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Making Waves in the Marine Market ...... 8

The marine industry was among the first to adopt composites decades ago, but it’s not settling for the status quo. Innovative boat builders are experimenting with materials and fabrication processes.

By Megan Headley

Doing It Naturally ................................. 14

Biocomposite materials made from natural fibers and bio-based resins are making inroads into markets ranging from automotive and building materials to clothing and sporting goods.

By Mary Lou Jay

Shifting Paradigms ................................. 19

North American universities are at the forefront of composites research and development. In our annual report on R&D efforts across college campuses, we highlight five pioneering projects.

By Evan Milberg

About the Cover:
The Figaro Beneteau 3 racing yacht is the first-ever production monohull boat to feature foils, according to the company. The bright orange CFRP foils, which lighten the boat’s weight and create a more powerful racing yacht, are vacuum infused.

Photo Courtesy of JB d’Enquin/Beneteau
A Glimpse into the Future

In a rapidly evolving composite materials marketplace, it can be challenging to predict what the future holds. However, thanks to innovative research happening all over North America, during the next 20 years we may see the rise of several new materials and manufacturing processes that could change the way we think about the industry.

These developments are not just happening for the sake of technological advancement. In this issue of Composites Manufacturing, we highlight five projects that simultaneously solve real-world problems and open new opportunities for the industry (page 19). To continue to grow the use of composites, all of our companies need to focus our R&D initiatives on identifying “problems” to solve that can ultimately create new opportunities.

For example, at the University of Southern Mississippi, researchers have created a unique flax-reinforced thermoplastic that could one day be used to make biodegradable car parts. Bio-composites that incorporate natural fibers could play a key role in other markets, too. Check out our story on page 14 to learn more about the latest trends in biocomposites and how they could change the composites industry.

While markets that underutilize composites such as automotive could be impacted by the latest RD&F, mature markets such as marine are poised for change as well (page 8). CFRP and FRP composite hybrids are making their way into marine applications traditionally dominated by fiberglass. All markets, even mature ones, offer opportunity for those who innovate. ACMA is ready to help with this innovation through our numerous Composites Growth Initiative (CGI) committees. I recommend you join a committee if you are not already involved!

If you enjoy reading about the latest research and material technologies in CM, I encourage you to see innovations like these in person at CAMX (Oct. 15-18, 2018, in Dallas). The exhibit hall will be teeming with new products and processes that offer a glimpse into the future of our industry. Make sure to stop by ACMA’s Awards for Composites Excellence (ACE) booth to see groundbreaking developments from our members. The CAMX poster session will also offer a look at the latest and greatest composites research. To learn more about what you can expect at CAMX, check out our “Inside ACMA” interview with CAMX Chair Carl LaFrance (page 26). I hope to see you this fall in Dallas!

Sincerely,

Kevin Barnett
Core Molding Technologies
ACMA Chairman of the Board
kbarnett@coremt.com
While large architectural projects such as building façades certainly garner attention, composite applications don’t have to be massive to turn heads. Check out these two eye-catching European structures.

**Banco Popular – Madrid**

When the architectural team of Arquitectos Ayala and façade consultant ENAR designed the auditorium for the new headquarters of the Banco Popular in Madrid, their goal was to create a fully transparent glass room with minimal visible support. The contractor for the international bank’s auditorium, Portugal-based Martifer Metallic Constructions, developed a special system to hold in place the huge panes of double structural glass that make up the exterior wall.

To provide a dedicated space for the language interpreters sometimes needed for meetings in the auditorium, the architects designed another box-like structure to suspend from the ceiling at the back of the room. They chose glass for the walls of this interpreters’ box to maintain the sense of openness in the room; they selected composite materials for its top and bottom to provide a strong and lightweight means of supporting those walls.

The architects specified the use of composites for the box, which measures approximately 24 feet long by 9.8 feet high by 8.2 feet wide. “This material allowed us to manufacture pieces of great dimension without joints, with good finishes, lightweight and meeting fire requirements,” says Miguel Angel Ruiz, commercial director at Martifer Spain. A metallic substructure connects the two composite structures to the glass walls.

Spanish composite manufacturer Carbures and Swedish core material developer Diab built the composite sections. Carbures constructed two composite cases, one forming the ceiling of the box and the other the floor. Each case consisted of three curved GFRP panels measuring 24 feet long and 3.6 feet wide. The panels, made through a vacuum infusion process, included a Divinycell PET 60 core in thicknesses of 55 mm and 12 mm.

One of the most challenging aspects of the job, according to Diab, was finding a resin with the required additives for fire safety. The company chose Crestapol® 1213A, a urethane acrylate resin from Scott Bader. The combination of the resin and Divinycell PET assured that the composite cases met the necessary fire, smoke and toxicity requirements.

The composite cases, each weighing only 265 pounds, and the glass for the...
interpreters’ box were brought to the Banco Popular site for assembly and installation. The completed box, now in place, will provide a quiet working space for interpreters while maintaining the light-filled ambience of the auditorium.

West Croydon Bus Station – London

Opened in late 2016, the West Croydon Bus Station in London has won several awards, including the RIBA (Royal Institute of British Architects) London Award in 2017 and the RIBA 2017 London Project Architect of the Year honor for its architect, Martin Erickson. Composite materials are a key part of this building, which is owned by Transport for London (TFL), the agency responsible for London’s buses, trains, trams and taxis.

Kalwall produced the 2 ¾-inch-thick translucent composite sandwich panels that form the building’s canopy. The pieces of the panels – including the support grids between the panes, the proprietary fiberglass used for the top and bottom faces, and proprietary resin applied along the gridlines – were assembled into a mechanical locking grid. The panels, composed of many different sized rectangles, triangles, trapezoids and other shapes, were then processed in heat and pressure ovens, cross linking the faces with the structural grid core.

“This was not a standard project; it was a highly crafted canopy,” says Amy Keller, Kalwall principal and vice president for international sales. “Parts of the building were very difficult because the detailing was tricky. We had to work very carefully on water management and interfaces with the structure.”

Martin Erickson chose the structural composite panels because he wanted to rejuvenate a run-down, very high-volume bus station and they presented an affordable way to do it, says Keller.

“Using [the panels] brought many advantages and benefits in relation to their lightweight yet strong structural qualities,” says Erickson in a statement on Kalwall’s website. “It has helped enhance daylight transfer and protects from sun glare whilst reducing hotspots and solar gain. The material’s soft translucent qualities contrast beautifully with the building’s warmth and texture, providing a sheltered waiting environment with the added advantage of..."
Innovation from Students

ACMA recently announced the winners of its third annual Composites Design Challenge for architecture students. Visit acmanet.org to learn about the winning entry from Cornell and how ACMA’s design challenge will help foster the next generation of architects with FRP expertise.

low-maintenance and high performance.”

Low maintenance was important, since the West Croydon bus station serves 23,000 passengers traveling on 25 different bus routes each day, leaving little time for crews to clean it. Unlike glass, the translucent panels don’t show bird droppings or other dirt. “The panels are also very rugged, so they are vandalproof and man-safe as well,” says Keller.

TFL has been so pleased with the performance and relatively low cost of the panels that designs for at least two future bus stations will feature them.

Mary Lou Jay is a freelance writer based in Timonium, Md. Email comments to mljay@comcast.net.

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Be the Expert Get Certified
There are a handful of all-electric cars on the road, from the Chevrolet Bolt to the Tesla Model S – the best-selling, all-electric model in the U.S. in 2017. The environmental benefits of plug-in electric vehicles are compelling to many consumers, but are they equally attractive to companies for commercial vehicles? One Ohio-based company, Workhorse Group Inc., is counting on it.

