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SEPTEMBER 2019

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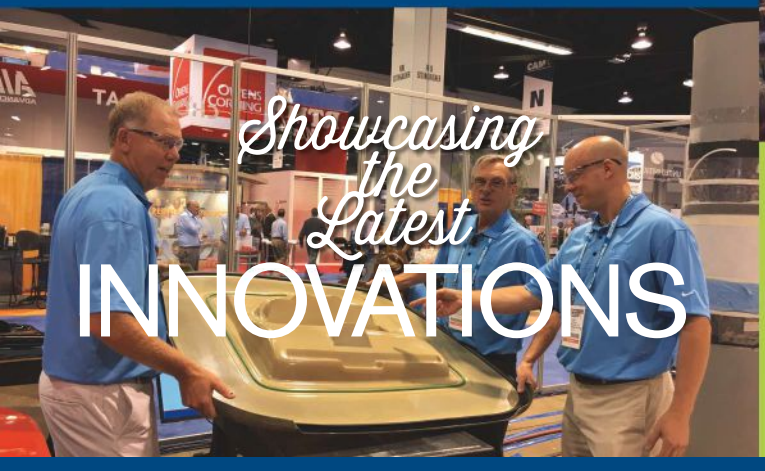

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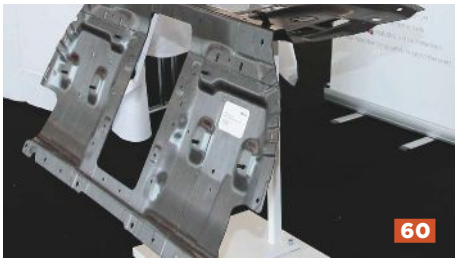


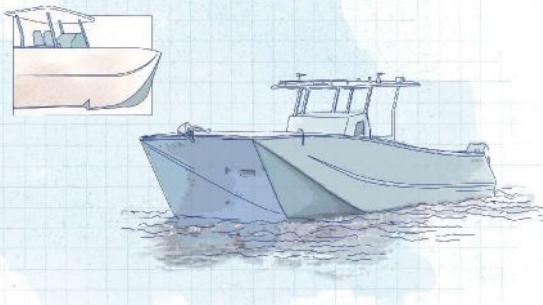
FEATURES

» ON THE COVER

ZLP in Augsburg has developed a robot-based continuous ultrasonic welding system consisting of an end-effector mounted on a KUKA QUANTEC KR210 robot on a 7-meter linear track, shown here. This has been proven on components including a stiffened fuselage panel and a rear pressure bulkhead. See p. 60

Source / DLR

FOCUS ON DESIGN



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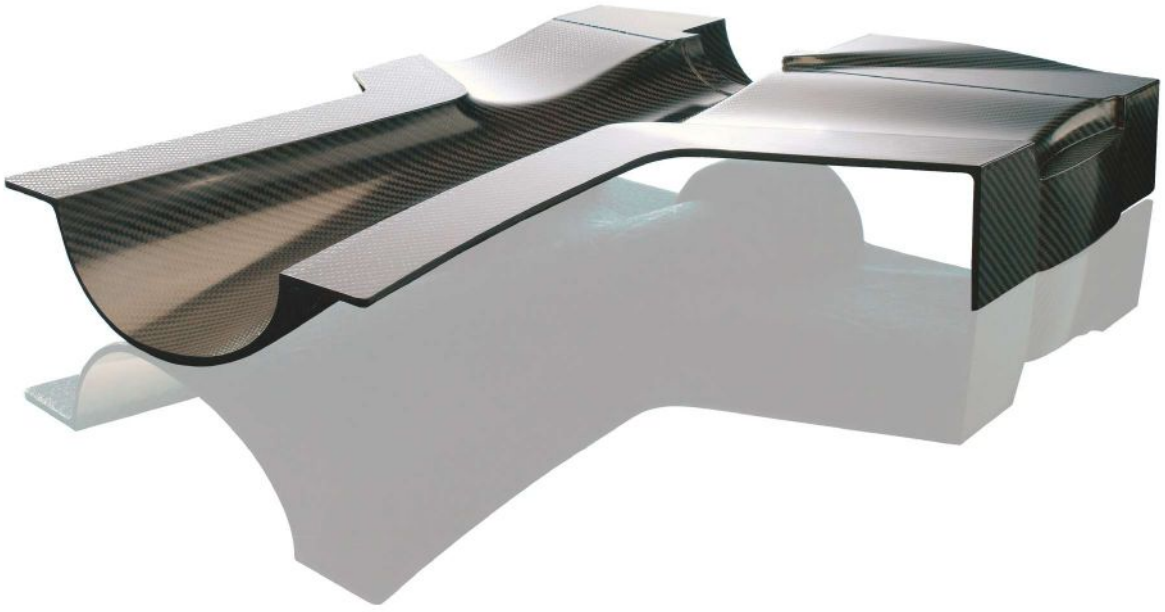

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» The world's largest composites-related trade exhibition is JEC World, held every March in Paris. It's a great show — busy, crowded, bustling, full of technologies and exhibitors from throughout the composites supply chain. The aisles are crammed with attendees representing every major end market the industry serves. Three days at JEC World makes you feel like you're in the middle of the composites manufacturing universe, and nothing else matters.

There's just one problem. It's very likely that you, as a subscriber to *CompositesWorld*, have never attended JEC World. And if you have attended, it's even more likely you've done so only once or twice. The reason? The center of gravity in the world of composites is in North America, and if you are an engineer or plant manager or VP of manufacturing for a composites fabricator in the U.S. or Canada, traveling to Paris annually to attend JEC World is just not economically feasible, no matter how valuable and important the show is. Indeed, each year the fraction of JEC World attendees from the U.S., as reported by show organizer JEC Group, is substantially smaller than the fraction of composites professionals from the U.S. that make up the entire global composites industry. Still, it's a great event — hard to beat.

CAMX 2019 represents the sixth iteration of the show.

There is no direct analog to JEC World here in North America — nothing that compares with the size and intensity of JEC World. What we do have, however, CAMX, comes pretty close. CAMX, for those of you new to composites, or for those of you who just plain forgot, is a relatively new composites exhibition, having begun in 2014, in Orlando, Florida. You might recall, prior to 2014, the American composites trade show scene was cleaved by two major events: SAMPE's conference and exhibition in the spring and ACMA's conference and exhibition in the fall. The former catered to the aerospace end market; the latter catered to everything else.

In 2014, however, the leadership of SAMPE and the leadership of the American Composites Manufacturers Association (ACMA) decided it was time to forgo this segregation and develop a single event designed to meet the needs and expectations of the entire composites industry. Thus, CAMX was born — a conference and exhibition for the entire composites industry supply chain, from raw material suppliers to machinery manufacturers to intermediates producers to moldmakers to fabricators and OEMs. And all end markets are fair game, including aerospace, space, automotive, wind, architecture, marine, industrial, consumer, sporting goods and on and on.

CAMX 2019 represents the sixth iteration of the show, and it will be held this month in Southern California at the Anaheim Convention Center, Sept. 23-26. Unlike JEC World, CAMX has not had a couple of decades to mature and grow, but it has had time to become the largest composites trade event in the world's largest composites market, and that's meaningful. CAMX organizers have worked diligently each year to evolve the show and make sure the event is useful, relevant and a source of great technical information.

This year's CAMX is expected to draw more than 8,000 attendees and 550 exhibitors. Further, one of the strengths of CAMX is a robust conference program, which this year offers more than 180 presentations covering additive manufacturing, bonding and joining, workforce development, design/simulation, sustainability, processing technologies and testing.

In short, you have in CAMX a composites trade event that is easily accessed and is a great source of technical and market information about where and how composite materials are being applied today.

Preparatory to the show, we asked all CAMX exhibitors to send us whatever information they have about the products, technologies and services they are featuring in their booths. You will find on p. 20 of this issue a preview of that exhibit information. *CW* will, of course, be at the show itself, and we hope you will be there as well. And if you are at CAMX this month, I encourage you to stop by and visit us in booth K72. I look forward to seeing you in Anaheim.

JEFF SLOAN — Editor-In-Chief

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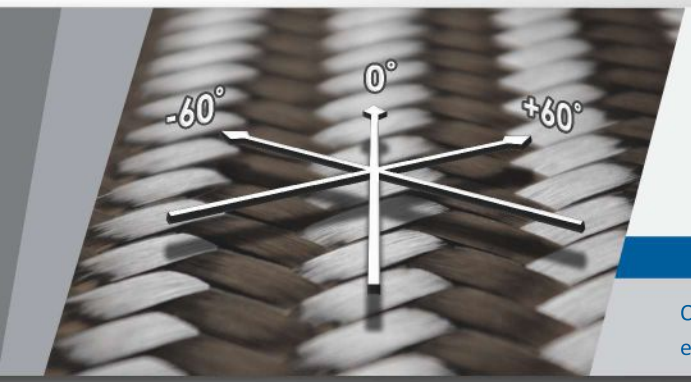

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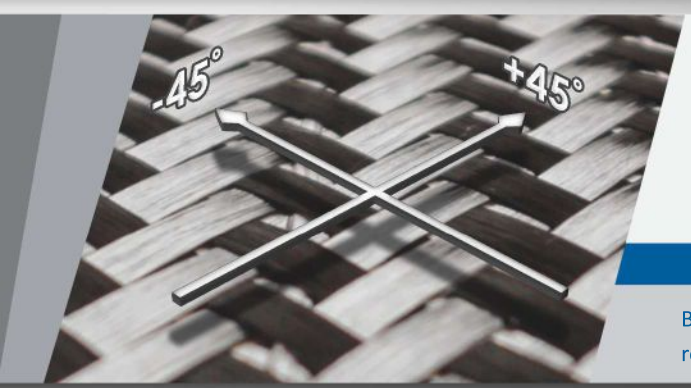

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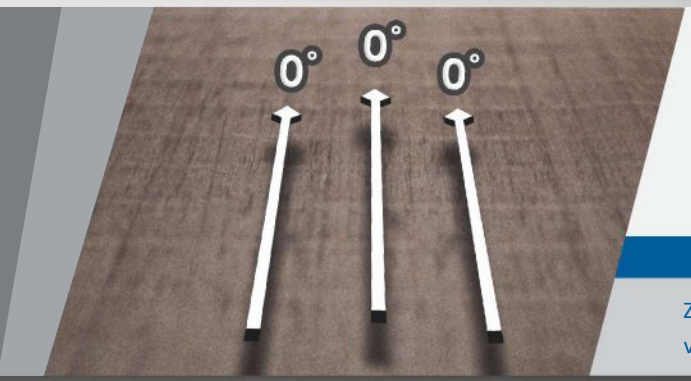

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The impact of Apollo 11

» It's July 20 as I start this column, exactly fifty years since Apollo 11 became the first space mission to land Earthlings on the moon. After the landing, Neil Armstrong and Buzz Aldrin spent a few hours collecting dust and rocks from the lunar surface before catching a bit of sleep and departing to rendezvous with Michael Collins in the command module orbiting above. The trio successfully splashed down in the ocean three days later, completing the first manned mission to the moon, which had been promised by President John F. Kennedy eight years earlier in 1961.

The night of the landing, I was one month shy of my 11th birthday. Right after Armstrong took his first steps on the surface, my younger brother and I ran outside, looked into the sky and both claimed we could "see the astronauts on the moon!" Of course, we couldn't, but as sibling rivalries go, neither of us would be willing to admit *that*! We lived in a Houston suburb, only 15 miles from NASA Mission Control, and without a doubt the Apollo program, especially Apollo 11, inspired my already engineering-inclined mind to pursue a career based in science.

> What role, if any, did composites play in Apollo?

Humans have had a fascination with the moon for millennia. An estimated 600 million people, or one-sixth of the global population at the time, watched the moon landing live. That's impressive. To put this event in perspective, 1969 was the year The Beatles released "Abbey Road," and that summer there was also this little music festival called Woodstock. While the Advanced Research Projects Agency (ARPA) was already developing the backbone of what would, in 1974, be termed "the Internet," it would take until 1989 before the World Wide Web was a thing, and until 1991 before it became widely available to the public. True personal computers appeared in 1977, and mobile phones everyone could buy didn't happen until 1984.

Apollo was built upon a long history of rocket science. Even today, all rockets are governed by the famous equation developed in 1903 by Russian visionary and scientist Konstantin Tsiolkovsky, who first postulated the concept of escape velocity to defeat Earth's gravity. Although he never built a rocket, Tsiolkovsky inspired the famous scientists who did, including American Robert Goddard and Germans Hermann Oberst and his protégé Werner von Braun. After World War II, von Braun emigrated to the U.S. and was instrumental in establishing the Mercury, Gemini and Apollo efforts.

What role, if any, did composites play in Apollo? Aside from the ablative head shield on the command module — a mix of epoxy phenolic novolac resins potted into a fiberglass honeycomb — it's hard to say. It's possible that composites using fiberglass and/or boron fibers found their way onto certain non-critical components. Although carbon fiber composites based on rayon fibers were available, they were not known for having high strength or stiffness. PAN-based carbon fiber became commercially available around 1970, too late for Apollo, which completed its last mission in 1972.

On the other hand, advanced composites have played significant roles in spacecraft developed *since* Apollo. The Space Shuttle used advanced composites extensively during its run after Apollo, flying from 1981 to 2011, a period of 30 years. Satellites, space telescopes, the International Space Station and launch vehicles are enabled by the properties of carbon fiber. No doubt future vehicles, perhaps returning to the moon or going to Mars, will rely on advanced composite materials to fulfill their missions.

That American astronauts would go from first orbiting Earth to landing on and returning from the moon in only eight years is incredible. Most of the technology for the Apollo program *had to be invented.* Such progress happens only as a result of clear vision of the goal and a corresponding commitment to achieving it, both in human effort and funding. By some estimates, more than 400,000 people worked on the Apollo program, and the cumulative budget was $288 *billion* when adjusted for inflation.

The Apollo mission was driven in large part by a geopolitical space race between the U.S. and the Soviet Union. Do we have the same impetus to go back to the moon and onward to Mars? Are we willing to spend the sums required to do it, or would our monies be better spent solving other global needs, such as stemming climate change? My good friend Steve Nolet of TPI Composites, also inspired by Apollo 11 to pursue a science career, asked some of the same questions in his March 2019 column for this magazine. What will spur us to take on such challenges and prevail at all effort and cost? Fifty years from now, what will be the legacy of *our* generation? CW

ABOUT THE AUTHOR

Dale Brosius is the chief commercialization officer for the Institute for Advanced Composites Manufacturing Innovation (IACMI), a DOE-sponsored public-private partnership targeting high-volume applications of composites in energy-related industries including vehicles and wind. He is also head of his own consulting company, which serves clients in the global composites industry. His career has included positions at US-based firms Dow Chemical Co. (Midland, MI), Fiberite (Tempe, AZ) and successor Cytec Industries Inc. (Woodland Park, NJ), and Bankstown Airport, NSW, Australia-based Quickstep Holdings. He served as chair of the Society of Plastics Engineers Composites and Thermoset Divisions. Brosius has a BS in chemical engineering from Texas A&M University and an MBA.

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Riding the rollercoaster that is the aerospace industry

» Between 2010 and 2015, the supply chain for the commercial aerospace industry underwent a transformation that had profound impacts on the business models and profitability of OEMs and their tier suppliers. New models were launched, new technologies were harnessed — principally the extensive use of composites — and new ways of doing things were trialed.

Over this period, the build rates of the two major OEMs — Airbus (Toulouse, France) and Boeing (Chicago, Ill., U.S.) — increased at a compound annual growth rate (CAGR) of 7%. In order to cope, their suppliers had to make large capital investments in equipment and ramp-up production correspondingly.

> This period of relative stability may not last long, with further changes on the horizon.

In this business environment, the OEMs became more reliant on their Tier 1s. In the cases of the composites-intensive 787 *Dreamliner* and A350 XWB, Boeing and Airbus deemed a high degree of outsourcing necessary to get access to the most advanced composites technologies and to mitigate the risks associated with these projects. To reduce risks further, the OEMs also looked to keep their suppliers on a tight leash.

For the *Dreamliner*, Boeing came up with the idea of the risk-sharing partnership, which turned suppliers to the program into stakeholders. Through these partnerships, Boeing essentially asked its suppliers to soak up the research and development (R&D) investment for their work, and to wait until the plane was certified and delivered to customers before they got paid.

These partnerships substantially reduced Boeing's up-front investment and its exposure to delay risks, and incentivized Boeing's suppliers to keep the program running to budget and deadlines. For the suppliers, they make more money the more planes Boeing sells, and retain the intellectual property rights to their technologies — making it more difficult for Boeing to abandon them in the future.

