “Just because we have a chemistry that works well doesn’t mean that it will be commercially viable. If you look at corrosion-resistant structures, better than 90 percent of tanks, piping, scrubbers and ducting are built from metal. We are a single digit market provider in that particular industry.”

No matter how well composite materials perform in harsh conditions, it can be tough for them to gain market share since design engineers prefer to use materials with proven performance instead of taking risks with leading-edge materials. “It’s been known for years that composites are far better for the design and erection of bridges than concrete and steel, but you don’t see...
many composite bridges out there,” Johnson says. “When we’re developing chemistries for the corrosion environment in particular, we are not only balancing cost and performance; we have to develop supporting laboratory data to establish the fit and then, more importantly, build case histories in the field to demonstrate that the composite will perform as designed,” he adds. “Once you establish those case histories it gets a lot easier to influence these design engineers to take a chance.”

Ashland collaborates not only with fabricator customers but also with asset owners and design engineers to bring them the most durable, cost-effective solutions. “But it’s not an overnight success,” admits Johnson.

Composite fabricators depend on large raw material suppliers, including resin producers, to help them develop new markets. “We need to enable them, with support on the R&D side and with some creative selling, to influence the end users to take another look at composite science for these applications,” says Johnson. Suppliers’ increased activity in organizations like ACMA and the National Association of Corrosion Engineers should also help bring composites to the forefront.

Johnson believes that over time the benefits of composites and their hardworking resins in demanding environments will become clear. “They are starting to take hold with the design community,” he says. “I think it’s a really bright future.”

Mary Lou Jay is a freelance writer based in Timonium, Md. Email comments to mljay@comcast.net.
ACMA Advocacy in 2016: Your Agent for Growth and Protection

By John Schweitzer and MJ Carrabba

One of the most important benefits of ACMA membership is the association’s ability to tackle challenges that would be difficult for any company to confront on its own. One such task is our ability to work in Washington, D.C., and in state capitals across the country to grow key markets for composites and protect the industry against invasive regulation. That’s a tall order for ACMA, but a virtually impossible one for companies on their own. For 2016, we’ve outlined an ambitious strategy to grow key markets through advocacy on Capitol Hill and empower the industry to overcome regulatory challenges. Here are some of the highlights of our advocacy plans.

Cracking Open the Infrastructure Market

We know that composites are great solutions for our national infrastructure. Our products are stronger and lighter, last longer and don’t corrode. But having the solution doesn’t do any good if nobody knows about it. Throughout 2016, ACMA will focus on educating key policymakers in Washington, D.C., by explaining that expanding the use of composites in infrastructure is the best way to maximize the value of taxpayer dollars.

Over the last couple decades, composites have made great strides in penetrating transportation infrastructure. We had a victory in late 2015 with the inclusion of language in the FAST Act that directs the Federal Highway Administration (FHWA) to assess and release a study on the performance of composite reinforced bridges built under the Innovative Bridge Research and Construction (IBRC) program. We will focus on ensuring the study is fully funded through the appropriations process and is designed so the composites industry can collaborate closely with the FHWA. If everything falls into place, the industry could use this study to achieve more commercial success in the infrastructure market.

Over the past year, we have also begun to penetrate the utility structures market. Composite poles and crossarms do not have structural and environmental downsides. They also perform better than poles made with alternative materials. We will continue to work with Congress on legislation and with the Department of Energy on agency efforts to further create opportunities to expand their deployment. We will open dialogue with other key agencies, like the Federal Emergency Management Agency and the Federal Energy Regulatory Commission, and work with utility stakeholders to demonstrate how composites are the best materials to build a more reliable and resilient grid.

Because our products do not corrode, they are ideal for applications in water and wastewater treatment and marine infrastructure. This year, ACMA will work with Congress on reauthorizations of the Water Resources Development Act and the Water Infrastructure Finance and Innovation Act to include provisions that give greater attention to corrosion-resistant technologies in water projects.

As always, you have a role to play. Nobody can tell the story about the superiority of your products better than you. We strongly urge you to join ACMA and your colleagues to engage with policymakers to press for positive change.

Promoting Safe Workplaces and Efficient Compliance

ACMA’s regulatory affairs efforts in 2016 will focus on the characterization of health hazards and physical risks, and appropriate protective measures related to the manufacture and use of composite products. The Government Affairs Committee’s objective is to encourage health and safety by providing resources that promote an informed industry, compliance with regulations and productive partnerships with regulators, suppliers, employees and customers.