Workhorse, an OEM of electric commercial vehicles, has recently begun focusing on last-mile delivery. “Last-mile delivery of goods – usually by fairly good size vehicles – tends to cause quite a bit of pollution, so it’s low-hanging fruit,” said Workhorse CEO Steve Burns at the Advanced Clean Transportation Expo in 2016. “If we can lower the emissions and the cost of those vehicles, it floats a lot of boats.”

The company is making significant inroads, partnering with UPS to deploy 50 of its new N-Gen electric delivery trucks across the U.S. this year, adding to the 365 other electric vehicles the company has already provided UPS. In addition, Workhorse has submitted six prototype “Next Generation Delivery Vehicles” (NGDV) for the United States Postal Service (USPS). On the latter, Workhorse is providing a chassis and powertrain to partner VT Hackney, which is building the body. The duo are among six supplier finalists vying to replace the Postal Service’s longstanding mail delivery trucks.

All of Workhorse’s delivery vehicles rely on a mix of composite materials to facilitate lightweighting. While the company doesn’t disclose details on the materials, it utilizes honeycomb core sandwich panels and CFRP. “When you have pickup and delivery trucks that are basically flat with a huge surface area being the wall of the truck, it lends itself to a rib cage with some honeycomb materials over top of it,” says Burns.

For all of its electric vehicles, Workhorse builds the drive train and chassis at its Indiana plant. Then, employees assemble the vehicle there using body components made by an outside firm.

Workhorse began work on the NGDV in 2015, when USPS opened a request for proposals (RFPs) from companies interested in developing the new vehicles. The winning prototype will land a lucrative contract to replace up to 180,000 mail trucks estimated at more than $6 billion in business.

At the time of the RFP, Workhorse was less than a decade old and understandably cautious about throwing its name in the hat. “We are a little company, and the post office bid is the largest automotive contract in history. Could we place such a big bet on this?” says Burns. “Early on, we realized we could probably leverage this into some commercial vehicles that would justify the developmental costs.”

Two vehicles developed by Workhorse that piggyback on the NGDV project are the W-15 electric pickup truck and, most recently, the N-Gen electric cargo van. The W-15, which features a CFRP body, has a gross vehicle weight rating of 7,200 pounds and an 80-mile all-electric range. During development, Workhorse pre-sold the vehicle to 18 different fleets that bought 5,500 trucks, equating to approximately $300 million in sales, according to Burns. Customers ranged from municipalities to energy companies.

Although the W-15 is designed for commercial use, Burns says it’s drawn interest from consumers, too. “It’s a good-
looking, electric range-extending, carbon fiber pickup truck. It gets the equivalent of 75 mpg, and it’s very quick and strong,” he says. “Once we get through our first wave of fleet deliveries – and we’re at the tail end of that – consumers can get their place in line.”

The N-Gen is a cargo van similar to the Ford Transit. “The only difference is that the Transit is the same product used by plumbers or florists or a last-mile delivery person,” says Burns. “The N-Gen is a for-purpose, last-mile delivery vehicle.”

Last-mile logistics refers to the movement of goods from the transportation hub to the final delivery destination. Transportation companies are battling to dominate the market, which is skyrocketing thanks to e-commerce. A key priority is reducing costs associated with last-mile delivery, which can account for up to 28 percent of a product’s total transportation cost, according to a report from Supply Chain Dive, a manufacturing news curator.

“Usually, vertical markets aren’t big enough to build a for-purpose truck,” says Burns. “But with last-mile delivery and e-commerce ballooning, we thought it warranted a dedicated vehicle.” The N-Gen, which has a CFRP body and weighs just under 5,500 pounds, has an anticipated range of 100 miles on a single charge. It can carry a one-ton load in its 450-cubic foot cargo bay. Comparable gas and diesel vans typically weigh thousands of pounds more, decreasing their fuel efficiency and carrying capacity.

In addition, the N-Gen was designed with a low 19-inch floor and a 105-inch roof height to maximize cargo space and make it easy for the driver to get packages in and out of the van. The N-Gen also is available with Workhorse’s optional integrated HorseFly™ unmanned aerial vehicle package delivery system. The CFRP drone launches from the roof of the van and delivers packages to their destinations within the driver’s line of sight.

Earlier this year, Workhorse deployed two N-Gen cargo vans in a pilot program in San Francisco. The company is delivering approximately 270 packages a day for a local firm. Burns says the next batch of N-Gen vans will likely roll out elsewhere in California, then Ohio. In the contract with UPS, Workhorse is designing and deploying 50 larger N-Gen vans with 1,000-cubic-foot bays and up to 5,000 pounds of cargo capacity.

“Our goal is to make it easy for UPS and others to go electric by removing prior roadblocks to large scale acceptance, such as cost,” says Burns. “While consumers typically look at the initial purchase price [of vehicles], a fleet looks at the purchase price plus eight years of fuel and maintenance.” Burns says that Workhorse’s vehicles are less expensive in total cost of ownership than standard pickup trucks or cargo vans.

As he looks across the transportation industry, Burns believes the combination of electric drive trains and composite monocoques in Workhorse’s commercial vehicles is unique – and cost-effective. The battery of electric vehicles is the most expensive component. Lightweighting vehicles means less battery, which keeps the price point down.

“We needed the weight savings, and we didn’t want to go with aluminum because of all the tooling and replacement costs,” says Burns. “Composites just seem like a natural fit. We’re surprised more vehicles aren’t made like this.”

Susan Keen Flynn is managing editor of Composites Manufacturing magazine. Email comments to sflynn@keenconcepts.net.
Boat builders around the world seem to be closing the mold, so to speak, making a move from open to closed mold processing for a variety of reasons.

“There are a lot of advantages with closed mold,” points out Leon Garoufalis, president and COO of Composites One LLC in Arlington Heights, Ill. As he puts it, vacuum infusion processing (VIP) can significantly reduce emissions compared to open mold processes, creating a cleaner working environment that makes it easier to attract workers. Plus, VIP typically allows for a higher quality of finishing. “Even with small parts you can get a high-quality finish surface on both sides,” Garoufalis explains.

Utilization of closed mold processing is a trend that has been picking up speed in recent years, across a wide range of boat styles. “Many of the very large boats are being infused and so [boat builders] are finding the quality of infusion and the type of laminates they’re getting are of a much higher quality, and they’re able to sell that quality in the marketplace,” Garoufalis says. “There’s no question there’s been a move to infusion and that has allowed suppliers to really improve their laminate structures.”

Now that closed mold processing has taken hold, boat builders are experimenting with materials more than ever, including carbon fiber and epoxy resins.

**CFRP Foils Provide Stability**

France-based Beneteau’s latest racing yacht is an innovative case in point, featuring a mix of CFRP and GFRP. Many racing boats feature foils that extend vertically down from the bottom of the hull and allow the boat to essentially fly above the water, gaining greater speed in the process. But on Beneteau’s Figaro 3, the addition of carbon fiber foils wasn’t meant to lift the boat out of the water. Instead, it eliminates the need for water ballast tanks otherwise used to provide stability to a boat, making the new-generation racing boat 10 percent lighter.

Achieving that balance or “righting moment” with a lighter part leads to a much more powerful boat. “It has to be very light in order to be efficient and quick,” explains Raphael Surun, composite research and development director at Groupe Beneteau.
The solo offshore racing yacht is also the first-ever production monohull boat to feature foils, according to the company. To create the foils for this monohull sailboat, Beneteau subcontracted with France-based Multiplast Groupe Carboman. “The project was an ambitious one,” commented Yann Penfornis, Multiplast general manager, in a news release. “We had to reach a lower target cost, achieve a perfect foil shape, guarantee identical weight for all parts and produce a set of foils per week over a period of one year.”