These developments led to growing revenues for OEMs and Tiers 1s, but their profitability was volatile. The *Dreamliner* program ran significantly over time and over budget, suggesting that Boeing's risk-sharing strategy did not work as intended. Lower tier companies and intermediate composite material providers, by contrast, were better able to resist supply chain pressures.

The situation has since stabilized and OEMs and tiers are now reporting higher levels of profitability. Indeed, across more than thirty OEMs and suppliers analyzed by Future Materials Group (FMG, Cambridge, U.K.), earnings before interest and taxes (EBIT) have increased by an average of 4%. Build rates have dropped slightly, but the CAGR of 4.4% predicted for the next 20 years remains healthy. There is growing confidence in composites and processes for their conversion into parts. Further, the high numbers of mergers and acquisitions (M&A) in the global aerospace industry point to overall health in the industry — in fact, the ratio of its enterprise value (EV) to its earnings before interest, taxes, depreciation & amortization (EBITDA) rose from 9.9x in 2015 to 14.2x in 2018.

Boeing and Airbus improved their EBIT by 4% and 3%, respectively, between 2013 and 2018, deploying a number of strategies to achieve this. Boeing's Partnership for Success exerted a great deal of pressure on its supply chains to cut costs. The company entered into the stable and profitable maintenance, repair and overhaul (MRO) market, and have brought certain operations in-house through joint ventures (JVs) and acquisitions. In October 2018, for instance, Boeing entered into a JV with global seat manufacturer Adient Plc (Plymouth, Mich., U.S.) to form Adient Aerospace, and bought KLX Aerospace Solutions (Hialeah Gardens, Fla., U.S.), a supplier of aviation parts, services, composites and chemicals. Further, through the increasing use of digital technologies across their supply chains, both OEMs have achieved better transparency in terms of logistics and have improved the efficiency of their production processes.

The Tier 1s, meanwhile, have emerged from the transition in a wide variety of forms, and remain the preferred partners of the OEMs. They range from composites specialists to diversified metal and composite assemblers, and their annual revenues vary from around $132 million (Avcorp; Delta, British Columbia, Canada) to the $100 billion that will be generated by Raytheon Technologies Corp, which will be formed through the merger of Raytheon Co. (Waltham, Mass., U.S.) and United Technologies Corp. (Farmington, Conn., U.S.). The large Tier 1s are active in all aerospace segments, from defense to structural commercial aviation, interiors and aeroengines, while others, such as Premium Aerotec (Augsburg, Germany) or Sonaca (Gosselies, Belgium), focus primarily on single segments. Most of these Tier 1s have strategic relationships with a single OEM, but supply several as secondary partners.

Some Tier 1s have taken advantage of the change and have grown significantly through acquisitions. This strategy has increased their profits, given them a larger balance sheet and, through the exploitation of economies of scale, improved their ability to cope with the major capital investments (automation equipment, for example) that were required of them. These acquisitions also enhance their bargaining positions with OEMs; for example, post-merger, Raytheon Technologies Corp.'s turnover will be similar to that of Boeing's. Some have expanded the scope of their responsibilities to include the qualification of processes and materials; for instance, Spirit AeroSystems (Wichita, Kan., U.S.) could be in charge of the process design and material qualification for Boeing's new narrow-body fuselage. Many have also diversified their activities. In October

2018, for instance, engine manufacturer Safran (Paris, France) bought interiors Tier 1 Zodiac (Plaisir, France).

Other smaller, more specialized Tier 1s (such as Avcorp, Ducommun, Premium Aerotec) have had more of a difficult time, with significant variation in their annual profits. Premium Aerotec, for example, reported its lowest EBIT of –38% in 2013 and its maximum, of 3.5%, in 2015. This decreased again, to –10%, in 2017.

This period of relative stability may not last very long, however, as there are further changes on the horizon.

The Asian market will become increasingly important; Airbus forecasts that the continent will receive 42% of all passenger aircraft deliveries over the next 20 years. This could lead to the development of new OEMs there.

The established OEMs, meanwhile, are beginning to reveal glimpses of their plans for the future. At the 2019 Paris Air Show, for instance, Airbus launched the A321 XLR — currently the longest-range single-aisle plane available — which may eat into potential market for Boeing's yet-to-be-confirmed New Midsize Airplane (NMA).

For its part, Boeing received a big order for its 737 MAX at the Paris Air Show from International Airlines Group, which had previously been an exclusive Airbus single-aisle operator. Even so, the 737 MAX is yet to re-enter service after being grounded over safety concerns in March 2019. Further, the 737 is an older platform than the A320, and cannot be modified to create an equivalent to the A321 XLR. Will this put pressure on Boeing to accelerate plans for its replacement?

Regardless, any new narrow-body platforms will be built from a mix of metals and composites, with the latter's share increasing as production technologies have matured. It seems highly likely that these platforms will feature CFRP wings and fuselages, which will have a profound impact on the demand for carbon fiber and the composites supply chain as a whole. It also seems likely that the use of thermoplastic composites will increase significantly as well, given the level of investment in this technology made by suppliers of composites to the aerospace industry.

These changes will create new opportunities, but also new risks. The supply chain will have to adapt accordingly. CW

ABOUT THE AUTHOR

As a consultant in the Research & Analysis team of Future Materials Group (FMG), Dr. Myriam Yagoubi supports clients in developing and delivering their business growth strategies. She conducts market assessments, benchmarking analyses and develops forecasting models and tailored market entry approaches. She carries out commercial due diligence assignments and assists in buy-side and sell-side transactions. She holds a Ph.D in organic chemistry from the University of Oxford.

Composites Index contracts on a surprise five-point decline

July 2019 — 47.4

» The Composites Index closed July at 47.4, ending a 31-month expansion that first started in late 2016. The duration of the expansion was the longest on record, dwarfing the last recorded expansion on record of 10 months set in 2014. The latest Index reading is 17.4% lower compared to the same month one year ago, and 10.6% lower from just the previous month. Index readings above 50 indicate expanding activity, while values below 50 indicate contracting activity. The further away a reading is from 50, the greater the change in activity. Gardner Intelligence's review of the underlying data revealed that both production and new orders experienced an inversion in July. The Index — calculated as an average of its components — fell lower further by the ongoing weakness in exports. Contracting new orders and production data pressured backlog activity, which reported the lowest reading among all components in July.

Surprise declines in new orders and production activity have occurred in the past, and each time the Index was able to quickly recover. Since late 2011, there have only been two periods of sustained contraction, both of which lasted for approximately six months before the Index resumed expansion. CW

ABOUT THE AUTHOR

Michael Guckes is the Chief Economist/Director of Analytics for Gardner Intelligence, a division of Gardner Business Media (Cincinnati, Ohio, U.S.). He has performed economic analysis, modeling and forecasting work for nearly 20 years in a wide range of industries. Guckes received his BA in political science and economics from Kenyon College and his MBA from Ohio State University.
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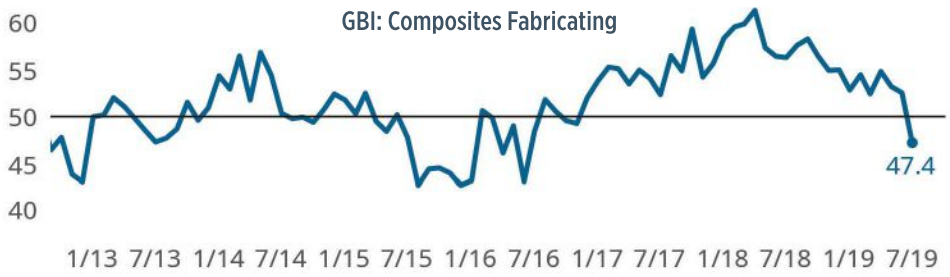
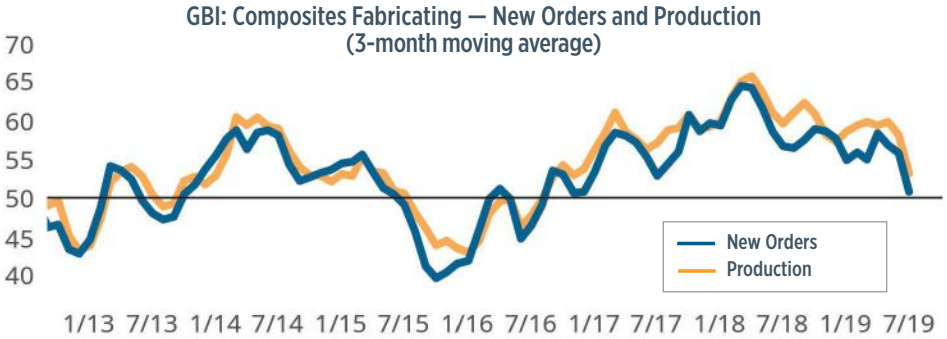


Composites Fabricating Index ends 31-month expansion

The Composites Index ended 31 months of continuous expansion with July's 47.4 reading. Five of the six components that comprise the Index fell during the month.



New orders and production activity end expansion record

The new orders and production components of the Composites Index are often considered the most sensitive to economic change. Past contractions have been for relatively short periods of time, around six months.

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A Q&A with Hexcel's Achim Fischereder, one carbon fiber manufacturer's transition from skateboards to contract components, new applications for recycled wind turbine materials and more.

CARBON FIBER

From carbon fiber skateboard maker to contract manufacturer

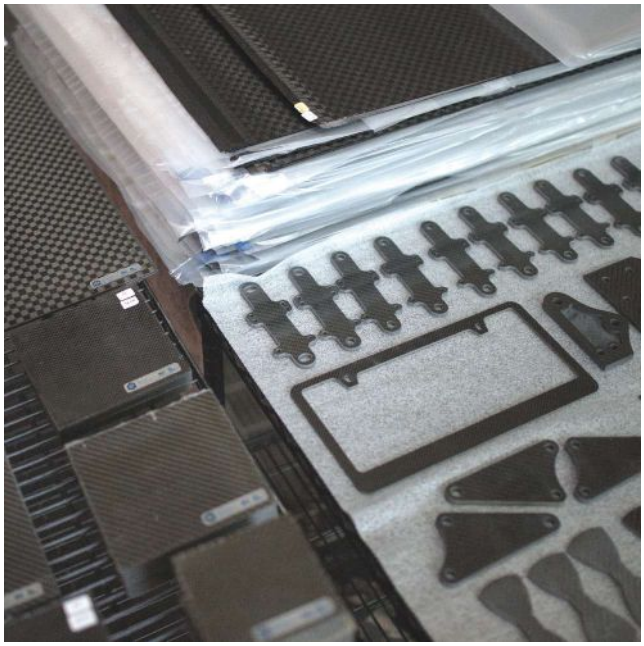
Elevated Materials (Gardena, Calif., U.S.) takes a bit of an unconventional approach to recycling carbon fiber. While studying aerospace engineering at the University of Southern California (USC, Los Angeles, Calif., U.S.), company founder and CEO Ryan Olliges saw the amount of unused carbon fiber being sent to the landfill. With the help of USC assistant professor Greg Autry, he launched 121C Inc. and built a heated press to create carbon fiber skateboards. Once the fledgling company realized just how much carbon fiber scrap existed, it saw a larger opportunity to do more than just make skateboards. Olliges says the ultimate goal wasn't just to be a skateboard company, but to save the valuable material from the landfill and use it to do something good for the earth.

"Between 20 and 40% of material is thrown away from the production line," says Olliges, speaking of the commercial aerospace and space flight industries. "And that's still good, unused material."

The company soon began receiving inquiries about parts that other companies wanted made for them and recognized this as an opportunity to make use of even more waste material. At that point it transformed into a contract manufacturing company to service numerous industries with reclaimed material, and the Elevated Materials brand was born.

Elevated Materials' mission is to deliver high-quality, aerospace-grade carbon fiber to industries that haven't considered using the material due to cost. The company collects carbon fiber trim scrap, ply cutter trim scrap, excess tape rolls and expired material, sorts it all and cuts the material into standardized shapes. Those shapes are then sorted into kits, laid up in a mold and pressed into cured flat sheets. Olliges says outlife of the material isn't a huge problem, as the trim scrap is collected on a daily basis and most of the material goes directly to the hot press to be processed. The company freezes any material that isn't used immediately and employs a tracking and identification system to ensure leftover material is used within its shelf life.

Elevated Materials stocks different thicknesses of sheets and has machining capabilities to cut those pieces into different products. Parts can be created from stock sheets, or custom-sized sheets can be made to order based on the application and the material on hand. Sheets range from quasi-isotropic layups to aluminum honeycomb panels, and can be made to a custom thickness and then cut into any size or shape that is needed. CNC routers and waterjet cutters are used to cut parts, and the company continues to explore ways to expand its offerings.



Elevated Materials stocks different thicknesses of sheets and has machining capabilities to cut those pieces into different products. Source | Elevated Materials

"As we design and build out our manufacturing capabilities, we make use of open-source software, self-fabricated equipment and IoT data collection to implement a system for process control and rapidly scale for our customers," says Elevated Materials' CTO Jaysen Harris.

"So many industries out there want to use carbon fiber, but it's so cost prohibitive," says Olliges. "We can deliver really good high-quality aerospace material to industries that haven't considered using it before."

Elevated Materials has worked with a range of clients in the consumer product space. Product examples include snare drum shells, drones and brackets for T-slot framing as well as aftermarket for automotive, ATVs and motorcycles. Olliges' current favorite products are road cases for concert or film equipment. He says the cases have the potential to consume tens of thousands to hundreds of thousands of pounds of recycled material.

Olliges thinks there's eventually potential for the company to make bulk molding and sheet molding compounds (SMC) for use in panels for the automotive market.

Q&A: Achim Fischereder, director of sales and marketing at Hexcel

Achim Fischereder has been at Hexcel for almost eight years, working almost exclusively on the automotive side of the business. In a recent episode of the podcast CW Talks, he and CW editor-in-chief Jeff Sloan discuss composite use in cars and trucks today, the future of composites in automotive, and what the composites industry needs to keep in mind as it considers car consumers. You can listen to the full CW Talks podcast on iTunes or GooglePlay, or visit www.compositesworld.com/podcast.

Q: During your time at Hexcel, what kinds of projects have you done and what's your area of expertise?

A: … In the eight years, I've done a whole variety of different projects in many different functional areas. For the first two years, I was actually working on the operational side. I designed new manufacturing processes for advanced composite materials. … After these two years, I had the opportunity to take over the industrial innovation phase of the BMW B-pillar project. … At that time, I was responsible for the internal project management … and I was also the main customer contact at that point to BMW. … So basically, that was my start into the automotive business, that project. … That project took a year, and then at that point, Hexcel created three subsegments of the industrial business, and one of these subsegments was automotive. I was given the opportunity, based on my experience on the BMW project, to take over the role as automotive product manager. … And then a year ago, I was offered the position of sales and marketing director for automotive, which basically means that I'm now responsible for all the automotive business tactics at Hexcel globally, and that's the position where I'm at now. And so you asked where my area of expertise lies: I would say actually everywhere a little bit, especially taking into consideration that I'm actually a technical chemist from my studies, but I would say nowadays, my expertise clearly lies in sales and marketing.

Q: Let's talk a little about the larger automotive composites market. I'd first like to hear your assessment of the market itself. I think you and I would both agree that BMW, when it built the supply chain for the *i3* and the *i8*, sort of established some pretty serious expectations about the growth potential of carbon fiber, especially for body-in-white structures. I suspect you'd also agree that those expectations have not been met, or maybe the way we thought automotive composites would evolve following those vehicles has not played out as expected. I'm just wondering what your assessment is of the last five years and where are we today?

A: I absolutely agree with what you've said. I think that there were great expectations about the growth of composites, especially in body-in-white structures. A few years ago, many people thought that in a few years' time, every car would have a composite body. Looking now at today, we can clearly see that that did not happen. Now, to be honest, I personally think that this situation was still the best thing that could have happened to the composite industry. … Every OEM, every big Tier 1, started to look into composites and is now familiar with that kind of material. … I think it will really help them or is already helping them now to identify solutions with composites that can really compete face-to-face with metal, and I think that's really important.

Q: Given your place within the supply chain and your role at Hexcel, what do you hear from automotive OEMs about how they view composite materials now and what business case is often most compelling for use of composites in cars and trucks?

A: The feedback we get from OEMs today is more and more that they basically view composites as like any other material in their toolbox. … Composites for me do not make sense in every application, but there are numerous applications where composites make a lot of sense, and where they can provide a strong business case. … I think what is important … is when an engineer starts from a given metal design, it will always be difficult for composites to develop a compelling business case, because if you're not changing the design criteria and design volume of your part, you will not take all the benefits that composites can provide and you will not maximize their full potential. … On the contrary, if you start from a blank page, and you really take all the design limitations of composites into account in your part design, I think you can really end up with a great business case. I think that's what we start to see more and more with electric cars, where new parts are coming and engineers really start to design with composites straightaway on a new part with new requirements, and that creates strong business cases.