The GAC has targeted two regulatory programs that highlight risk characterization and communication challenges. The first is California’s Proposition 65 toxicity warning regulation. Cal-EPA has proposed listing styrene under Prop 65 as a “substance known to the state to cause cancer.” Should this listing go forward, as expected, composites manufacturers whose products contain styrene and are sold in California would either have to affix cancer warning labels on products or run the risk of expensive litigation by private “bounty hunter” enforcers.

Cal-EPA allows a “safe harbor” exemption from the required warnings for manufacturers that can demonstrate that exposures associated with product use are below levels that would cause a significant health risk. Each composites manufacturer could test products that may be sold in California, estimate the resulting exposures to product users and demonstrate that the exposures do not present a significant risk. For companies acting on their own, this would be an uncertain and very expensive process.

ACMA has designed a program to provide exposure estimates for many typical composite products. The estimates are based on careful testing of products to measure residual styrene content and then using engineering models to project exposures in typical end-use scenarios. All of the modeled exposures associated with use of composite products are below levels expected to present a significant cancer risk. A full report of the exposure and risk estimation project will be available in mid-2016.

Many composites manufacturers will be able to use ACMA’s report directly to justify decisions not to provide Prop 65 cancer warning labels with products. Others will be able to use ACMA’s exposure estimates to efficiently and effectively develop exposure warning labels with products. Others will be able to use ACMA’s exposure estimates to efficiently and effectively develop exposure warning labels with products.
estimates for their products and product-use scenarios. ACMA will provide its report to Cal-EPA to support a request that the agency issue a blanket exemption from Prop 65 requirements for composite products.

Another focus area for ACMA is OSHA’s Hazard Communication Standard (HCS). The agency is beginning to provide policy clarifications and enforcement guidance for the major HCS revision it promulgated in 2012. It’s clear that composites manufacturers, like other chemical suppliers and processors, will be under close scrutiny by OSHA to ensure that the HCS is working so that employees are receiving all the information needed to be safe and healthy at work.

In particular, OSHA expects each company using chemicals to conduct a careful hazards analysis to identify the health risks that employees need to be educated about and which protective measures are to be provided. This may be a serious challenge for many composites manufacturers. Even if they hire consultants to conduct hazards analyses, the results may still be open to an OSHA challenge.

Since so many composites manufacturers use basically the same raw materials and manufacturing processes, ACMA will produce a generic hazards analysis that could be adopted across the industry. When near completion, ACMA will invite comments from OSHA staff to reduce the chance that composites manufacturers relying on the program run into compliance difficulties.

OSHA expects composites manufacturers and other employers to train workers on using the supplier-provided Safety Data Sheets (SDS) to understand health hazards and physical risks (like fire) and employ the proper safeguards. The GAC sees this as a challenge for companies because the SDS for many composite raw materials are often complicated, inconsistent and may contain a lot of information not directly relevant to employees. As part of its generic hazards analysis, the GAC intends to provide clear, consistent, transparent and scientifically valid information and training that composites manufacturers can use to meet OSHA’s objectives for informed workers and to promote safe and healthy workplaces.

ACMA members can keep up to date on the regulatory challenges facing the industry, and the tools and resources ACMA provides to successfully address those challenges, by reading the monthly Policy Spotlight newsletter and by visiting acmanet.org/advocacy.

John Schweitzer is vice president of government affairs for ACMA. Email comments to jschweitzer@acmanet.org. MJ Carrabba manages legislative affairs for ACMA. Email comments to mcarrabba@acmanet.org.
Inside ACMA

CAMX Grows in Second Year

During CAMX, the ACMA booth had more than 300 visits by members and non-members over three days. Two companies joined ACMA during CAMX and eight after CAMX. Overall, CAMX welcomed 7,470 attendees from 50 countries and every state in the U.S., surpassing last year’s total of 7,100 attendees. Exhibit floor space was also larger than 2014, with 549 exhibiting companies and 111,000 net square feet of exhibit booth space. With 309 sessions on topics covering every subject in the industry and 360 expert speakers, conference attendees had over 13 concurrent tracks of topics to choose from. Save the date for CAMX 2016: September 26-29 in Anaheim, Calif., at the Anaheim Convention Center.