Helping achieve that perfect shape is Chomarat’s C-TAPE™, a new unidirectional woven carbon reinforcement developed in response to this project’s unique demands. Each foil is made up of 50 plies of tape, which testing determined was necessary to help the foil resist high levels of stress and achieve the desired performance. The structure of C-TAPE is meant to facilitate the flow of resin infused throughout the multi-ply carbon structure.

In addition to the foils, every GFRP component from the hull to the bulkheads and smaller parts are also vacuum infused. Surun notes that the company first adopted closed mold infusion 15 years ago in response to European pressures to reduce VOCs. But among the other benefits provided by vacuum infusion, the process ensures that every boat in this line is identical to others. This is important in establishing fairness among competing racers who all use the same boat.

The hull and deck of the Figaro Beneteau 3 are fully built using the infusion process. (The company uses the injection process for other boat models.) The hull features multiple layers of fiberglass and a foam sandwich core, topped by thicker foam that forms the stringers that add strength throughout the boat.

Production is underway on the Figaro Beneteau 3, and the boat will ship to buyers in early 2019. Although the foils won’t prove themselves competitively until next spring, they’re expected to bring 15 to 20 percent speed gains downwind, making waves for competing boat builders today.

**Epoxy Adds Strength**
Carbon fiber is nothing new for Hinckley Yachts, a Portsmouth, R.I.-based boat builder. “We have been building
our Picnic Boats of vacuum-infused resin with an inner layer of carbon fiber and an outer layer of Kevlar® from bow to stern since 1994,” says Peter Saladino, chief marketing officer for Hinckley Yachts. “This really is a premium boat building approach with a long heritage of over 1,000 Hinckley jet boats built in that timeframe.” But the company has made a switch, opting to add epoxy into the mix.

The use of VIP seems to be encouraging the switch from unsaturated polyester resin to epoxy, Garoufalis finds. “For the more expensive boats, appealing to a higher-end crowd, epoxy is a good way to go in a closed mold infusion process,” he says. “It provides tremendous strength. The physical [properties] of epoxy over unsaturated polyester resin are significant, and it provides an outstanding finish as well.”

Hinckley aims to lead that change to epoxy resin. In March 2018, the boat builder unveiled what it called the world’s first carbon epoxy performance boats in production.

“We have a very strong vacuum resin infusion capability, which minimizes excess resin and therefore resin weight,” Saladino says. The addition of lightweight carbon fiber helps the Hinckley Sport Boat efficiently achieve speeds exceeding 60 mph without stacking outboard motors on the stern. Hinckley is quick to point out that optional twin 627 horsepower outboards from Seven Marine will allow the Sport Boat to reach 63 mph, indicating that speed is a growing demand for its customers.

By adding epoxy into the mix, the builder is able to balance light weight with greater strength and durability. “We see this as the optimal approach for a strong, durable and safe hull,” Saladino says.

The company dry-lays its molds so that all of the fibers in the hull and support structure can be aligned to designed load paths before resin infusion. “When the resin is vacuum infused there is a chemical bond between the hull and the support structure as the resin cures. This is an improvement over other approaches, which insert the support structure after hull infusion when only a physical bond can be made,” Saladino says. “Our confidence in this approach is why we guarantee our hulls and decks for life.”

The company is now working to extend this vacuum-infused carbon epoxy across its full line of yachts, a goal that will place the company “well ahead of current industry practice,” according to Saladino.

**Epoxy Achieves a Richer Finish**

Around 2016, Scout Boats in Summerville, S.C., began introducing a carbon fiber/E-glass hybrid into its mix in response to a shift in how boaters use their watercraft. According to Steve Potts, owner, founder and president of Scout Boats, the introduction of add-ons – ranging from aftermarket stabilizers to stacking of outboard motors – is making boats heavier.

“Even though we’re not building race boats we put a lot of emphasis on performance – both high-speed performance and fuel burn – and the handling characteristics of the boat,” Potts says. “Rather than to say this is just the nature of the beast, we started to address this [trend] by changing our methodologies to basically make the boat ultra-light to offset those added weights.”

By applying CFRP within its 42-foot sport fishing boat, for
example, the team was able to shave off 600 pounds. “It doesn’t sound significant, and it certainly adds a significant cost, but we see the reduction in pounds as well worth it once you add a 700-pound stabilizer,” Potts points out.

But the addition of carbon fiber isn’t the only material change Scout has made. The company’s latest introduction is a switch from polyester and vinyl ester hulls to epoxy resin. “It all started because we have a lot of our customers who want dark colored hulls,” Potts recalls.

Producing a black hull can be a challenge because imperfections show up more easily. As Corbett Leach, Composites One technical support manager, explains, “Fabrication with polyester resins often requires the addition of print blockers and barrier plies to prevent surface distortions and imperfections. In addition, completed hulls typically need time-consuming secondary rework and refinishing.”

But Scout’s goal was to produce a dark Class A finish that could weather “gracefully,” as Potts puts it, requiring only minimal maintenance against the long-term effects of sun and saltwater. After years of testing different formulations and curing packages, the company determined that there was no substitute for a post-cured epoxy resin system.

As Potts point out, getting improved weathering from this resin system turned out to be icing on the cake. “We already knew that the physicals of epoxy are significantly better than polyester and even better than vinyl ester. So, we not only got the Class A finish to age more gracefully, but we also got much better physicals,” Potts says.

According to Huntsman Advanced Materials, which supplied the resin for this project, epoxy resin is 20 to 30 percent stronger than polyester and vinyl ester materials, with a higher elongation, tensile strength and modulus/stiffness properties. By making the switch to epoxy, Scout decreased the number of laminate layers while maintaining the strength and performance it achieved with other boats.

Scout Boats’ in-house designers worked closely with Composites One in fine-tuning this system. The build team began assembling the hull with a polyester gel coat backed by a vinyl ester barrier coat and hand-laid vinyl ester skin coat. Next, they sanded the skin coat, then put down multiple plies of a pre-cut dry carbon hybrid quad knit fabric. The rigid foam core was sandwiched between fiberglass laminate layers. A tackifier adhesive secured the plies in place.

Huntsman notes that the high-performance resin system used on this project was specially formulated for use on large parts. Its water-like viscosity makes for a more controlled resin flow throughout the laminate, ensuring each area of the hull is evenly coated. After infusion, the epoxy cured at room temperature and then post-cured under a tarp with a heat blanket that helped ensure a constant temperature.

“The post-curing process was a challenge,” Potts recalls. Every epoxy-infused part, including some of the company’s hulls, are
post-cured for eight hours at 135°F. It took some trial and error before the team realized they needed consistent temperatures, which it achieved with the addition of thermocouples.

“We have some good quality control processes that we developed over many, many parts that enabled us to dial in the process that makes this near flawless,” Potts says. According to information from Huntsman, the epoxy resin showed a cured shrinkage of less than 2 percent compared to 7 to 10 percent for polyester and vinyl ester and yielded perfect, unblemished parts right out of the mold.

After three years of in-house research, Scout Bouts debuted its 42-foot-long luxury sport fishing boat, the 420 LXF, in February 2015. Today Scout uses epoxy infusion on three models – 35-, 38- and 42-footers – with plans to soon release a 53-foot boat using the same production method.

**Solutions to Speed Up Production**

Epoxy infusion allowed Scout Boats to blend the performance of a fishing boat with the aesthetics of a high-end, center-console cruiser. But it was the closed mold process that ultimately allowed the team to reduce the injection time on its epoxy-infused boats from 1½ hours to 45 minutes. Scout is now able to produce each hull in less than a week and a completed boat every 3 to 3½ weeks.