Q: You've already talked a little bit about converting steel automotive parts into composites, and how that is not optimal but it still goes on. Are there any trends you see that lend themselves to conversion opportunities?

A: You're right, I mentioned it's always hard to convert a metal part into a composite part straightaway without changing requirements. Still, there is one opportunity I think that makes a lot of sense, and for me, that's composite leafsprings. … These parts are highly fatigue-driven, and that's a property composites are excellent at resisting. … In addition, there's weight savings potential with composite leafsprings … and it can be a highly cost-competitive solution as well. … I strongly believe we'll see a lot more adoption coming in the next few years on that application. We at Hexcel are working hard to position ourselves in that area.

CW MONTH IN REVIEW

Notes about newsworthy events recently covered on the *CW* website. For more information about an item, key its link into your browser. Up-to-the-minute news | www.compositesworld.com/news/list

Montefibre Carbon unveils its first carbon fiber PAN precursor
The company's 80K carbon fiber precursor for non-aerospace use is expected to be available by mid-2020.
8/7/19| short.compositesworld.com/Montefibre

FIBRESHIP demonstrates ship hull section built in fiber-reinforced composite
EU-funded project aims to replace steel in ships, reducing weight, fuel consumption and carbon emissions.
8/6/19 | short.compositesworld.com/FIBRESHIP

Teijin completes acquisition of Renegade
Teijin says Renegade's heat-resistant prepreg technologies will bolster its aerospace business.
8/2/19 | short.compositesworld.com/Renegade

eFlyer 2 begins flight testing with Siemens production motor
Bye Aerospace begins a new flight test phase for its two-seat composites-intensive all-electric *eFlyer 2* prototype with a new 90-kW Siemens SP70D production motor.
7/25/19 | short.compositesworld.com/eFly2_test

EU project develops industrial process for hybrid metal, composites
Laser textured steel is joined with continuous fiber-reinforced thermoplastic stiffeners using laser-assisted tape placement for joined structure without adhesives.
7/24/19 | short.compositesworld.com/ComMUnion

GE Renewable Energy completes first nacelle of Haliade-X wind turbine
The first manufactured nacelle of the Haliade-X 12-megawatt offshore wind turbine will be tested on a prototype in Rotterdam, Netherlands.
7/24/19 | short.compositesworld.com/H-Xnacelle

HUESKER develops W8SVR Neolaminate, refinement of organosheets
Continuous fiber-reinforced thermoplastic (CFRTP) composite offers up to 20% less weight or 35% higher flexural stiffness.
7/22/19 | short.compositesworld.com/W8SVR

ENGEL unveils IR robotic cell for large-series thermoplastic composites
Infrared radiation heats up and forms three organic sheets of differing thicknesses, for aesthetic surfaces while overmolding.
7/19/19 | short.compositesworld.com/ENGEL_IR

Clean Sky 2's PASSARO project targets one-shot OOA composite cockpit
Synergies with MOSHO project for NDT, repair and also developing cobots for 70% cut in cycle time.
7/16/19 | short.compositesworld.com/PASSARO

DLR tests flexible and actively controlled wing designs
Carbon and glass fiber aeroelastic and flutter wing concepts tested as part of multi-partner FLEXOP project.
7/12/19 | short.compositesworld.com/DLR_FLEXOP

CARBON FIBER

Carbon fiber recycler Vartega expands capacity

Vartega (Golden, Colo., U.S.), on July 23, cut the ribbon to officially open its new 10,000-square-foot manufacturing facility designed to allow the company to take the next steps in its efforts to expand its carbon fiber recycling operations and products.

Andrew Maxey, CEO and founder of Vartega, thanked the Vartega team, which now numbers about 15 people, for their help in maturing the company and its chemistry-based recycling technology. Maxey also pointed to the State of Colorado, the Colorado Cleantech Industries Assn., Colorado State University, the University of Colorado, the Colorado School of Mines and the Institute for Advanced Composites Manufacturing Innovation (IACMI; Knoxville, Tenn., U.S.) as particularly critical to the company's growth. "I am so very grateful for the ecosystem that holds us up," he said. "Our successes — and our future successes — are represented in this ribbon-cutting."

Maxey noted that he launched Vartega in his garage five years ago when carbon fiber recycling was in its infancy. He reflected on the fact that although carbon fiber recycling technology itself is quite evolved, the markets that might consume recycled carbon fiber are just now starting to take shape — a combination that has created some market headwinds for the global carbon fiber recycling industry. Still, said Maxey, there are applications on the horizon that seem to be excellent targets for recycled carbon fiber, including autonomous vehicles, sporting goods and additive manufacturing. "We are closing the gap in the materials supply chain," he said.

John Hopkins, CEO of IACMI, was on hand for the ribbon-cutting and noted Maxey's significant involvement in and support of IACMI. Vartega, he said, has taken full advantage of the partnerships and cooperation that IACMI fosters to help mature the composites industry. "I appreciate what Andrew has done personally to help grow this industry," he said.

From the new facility, Vartega will initially process 168 metric tons of 65% FVF carbon fiber prepreg annually, producing 109 metric tons of carbon fiber and 59 metric tons of epoxy resin. Most of that carbon fiber will be compounded off-site with a thermoplastic resin for injection molding operations. Vartega also has a twin-screw extruder on-site to do some of its own compounding.

By the end of 2020, Maxey said, *(continued on p. 16)*

Vartega employees stand by during the ribbon-cutting of the company's new 10,000-square-foot facility in Golden, Colo., U.S. Holding scissors are Katie Woslager, advanced industries senior manager at the Colorado Office of Economic Development and International Trade; Ed Pilpel, Vartega board member and technical advisor to PolyOne; Andrew Maxey, CEO and founder of Vartega; and John Hopkins, CEO of IACMI.

Photo | *CW*

(continued from p. 15)

Vartega plans to install its first Hardware as a Service (HaaS) product at IACMI's SURF manufacturing demonstration facility in Corktown, Detroit, Mich., U.S. HaaS is a modular, scalable, 100-metric-tons/year carbon fiber recycling system designed for installation at a composites fabrication facility. The customer — fabricator — will be able to use HaaS for on-site processing of uncured prepreg scrap to recycle carbon fiber and resin. The materials that result can be either integrated back into the customer's manufacturing operations or sold onto the open market. Customers who install HaaS will pay a subscription fee for the equipment, software and associated technology.

The ribbon-cutting coincided with IACMI's summer membership meeting in Denver, Colo., and was attended by about 200 people. The ribbon was cut by Maxey; Hopkins; Ed Pilpel, Vartega board member and technical advisor to PolyOne (Avon Lake, Ohio, U.S.); and Katie Woslager, advanced industries senior manager at the Colorado Office of Economic Development and International Trade.

BIZ BRIEF

Toray Advanced Composites (Morgan Hill, Calif., U.S.) and **BASF** (Wyandotte, Mich., U.S.) signed a manufacturing and supply agreement in August focused on the production of continuous fiber-reinforced thermoplastic tapes for the automotive and industrial markets. Toray Advanced Composites will produce glass fiber- or carbon fiber-reinforced tapes using BASF's Ultramid PA6 (polyamide) engineering thermoplastics.

AM2019

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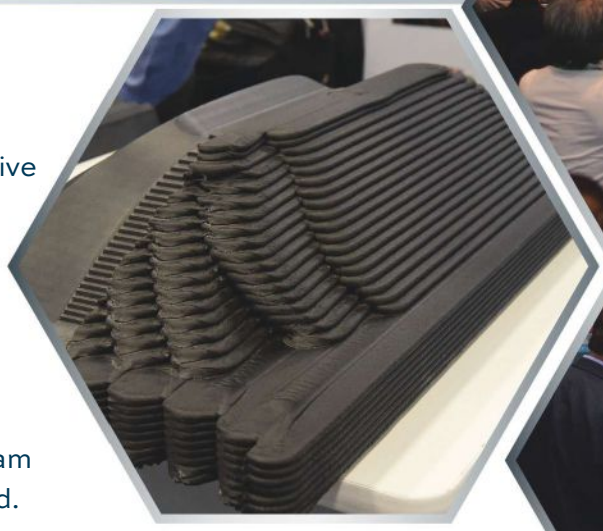

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ENERGY

Decommissioned wind turbine blades used for cement co-processing


Source | WindEurope

A recently announced project by a group of European wind and chemical industry partners has been formed to advance recycling efforts for composite wind blades. The partnership includes WindEurope (Brussels, Belgium), the European Chemical Industry Council (CEFIC, Brussels, Belgium) and the European Composites Industry Association (EuCIA, Brussels, Belgium).

There are more than 2.5 million tons of composite material in use in the wind energy sector, with 130,000 wind turbines active in the European Union (EU) today. But as the industry develops, aging turbines will need to be replaced — in the next five years, 12,000 wind turbines are expected to be decommissioned. Broadening the range of recycling options is critical as the industry continues to grow.

WindEurope CEO Giles Dickson explains, "Wind energy is an increasingly important part of Europe's energy mix. The first generation of wind turbines are now starting to come to the end of their operational life and be replaced by modern turbines. Recycling the old blades is a top priority for us, and teaming up with the chemical and composites industries will enable us to do it the most effective way."

One of the areas being explored is the use of recycled wind blade material as filler for cement in a process that is said to reduce the carbon dioxide output of the cement manufacturing process by up to 16%. The members of CEFIC, including INEOS (Covington, Ky., U.S.), AOC Aliancys (Collierville, Tenn., U.S.; Schaffhausen, Switzerland), Polynt (Miehlen, Germany; Bergamo, Italy) and Scott Bader (Northamptonshire, U.K.), among others, are supporting efforts to promote cement production as true recycling. Composite materials are being recycled today at commercial scale through cement co-processing, where the cement raw materials such as silica are being partially replaced by the glass fibers and fillers in the composite, while the organic fraction is burned in the process for energy, replacing coal. The wind blades can be broken down by the grinding equipment on location, so there is no need to ship entire blades to a recycling point.

The process boasts the reuse of raw materials as well as energy recovery and reduction of CO_2. Currently the process is only suitable for glass-reinforced composites, but the partnership is exploring a number of solutions for recycling aging wind turbines. Besides recycling through cement co-processing, alternative technologies like mechanical recycling, solvolysis and pyrolysis are being developed, ultimately providing the industry with additional solutions for end of life.

"As a global supplier to wind blade and nacelle producers, we hope to set an industry standard where learnings from wind turbine recycling will then be transferred to other markets to enhance the overall sustainability of composites," says Stefan Osterwind, vice president of Europe, the Middle East, Africa and India (EMEA & India) for Ashland and chairman of the CEFIC UPR sector group.

EUCIA president Roberto Frassine adds: "The wind energy sector has always been at the forefront of using composites. … With this collaboration we hope to set a great industry standard that ultimately will also help customers in other industries like marine and building, and infrastructure."

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CAMX 2019 Exhibit Preview

What:
2019 Composites and Advanced Materials Expo (CAMX)

Who:
American Composites Manufacturers Assn. (Arlington, Va., U.S.)
Society for the Advancement of Material and Process Engineering (Diamond Bar, Calif., U.S.)

When:
Sept. 23-26, 2019

Where:
Anaheim Convention Center in Anaheim, Calif., U.S.

By Jeff Sloan / Editor-in-Chief

North America is the world's largest composites market, and CAMX is the largest composites trade show and conference in North America. Because of this, CAMX 2019 has become the most important composites event on the fall calendar. If you are headed to Anaheim, Calif., U.S., Sept. 23-26 for CAMX 2019, what can you expect to find?

To answer that question, the editors at CompositesWorld conceived of the CAMX Exhibit Preview, to help show-goers anticipate in a knowledgeable way what might be awaiting them when they step onto the CAMX show floor. See the individual previews in *CW*'s online CAMX Expo Zone (www.compositesworld.com/zones/camx-composite-and-advanced-materials-expo).

As in past years, *CW* polled CAMX exhibitors to get a sense of what visitors to the show might find when they walk the aisles of the Anaheim Convention Center. What follows is a summary of some of the previews we received, ranging from fibers, resins and tooling to machinery, software and services.

You can find out more about many of these companies by checking out their listings at the online SourceBook, *CompositesWorld*'s composites industry supplier directory (www.compositesworld.com/suppliers). Also, the CAMX website offers the MyCAMX Planner, a tool that helps you see and evaluate the conference and trade show offerings available, and then organize each day to help make sure you see the exhibitors that interest you most. You can use MyCAMX Planner to conduct searches, communicate with exhibitors, make appointments with exhibitors and tag presentations. You can then link this data with the CAMX app on your mobile device to keep your schedule close at hand during the show.

Along those lines, don't forget that CAMX is a conference *and* a trade show. This year's conference features tutorials, technical papers and educational presentations spanning the breadth of the industry, covering additive manufacturing, bonding and joining, design simulation, process technologies, testing and evaluation and much more. A full conference schedule and all other relevant information is available online at the CAMX website.

One final note: We've included booth locations with the previews that follow, but this data can change. For updates on logistical information, not to mention a complete list of CAMX exhibitors, the CAMX conference schedule, Anaheim lodging information and — last but, of course, not least — to register for the show, visit the CAMX website | thecamx.org.

Source | Abaris

Updated composites textbook, training resources

Abaris Training Resources Inc. (Reno, Nev., U.S.) is promoting its latest facility expansion, newly released textbook and updates to its engineering, manufacturing, repair and inspection courses. In addition, the company's Lou Dorworth will be moderating a panel discussion on nondestructive inspection of composites.

Abaris' new second edition textbook, titled "Essentials of Advanced Composite Fabrication & Damage Repair," and published by Aviation Supply & Academics, 2019, will be available for review at the booth. New to this edition are an introduction to nanomaterials in composites, and an overview of industry molding methods, adhesive bonding, extended joining and fastening coverage, advances in matrix technology and fiber reinforcements, as well as tooling, fiber/tape placement and various testing and nondestructive inspection methodologies. Abaris staff members will also be discussing updated engineering, design and analysis curricula.

Abaris Training Resources Inc., Booth E35, www.abaris.com

Source | Accudyne

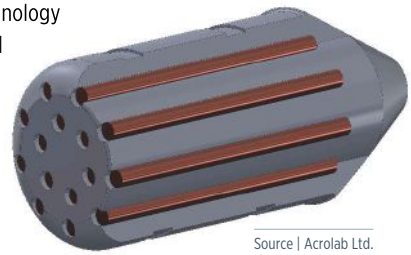
Custom automation equipment

Accudyne Systems (Newark, Del., U.S.) is highlighting its custom automation equipment for producing intermediate materials, preforms and finished parts. The company designs and manufactures part-specific equipment to automate difficult and/or labor-intensive processes. Specialty areas include development, prototype demonstration and full-scale equipment manufacturing. Accudyne's typical project phases emcompass development, engineering design, fabrication, systems integration, start-up and support.

Accudyne Systems Inc., Booth U58, www.accudyne.com

Thermal conductors

Acrolab Ltd. (Windsor, Ontario, Canada) is highlighting its Isobar thermal conductors, which are able to transfer large amounts of energy at high speeds in both heating and cooling applications. Isobars use two-phase heat transfer technology that is said to enable thermal energy to move up to 250 times faster than standard copper material.



Source | Acrolab Ltd.

Isobar can be implemented in compression tooling, filament winding, pultrusion, resin transfer molding (RTM), hand layup and injection processes. The company says that in ideal conditions, average heat up/cool down times can be reduced by 10-30% with the use of Isobars. Isobars should ideally be implemented at the start of a project, but they can also be augmented into an existing application to improve part quality and cycle times.

Acrolab, Booth D41, www.acrolab.com

Source | Airborne

Digital portal for composites laminates

Airborne (The Hague, Netherlands) is highlighting systems that perform automated kitting, automated laminating and automated honeycomb potting, as well as a digital online portal where clients can design and order laminates.

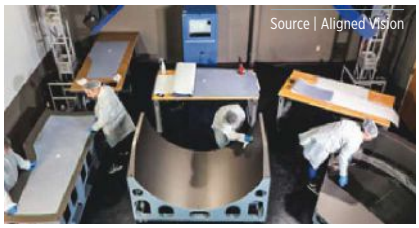
The company is showing its fully automated laminating cell, which uses tape laying, cutting and pick and place of composite laminates, as well as its automated honeycomb potting solution said to efficiently and accurately fill sandwich honeycomb with potting compound. Airborne also has developed a fully automated manufacturing process for picking, sorting and placing composite plies. This solution can be fully integrated into a cutting table system, which Airborne says will reduce cost and time to convert fiber reinforcement fabric rolls into a sorted kit. A digital client portal for ordering laminates provides a configured front-end and a back-end connected to the digital system of the production cells. The portal is intended to give consumers direct control over the process, and provides direct feedback on the performance, cost and delivery time of a design.