FRP Products Considered by EGA

Since ACMA’s testimony on October 14 before the United States International Trade Commission (ITC) which requested an equal playing field for tariffs on composite products covered in the Environmental Goods Agreement (EGA), both FRP utility poles and FRP crossarms have specifically been added to the EGA list of goods being considered. ACMA’s members have attempted to export composite utility poles to participating EGA member countries, but have been met with high tariffs. By contrast, other countries have much lower tariffs. While ACMA

CompositesLab Wins Awards

ACMA’s CompositesLab, the first comprehensive guide to composites and the composites industry, received two Platinum MarCom awards from the Association of Marketing and Communication Professionals. ACMA won in the Association Website and Informational Website categories. This year, the competition received roughly 6,500 entries from North America and more than a dozen other countries. Only five websites won in the Informational Website category, including entries from IBM and Johns Hopkins University. Visit CompositesLab at compositeslab.com.

New Members

C1 Pultrusions, LLC
North Tonawanda, N.Y.

Composite Reinforcement Solutions
South Fremantle, Australia

Continental Structural Plastics, Inc.
Auburn Hills, Mich.

Crown Composites Tooling, LLC
Twinsburg, Ohio

Fine Tube and Technology, SA de CV
Tlalnepantla de Baz, Mexico

Hexcel Corporation
Carbon Fiber Headquarters
Dublin, Calif.

Louisiana Center for Manufacturing Sciences
New Orleans, La.

University of Alabama at Birmingham
Birmingham, Ala.

University of Washington
Seattle, Wash.

For more information on becoming a member of ACMA, email membership@acmanet.org or call 703-525-0511.
COMBINED STRENGTH. UNSURPASSED INNOVATION.

CAMX announces the 2016 Call for Abstracts! Abstracts are being accepted now through March 1, 2016.

The Composites and Advanced Materials Expo – CAMX – is seeking high-quality technical papers and education sessions featuring new research and applications.

Interested candidates must submit a 250-word abstract detailing the proposed paper/presentation by March 1, 2016. Authors and presenters of accepted papers and presentations receive discounts on CAMX registration, and are published in the CAMX proceedings. Visit www.theCAMX.org/call-for-abstracts for more information.

AREAS OF INTEREST:
Accelerating Materials Insertion
Advances in Traditional Materials
Business & Regulatory
Design, Analysis, & Testing
Emerging/Disruptive Technologies
Green & Sustainability
Manufacturing
Market Applications (Aerospace & Defense)
Market Applications (Industrial/Consumer)
New Materials
Non Destructive Evaluation
Processes
Safety & Compliance
Work Force Development & Technologies

FOLLOW US!
Twitter: #CAMX16
LinkedIn: Join CAMX – The Composites and Advanced Materials Expo
Facebook: Like “CAMX”
YouTube: Search “theCAMX”
members’ products had been classified in two provisions in the EGA on the EGA list, ACMA member products were not specifically named. Having them named now is a critical step in getting the 17 EGA nations to decide which products remain on the final list.

**OSHA’s Ruskin Provides Direction for ACMA Compliance Programs**

During an October 28 CAMX panel discussion, senior Occupational Health and Safety Administration (OSHA) official Maureen Ruskin said the composites industry needs to consider whether molded products are exempt from requirements for manufacturers to provide safety data sheets (SDS) and warning labels. Ruskin and other panelists also identified possible industry programs that would help composites manufacturers engage employees in promoting healthy and safe workplaces. Ruskin also suggested the industry should help employees understand how to find important information on SDS. The panel noted that much of information on SDS is not relevant to workers. In addition, the SDS for many composite industry raw materials are confusing, and some are incomplete, inconsistent or incorrect. ACMA’s Government Affairs Committee is holding a series of discussions through early January to consider new compliance programs in light of the input provided by the CAMX panel.
Wisconsin Oven’s equipment has fulfilled our expectations 100%. I am very satisfied with their product. It is easy-to-install and a high quality product. They are very well built. These ovens have a long life span, and are reasonably priced on top of that. These machines are an extremely good value for the money.

I’d also like to say that Wisconsin Oven’s customer service has been impeccable. Whenever I’ve contacted them, the service has been excellent. But I guess I should say that the quality of these ovens has been so good that I haven’t had to rely on the customer service all that much.

Kirk Flannery
Maintenance Manager, AIM Aerospace

262-642-3938 • SALES@WISOVEN.COM
www.wisoven.com
THE FORMULA FOR YOUR SUCCESS

RESINS
Exceptional quality, flexibility and efficiency for every composites market.

GEL COATS
Superior clarity, gloss, and durability for critical environments.

COLORANTS
Advanced pigment dispersions, colorants & additives for every application.

Contact AOC today at 1-866-319-8827 or visit us at AOC-Resins.com today to learn more.