With today’s high market demand, other boat builders are looking for new ways to speed processes along. In the spirit of simplifying production, PolyOne released its Hammerhead™ Marine Composite Panels during CAMX 2017 to replace the laborious hand lay-up and vacuum assisted process with a single ready-to-install panel. The panels will be distributed exclusively by Composites One.

“It was the need for labor savings [around surface preparation, sanding, ease of installation] that we were addressing,” explains Darcy Hornberger, application development manager for PolyOne Advanced Composites. “We heard a common desire for reducing labor costs when talking with several boat builders.
They confirmed that a panel that could help them reduce the labor involved in boat construction would be a game-changer for the industry. Our panels reduce the need to glass-in traditional plywood or use hand lay-up for core construction, which is also time-consuming.

According to information from the manufacturer, the continuous-fiber reinforced thermoplastic sandwich panels provide weight savings of more than 50 percent over plywood. The panels feature continuous glass fiber face sheets and foam cores, a configuration that PolyOne found improved bondability to different surfaces and improved thermal lamination to varying materials and finishes. This provides the design flexibility that boat builders expect.

The Hammerhead panels can be installed using traditional methods of tabbing and glassing, Hornberger explains, and are used in both cosmetic and structural areas, including flooring, bulkheads and stringers.

“They can be bonded to the support structure and joined together at the seams, which can be easily covered,” says Hornberger. “Gel coat can be applied with minimal sanding and surface preparation, compared with the traditional labor-intensive sanding process needed to achieve a smooth, level surface for a finish coat.”

Beneteau also is striving to streamline labor-intensive processes. The company is a partner in a European Union-funded project to automate certain boatbuilding processes, such as sanding and grinding, in order to improve worker safety. “The target is mainly to reduce repetitive motion,” Surun explains.

The collaborative COROMA (which roughly translates to Cognitively Enhanced Robot for Flexible Manufacturing of Metal and Composite Parts) notes that the project has already demonstrated a completely automated sanding application and expects to roll out new technologies next year.

After all, sailors aren't the only ones looking for a streamlined vehicle to boost their performance. Builders, too, are always looking for new strategies to streamline their manufacturing processes.

Megan Headley is a freelance writer based in Fredericksburg, Va. Email comments to rmheadley3@gmail.com.
Most people associate crops in farmers’ fields with food production. What they don’t realize is that those plants, or at least some parts of them, could one day be incorporated into their cars, tennis rackets or shoes.

Biocomposite materials made from natural fibers and/or bio-based resins are making inroads into markets ranging from automotive and building materials to clothing and sporting goods. According to Lucintel, the global biocomposites market should grow by 7.9 percent from 2018 through 2023, reaching an estimated $7.6 billion in value.

In Europe, biocomposites made their first appearances in 1972, when Fiat introduced a 50 percent wood/50 percent polypropylene “woodstock” material into its vehicles. This material is still used successfully in different markets.

Some European automotive manufacturers today use components that contain as much as 70 percent natural fibers like kenaf or hemp and only 30 percent oil-based resin. “You can have savings on the CO2 footprint and have very good technical properties, and at the same time the material is very lightweight,” says Asta Partanen, who specializes in bio-based materials and composites at Germany’s nova-Institute, a consulting organization with a focus on the bio and CO2-based economy.
Biopolymers used in European composite production include bio-polyethylene (bio-PE), polyactic acid (PLA) and bio-based polybutylene succinate (PBS). Natural fibers are derived from many sources, including wood, cork, linen, flax, hemp, bamboo and sunflower shells.

The benefits of using natural fibers for composites begin with their optical and haptic properties, according to Partanen. Natural materials allow composites to cool much sooner, reducing the cycle time in injection molding.

In general, natural fibers can’t achieve the strength of carbon fiber composites and they don’t have the same tensile or impact strength as GFRP. “But they may have different properties that are important in the differentiation of products from standard plastic products. It’s always a matter of application,” says Partanen. Natural fiber composites are a better environmental choice than GFRP because they have a 20 to 50 percent lower carbon footprint.

Working with Biofibers

In Canada, the Composites Innovation Centre (CIC) in Winnipeg, Manitoba, helps composites manufacturers incorporate biofibers into their products. “We’re trying to address some of the technology gaps and hurdles that our clients and industry are facing,” says Lin-P’ing Choo-Smith, vice president of CIC’s biomaterials program.

To minimize the adjustments that composites manufacturers must make to use natural fibers, the CIC primarily uses traditional industry resins, processes and equipment in its research. “If [manufacturers] have to change too many things, it becomes a barrier,” says Choo-Smith.

The first step is finding the right fibers. For composites taking on structural loads, “we want fibers on the longer side (i.e. high aspect ratio of fiber length to diameter) with good chemical properties and tensile strength,” says Choo-Smith. “We tend to focus on flax and hemp because they fit these requirements, grow well in our prairie regions, and we have a good amount of it.”

In choosing a fiber, CIC staff look at how well a plant goes through the decortication process, which separates the fibers from the hurd (the woody or pulpy matter of the plant). Fibers with more hurd can’t be used for higher end applications like textiles. CIC tests the fiber’s tensile strength, its moisture uptake and its behavior with various resins. “If there is a nice affinity between resin and fiber, then there is a good chance that it will stick well to the fiber, which is known as wet-out,” says Choo-Smith. “If it doesn’t, we may need to treat the fiber with chemicals to change the surface properties.”

One benefit of biofibers is that they come from a renewable resource, but that also makes them more heterogeneous in the way that they behave. Synthetic fibers produced in a factory are very consistent. But bio-based fibers may change with growing conditions; if there’s more or less rain in the summer, what happens to the quality of the product? Choo-Smith notes that winemakers have overcome a similar dilemma by blending various harvests, and the same could be done with biofibers.

CIC staff hope to provide an economic boost to rural communities by making better use of the parts of crops that are otherwise composted or burned. But the conditions ideal for food production may not be the best for producing composite fibers. For example, spacing flax plants close together results in narrower stems and finer fibers, which is ideal for some end-use applications in composites. But farmers prefer wider spacing, since they produce more seed that way. If the demand for bio-composites grows and the economics are right, farmers may be willing to adjust their growing patterns to the industry’s needs.

Resins from Plants

Dixie Chemical of Pasadena, Texas, has been working with bio-based materials for their resins since 2011. Alejandrina Campanella, the company’s thermoset and bio-based material platform leader, says it’s easier to work with plant oils, which are fairly consistent in their performance, than with biofibers, which can vary with environmental conditions.

Dixie currently produces two lines of bioresins; MAESO, derived from soybean oil, and MAELO, from linseed oil feedstocks. Like typical unsaturated polyester resins, they contain a reactive diluent such as styrene or vinyl toluene. However, Dixie also makes a methacrylated fatty acid (MFA) derived from palm, coconut and soybean oils, which can be used to replace all or some of the styrene or vinyl toluene. Using MFA reduces emissions and odors in the manufacturing process, and the MFA resins are tougher and less brittle than those made with styrene.

“We’re also working on a toughener made with soybean oil, which can be used for epoxies, vinyl ester and polyester resins. When we’ve compared it to products that are currently available in the market, it appears to have similar properties. This could have a really big impact,” says Campanella.

In most cases the processes for manufacturing bio-based composites are no different than those for oil-based composites. “You may have to optimize your formulation, but that also happens if you’re using a resin made from oil,” says Campanella. Dixie generally sticks with palm oil, soybean oil and linseed oil or their fatty acids because of their pricing and availability.