Airborne, Booth F12, www.airborne.com »

Automatic alignment system

Aligned Vision (Chelmsford, Mass., U.S.) is featuring its TARGETGUIDE automatic alignment system, which enables operators to ergonomically position and reposition tooling without manual steering to targets.

Aligned Vision is also displaying its LASERGUIDE laser templating solution for composites layup, which combines the company's laser templating with automatic inspection technology to verify material position, fiber orientation and FOD, including peel ply FOD in bonding applications.


Source | Aligned Vision

According to the company, LASERVISION is now enabled by artificial intelligence (AI), employing machine learning for application development and to provide deep learning data to smart manufacturing systems.

Additional products on display include the company's Software Development Kit (SDK), which can be integrated into any production work cell, and its BUILDGUIDE system, which replaces paper travelers and work instructions with Android remotes for advanced composites fabrication. BUILDGUIDE provides graphic step-by-step guidance for both layup and non-layup tasks. **Aligned Vision, Booth T50, www.aligned-vision.com**

Adhesive technologies

DH Sutherland, a distribution partner for **L&L Products** (Romeo, Mich., U.S.), is showcasing L&L Products' latest adhesive technologies at CAMX 2019. The company is also holding a live demonstration of how to create a clean, strong and flexible impregnated composite panel using L-F610 thermoplastic epoxy adhesive film on both carbon fiber and fiberglass.

Products on display include L&L Products' L-9100 series of room temperature cure FST adhesives, its L-9000 series of foaming adhesives, and its L-F610 thermoplastic epoxy adhesive film.

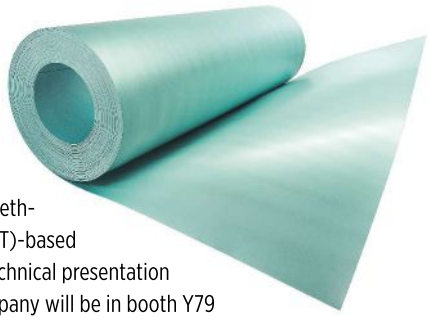
L&L Products' L-9100 series of epoxy-based adhesives have been developed to bond various substrates (including composites and thermoplastics) that are common to the aircraft industry. These adhesives are said to cure at room temperature and provide high performance bonding. Designed for interior applications, they are reported to meet the latest FAA fire regulations (vertical burn, smoke density and toxicity) and are available in different open time versions that allow for a work life from 5 minutes to one hour, to fit the required application processes. They can be supplied in twin-barrel cartridges, pails or drums.

The L-9000 series of foaming adhesives are designed to be applied quickly and easily to trim honeycomb interior panel edges. Curing these products at a range of 250°F to 350°F (121-177°C), the L-9000 foaming adhesives can reportedly expand from 100-500% of their original volume. This versatility allows for filling voids and providing an edge that can be finished to optimal fit and finish specifications. The predictable post-cure density provides uniform material specification for finished panels and can be saw-cut, laser-cut, milled, sanded or lathed. L-9000 can also be potted into structures and provide local reinforcements.

L-F610 is a thermoplastic epoxy-based adhesive film said to combine the adhesion benefits of an epoxy with the processing ease and flexibility of a thermoplastic. The company says this product is ideal for applications that require greater adhesion strength and stiffness than typical films allow.

DH Sutherland, Booth J53, www.dhsutherland.com »

PET-based foam solutions



Source | Armacell

Armacell (Thimister-Clermont, Belgium) is set to present its polyethylene terephthalate (PET)-based foam solutions and a technical presentation at CAMX 2019. The company will be in booth Y79 showcasing the following products:

- ArmaForm Core: Structural foam cores that combine various materials and processing properties, such as high strength-to-weight ratio, durability and temperature stability.
- ArmaForm Foil: A fully recyclable and thermoformable thermoplastic foil product designed to provide an alternative to cross-linked polyethylene (XLPE) and cross-linked polypropylene (XLPP) products in mainly thermoforming applications.
- ArmaShape: Loose PET-based beads for manufacturing lightweight 3D-shaped foam cores for composite sandwich structures. Used as a loose filler grade, Armacell says ArmaShape is an alternative to conventional material with improved compression strength and temperature resistance.

Armacell, Booth Y79, www.armacell-core-foams.com

High-temperature resins, adhesives

Source | ATSP

ATSP Innovations Inc. (Champaign, Ill., U.S.) is exhibiting its full line of Aromatic ThermoSetting coPolyester high-temperature resins designed for coatings, composites and stock shapes, Self-Bond structural adhesives and molding compounds. All ATSP resins are said to offer high thermal stability (greater than 300°C) and glass transitions (up to 310°C unfilled), low moisture pickup, flame resistance and compatibility with ATSP's Self-Bond adhesive process.

Self-Bond technology reportedly enables rapid (bonding times less than 5 minutes), low-mess, non-tacky, high-temperature adhesion (60 MPa pulloff strength at 25°C, 4.6 MPa at 380°C) during the manufacturing process. Self-Bond resins can be deployed via electrostatic powder deposition, and enable metallic, ceramic and high-temperature composite materials coated with ATSP to covalently bond to each other as solids throughout the entire process via bond exchange reactions.

ATSP Innovations is also introducing its Estherm molding compound reinforcements, which include carbon fiber, glass fiber, graphene nanoplatelets, carbon nanotubes and molybdenum disulfide. The NOWE wear solutions product line is also available.

ATSP Innovations, Booth T72, www.atspinnovations.com

Automated cutting systems

Autometrix (Grass Valley, Calif., U.S.) is displaying its automated cutting systems at CAMX 2019. The company is providing demos during the show of its high-speed Argon cutting machine, Patternsmith 10 software, InSight projection system, CadShot mobile application and a virtual reality experience of the Autometrix Radium cutting machine.

Patternsmith 10 pattern development software, designed for easy use as well as design flexibility, enables the user to create patterns from scratch, import patterns from standard design files like DXFs or to design complex patterns simply. PatternSmith's CadShot mobile application enables use of a phone or tablet to digitize patterns easily and accurately.

The InSight overhead projector system projects an image of the pattern piece numbers on top of the pattern pieces, creating a simple, light-based labeling system for faster cutting.

A virtual reality video is available at the booth to show the production of an Autometrix bicycle made at the Allied Cycle Works facility, using the Autometrix Radium cutting machine.

Autometrix Inc., Booth D16, www.autometrix.com

Z-axis milled carbon fiber reinforcements

Boston Materials (BM; Bedford, Mass., U.S.) is announcing the launch of its Supercomp z-axis milled carbon fiber reinforcement products. Supercomp 1015, 1015 Sport and Supercomp 2515 prepregs target customers that require durable, high-performance and differentiated products. Reinforced with z-axis milled fibers, Supercomp prepregs reportedly improve through-thickness properties by 300%, and double the ductility without diminishing in-plane strength or modulus when compared to conventional prepregs.

Z-axis milled carbon fiber content ranges from 75 to 170 microns, has a fiber areal weight of 280 to 375 gsm and total prepreg areal weight of 490 to 667 gsm depending on the grade of Supercomp. Boston Materials also says it can vary the amount of milled carbon fiber content and the orientation of either z-axis or off-axis on fabrics depending on the desired properties. Applications currently include sporting goods, prosthetics and industrial components. Boston Materials is also developing thermoplastic products that are ideal for high-volume production (for example, automotive or consumer electronics).

Supercomp products are specifically designed to integrate into pre-existing production processes and established composites processing systems including compression molding, vacuum bagging, roll wrapping and hand/automated layup.

Boston Materials, Booth F95, www.bostonmaterials.co »

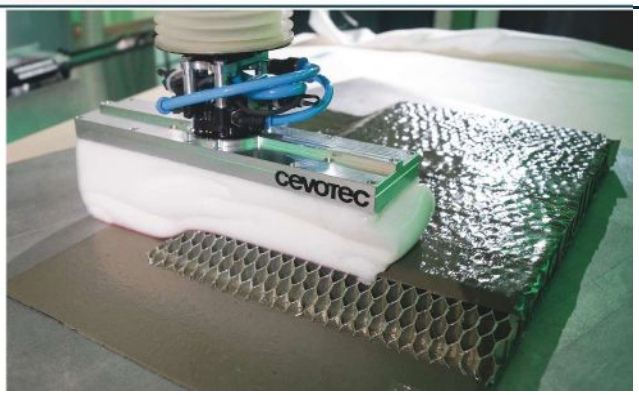
Automated surface analysis tool

BTG Labs (Cincinnati, Ohio, U.S.) is featuring its recently launched Surface Analyst XA, an automated solution for evaluating material surfaces for bonding, coating, sealing, painting or printing. The XA reportedly delivers real-time surface condition feedback to manufacturers, to ensure successful adhesion processes.

Also at CAMX, Dr. Giles Dillingham, CEO and chief scientist, is presenting a paper called "How Advanced Composite Materials Respond to Surface Treatment."

The XA applies the technology from the company's original handheld Surface Analyst to deposit a highly purified drop of water on a surface and then measure the contact angle. By automating this process, the XA increases the speed and efficiency by completing inspections on multiple points on a material surface at rates of up to 5,000 inspections per hour, ensuring consistency and uniformity of surface quality. The XA measurement process is said to be non-destructive, using HPLC-grade water to prevent contamination of inspected material surfaces. Touchless measurement eliminates potential transfer of contamination from point to point, and the automation limits operator error and variation. Data capture and transfer to MES is automatic and completed via Archer software, providing statistical process control and long-term trend analysis. The XA unit can be integrated into a production line using either a robot or linear actuator to move it from point to point, or it can be fixed in place on the line.

BTG Labs, Booth N87, www.btglabs.com

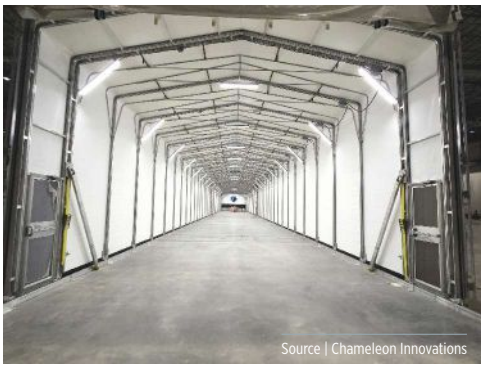


Automated fiber patch placement system

Cevotec (Taufkirchen bei München, Germany) is featuring SAMBA, its fiber patch placement system said to automate the multi-material layup of geometrically complex sandwich components for aerospace parts in one production system that is monitored and guided by self-corrective process control.

SAMBA features parallel feeding units for processing up to four materials and placing them on 3D sandwich cores. By mounting the placement unit on a linear axis, the system also enables the production of long and wide components in aerospace applications. Additional Industry 4.0 modules for SAMBA cover predictive maintenance and in-depth analytics of production data. Analyses of production data enable insights into process reliability and repeatability. Correlating the data with actual layup quality enables engineers to set and adjust process parameters in real-time. **Cevotec GmbH, Booth G71, www.cevotec.com/en**

Retractable booths


Source | Chameleon Innovations

Chameleon Innovations (Montreal, Quebec, Canada) is featuring its retractable booth designs, which the company says have been adapted for the air quality and dust control compliance needs of the composites manufacturing industry.

The company's retractable booths are said to contain and filter composite dusts for products as small as fiberglass tanks to larger items such as wind turbine and aerospace components. The retractable solutions are designed to benefit both manufacturers that need temporary environmental control solutions without taking up extra plant space and for those needing to move large products in and out of the booth.

Chameleon offers a complete line of retractable booths, filtration systems for both non-combustible and combustible dusts, and LED lighting systems and other accessories. These services are meant to help composites manufacturers both achieve efficiency and comply to safety regulations such as OSHA plant air quality regulations and NFPA combustible dust standards. **Chameleon Innovations, Booth X70, www.chameleon.ca**

Mobile surface analysis

Source | KRÜSS

KRÜSS Scientific Instruments Inc. (Hamburg, Germany) will demonstrate the power of mobile surface analysis with its Mobile Surface Analyzer.

The instrument offers users:

- Mobile quality control — Users can capture the surfactant content of the bath within seconds using surface tension measurements with the Bubble Pressure Tensiometer Mobile (BPT Mobile).
- The ability to optimize wetting — Users can analyze and understand the wetting properties of inks. The K100–Force Tensiometer is composed of high-quality components and a wide range of methods to carry out various tests in the field of liquid analysis and wetting measurements to better understand ink formulation.
- The ability to understand surfaces — Users can simultaneously dose two parallel drops within milliseconds, with high-volume precision and minimal kinetic energy to understand the substrate's surface free energy. The Mobile Surface Analyzer measures the wettability of a sample based on contact angle measurements with the use of two test liquids.

KRÜSS is offering an education session at CAMX 2019 on Thursday, Sept. 26 on "Surface Free Energy: Highly Reliable Surface Property Used as a Guide for Surface Cleaning, Preparation, and Treatment," presented by Dr. Raymond Sanedrin.

KRÜSS Scientific Instruments Inc., Booth J71, www.kruss-scientific.com »

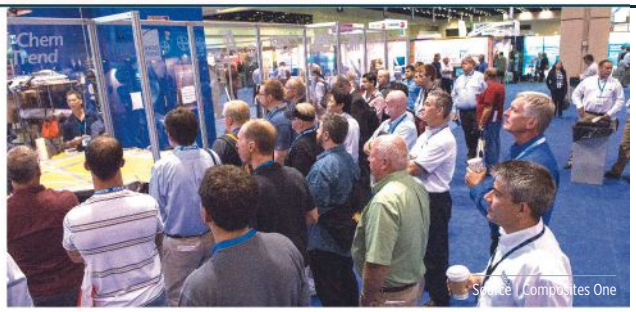
Source | Coastal Enterprises

High-density urethane tooling board

Coastal Enterprises Co. (Orange, Calif., U.S.) is introducing a new 25-lb. density option for its Precision Board high-density urethane tooling board, available in both PBLT and PBHT versions. The new tooling board is said to provide similar performance to the company's 30-lb. material, but provides a more cost-effective and lightweight option. Coastal Enterprises says its 25-lb. material is ideal for use with composite master molds, short-run thermoforming tools, fixtures and more.

The company also offers eight standard sheets sizes ranging from 20" × 60" to 5 ft. × 10 ft., with 16 Precision Board densities.

Coastal Enterprises Co., Booth X26, www.precisionboard.com


Source | Composites One

Closed molding demos

Composites One (Arlington Heights, Ill., U.S.) and the **Closed Mold Alliance** are presenting a series of live demos on closed molding and advanced processes at CAMX 2019. The demos are taking place inside a large, enclosed staging area on the exhibit floor (Booth U24).

The demos are broken down into multiple segments presented on the same or succeeding days, and topics include vacuum infusion, light resin transfer molding and advanced processes producing real-life parts for aerospace, transportation, marine, wind energy, consumer recreation and other markets. Part demos highlight real-life marine, aerospace, sporting good and tooling applications.