Much of the interest in bio-based composites comes from the transportation industry, says Campanella. Ford, BMW, Mercedes Benz and Jaguar all have interior products made with bio-composites, ranging from seat backs and door panels to carpeting and insulation. There are bio-composites in many sporting goods, including tennis rackets, snowboards and bicycles. In the construction industry, windows, doors, insulation and other building products have all been made with bioresins and/or natural fibers.

Recycling Potential

Megan Robertson, associate professor in the department of chemical and biomolecular engineering at the University of Houston, is researching several aspects of bio-based resins. Her research group initially tried replacing Bisphenol A (BPA) in epoxy resins with readily-available vegetable oils, but the resulting composites did not have the necessary strength or thermal properties.

They then tried bio-based phenolic acids derived from fruits and vegetables. “They have very similar functionality and similar chemical structures to BPA, which can impart desirable physical properties to the resin,” says Robertson. The problem is that bio-based phenolic acids aren’t currently obtainable in large volumes. More recently the researchers have focused on epoxies made from...
Robertson is also researching bioresins and composite recyclability. Current recycling processes, based primarily on thermally treating the materials, work only with thermoplastics. Recent advances in the chemical recycling of polymers, which breaks the plastic down into monomers so the materials can be repolymerized, hold some promise for thermosets.

Since the esters in bio-based resins can undergo chemical degradation reactions like hydrolysis, “our hypothesis was that if we can distribute those ester linkages throughout the epoxy resin network, we can make a network that can be degraded under the right conditions,” says Robertson.

Researchers tested two epoxy resins – one a soybean oil-based and the other made with BPA – in a solution with a very high pH, which accelerates hydrolytic degradation. “We found that if we put a traditional epoxy resin through this process, even after three months we found no noticeable change in the mass,” explains Robertson.

The test with the bio-based resin was more promising. “The soybean-oil based epoxy resin degraded within two weeks; the solid mass completely disappeared,” she adds. Other bio-based epoxies, which also contain high concentrations of esters, have reacted to the solution the same way. The challenge will be to make a thermoset that could maintain the desired properties in applications, but that could be broken down after it reaches the end of its useful life.

**The Case for Bio**

Deborah Mielewski, Ford’s senior technical leader for materials sustainability, has worked for decades trying to get more bio and recycled materials into the company’s vehicles. One of her first victories came in 2008, when Ford introduced seats for its Mustang that contained foam made from soybean oil. A few years later the company added composite storage bins made with wheat stalk fibers into its Flex SUV, reducing its annual petroleum usage by 20,000 pounds and CO2 emissions by 30,000 pounds.

The wheat straw bin, developed by the Ontario BioCar project, helped focus Mielewski’s team on the benefits of incorporating agricultural waste fibers into composites. “They are lighter in weight than the glass fiber and the talc that we currently put in. So, if we’re worried about fuel economy, here’s a way to lightweight and use something that you would otherwise burn or landfill,” says Mielewski.

A good example of this approach is the incorporation of pulp from Weyerhaeuser’s lumber operations into the Lincoln MKX’s composite armrest. “The pulp industry is struggling in this country because China is producing paper at a very low cost. So, putting pulp in a high-end composite was very attractive to Weyerhaeuser,” says Mielewski.

She’s grown used to skepticism when she proposes using natural fibers for various vehicle components. “People said, ‘You can’t put soy oil in and make a good foam.’ Well, you couldn’t just drop it in and make a good foam; it took some work,” she explains. “But the chemistry can be rebalanced, and you can incorporate hydroxylated soy bean oil into the foam. We do it in every single North American-built vehicle now, and many other industries do it, too.”

One problem is that people don’t think of green solutions as technical solutions. “They put biofiber materials in the green box, and they’re only in the green box,” she says. “When you say lightweight, everyone goes directly to carbon fibers.” While there is more weight savings with carbon fiber, natural fibers offer both the environmental benefits and the opportunity to work with other industries to provide a revenue stream for them.

Another benefit to natural fibers is that unlike glass fibers they don’t break during injection molding. “Natural fibers tend to flow and bend and fill all the cracks and crevices where glass fiber does not make its way,” Mielewski says. In addition, glass fibers are less conducive to anisotropy (orientation in all directions)
than natural fibers.

“If our engineers got used to designing with natural fibers they would love it, because they wouldn’t have to worry about all the directional shrinkage and directional reinforcement,” Mielewski explains.

Ford is currently developing a console for the Lincoln MKX that will incorporate both pulp and glass fibers into the composite, and Mielewski hopes that designers will use more biofibers as they learn more about them.

Mielewski’s group is currently studying bamboo for composite fibers and algae oil for resins. They’re also working with Mexican tequila producer Jose Cuervo to develop applications for composites made with fibers from agave, which is used in tequila production. Since Ford has three assembly plants in Mexico, this research fits well with the company’s efforts to convert local waste streams into sources of revenue for residents.

The challenge is developing the supply chain to deliver a steady stream of the agave material. Someone must be willing to harvest the fiber, dry it, chop it and compound it into plastics so that it’s commercially available to use for vehicles. The problems involved in setting up such supply chains have been an important part of the learning curve in working with biocomposites, admits Mielewski.

Encouraging Adoption

Building a supply chain is just one barrier to biocomposites going mainstream. When oil prices are relatively low, as they are today, there’s less economic incentive for companies to use biomaterials. In addition, companies happy with their current composites may be reluctant to make formulation changes and go through the rigorous testing procedures required to make the switch, observes Campanella.

At Ford, Mielewski hopes to overcome this reluctance by working with upper management on a company-wide policy that requires the use of biomaterials and recycled materials. Partanen thinks the outlook for biomaterials would improve if they received the same kind of government support that biofuels have been given.

Nevertheless, Campanella remains optimistic about the long-term outlook for biocomposites. “We think there will be a lot of opportunity in a few years, and we have to be prepared,” she says. “We cannot depend upon a continuous stream of petroleum.

No matter how you slice it, that is a limited resource,” adds Mielewski. It’s time to give robust, high-performance biocomposites the attention they deserve. “They are lighter, better for the planet, they produce less pollution and less landfill,” she says. “They have a lot of really positive aspects to them.”

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ACMA Leads the Way in Recycling

Thanks to innovation in biocomposites and other traditional FRPs, composites recycling is inching closer to becoming a commercial reality. ACMA has been working with its industry colleagues to create a business case for recycling. Earlier this year, during ACMA’s first-ever Composites Recycling Conference, leaders from all over the world shared new products and insights that will allow the industry to continue making progress. To learn more about where the industry stands in its efforts toward greater sustainability, visit http://bit.ly/compositesrecycling.
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Across the global composites industry, businesses are constantly searching for innovative ways to improve the structures we make and how we make them. But much of the innovation we see today doesn’t start in a corporate meeting room – it starts at the research and development level at universities all over the world.

In North America, a lot of that research is focused on sustainability, including the development of biodegradable car parts, eco-friendly pavement that absorbs stormwater runoff and thermoplastic composite-reinforced concrete to make our infrastructure greener. Researchers are also looking for ways to make composite structures smarter through 4-D printing and magnetism. Here are five projects Composites Manufacturing has its eye on this year.
Cellulosic Composites for Cars

Project: Flax-reinforced thermoplastics
School: University of Southern Mississippi
Location: Hattiesburg, Miss.
Principal Investigator: Joshua Otaigbe, Ph.D.

Over the past decade, one of the global automotive industry’s biggest concerns has been increasingly stringent fuel economy standards. As a result, the composites industry has seen increased interest from OEMs that are looking to make vehicles lighter and therefore more efficient. However, some experts anticipate that decades from now, OEMs will need to push the envelope even further with parts that are not only lightweight, but also biodegradable.