Demos feature systems from Magnum Venus Products (MVP) and tooling from RTM North Ltd. Along with Composites One, both MVP and RTM North are founding members of the Closed Mold Alliance, a resource dedicated to helping manufacturers successfully convert to closed mold and advanced processes. **Composites One and the Closed Mold Alliance Demo Zone, Booth U24, www.compositesone.com**

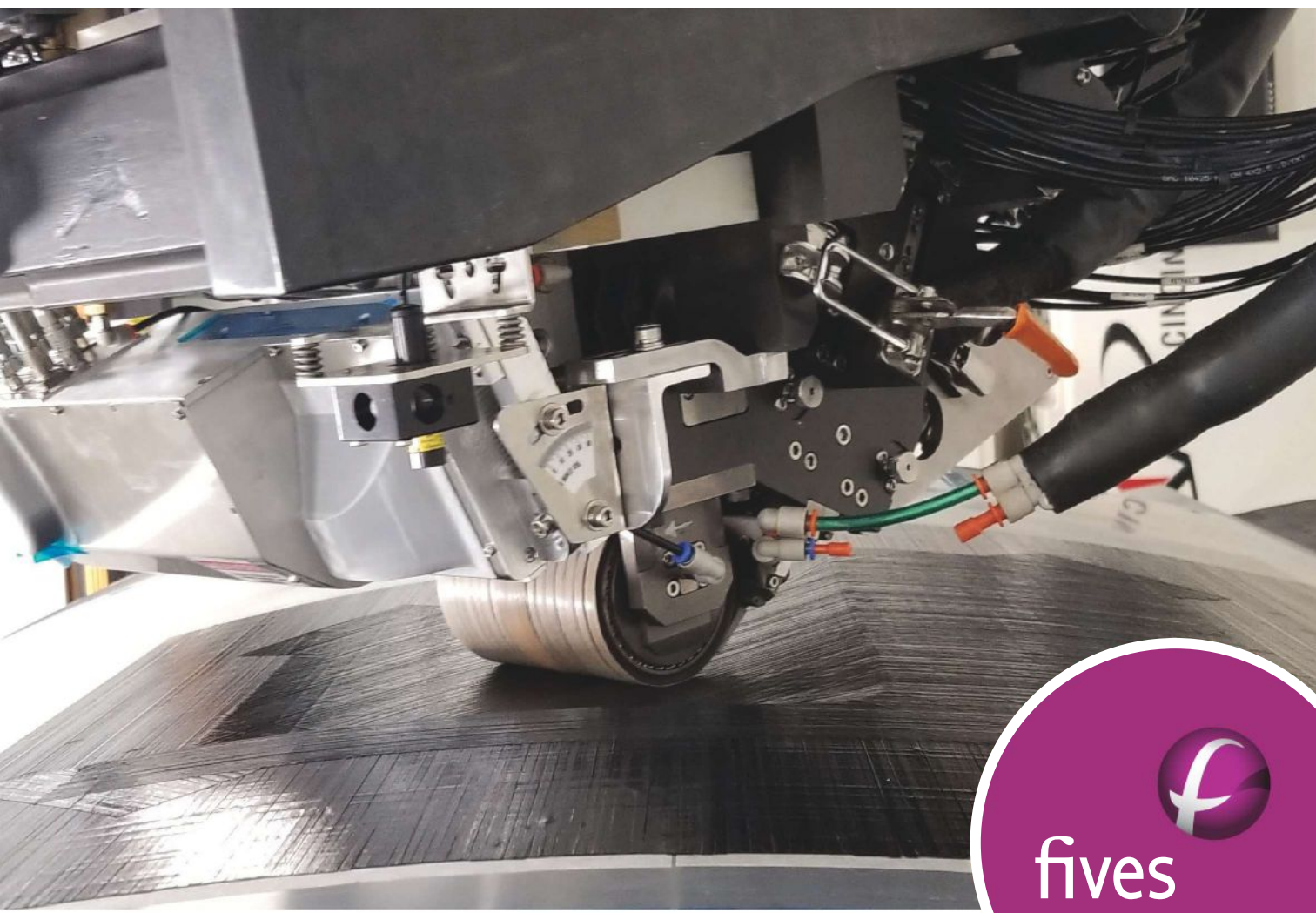
Composites One, Booth X30, www.compositesone.com »

Fives IPI

In-Process Inspection

Real-time monitoring and control of the manufacturing of composite materials to performa inline quality assessment of the automated fiber placement process.

LAYUP | IN-PROCESS PLY-BY-PLY INSPECTION | CURE | NON-DESTRUCTIVE INSPECTION



fives

BOOTH X71

CAMX

THE COMPOSITES AND ADVANCED MATERIALS EXPO

SEPTEMBER 23-26 | 2019 | ANAHEIM, CA


Source | Cygnet Texkimp

Prepreg machinery and fiber processing technology

Cygnet Texkimp (Cheshire, U.K.) is highlighting its prepreg machinery and associated fiber processing technologies for the aerospace, automotive, industrial and energy industries.

The company emphasizes the reliability and speed of its prepreg technologies, which it attributes to four decades of engineering expertise and product development. Its prepreg machines have been engineered to perform with high levels of consistency and output, to deliver prepreg materials of optimum quality, weight and thickness.

The company is also featuring its range of associated technologies including fiber unwinding creels, spreading, coating and laminating machines. These range from a high-tolerance, reverse-roll coating machine capable of creating low coat weight films of less than 5 gsm for the aerospace-quality prepreg market, to a high-volume, self-calibrating Flatline creel with patented tensioning mechanism.

Cygnet Texkimp Ltd., Booth F54, www.cygnet-texkimp.com


Source | Dexmet

Thin-gauge perforated polymers and foils

Dexmet (Wallingford, Conn., U.S.) is introducing thin-gauge perforated foils and polymers to its product lineup of expanded foils. The new perforated products were developed as the result of the need for thinner, lighter materials.

The company says its ultra-thin perforated materials are versatile, open-area materials offering strength and functionality for applications where weight, conductivity and controlled openings are crucial for performance.

The perforated thin-gauge materials are designed to meet critical specifications in industries such as aerospace, energy, electronics, automotive and filtration. Dexmet says its new materials are thinner (specializing in sub-200 μm, or .008″) as well as wider (up to 1.6 m, or 63″) compared to other materials. Other benefits are said to include open areas between 1% and 35%, and increased tensile strength. Dexmet can accommodate needs for materials with solid borders or interrupts, and provides multiple hole shapes and patterns for optimizing electrical, mechanical or filtering properties. **Dexmet Corp., Booth N54, www.dexmet.com**

Source | Airtech Advanced Materials Group

Core-holding film, vacuum valves

Airtech Advanced Materials Group (Huntington, Beach, Calif., U.S.) is featuring four of its recently launched products: Corehold P-HA pressure-sensitive tape, Vac Saver HT, Vac Valve 429 SS HTR and Stretch Flow P 2000 Breather.

Corehold P-HA is a core-holding film designed to hold honeycomb core and other core materials during machining. It is a polyester film coated on one side with a silicone-free synthetic rubber adhesive. Corehold P-HA is said to provide high peel adhesion and is ideal for strong core fixation and machining when used with a vacuum table. It is said to work well on contoured applications and to have high adhesion properties while leaving little residue.

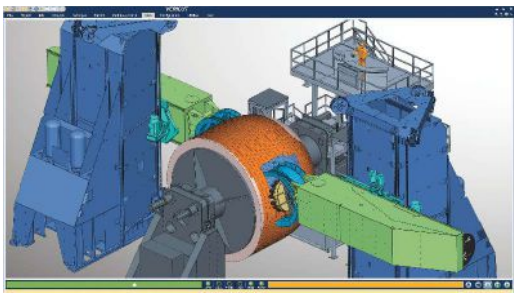
Vac Saver HT is a one-way check valve used to protect vacuum-bagged parts against vacuum loss. The valve is said to protect against back pressure when multiple lines are connected to a single vacuum source. It can be used with the company's quick disconnectors like AQD 500TF, Airlock 450TF or 550TF, as well as Airflow vacuum hoses. The Vac Saver HT results in a reportedly safer vacuum bagging process and reduces risk of part loss and scrap.

Vac Valve 429 SS HTR has been designed for high-temperature cures as an alternative to standard valves with silicone rubber seals. Vac Valve 429 SS HTR is used for direct connection to vacuum hoses, said to be a replacement for complex and expensive coupling systems. It is usable up to 900°F (482°C) in combination with high-performance graphite seals. This valve can be directly screwed to the company's Airflow 800 or BBH1080 hoses that provide a safe connection for high-temperature processes with materials such as thermoplastics.

Stretch Flow P 2000 is a high-stretch, knitted, polyester breather able to conform to many complex contour surfaces, ensuring good application of pressure by vacuum bags. The breather's stretch properties are said to also eliminate wrinkles and quality issues, as well as bridge conditions that can result in resin-rich corners requiring rework. **Airtech International, Booth U2, www.airtechonline.com**

Composites simulation software

CGTech (Irvine, Calif., U.S.) is demonstrating the latest versions of its Vericut Composite Programming (VCP) 8.1.3 and Vericut Composite Simulation (VCS) 8.2.2.1. The company also is highlighting project implementation and use of machine-independent, off-line NC programming software for automated fiber placement (AFP) and automated tape laying (ATL) machines.



VCP 8.1.3 is said to enable easier profile edits and a speed increase of 30–40% on course generation. Improvements in VCS 8.2.2.1 include a configurable head-up display (HUD) and Radial Menu, which makes commonly used functions more accessible. Part programmers can generate and export part statistics directly from VCP. The addition of the all-new summary reports enables engineers to compare different layup strategies.

Visitors to CGTech's booth can also preview the latest version of Vericut 9.0 software. VERICUT is CNC machine simulation, verification and optimization software that enables users to eliminate the process of manually proving out NC programs. Vericut simulates various types of CNC machining, including drilling and trimming of composite parts, water jet, riveting, robotics, mill/turn and parallel kinematics. Vericut runs standalone, but can also be integrated with CAM systems.

CGTech's Composites Product Manager, André Colvin, is hosting a presentation titled "An Era of Automation," on Thursday, Sept. 26, 2019, at 12:00 p.m. **CGTech, Booth X75, www.cgtech.com** »

Prepreg, fabrics and composite parts

JiangSu TiWin Composites Co. Ltd. (TiWin, Jiangsu province, China), develops composites technology both for equipment and products and consists of two subsidiaries, Chanzhou SR Tech Co. Ltd. and TiWin.

Chanzhou SR Tech is an equipment developer and manufacturer for PAN creel, carbon weaving lines, prepreg lines, cross lapping lines for UD material and customized solutions.

TiWin produces prepreg, carbon fiber fabric, hybrid fabric, thermoplastic prepreg, 3D products, other medial materials and composite parts by using equipment manufactured by Chanzhou SR Tech.

JiangSu TiWin Composites Tech Co. Ltd., Booth N88, www.orit.cn »

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The world continues advancing and requires lighter and stronger structures. Hexcel is creating the materials that make a cleaner, more efficient, more powerful world possible. We are the market's most integrated composite solutions provider offering carbon fiber, fabrics, resin formulation, thermosetting prepregs, out-of-autoclave processing solutions, adhesives, pultruded components, molding materials, additive manufacturing, composite tooling, shielding technology, honeycomb and machined core. Hexcel innovations increase manufacturing efficiencies, provide function integration and boost structural performance.

Learn more by visiting us online at www.hexcel.com or at
CAMX 2019, September 24-26 in Anaheim, CA in booth L42

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Foam tooling board

General Plastics Manufacturing Co. (Tacoma, Wash., U.S.) is showcasing its new LAST-A-FOAM FR-4800 tooling board. This thermally stable tooling board is said to withstand high processing temperatures and provide a fast and economical tooling option for producing high-tolerance parts, proofs-of-concept, demo models and one-off builds. In addition to the new tooling board, General Plastics is also featuring various rigid and flexible foam products, as well as its molding and parts fabrication capabilities.

LAST-A-FOAM FR-4800 tooling board is reported to be dimensionally stable, non-abrasive and easily machined. It can withstand peak temperatures up to 480°F (249°C) and continuous use temperatures up to 400°F (204°C). It has been developed with a low coefficient of thermal expansion (CTE) for reliable production of high-tolerance parts. It can be used with high-temperature resin systems such as vinyl esters, epoxies and bismaleimides, in high-pressure autoclaves and vacuum-forming.

General Plastics is also featuring its premier line of rigid and flexible foams, said to accommodate physical property, flammability and processing requirements for aerospace, transportation and other composite applications.

General Plastics Manufacturing Co., Booth M36, www.generalplastics.com

High-performance thermoplastics

Ensinger (Bensalem, Pa., U.S.) offers engineering capabilities for high-performance thermoplastics and thermoplastic composites, ranging from compound development to part and process design. The company is highlighting a project it completed in collaboration with aircraft interior and automotive equipment specialist Bucher Leichtbau AG. Bucher needed to develop non-conductive connector mountings for electrical plug-in connections for commercial aviation. The company wanted to eliminate the complexity of extra fastening components and high costs of planning, installation, maintenance and testing that previously arose from trying to position a metal mounting to a non-conductive structure. Because of the operating temperature and fire safety requirements, a low-cost, standard plastic was not an option, and the material used needed to be rigid, high-strength and require only minimum tooling costs. For this project, Ensinger's Otelfingen, Switzerland division developed a thermoplastic fiber-reinforced composite solution. The chosen material was an aircraft-approved polyetherimide (PEI) with glass fiber reinforcement. At the Otelfingen site, Ensinger produced the semi-finished parts in an angular shape from the PEI prepregs, created using individual prepreg layers pressed in a tool into the defined form. Ensinger then used CNC machining to finish the individual parts.

Ensinger Composites, Booth Z31, www.ensingerplastics.com

Portable pneumatic vacuum

Eurovac Inc. (North York, Ontario, Canada) is highlighting its Eurovac II Pneumatic Portable. The portable unit was designed to safely collect a variety of fine powders, explosive dusts and debris. The Eurovac II Pneumatic Portable is powered by compressed air forced through a venturi to create a powerful vacuum capable of supporting two technicians sanding simultaneously. The use of compressed air eliminates the chance of either a dust or gas explosion by removing the element of a sparking motor. The system is grounded and the vacuum hoses and cuffs are static conductive, meeting NFPA codes. The system is also available with an optional HEPA filtration upgrade.

Eurovac Inc., Booth N53, www.eurovac.com

Filament winders and pattern-generation software

Engineering Technology Corp. (ETC, Salt Lake City, Utah, U.S.) is presenting its standard filament winders and will provide individual demonstrations on the use of its pattern-generation software, FiberGrafiX.

ETC's filament winders are designed for cost-effectiveness and reliability, with standard options ranging from laboratory scale table-top winders specifically made for winding test coupons, to multi-spindle automated pressure vessel winders with industry-leading fiber payout.

FiberGrafiX is ETC's pattern-generation software for filament winding, and the company says that every CAMX attendee who reserves a spot in advance will receive an individual FiberGrafiX demonstration conducted by Carlos Ferreira, ETC's product development manager. During this workshop, participants will develop a pattern using FiberGrafiX and then view this same pattern being used in a live winding demonstration.

Engineering Technology Corp. Booth N67
www.etcwinders.com

Automated UV laser systems

DPSS Lasers Inc. (Santa Clara, Calif., U.S.) is featuring its Samurai UV Laser at its CAMX 2019 booth, showcasing its higher-power UV laser solutions and fully automated systems.

DPSS Lasers specializes in manufacturing 355-nm, UV laser markers, as well as low-cost UV lasers said to have high peak powers and repetition rates ideal for marking and engraving materials such as HDPE, ceramic, plastics and metals. The Samurai uses a 355-nm wavelength to provide a small spot size and large depth of focus. DPSS says that its UV lasers take advantage of a "cold" marking process that does not require high average power levels and allows damage-free marking on many materials. UV lasers are also being used in carbon fiber surface prep.

DPSS Lasers Inc., Booth T62, www.dpss-lasers.com »


Source | DMS

Five-axis CNC machining

Diversified Machine Systems (DMS; Colorado Springs, Colo., U.S.) is showcasing its 5-axis CNC machining capabilities at CAMX 2019.

DMS says its machines are known for their durability and repeatability, and that all of its 5-axis machines feature a stress-relieved steel frame that is fabricated and assembled in-house.

DMS's 5-axis Enclosed Overhead Gantry CNC machine is a heavy-duty machine that can be used to process a variety of applications and materials, including composites. This model is available with either a solid roof or a retractable "clamshell-style" roof that is designed for easier access and more efficient loading and unloading of materials.

The 5-axis Enclosed Dual Cell Moving Table CNC Machine is designed to be a continuous-use, medium to heavy-duty series of machines, available in a range of sizes and styles.

The 5-axis Enclosed Dual Cell Moving Table CNC router is designed for use with honeycomb, composites, carbon fiber or aluminum. The enclosed design keeps debris inside, making it suited particularly for fine materials such as foam or carbon fiber. The twin moving table design pairs with DMS' quick-change fixture system, enabling a single operator to switch between product runs.

Diversified Machine Systems, Booth J22, www.dmscncrouters.com

High-performance thermosets, respiratory protection

Composite materials distributor **Plastic Materials Inc.** (Ontario, Calif., U.S.) is emphasizing products from several suppliers.

Proxima HPR materials are high-performance thermoset resins from Materia Inc. (Pasadena, Calif., U.S.), designed to deliver excellent thermal and mechanical properties in an easy-to-process system. Reported benefits include better thermal stability than standard thermoplastics and better wear resistance than typical compression-molded thermosets, while delivering corrosion resistance, good machinability and ease of fabrication.

Featured from Sundström Safety Inc. (Warwick, R.I., U.S.) is SR 500 PAPR (power-aired purifying respirator) and its new SR 570 face shield. The SR 570 face shield features a flip-up visor and is designed to provide the user comfortable and safe respiratory and eye protection. The face shield is fitted with an attachment for hearing protectors. A wide range of accessories enable the user to customize the shield for various work situations and is designed to withstand the toughest work environments. The SR 570 shield is meant to be used with Sundström's SR 500 powered fan unit.