“We need to be concerned about what happens with the material that you use in cars after their service life,” says Joshua Otaigbe, Ph.D., a professor in the School of Polymers and High Performance Materials at the University of Southern Mississippi. “So if you have biodegradable components, they’ll get a useful life. Those materials can either be recycled, or they can biodegrade without harming the environment.”

Last summer, thanks to a $50,000 grant from the National Science Foundation’s I-Corps program, Otaigbe and doctoral student Shahab Rahimi developed a cellulose-reinforced Nylon 6 nanocomposite that is not only biodegradable, but also 15 percent lighter than GFRP while maintaining comparable mechanical strength and stiffness. The researchers say the material could be applied to roofs, door panels and interior parts in automobiles, as well as rear decks, sidewalls and fenders in trucks and trailers.

Typically, cellulose-based nanocomposites are made with wood particles instead of actual fibers. Those particles, according to Otaigbe, can help save money but make nanocomposite manufacturing inefficient, as cellulose has many inherent chemical properties that stifle polymerization.

Instead, Otaigbe chose to extract flax fibers, which are a lot stiffer and stronger than wood particles, from wooden signs provided by Oregon State University. He then placed them in a mold injected with Nylon 6 and an amino propyltriethoxy silane (APS) catalyzing agent. With actual fibers in the polymer matrix, he and Rahimi could shape the material without having to melt it. Otaigbe says the low viscosity of the thermoplastic polymer also helped facilitate the chemical reaction. After one to two minutes at 150 C, the composite is fully cured. That temperature is important, according to Otaigbe, because cellulose-based composite materials can lose their flexural and tensile strength if heated above 190 C.

The technology is currently patent pending, and Otaigbe and Rahimi are working to optimize the process to make it commercially viable not just for the automotive industry, but all industries that use composites. They see big potential for these nanocomposites in construction and aerospace, two markets driven by a desire for lower costs and increased sustainability.

“The cost-effectiveness, lightweight, renewability and environmental sustainability of the nanocomposites of this study compared to that of traditional glass or carbon fiber reinforced (micro) composites may spur a better understanding of the current nanocomposites for a number of engineering applications where traditional carbon or glass fiber-reinforced polymer (micro) composites are not useable,” the researchers wrote in a paper about the project.

A New Approach to 4-D Printing

Project: Curved composites without molds
School: Concordia University
Location: Montreal
Principal Investigator: Suong Van Hoa, Ph.D.

The rise of 3-D printing has opened the door to a wave of new possibilities in manufacturing. However, while 3-D printing enables manufacturers to create a wide range of complex shapes, some researchers believe the process can be ever better. Many researchers have begun exploring 4-D printing, which allows regular 3-D printed structures with strategically aligned materials to self-fold like origami after being exposed to an activation mechanism like heat or moisture absorption.

According to Suong Van Hoa, Ph.D., a professor in the Department of Mechanical, Industrial and Aerospace Engineering at Concordia University and director of the Concordia Center for Composites (CONCOM), typical 4-D printing uses flexible materials, such as rubber, which facilitate the process but don’t make parts particularly strong. CFRP, however, could provide that strength. In traditional manufacturing, creating a composite part with a curved shape would require the time-consuming process of building an expensive and complex mold, but thanks to Van Hoa’s latest research on additive manufacturing, that may no longer be necessary.

The key, he says, is anisotropy – the quality of exhibiting properties with different values when measured along axes in different directions. Van Hoa discovered that by using automated fiber placement (AFP) to lay down layers of a flat laminate containing fibers running in different directions, he can control how the laminate changes shape after it cures in an autoclave. The laminate can curve in a variety of ways depending on the manufacturer’s choice of material properties, lay-up sequence, fiber orientation, thickness and the strategic position of the laminate.

For his experiment, Van Hoa used Cytec’s CYCOM® 977-2 carbon/epoxy prepreg system, with some laminate layers utilizing fibers oriented at 0 degrees (parallel to the main axis of the laminate) and others with fibers at 90 degrees (perpendicular to the main axis of the laminate).

By laying stacks of prepreg composite layers in an unsymmetrical laminate, Concordia University professor Suong Van Hoa, Ph.D., can control how they change shape.
“Normally when people work in composite materials … they don’t like the unsymmetrical laminate,” Van Hoa says, noting that symmetry makes it easier to predict how the laminate will behave in certain conditions. “I look at it the other way around. I look at it as an advantage rather than a liability.”

Two factors can cause the unsymmetrical laminate to curve on its own. During curing, the shrinking of the polymer matrix causes different amounts of deformation along different directions in a layer. Then during cooling, the different coefficients of thermal expansion (or contraction) along different directions in each layer also lead to deformation.

So far, Van Hoa has developed prototypes of curved leaf springs, the lightweight vibration absorbers found in cars. He also envisions his novel process being used for prosthetic legs or space applications, including satellites, where the structures are subjected to extreme temperature fluctuation.

Recycled CFRP in Concrete
Project: Improved permeable pavement
School: Washington State University
Location: Pullman, Wash.
Principal Investigators: Karl Englund and Somayeh Nassiri

In Washington and Oregon, the success of the salmon and fishery industries is a critical component of the states’ economies. But for years, contamination from stormwater runoff has severely stunted salmon growth. One strategy that several cities have attempted is to create permeable concrete in parking lots and low-traffic streets that could allow runoff to drain through the pavement and not go directly into the watershed. However, because it is highly porous, permeable concrete is not nearly as durable as traditional concrete used in major roads.

To innovate new solutions for mitigating contaminated stormwater, Washington State University’s Karl Englund, Ph.D. and Somayeh Nassiri, Ph.D. teamed up with Boeing to develop a new type of permeable pavement. Englund, who had already been collaborating with Boeing for years on creative applications for excess CFRP material, saw the project as an opportunity to demonstrate the strength and stiffness of reusable composites and help solve a critical problem. Not only does this new permeable pavement absorb runoff, but it also has long-term strength and durability.

Unlike some traditional CFRP reutilization applications, Englund and Nassiri did not attempt to liberate the fibers from the polymer matrices. Instead, the researchers used inexpensive milling techniques to cut unused cured composite material into pieces that they added to a permeable concrete mixture. This method, according to Englund, helped minimize energy use and keep costs down. He notes that the specific gravity (the ratio of the density of a substance to the density of a reference substance) of the scrap was similar to the specific gravity of the concrete, which helped with dispersion.

According to Nassiri, the results were very surprising. When she and Englund first began the project, she was simply hoping the strength of the concrete would not decline. “And then all of a sudden our test results came out, and we were having 20 to 60 percent improvement in bending strength,” says Nassiri. “I would call that a nice, pleasant surprise.”

Currently, the permeable pavement is undergoing tests at a
Making Military Vehicles Smarter
Project: Magnetic damage detection
School: Clemson University
Location: Clemson, S.C.
Principal Investigator: Oliver Myers, Ph.D.

In the U.S. Army, soldiers depend on regular maintenance of helicopters and tanks to ensure safety. However, in many cases, the Army replaces parts of vehicles based on how long they have been in service, whether they appear damaged or not. As a result, many Army vehicles are replaced prematurely by new ones that are destined for the same fate. For years, the Army has looked for ways to break the cycle and reduce sustainment costs. One way to accomplish that is by making it easier to determine if a vehicle has been damaged.

Last December, the U.S. Army Research Laboratory awarded $993,492 to Oliver Myers, Ph.D., an associate professor of mechanical engineering at Clemson University, to develop a solution that enables military vehicles to self-detect damage. Unlike typical sensors, which are attached externally to structures, Myers envisions sensors that can be integrated in the structure itself. He and his team are creating epoxy-based CFRP prepreg laminates embedded with Terfenol-D, a rare earth metal alloy that changes shape when exposed to a magnetic field. The technology can detect everything from impacts and cracks to abnormal mechanical loads.