Resin systems from INEOS (Columbus, Ohio, U.S.) on display include the company's full line of fire-resistant unsaturated polyester and vinyl ester resins.

Plastic Materials Inc., Booth Z23, www.plasticmaterials.net »

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And this year, we may have a brand-new look, but we still have the largest and most comprehensive composites inventory in the industry.

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We also keep up with the latest trends and techniques in our industry which all comes down to one word:

Reliability.

And yes, we are the company with great big numbers on our products for easy ordering and no big composite names to remember!

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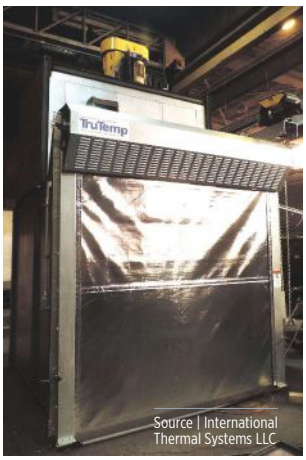
To start making your own amazing things, go to **www.fibreglast.com**

OOA curing system with integrated vacuum system, process controller

International Thermal Systems (ITS, Milwaukee, Wisc., U.S.) offers a complete out-of-autoclave curing system that includes a TruTempCC batch oven, integrated multi-port vacuum system and process controller. The TruTempCC system reportedly maintains tight temperature uniformity at ±5% F or better in custom-designed ovens by ITS.



Source | International Thermal Systems LLC

State-of-the-art designs by ITS incorporate multi-part thermocouple and vacuum systems that meet NADCAP, AS9100 and AMS2750E. ITS can provide a solution as simple as a curing oven with vacuum headers and ports, or it can provide a complete out-of-autoclave system. The ITS engineers are airflow design experts and can incorporate combination airflow or the company's proprietary Three5 Air Flow technology into the ovens. **International Thermal Systems, Booth K22, www.internationalthermalsystems.com**

Large-scale 3D printers

Ingersoll Machine Tools' (Rockford, Ill., U.S.) MasterPrint is part of the Ingersoll family of wide and high 3D printers. Machine sizes begin at 12 m for x-axis, 4 m for y-axis, and 2 m for z-axis. MasterPrint offers the ability to seamlessly program, simulate, 3D print and mill wide-and-high composite parts on a unique platform, driven by the Siemens 840D CNC.

Source | Ingersoll Machine Tools

Also highlighted at the show is Ingersoll's Mongoose, its machine tool platform for delivering advanced composites automation. Driven by the Siemens 840D CNC, Mongoose began as a fiber placement machine with a very compact end effector, capable of tackling highly complex shapes efficiently and cost-effectively. It has evolved into a hybrid platform that delivers advanced composites automation through an array of automated quick-exchange modules. **Ingersoll Machine Tools Inc., Booth H47, www.ingersoll.com**

Source | IKONICS AMS

Machining methods for perforating composites

IKONICS Advanced Material Solutions (Duluth, Minn., U.S.) is well-known in the aerospace field for its non-traditional machining method, Precision Abrasive Machining (PAM). The company is also branching into a variety of new areas such as designing customized patterns for prosthetic limb enhancement, emergency vehicle interiors, fenders, steel screen replacement and more.

During CAMX, IKONICS AMS is offering a presentation on "Machining Methods for Perforating Composites," presented by Wes Barton, senior application and sales specialist.

IKONICS Advanced Material Solutions, Booth Y67, www.ikonicsams.com

Carbon rods and tubes

Goodwinds Composites (Mount Vernon, Wash., U.S.) is showcasing its micro-pultruded carbon rods, wrapped carbon tubes and composites machining capabilities. The micro-pultruded carbon rods are produced in short runs and can have a diameter as small as 0.020". Frequently used for z-axis reinforcement of laminate stacks, the company's micro carbon is said to have all the attributes of larger pultruded carbon rods such as optimal stiffness-to-weight ratio and high fiber volume fraction.

Goodwinds Composites' wrapped carbon tubes can be found in guitars, tents, backpacks, hiking poles, pool cues and the NASA Mars Helicopter. Goodwinds Composites says it is well-versed in metrology and can precisely and repeatedly machine composite rods and tubes to tight tolerances. The company's capabilities include notching, milling, drilling, sanding, cutting and grinding to specific outer diameters.

Goodwinds Composites, Booth Z46, www.goodwinds.com

Inorganic materials, additives

Cimbar Performance Minerals (Chatsworth, Ga., U.S.) is featuring its product portfolio of inorganic minerals and additives, including barium sulfate, talc, magnesium hydroxide, 100% recycled mineral products and its most recent addition, alumina trihydrate (ATH). Cimbar says its products are engineered to enhance the performance, appearance, processing and functionality in product markets including industrial, automotive, pharmaceutical and consumer-based applications. Cimbar operates 13 production/mining sites worldwide.

Cimbar Performance Minerals, Booth F53, www.cimbar.com »

Winders, creels and tensioning devices

Izumi International Inc. (Greenville, S.C., U.S.) was founded in 1977 in Greenville, and established itself by providing cutting-edge technology primarily for Japanese water jet and air jet weaving machines. Shortly after opening, Izumi began carrying the winding machines made by Kamitsu Seisakusho Ltd. (Osaka, Japan), for the carbon fiber industry. After nearly 40 years, the company now offers various kinds of winders, creels, warp and weft feeding and tensioning devices for carbon fiber and other critical high-performance fibers in the U.S. and Europe.

Izumi's newest partnerships are with Musashi Engineering Inc. (Tokyo, Japan), makers of super precision fluid dispensers, and Moltec International (Oakville, Ontario, Canada), offering wire and cable protection with the patented Grip Lock technology. In 2013, the company launched a new 3D dispensing robot for bioengineering applications.

Izumi says its mechanical and electrical engineers can assist in selection of a component or completely design a custom machine. The company's technicians service machinery in the field, install new equipment as well as servicing older machinery. The company also offers light machining capabilities and various forms of cutting.

Izumi International Inc., Booth J54, www.izumiinternational.com

Source | OMAX

Compact abrasive waterjet

OMAX (Kent, Wash., U.S.) is demonstrating its compact ProtoMAX abrasive waterjet, which can reportedly cut through nearly any material, including glass fiber-reinforced plastics, carbon fiber and G10 composite. The company says the machine's compact footprint and versatility make it ideal for prototyping and R&D for customer one-offs and proof-of-concept fabrication. The pump and cutting table are on casters for easy relocation. The machine has a clamshell cover and the work material is submerged under water for safe, quiet cutting, at approximately 76 dB.

The company says that its abrasive waterjets are ideal for cutting composite materials because they never dull, enabling unlimited machining without time-consuming changeouts of cutting heads or subsequent blemishes on the final product. Since it is a cold cutting process, waterjet cutting also eliminates material distortion from heat and does not produce fumes that some heat-based machining methods can generate. **OMAX Corp., Booth Y71, www.omax.com** »

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Ph.**(704)-522-1823** Fx.**(704)-522-0871** **www.andersonamerica.com**

Convection ovens for OOA curing

LEWCO (Sandusky, Ohio, U.S.) is featuring its line of convection oven systems for out-of-autoclave (OOA) composites curing applications. LEWCO's composites curing control package includes a multiple-recipe ramp/soak temperature controller, redundant high-limit controller and a multiple-input digital data logger, which continuously records temperature and other process data. The data logger also allows downloading of digital data files through USB or Ethernet connection. The company's standard programmable logic controller allows easy control of processes with numerous inputs and outputs, or processes that require automation of material handling equipment. The PLC can also allow for Ethernet connectivity for remote system monitoring.


Source | LEWCO

Circulation and exhaust fans include air-proving circuits that are electrically interlocked with the heating circuit. All controls are housed in a NEMA 12 enclosure and employ a full voltage-lockable disconnect switch. Controls are wired to NFPA 70 and 79 electrical standards. Other third-party certifications are also available.

LEWCO Inc., Booth K53, www.lewcoinc.com

Compression molding and heated platen presses

Macrodyne Technologies Inc. (Concord, Ontario, Canada) is featuring its compression molding, shuttle, single- and multi-opening heated platen presses. Macrodyne presses are currently being used in numerous locations in North America, Europe and Asia to mold, laminate, preform, form and consolidate thermoset and thermoplastic composite materials used in the aerospace, automotive, appliance and other industries. Macrodyne offers multiple press frame styles including pre-stressed housing, monolithic, multi-frame, four-column and gap-frame presses, and works with end users to determine the optimal frame style for their applications. Materials molded with Macrodyne presses include sheet molding compound (SMC), bulk molding compound (BMC), glass mat thermoplastics (GMC), high-temperature thermoplastics such as PEEK and PAEK, long fiber-reinforced thermoplastics, low-pressure molding compound (LPMC) and others. Features of the presses include pressure-compensated axial piston pumps with electronic pump control, high-pressure piston pumps, proportional or servo-controlled valves, variable-speed motors, high position accuracy, leveling, accumulator drives, extremely slow pressing speeds, extremely accurate pressure control and fluid condition monitoring.

In addition to presses, Macrodyne also designs and builds automated press lines and die-handling equipment. Systems can be built to handle caul sheets and load and unload parts from an oven into the press.

Macrodyne Technologies Inc., Booth M71, www.macrodynepress.com

Composite components and assemblies for aerospace, defense

Matrix Composites (Rockledge, Fla., U.S.) emphasizes its design and manufacture services for aerospace, defense and commercial/general aviation composite components and assemblies.


Source | Matrix Composites

Operating under ITT Connect & Control Technologies, Matrix Composites' full service capabilities include design, development, tooling, fabrication, testing and integration. Specializing in precision resin transfer molding (RTM) and conventional composites, the company says its robust manufacturing methods are ideal for composites and integrated structures requiring multiple finished surfaces, low void content and high fiber volume. Matrix uses precision machined tools and high-pressure processing systems to produce composite components with a high degree of repeatability and process control. The company's supported processes include: RTM, Hot Isostatic Resin Pressure Molding (HiRPM), vacuum-assisted resin transfer molding (VARTM), autoclave curing, oven curing and trapped bladder molding.

Matrix Composites' proprietary closed molding process solution is called Hot Isostatic Resin Pressure Molding or HiRPM), and is said to be an ultra-precision technique for custom manufacturing parts for aerospace and defense applications. The technology is a compilation of tooling and manufacturing methods said to result in improved part quality and reduced cost. **Matrix Composites Inc., Booth T21, www.matrixcomp.com**

New dibenzoyl peroxide formulation for composite curing

Nouryon (formerly AkzoNobel Specialty Chemicals; Amsterdam, Netherlands) is featuring Perkadox GB-50, a new version of its dibenzoyl peroxide (BPO) under production at the company's Los Reyes, Mexico facility. The company says Perkadox GB-50 is the first dry BPO on the market that does not use the desensitizing agent dicyclohexyl phthalate (DCHP), which has been reclassified as a category 1B reproductive toxin by the EU. Perkadox GB-50 is used as a curing agent for road markings, flooring, elastomeric roof coatings, adhesives, chemical anchors and other acrylic composites. **Nouryon, Booth S40, polymerchemistry.nouryon.com/about-us** »

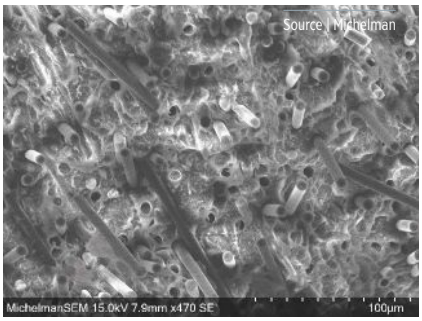
Vacuum mixing equipment

Myers Mixers (Cudahy, Calif., U.S.) is emphasizing its multi-shaft, multi-impeller vacuum mixing equipment for composite and advanced material processing and compounding. Applications include paints and coatings, adhesives and sealants, potting compounds, hot melts, gel coats and other applications where a liquid-liquid blend or liquids and solids need to be homogenized.

The company's range of 550 Series dual-shaft and 550/500 Series tri-shaft mixers are said to offer low, intermediate and high-speed shafts to provide tank wiping, folding or kneading, and high-shear dispersing action, respectively. Myers also now offers a line of horizontal mixers for liquid-powder blending applications. **Myers Mixers, Booth F6, myersmixers.com**

Carbon fiber sizing solutions

Michelman (Cincinnati, Ohio, U.S.) is featuring its new line of Hydrosize carbon fiber sizing solutions, designed to optimize interfacial adhesion between polymers and fibers. The Hydrosize Carbon 200 series is designed for polyamides and is said to be APE-, solvent- and VOC-free. This grade is intended for fiber-reinforced nylon composites requiring thermal stability, such as the manufacture of coolant pumps for the automotive industry.



The Hydrosize Carbon 300 series is formulated for polycarbonates (PC) and other PC blends such as PC-ABS. It is designed for high chemical resistance and interfacial adhesion to polymer systems. Applications include laptop cases or other electronic components.

The Hydrosize Carbon 400 series includes high-performance grades that reportedly can withstand the extreme processing temperatures that many high-temperature thermoplastics require. Appropriate materials include polyetheretherketone (PEEK), polyphenylene sulfide (PPS), polyetherimide (PEI) and others used to produce composite engine components.

The Hydrosize Carbon 700 series, currently in the final stages of development, has been formulated to improve the performance of carbon fiber-reinforced vinyl ester composites, targeted specifically for sheet molding compound (SMC) applications. Its proprietary chemistry is said to increase adhesion between the carbon fiber and various vinyl ester compounds.

Michelman, Booth H48, www.michelman.com

Compact temperature control system

Mokon (Buffalo, N.Y., U.S.) is exhibiting its Full Range temperature control system, which is a compact, self-supporting combined heating and cooling system. The Full Range system integrates either a water or an oil heating system with a select chiller, and is available in temperatures ranging from -20°F to 600°F (-29°C to 315°C).

Source | Mokon

The Full Range system is said to be ideal for applications such as jacketed vessels, mixers, reactors, molding, multiple-zone processes, laboratories, clean room and sanitary environments, as well as other processes that require both heating and chilling.

Systems are available in air or water-cooled condensing, up to 96 kW of heating, flows to 120 GPM (454 LPM) and up to 60 tons (211 kW) chilling capacities. Full Range systems are also available with NEMA 4, NEMA 4X or special wash down demands. Additional options are available for higher or lower operating temperatures, larger heating and chilling capacities, stationary skid-based assemblies and stainless steel construction.

Mokon, Booth S45, www.mokon.com

Closed mold applications

Design Concepts (Sarasota, Fla., U.S.) is emphasizing its closed mold applications for both tooling and private label manufacturing in the entertainment, simulation, aerospace and wind energy markets.

The company's light resin transfer mold (LRTM) technology is said to accommodate applications requiring attributes such as surface profile, part weight or production ergonomics. In addition, the company will be promoting its vacuum-bagged, infused part capabilities.

Design Concepts, Booth M11, www.designconcepts-us.com »

Silicone-free mold release system

Source | Chem-Trend

Chem-Trend (Howell, Mich., U.S.) is exhibiting its Zyvax silicone-free mold release system for the aerospace manufacturing industry. Booth attendees can see demonstrations of the company's silicone-free Zyvax 1070W mold release agent, a water-based product that is said to reduce tool prep time with one-step application. In addition, the company says that heat cure is not required, buildup and fouling are minimized, and VOCs are reduced.

Also on display, Zyvax MPP 1006W is a water-based mold primer developed to restore uniform surface to composite or polymeric molds while providing a better bonding surface for sealers. Zyvax Sealer 1050 is a semi-permanent mold sealer designed for simple application through a one-step, wipe-on and let-dry method.

Chem-Trend LP, Booth W56, www.chemtrend.com

Tooless engineered composites

Plastics Unlimited (Preston, Iowa, U.S.) is featuring its TEC (Tooless Engineered Composites) process. TEC starts with a thermoformed plastic skin that is structurally reinforced by a composite material from the back side of the part. The benefits are a nonpainted Class A finish that can have a solid color with clear protection, metallic with clear top layer, chrome or designs such as carbon mesh, camouflage and more. There are also different textures that can be used for scratch and mar resistance, which the company says is not achievable with gel-coated parts.

The cost of TEC is said to make it a good fit for low- to mid-volume production parts that require structure and a high-quality appearance. TEC reportedly also has fast turnaround because of the shorter cycle times. Each thermoformed shell is a new mold, which means that there is no waiting on parts to cure. Plastics Unlimited says it can produce a part every 2-3 minutes, compared to other composite processes that can take 1-8 hours.

Plastics Unlimited, Booth Y25, www.plasticsunlimited.com

Elastomer for hybrid composite structures

Gummiwerk Kraiburg GmbH & Co. KG (Waldkraiburg, Germany) is introducing KRAIBON, a thin film made of non-cross-linked rubber that hardens within the composite laminate during production process. The result is a hybrid material that combines composites with elastomer compounds. Kraiburg says the integration of elastomer in the composite offers an alternating structure of hard and soft material that combines the strong mechanical properties of the composite with the elastic properties of the elastomer. The primary benefits says the company are improved acoustics, impact and splintering behavior.

Acoustics: KRAIBON is said to significantly improve the acoustic properties of FRP components by enabling outstanding structure-borne sound attenuation of up to 20 dB with minimal additional weight. In addition, the weight reduction of about 2.5 kg/m^2 reportedly holds potential for manufacturers of indoor panels and floor tiles, for example.

Hybrids: KRAIBON also is said to enable a new level of quality in the hybrid combination of materials, such as metal and carbon fiber. KRAIBON functions in this case as an adhesive between the two materials. While conventional adhesives do not equalize the different expansion properties of metal and carbon fiber under elevated temperatures, KRAIBON reportedly compensates for these differences to create adhesion on both sides. Another advantage is the electrical insulating property between the two materials, which prevents corrosion.

Impact: Another important application for KRAIBON is impact protection. Integration of KRAIBON elastomer into a composite reportedly can increase impact energies 100-300%. This allows either higher damage tolerances and therefore a longer life, or cost-effective production of a lighter component that delivers the same performance.

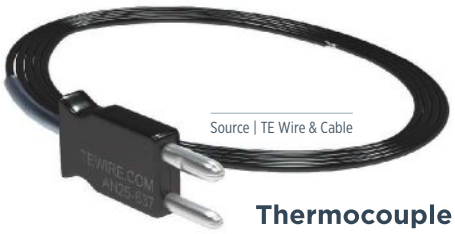
Gummiwerk KRAIBURG GmbH & Co. KG, Booth G24, www.kraiburg-rubber-compounds.com

Vacuum bagging materials

Shanghai Leadgo-tech (Shanghai, China) is featuring its lineup of vacuum process bagging materials for resin infusion, autoclave cure, oven cure and wet layup. The company has a manufacturing plant in Ningbo, China, that is certified to ISO 9001 and AS 9100 standards. Additionally, Leadgo-tech has offices in Toulouse, France and Los Angeles, Calif., U.S. Leadgo globally supports the wind power, aerospace, marine markets with peel ply, vacuum bagging film, release film, breathers, infusion mesh, sealant tape and pressure-sensitive tapes, among other products. **Shanghai Leadgo-Tech Co., Booth Y48, www.leadgotech.com »**

Thin-heater technology for high-temperature material measurement

Precision Measurements and Instruments Corp. (PMMI, Corvallis, Ore., U.S.) is featuring its thin-heater technology, designed for measurement of hard and porous thermally insulating materials up to 1250°C (2282°F). Controlled heating of all sample surfaces with top, bottom and side heaters, and thin-heater technology, supports a quick, steady state approach. PMMI says that traditional C1114 thin-heater configurations for thermal conductivity measurement of flat panels require large sample sizes, which may often constitute a challenge in material research and development. The company says that implementation of a three-layer model for edge heat loss not only allows much smaller sample sizes, but it also increases the accuracy of the measurement. The principle method for edge heat loss correction uses a three-dimensional analytical solution for the temperature distribution in the samples based on expanded eigenfunctions. Thermal conductivity of both samples and the lateral heat transfer coefficient defined by Newton's law of cooling are obtained using a non-linear fitting model. **Precision Measurements and Instruments Corp., Booth G50, www.pmiclab.com**



Thermocouple wires and cables

TE Wire & Cable LLC (Saddle Brook, N.J., U.S.), a Marmon Wire & Cable/Berkshire Hathaway (Chicago, Ill., U.S.) company, is featuring its line of thermocouple and specialty wire and cable products. The company manufactures a full line of thermocouple wire and cable, from iron and nickel-based alloys, and copper instrument and control cable. TE Wire & Cable maintains an in-house laboratory directly certified by the National Institute of Standards and Technology (NIST, Gaithersburg, Md., U.S.), allowing it to match and calibrate its wire, which in turn is said to provide a higher quality product with lower cost and enhanced performance.
TE Wire & Cable, Booth J57, www.tewire.com

Model, mold and tool engineering materials

RAMPF Group Inc. (Wixom, Mich., U.S.) is presenting its full range of model, mold and tool engineering materials for the automotive, marine and aerospace industries. New in the portfolio are liquid resin systems for structural and interior aerospace composites applications. This year's product highlights include epoxy board and contour paste.

RAKU Tool WB-0890 epoxy board for composite manufacturing offers an extremely fine surface structure, which is said to significantly reduce both finishing and the amount of sealer that has to be used. The surface finish can be transferred from the master model to the prepreg mold, so that no re-sanding of the mold is required and the service life of the prepreg molds is significantly increased. It is reportedly easy and quick to machine and compatible with all industry-standard paints, release agents and epoxy prepregs. The T_g of this material is 110°C (230°F).

RAKU Tool WB-0950 high-temperature epoxy board for tools and molds can be bonded in various shapes and sizes. It is heat resistant up to 200°C (392°F), has a closed surface structure and exhibits excellent machinability and good dimensional stability. The board is designed for the manufacture of layup tools for prepregs and vacuum forming molds. A special RAKU Tool adhesive matched in hardness and color also is available.

RAKU Tool CP-6131 close-contour paste is a two-component epoxy system that is applied to a close-contour substructure by hand or using a CNC machine. Many kinds of supporting structures can be used, including RAKU Tool SB-0080 styling board, EPS and cast aluminum. RAKU Tool CP-6131 is said to be easy to process and apply. The production process is fast and efficient — direct tooling does not require the production of a model, and the close-contour shape facilitates faster milling times. Furthermore, as with all close-contour products, less material is used and less waste is produced.

Other products on display include the RAKU EI-2510 structural liquid resin system and RAKU EI-2508 flame, smoke, toxicity (FST) epoxy system for aircraft interior applications.

RAMPF Group Inc., Booth P4, www.rampf-group.com

Modified epoxy prepreg resin system

Toray Advanced Composites (Morgan Hill, Calif., U.S.) is introducing TC522, a new highly toughened, modified epoxy prepreg resin system for the radome and communications market. TC522 reportedly has an excellent balance of electrical and mechanical properties for highly loaded dielectric structures in severe impact environments, making it suitable for the newest generation of supersonic aircraft and defense systems. Toray also is exhibiting the latest in aerospace structural thermoplastics, out-of-autoclave thermoset prepregs, high-temperature polyimide prepregs and Toray AmberTool composite tooling prepregs.

TORAY Advanced Composites, Booth J29, www.toraytac.com »


Source | SGL Carbon

Carbon fibers, textile semi-finished products and finished components

SGL Carbon (Wiesbaden, Germany) is shining a light on product solutions made with composite materials and manufacturing technologies for future-oriented industries under the theme "The Weight and Performance Optimizers." SGL's entire product portfolio will be on display, from carbon fibers and textile semi-finished products to finished components made of carbon and glass fiber-reinforced plastics.

Specific products in SGL's booth include a rear spoiler made of carbon fiber fabrics for a sports car manufacturer, a glass fiber-reinforced plastic (GFRP) leaf spring produced in an automated production process at the SGL plant in Austria, high-performance aerospace insulation components manufactured at SGL Carbon's Arkadelphia, Ark., U.S., plant, and a crossbeam made of carbon fiber-reinforced plastic (CFRP), used in small series in the press interlinking lines of the automation industry.

SGL Carbon, Booth M2, www.sglcarbon.com

Robotic filament winding technology

Roth Composite Machinery (Steffenberg, Germany) is showcasing its ROTHAWIN technology, robot winding and the machine type 1-ECO. Roth's ROTHAWIN technology accelerates winding processes by five to 10 times, makes production processes more effective and is said to be the next evolutionary stage in filament winding. The ROTHAWIN technology reportedly is the ideal solution for series and mass production of pressure vessels in the automotive industry. The machine Type 1-ECO was developed as a standardized version of Roth's successful gantry-type filament winding machine and represents an entry into the serial production of filament winding machines for the company. The Type 1-ECO machine is equipped with all essential basic functions and offers particularly cost-conscious newcomers to filament winding technology the attributes of robustness, durability and precision that Roth says it is known for. The new machine features a modular design consisting of up to four spindles. A maximum of four winding axes and two length variants (up to 4,000 and up to 10,000 mm, respectively) are configurable. Each spindle is driven separately and thus, a simple and cost-effective retrofitting is enabled.

Roth Composite Machinery GmbH, Booth T70
www.roth-composite-machinery.com

Advanced epoxy systems

Sicomin Epoxy Systems (Marseille, France) is featuring its line of advanced epoxy systems and high-performance composite solutions, including MaxCore, its new sandwich core infusion technology, and the latest addition to the GreenPoxy range, SR Greenpoxy 28, its new bio-resin specifically formulated for high-pressure resin transfer molding (HP-RTM).

Sicomin says MaxCore offers a new method of dry fiber insertion into sandwich core sheets for infusion manufacturing of large composite parts for civil engineering, transportation, wind energy and marine industries. Using MaxCore, dry fibers are inserted into foam in multiple orientations and are responsible for 100% of the mechanical properties of the infused processed core. With its patented manufacturing process, Sicomin says it is able to place these reinforcement fibers at precise angles and positions within the core, resulting in 70% fiber content by weight of infused glass.

SR GreenPoxy 28, the sixth product in Sicomin's GreenPoxy range, is a fast-cycle, low-toxicity, third generation bio-based formulation aimed specifically at HP-RTM molding processes. The new formulation reportedly has been optimized for fast production cycle times and superior mechanical performance.

Sicomin, Booth U83, www.sicomin.com

Supply chain database tool

The Utah Advanced Materials & Manufacturing Initiative (UAMMI; Salt Lake City, Utah, U.S.) is featuring its new supply chain database tool. The online tool is a searchable database of nearly every advanced material and manufacturing supplier and manufacturer in the state of Utah. In addition, it consists of a marketplace where companies can find buyers and sellers for industry items as well as donate expired materials and other equipment to education programs.

The objective of the program is to make Utah's advanced materials industry more globally competitive and capable of diversifying into new markets. The supply chain tool will enable anyone in or out of the state to easily locate Utah companies with the expertise and equipment to meet their requirements. It will also allow Utah companies to better connect into the supply chain and increase contract opportunities in both the defense and commercial sectors.

Utah Advanced Materials & Manufacturing Initiative, Booth F41, www.uammi.org »

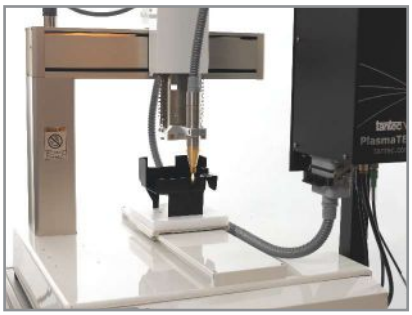
Boron and SCS silicon carbide monofilaments

Specialty Materials Inc. (SMI, Lowell, Mass., U.S.) is emphasizing its line of boron monofilament and prepreg materials, as well as SCS silicon carbide (SiC) monofilament. Boron monofilament offers extremely high compression strength in excess of 400 KSI. In addition, it provides high composite tensile strength (220 KSI) and high tensile modulus (28 MSI). It also provides a positive coefficient of thermal expansion (CTE) for space applications, does not require coupling agents and does not cause galvanic corrosion with aluminum. SMI also reports that it has teamed up with Toray Advanced Composites to offer its Gen-2 Hy-Bor materials, which combines boron monofilament with Toray's T1100G carbon fiber in a variety of resin systems, including epoxy, cyanate ester, BMI and polyimide.

SMI says its SCS SiC fibers have excellent high-temperature mechanical properties for increasing the strength, stiffness and use temperature of titanium matrix composites. They also are said to provide toughness to ceramic matrix composites. In addition, it has been used commercially to increase the efficiency of the manufacture of solar cells used in photovoltaic modules. As a result, SMI says it is one of the few domestic suppliers of SiC fibers with production capacity. Its premier SiC fiber, SCS Ultra, reportedly has the highest creep rupture strength of any SiC fiber. A newer, smaller diameter version (3 mils) of SCS Ultra has recently been developed and is currently being evaluated by turbine engine manufacturers.

Specialty Materials Inc., Booth D34, www.specmaterials.com

Plasma treatment systems



Tantec (Lunderskov, Denmark) is featuring its full line of plasma treatment systems, with specific emphasis on PlasmaTEC-X, the newest product in the company's atmospheric plasma treatment line. One advantage of PlasmaTec-X, says Tantec, includes low investment and operational costs compared to gas, flame and chemical treatment systems. It is also said to be compact and easy to install in existing manufacturing lines, requiring only power and compressed air. The PlasmaTec-X can be daisy chained up to eight units, all of which are controllable from one PLC controller/HMI. **Tantec EST Inc., Booth X22, www.tantec.com**

Composite modeling and simulation software

MultiMechanics (Omaha, Neb., U.S.) is showcasing its MultiMech 19.0 composite modeling and simulation software. Released in March of this year, MultiMech 19.0 features include:

- a new bi-modulus elastic model to enable engineers to better capture the mechanical behavior of carbon fibers,
- virtual DMA to more easily characterize the viscoelastic behavior of complex microstructures,
- parallel runs in Optimizer mode to reduce the job runtime,
- new material and failure models, including continuum damage models for orthotropic materials and new damage laws enabling users to capture unique material behavior with higher accuracy,
- enhancements to linear solver, including improved automated time step and optional displacement convergence check, as well as the ability to check for large displacements in the nonlinear solver, and
- a redesign of the material database and enhancements to speed up the workflow.

MultiMechanics, Booth D43, www.multimechanics.com »

Zyvax® 1070W silicone-free mold release agent is the gold standard for complex aerospace applications. It reduces tool prep time from hours to minutes, with no heat cure, or cure time required. You just need to spray or wipe and let dry. This minimizes buildup and fouling, makes tool cleanup easier, and requires minimal abrasion. All while reducing VOCs. It saves time. It saves complexity. And it's ready to take flight.

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Carbon fiber and composite material innovations

Toray Composite Materials America Inc. (Tacoma, Wash., U.S.) is featuring its latest innovations in carbon fiber and composite materials. Toray will further define performance advancements in its TORAYCA T1100 carbon fiber. Toray says T1100 has established a new class of carbon fiber (intermediate modulus +) by offering significant improvements in both tensile and modulus strengths vs. traditional intermediate modulus fibers. Toray notes that standard modulus (SM) carbon fibers typically exhibit a fiber modulus of 33-34 Msi, or slightly higher. These are the most cost-effective fibers as measured by tensile strength or modulus per unit cost. Intermediate modulus (IM) carbon fibers typically exhibit a tensile modulus of 42 Msi. Originally developed for aerospace applications, IM fibers now find use in recreational and industrial applications as well. Toray says its T1100 IM+ carbon fiber offers significant improvements in both tensile and modulus strengths vs. traditional IM fibers.

The company is also featuring its full line of prepreg materials, including unidirectional tape, slit tape, fiberglass fabrics, carbon fiber fabrics and resin products. In addition, for general aviation out-of-autoclave (OOA) applications, Toray is featuring its 2510 resin system for primary structural materials. For recreation/sporting goods applications, G-94M is Toray's standard 250-300°F cure system. This prepreg provides good mechanical properties, controlled flow, easy handling and a high T_g. For industrial applications, Toray's G83C resin system provides quick cure (290°F 143°C for 20 min) or a low-temperature cure (185°F /85°C for 6 hours), with the capability to achieve a Class A finish.

Additionally, Toray is promoting its extended capabilities, which now include Cetex thermoplastic composite materials, following Toray's acquisition of TenCate Advanced Composites, since renamed Toray Advanced Composites. **Toray Composite Materials America Inc., Booth J29, www.toraytac.com**

High-performance, high-volume continuous CFRT composites


Source | TPMC

Toray Performance Materials Corp. (TPMC, Camarillo, Calif., U.S.) is featuring its line of high-performance, high-volume, continuous fiber-reinforced thermoplastic (CFRT) composite materials. TPMC (formerly part of TenCate Advanced Composites) is highlighting application examples to the sporting goods, computer, construction, automotive and medical markets.