According to Myers, once the laminate is exposed to a magnetic field, it creates an effect akin to a human nervous system that sends pain messages to the brain. If the laminate is unscathed, it will display a uniform magnetic signature, but if an area is damaged, there will be a secondary magnetic signature that looks different.

For Myers, choosing carbon fiber and epoxy made sense due to their commercial availability and widespread use in military applications. However, determining the exact material formulation was a challenge. Because Terfenol-D is only 1 to 300 microns in diameter, one of the biggest obstacles the team faced was how to spread it thinly and evenly throughout the laminate.

Myers says that combining compression-molded chopped carbon fibers and epoxy separately would make it difficult to overcome that obstacle, which is why he chose prepreg. “Epoxy [in CFRP prepreg] has a low level of tackiness before curing, which allows us to spread a thin layer of the magnetostrictive material on the prepreg as we build the composite laminate,” says Myers.

Myers is using the process to create beam specimens that can fit into Instron testing machines, which are used to evaluate the mechanical properties of materials and components. His team has created several electromagnetic coils which, along with data acquisition technology, help simultaneously generate an excitation field and read the output from the Terfenol-D.

Currently, the team is using what Myers calls a “surrounding scan” to get a general overview of damage in a structure. The next step of the research, he says, is to refine the system so it can display damage to one part of a structure at a time through a single-sided scan. Within 10 to 20 years, he envisions the Army incorporating a real-time data collection system for structured health monitoring based on his technology.

Thermoplastics for Construction
Project: Hybrid composite/concrete beam plate
School: University of Maine
Location: Orono, Maine
Principal Investigators: Bill Davids and Roberto Lopez-Anido

At the University of Maine, graduate students Camerin Seigars and Benjamin Smith at the Advanced Structures and Composites Center (ASCC) are working with the Engineering Research and Development Center (ERDC) of the U.S. Army Corps of Engineers to develop a proof of concept for a novel concrete beam with a thermoplastic composite reinforcement. The goal, according to the students’ co-advisor, civil engineering professor Roberto Lopez-Anido, Ph.D., P.E., is to showcase what thermoplastics can offer, including recyclability, corrosion resistance, automated manufacturing, weldability, impact resistance and a high strength-to-weight ratio.

The students are making beam plates with two types of E-glass reinforced thermoplastics – one based on Arkema’s Elium™ acrylic resins and one based on polyethylene terephthalate glycol (PETg) prepreg tapes supplied by PolyOne. After the E-glass/PETg plates are made by stamp thermoforming, shear connectors are welded. They used a unique friction welding technique to adhere the shear connectors to the plate. The plates are used for stay-in-place formwork to support the weight of wet concrete and can then serve as tension reinforcement for the...
cured concrete to form a hybrid system.

For the Elium-based plates, the students used vacuum-assisted resin transfer molding (VARTM) to fabricate the base of the plate, as well as fiber-reinforced thermoplastic shear connectors to transfer forces between the composite and the concrete.

For the PETg prepreg tape-based plates, the students used Dieffenbacher’s signature Fiberforge RELAY®2000 machine, which uses an automated tape laying (ATL) system to produce tape lay-ups (tailored blanks) from continuous fiber-reinforced thermoplastic composite tapes. The students then transported the semi-finished part to an infrared oven where the material gets softened and later goes into a stamp forming press. This process allowed the students to generate both flat and corrugated plates.

According to the researchers, a corrugated structure can increase the flexural stiffness and strength of the plate, which allows it to withstand dead loads before the concrete has cured.

Lopez-Anido says the process of determining the best way to make each plate was not easy and would not have been possible without ACMA’s UMaine liaison Madeline Wehrle, who played a key role in connecting the university to ACMA members with expertise to help the students make the best use of the thermoplastics.

“I don’t think we could have done this by ourselves,” says Lopez-Anido. “This is not just a project where you order materials, they arrive and then you make the product. You need to really work with the material suppliers, and you need come up with a process that really takes advantage of the material.”

The students have completed initial testing of the material properties and have sorted them into a database that will later be used for structural analysis. The next phase, Lopez-Anido says, will be to design, prototype and test hybrid components and built-up members.

“We’re basically building concrete blocks with thermoplastic composite panels that are attached with new design concepts for transferring shear forces,” he says. “We’re looking at strength, and we’re looking at ductility of those shear connectors.” After that, the plan is to test full-size beams made with the materials. Eventually, says Lopez-Anido, the unique combination of materials and processes could be used to make bridge decks, retaining walls and columns.

Evan Milberg is communications coordinator for ACMA. E-mail questions to emilberg@acmanet.org.
2018 Elections Yield Key Opportunities for Composites Industry

By Brooke Wickham

The midterm elections are only a few months away, and the political environment is already heating up. No matter what the election results hold, the composites industry has an important stake in the 2018 election with significant outcomes for the industry.

Democrats face an uphill battle in the Senate as they defend 26 of the 35 seats up for reelection. While the Republican Party holds only a slight 51-49 majority in the Senate, for the balance of power to shift, Democrats need to hold all 26 seats and flip two Republican seats. Based on those odds, Republicans hold a better chance of maintaining the status quo in the Senate.

Although Republicans have a 238-193 seat majority in the House, this chamber is more likely to flip in favor of the Democrats. Of the 435 seats up for reelection in the House, Democrats need to keep all their seats and flip 24 Republican seats to gain control. Republicans lost several seats in the 2016 election, are currently defending districts that historically tend to be toss-ups for either political party and are fighting to keep several open seats. Based on those odds, House elections are worth watching.

Of the seats up for reelection, several long-standing composites industry allies are facing challenging campaigns in November. In the Senate, former chairman of the Congressional Composites Caucus, Sen. Joe Donnelly (D-Ind.) faces a challenging reelection in a state Trump won with significant margins. While it is unlikely that Tennessee will flip from Republican to Democrat, with Sen. Bob Corker (R-Tenn.) not seeking reelection this year, this will be another key race to watch in a state densely packed with composite companies. In the House, Rep. Barbara Comstock (R-Va.), a key ally in promoting composites in infrastructure, is fighting a tough reelection campaign in a battleground district that is becoming increasingly more Democratic leaning.

If either chamber flips, or if Republicans maintain their majority, the aftermath of the election is likely to have a noticeable impact on the composites industry. If the Republican Party fights off the Democrats, the Trump Administration has a greater ability to continue their efforts to identify and eliminate unnecessary government regulation and institute sensible regulations that do not have an adverse impact on businesses. However, if Democrats gain control of one of the chambers, the administration and Republican Party will have a harder time continuing their rollbacks in the regulatory arena.

On the other hand, if Democrats take over one of the Houses, there stands a greater possibility for an even larger infrastructure investment increasing the probability that infrastructure legislation will include provisions directing federal investment in innovative material solutions like composites and increases the possibility that federal research initiatives such as IACMI will continue to receive funding.

As members of Congress return home prior to the election, they are looking to meet with leaders in the community...
like you. Composites are innovative and provide viable solutions to real world problems. The key to expanding the industry's footprint on Capitol Hill is for all composites industry professional to develop meaningful relationships with their elected officials. Prior to the election, capitalize on opportunities to meet with your elected officials by hosting a congressional plant tour or scheduling a meeting in their local offices. Better yet, consider attending one of ACMA’s policy fly-ins like our Transportation & Defense Fly-In, Sept. 25 – 26, 2018, or Infrastructure Day, February 2019. Elected officials can only represent constituents if they know the issues their community is facing. Take advantage of this ever-changing political environment and seize your stake in the policy discussion.

ACMA continues to support the industry by meeting with congressional offices about the valuable capabilities of composites, educate regulators to produce regulations that are both feasible and protective and provide information the industry needs to open markets. Several months stand between now and the 2018 midterm elections and anything can happen to give either party a boost in the polls prior to Election Day. One thing remains clear – there is a lot at stake for the composites industry in 2018, and now is the time to act. Are you willing to do your part?

Brooke Wickham is government affairs coordinator at ACMA. Email comments to bwickham@acmanet.org.
Since its inception in 2014, CAMX – The Composites and Advanced Materials Expo has grown in size and scope. Industry professionals representing both ACMA and SAMPE serve on the CAMX Steering Committee, which plans the overall direction of the conference and all related activities. Carl LaFrance, senior VP of quality at Molded Fiber Glass Companies, chairs the CAMX Steering Committee. We had a conversation with LaFrance to talk about what’s new at CAMX 2018, which will be held in Dallas Oct. 15-18. A new aspect to this year’s CAMX is the co-location of the show with the International Fabrics Association International’s (IFAI) Expo. IFAI’s members’ products cover the broad spectrum of specialty fabrics and include fibers, fabrics, end products, equipment and hardware.

CM: What factors influenced the decision to co-locate CAMX with IFAI, and what new show features can attendees expect as a result?
LaFrance: Holding co-located shows allows us to showcase technologies that are relevant to both industries. In addition, some members of IFAI are also members of SAMPE and ACMA, or they provide products – especially equipment – to CAMX attendees. They have influence on composites manufacturing through their products. There also are IFAI attendees who are interested in learning how to integrate fabrics into the design of composite products. The IFAI exhibition floor will be adjacent to the CAMX exhibition floor, with a blend of exhibitors overlapping at the interface. There also will be information on topics of interest to both groups, such as smart materials, in this overlapping area.

CM: What can attendees expect from this year’s general session?
LaFrance: The general session is one of the most anticipated CAMX events for attendees and exhibitors. Each year, the CAMX Steering Committee spends a great deal of time and energy choosing the format and content of the general session. We strive to plan a general session that will match the energy of CAMX and excite attendees. After a couple years of CAMX Live!, which featured three speakers, this year we have chosen a single speaker format. Attendees can expect an engaging speaker with an important message for us all. And they can expect an announcement on the dynamic speaker shortly!

CM: Why is it important to the CAMX Steering Committee to offer new activities, like last year’s Innovation Park, at CAMX?
LaFrance: The success of Innovation Park demonstrated that CAMX attendees and exhibitors seek expanded venues to discuss industry topics, share ideas, make business connections and shape the future of the industry. We understand that not all CAMX attendees learn and network in the same way. Offering new formats for people to meet, discuss and form a community are important as we look to keep attendees coming back to CAMX year after year.

CM: Are there other changes in store for the future?
LaFrance: Ideas for increasing the CAMX experience are constantly discussed within ACMA, SAMPE and the collaborative CAMX Steering Committee. We are considering technologies, such as augmented reality and virtual reality, to demonstrate manufacturing techniques. We are also looking at including some special display areas. This year, we are taking advantage of the co-location to create a display on smart materials, as well as making some changes in the ACE and CAMX Awards to really demonstrate and celebrate the possibilities of the winning innovations. You’ll just have to attend CAMX 2018 in Dallas to see exactly how we’ve changed things up this year!

CM: Can you share how CAMX has benefited you or MFG?
LaFrance: It’s bigger than just one person or company: At MFG, we believe the CAMX concept has transformed our entire industry – the combined influence of ACMA and SAMPE in one powerful event. Just look beyond the acronyms and see how the words of our collaborating organizations fit together: Composites, Advanced Materials, Manufacturing, Process and Engineering. In a time where the economic influence and value creation of American manufacturing appears stagnant to some, we all benefit from CAMX.
Connecting with Ford

In 2016, ACMA launched an event series called No Limits Composites to connect its members with major automotive OEMs. In addition to serving as a platform for ACMA members' products, the event gives OEMs the chance to foster a deeper connection within the design community and supply chain and broaden their understanding of the potential of composites materials for automotive companies. While the first No Limits event was successful, ACMA's March 2018 event at Ford took OEM engagement to new heights, exposing more than 500 engineers to more than 70 composite components from ACMA members.

“It’s like making 300 sales calls in one day. It’s been very beneficial to talk to these people, find out what they do, find out what their challenges are and see if we can come up with a match,” says Eric Heilshorn, product manager at 3A Composites.

While the event is a great platform to display products, it also supports ACMA's efforts to help the composites industry speak with a unified voice. As companies like Ford look to consolidate their vehicle portfolios in the North American market, it is important for members of the composites industry supply chain to work together to provide solutions that help OEMs meet their evolving needs.

“IT takes a community to advance an industry,” says Dustin Davis, director of technology at Norplex-Micarta. “There’s no one company here who has the complete solution, and I think it takes an industry association like ACMA to bring us all together.” To participate in future OEM automotive or aerospace technology demonstration events, visit http://bit.ly/ACMA TechDays or contact Dan Coughlin at dcoughlin@acmanet.org.

Attendees at ACMA’s Ford Tech Day observe the structural support system of a Corvette.

SPREAD THE WORD, INSPIRE IDEAS, AND INCREASE THE USE OF COMPOSITES!

Use ACMA’s "Discover Composites" materials to amplify your marketing and outreach and present a unified message to end users.

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Log on to: myacma.acmanet.org to access unique collateral materials and messages.
Safe, Green Acetone Replacement

Approaching our sixth decade in the marketplace, U.S. Polychemical Corp. is proud to announce the availability of our Polychem Acrastrip line. Polychem Acrastrip is a safe, green alternative for all your cleaning needs within the composite industry.

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ACMA Upcoming Events

ACMA is your key connection with the best and brightest in the industry – people who share your interests and drive for success. Don’t miss these upcoming events:

Transportation and Defense Policy Fly-In
Sept. 25-26, 2018
Washington, D.C.
Join your fellow ACMA members in Washington, D.C., to advocate for the increased use of composites in aerospace, defense and transportation markets. Gain inside knowledge to grow your business relationships with federal agencies, find potential leads in federally-influenced markets and network directly with agency leadership and your industry peers.

CAMX
Oct. 15-18, 2018
Dallas, Texas
http://www.thecamx.org
Created by ACMA and SAMPE to connect and advance all aspects of the world’s composites and advanced materials communities, CAMX is an all-encompassing event. Regardless of the application – transportation, aerospace, marine, wind energy, software, construction and infrastructure, medical, academics or sports and leisure – CAMX is the must-attend event for products, solutions, networking and advanced industry thinking.

North American Pultrusion Conference
April 8-10, 2019
Rosemont, Ill.
The 2019 North American Pultrusion Conference, being held in partnership with the European Pultrusion Technology Association, will unite leaders in the composites industry, OEMs and suppliers to discuss the latest global opportunities for pultruders. The deadline for abstracts is Sept. 14, 2018.

New ACMA Members

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Lakewood, Colo.

Union of Composites Manufacturers
Moscow, Russia

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

Advertising Index
Advertiser - Page
Abaris Training Resources .......... 25
AOC Resins ......................... 12
Baltek .............................. 5
Composites One ..................... 4
Elliott Company of Indianapolis, Inc. ............... 13
GS Manufacturing .................. 23
Janicki Industries .................... 17
Magnum Venus Products .......... 10
Master Bond ....................... 21
Stiles Machinery ................... 7
Thermwood Corporation .............. IFC
US Polychemical .................... 28
Vortex Tool Company ................ 23
Wisconsin Oven .................... BC

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