The Air Jordan 11 (AJ11) is a performance footwear application for basketball enhanced by Toray CFRT BW1000 using TPMC's proprietary PMMA resin system with carbon and glass reinforcement. The composite material enhances multidirectional movement, and it is ultra-thin, lightweight and resilient for improved energy return.

The HP Buffalo notebook computer uses Toray Cetex TC920 (PC/ABS/carbon fiber woven laminate), which is inherently fire-retardant, meets UL-94 V0 standards without secondary FR fillers, and is also impact-resistant. Toray's materials were selected for this application to achieve a lightweight, thin profile and to dissipate heat when in operation on a user's lap.

The Toray Preform is a medical corrective device using Toray CFRT TL-2100. CFRT TL-2100 is the foremost material for podiatric correction and offers patients thinness for better fit and unmatched comfort, lightweight support and stability, functional control, and resiliency for fast response. Because it is thermoplastic, it is heat adjustable. **Toray Performance Materials Corp., Booth J29, www.toraytac.com** »

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INSTITUTE FOR ADVANCED COMPOSITES MANUFACTURING INNOVATION

IACMI for Manufacturing Day - Friday, Oct. 4, 2019

Manufacturing Day

October 4, 2019

#MfgDay2019

IACMI strives to engage communities across the United States in recognizing employment opportunities in composites manufacturing, appreciating the involvement of omposites-related organizations in their community, and training a future workforce that is driven to join the composites industry. By participating in Manufacturing Day, an internationally recognized event organized by the National Association of Manufacturers (NAM), IACMI celebrates a day to focus attention on the workforce development opportunities in the composites industry.

Learn more at: *iacmi.org/manufacturing-day*

Thank you IACMI members for attending the Summer 2019 Members Meeting

- Vartega world headquarter ribbon cutting
- Technical research outcome discussions
- 270+ attendees

The IACMI community continues to drive innovation in the adoption of advanced composites.

IACMI-The Composites Institute
2360 Cherahala Blvd
Knoxville, TN 37932

Become a member today! iacmi.org/membership

Source | Wisconsin Oven

Composite curing batch ovens

Wisconsin Oven Corp. (East Troy, Wisc., U.S.) manufactures electrically heated, gas-fired and indirect gas-fired composite curing batch ovens designed to meet customers' specific process requirements. Options commonly used for composite curing ovens include data acquisition instruments, vacuum piping, pumps and transducers. Wisconsin Oven's composite curing ovens offer the following advantages:

- Quicker heating rates and recovery times: Each oven features a high-pressure recirculation blower, which includes fully enclosed and pressurized supply ducts. As a standard, the equipment is designed for combination airflow arrangement that ensures even and uniform heat distribution throughout the work chamber, even with varying loads.
- Consistent temperature certification: Composite curing ovens are typically guaranteed and certified for ±10° at 350° F temperature uniformity. Tighter tolerances and certification at other temperatures are available. Equipment is completely tested prior to shipment and must pass an extensive quality inspection prior to shipment.
- Reduced maintenance: Ovens boast heavy-duty construction, brand-name components and quality workmanship. Equipment is backed by an exclusive three-year heat and recirculation warranty.
- Energy efficiency: The composite curing batch ovens are also available with the E-Pack Oven upgrade. This optional energy-efficient upgrade package includes thicker wall panels, higher efficiency motors and a few other energy-saving items.

Wisconsin Oven Corp., Booth S41, www.wisoven.com

Source | Vectorply Corp.

Lightweight carbon fiber non-crimp fabrics

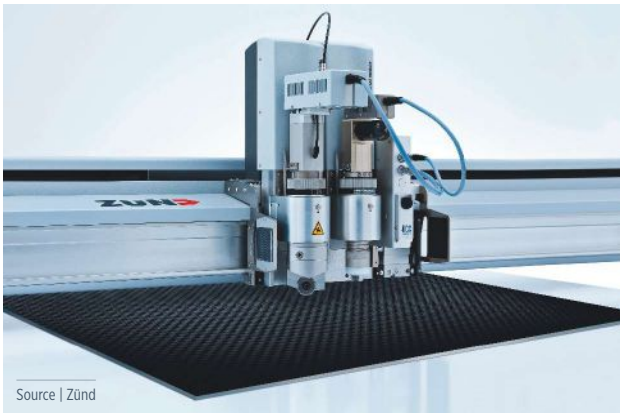
Vectorply Corp. (Phenix City, Ala., U.S.) is unveiling three new lightweight carbon fiber non-crimp fabrics, which range from a 208 gsm biaxial to a 410 gsm quadraxial. Vectorply's new carbon fiber fabrics offer benefits for customers seeking improved performance with the integration of carbon fiber materials featuring low fiber areal weights (FAW), especially compared to similar FAW woven alternatives. Non-crimped fibers offer higher fiber property translation in the composite compared to woven fabrics, and Vectorply's stitch-bonding format reportedly delivers high dry fabric stability. Additionally, fiber inputs used are current generation 12K standard modulus carbon fiber, providing higher fiber strengths than older 1K, 3K, and 6K inputs typically used in similar FAW woven fabrics.

The trio of products introduced at CAMX join Vectorply's 152 gsm +45°/-45° biaxial, C-BX 0450, to form a versatile fabric assortment for those seeking low-FAW carbon fiber products in a variety of architectures. These products include:

- C-BX 0450: +45°/-45° biaxial, 152 gsm
- C-LT 0600: 0°/90° biaxial, 108 gsm
- C-TLX 0750: 0°/+45°/-45° warp triaxial, 257 gsm
- C-QX 1200: 0°/+45°/90°/-45° quadraxial, 410 gsm

Engineered as lightweight solutions for high-end applications, Vectorply's new low-FAW fabrics are said to be ideal for applications in aerospace, marine, and sports and recreation markets, among others.

Vectorply Corp., Booth Y42, www.vectorply.com



Source | Zünd

Cutting and routing tools

Zünd (Franklin, Wis., U.S.) presents a variety of digital cutting and workflow solutions tailormade for the composites industry. Especially in the automotive and aerospace sectors, Zünd's modular, customizable cutters are said to be ideal for processing demanding materials while meeting the highest safety standards.

Raw materials that can be processed using specially designed Zünd cutting and routing tools include dry or prepreg carbon fiber, fiberglass, thermoplastic organosheets, honeycomb and foam-core materials and more. Zünd cutters enable all of these to be cut on a single, multi-functional cutting system that also offers a range of marking and labeling tools. With the aim of achieving more throughput in less time, Zünd cutting systems are systematically geared towards fully automated production; options are available for gradual implementation with semi-automated production workflows. Software solutions from Zünd range from prototyping to fully automated production. Zünd software automatically optimizes cutting contours and cut paths depending on the material and choice of tools. With integrated nesting functions, parts are laid out automatically for optimal material usage.

Zünd America Inc., Booth G30, www.zund.com

Composites molding presses

Wabash MPI and **Carver Inc.** (Wabash, Ind., U.S.) are showcasing their standard and custom molding presses for manufacturing and laboratory applications.

Wabash MPI offers standard and custom hydraulic and pneumatic presses for compression molding, vacuum molding, ASTM testing, laboratory and R&D applications. The company's transfer presses are said to offer precise molding of electrical components, medical products and other applications. Carver Inc. offers two-column and four-column benchtop, manual and automatic hydraulic laboratory presses with clamping capacities from 12-48 tons.

Carver presses are suited for various materials research, as well as pharmaceuticals, analytical chemistry, lab testing, laminating, rosin extraction and other applications.

Wabash MPI/Carver Inc., Booth U55, www.wabashmpi.com »

Nickel vapor deposition mold for OOA cure

Weber Manufacturing Technologies Inc. (Midland, Ontario, Canada) is showcasing use of a mold manufactured using the company's nickel vapor deposition (NVD) technology to demonstrate out-of-autoclave fabrication of a Class A automotive body panel. The demonstration emphasizes the tool's rapid heating and cooling capabilities.

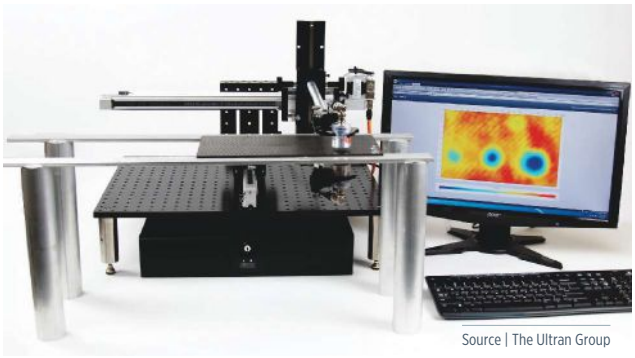

Source | Weber Manufacturing Technologies Inc.

Visitors can view firsthand the mold ramping quickly up to temperature and back to uniform mold surface temperature. Conformal heating capabilities allow users faster cycle times.

The company says NVD can produce nickel 20 times faster than electroforming. NVD is said to produce a more uniform shell thickness, is good at replicating finely detailed mold textures and surfaces, produces negligible residual stress and is weldable. A new NVD mold can be fabricated from an existing deposition mandrel in just two to three weeks and can be 3-30 mm thick.

Weber also manufactures large, high-quality tools from steel, aluminum and Invar, notably for large composites molding processes.

Weber Manufacturing Technologies Inc., Booth U49, www.webermfg.ca


Source | The Ultran Group

Non-contact ultrasonic inspection system

The Ultran Group (State College, Pa., U.S.) is highlighting its U710x turnkey non-contact (air-coupled) ultrasonic inspection system. Designed for detecting and measuring voids, cracks, porosity, density and thickness without the need for immersion or a coupling agent, the U710x provides freedom from touch and contamination of porous materials. According to the Ultran Group, it can scan parts faster and with higher signal-to-noise ratio than other non-contact quality inspection systems in the industry.

The system's lightweight design is versatile and portable, facilitating its use in a wide variety of applications.

The Ultran Group, Booth S65, www.ultrangroup.com


Source | Virtek

Laser projector software platform

Virtek (Waterloo, Ontario, Canada) is showcasing its newly enhanced Virtek Iris 3D vision technology software platform, which includes its latest high-visibility laser projector. Virtek says the enhanced version is faster and has a more productive user interface, with a patented FlashAlign feature that enables instant alignment. At the company's CAMX booth, representatives are demonstrating how Virtek's new thin client experience enables mobility and flexibility at the workstation, the multi-tasking functionality of its software and simplicity of its training.
Virtek Vision International, Booth X62, www.virtek.ca

Composites testing machines

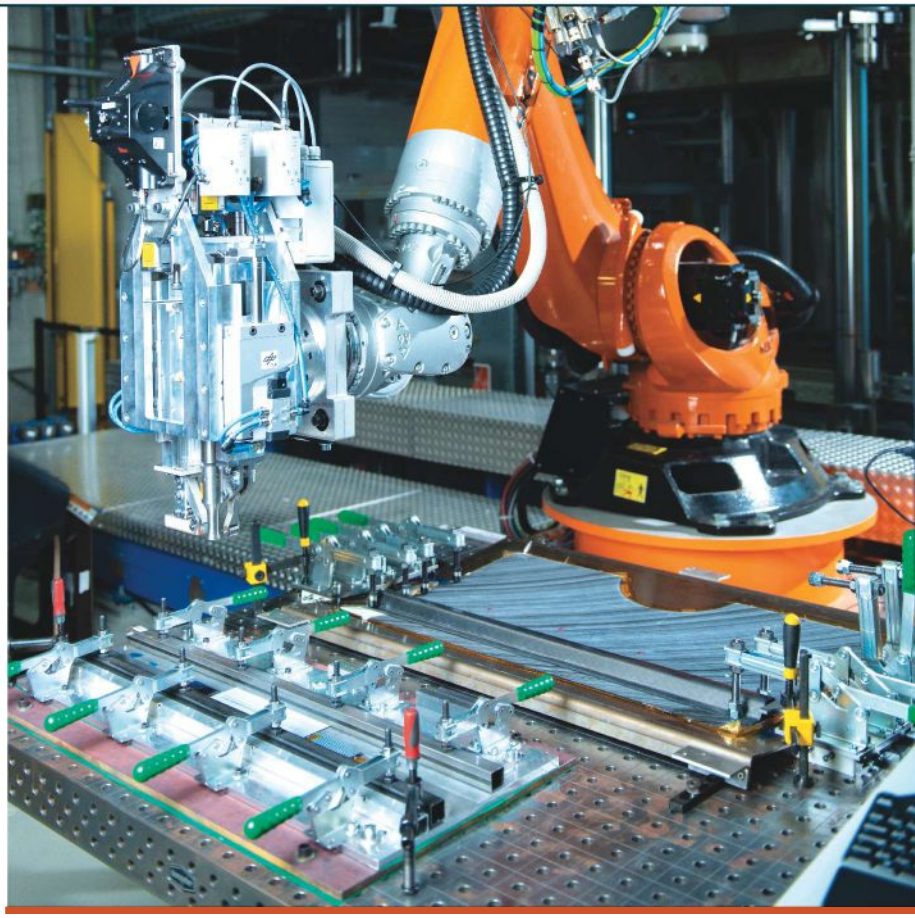
Zwick Roell (Ulm, Germany) presents its latest developments in composites testing: the Amsler HIT 600F drop weight tester and the AllroundLine testing machine with grips and alignment fixtures ideal for every composites application.

The AllroundLine system for composites testing features a wide range of test fixtures that can accommodate tests under ambient and non-ambient test conditions. With the AllroundLine system, additional fixtures for three- and four-point flexure tests, inter-laminar shear strength (ILSS), and the Iosipescu V-notch shear test may be conveniently attached via slide-in inserts in place of jaws used in the pre-mounted tensile grips. The inserts facilitate rapid equipment changes, with the added advantage of maintaining the preset axial alignment of the specimen grips.

The Amsler HIT600F works in concert with the AllroundLine to perform Compression After Impact tests, which require pre-damaging of fiber-reinforced composites (CAI) to ASTM D7136, DIN EN 6038 and AITM 1.0010. Testing at low impact speeds of 2.2 m/s requires a larger drop weight; if testing at 6.6 m/s is required, acceleration is necessary. This drop weight tester caters to both situations, making it well suited to satisfy the requirements of a wide range of automotive and aerospace industry specification standards.
ZwickRoell, Booth J80, www.zwickroell.com

Highlights: Composites Convention 2019

By Amanda Jacob / Contributing Writer



Joining: the key to thermoplastic composites in aerospace

DLR's Center for Lightweight Production Technology (ZLP) in Augsburg has developed a robot-based continuous ultrasonic welding system consisting of an end-effector mounted on a KUKA robot, which has been proven on aerospace components including a stiffened fuselage panel and a rear pressure bulkhead. Read more about this, the Composites Convention and DLR's Colloquium on Production Technology in Amanda Jacob's full report online: short.compositesworld.com/CCStade201. Source | DLR

» If the composites industry is to continue to grow and improve its competitiveness, it must exploit the opportunities that digitization and automation bring. Future Factory for Composites was the theme for this year's Composites Convention in Stade, Germany, held June 12-13. Jointly organized by CFK Valley e.V. (Stade, Germany) and Carbon Composites e.V. (Augsburg, Germany), the event attracted a record attendance of nearly 450 people. A strong U.S. presence resulted from a collaboration with the Utah Advanced Materials and Manufacturing Initiative (UAMMI, Kaysville, Utah, U.S.) as partner network and the United States as partner country.

In the opening keynote presentation, titled "Digitization: Transition from Computer Aided Manufacturing to Human Aided Automation," Dr. Jan Stüve, head of the Center for Lightweight Production Technology at the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR; Stade, Germany) offered a flavor of the program to come. Future factory technologies under development at DLR include multiple co-operating robots that work together to reduce production time and digital twins of machines that enable process optimization. Another key area concerns mobile autonomous robots for flexible production scenarios. These include the prototype Flappybot, a compact fiber placement unit that travels over the mold. Stüve warned of the potential dangers of over automation and discussed how digitalization *should* reinvolve humans in the manufacturing process.

In a second keynote, "Rapid Manufacturing and Thermoplastic Composites – Trends and Technologies," Dr. Robert G. Bryant, senior materials engineer at the NASA Langley Research Center (Hampton, Va., U.S.), took delegates away from the confines of the terrestrial factory toward building in space. A long-term human presence in space will require shelter and platforms as a first step. Development of ever-larger rockets to place increasingly complex structures off-planet is not economically sustainable. Solutions require near or on-site manufacturing. The use of a toolless advanced tape placement (ATP) process enabling in-situ consolidation of thermoplastic composite parts could be the answer. In this new technique, two ATP robots work opposite each other, one to deposit the thermoplastic prepreg tape, the other acting as the tool. Toolless fabrication (Go to short.compositesworld.com/GAToolless to learn more) could reduce the cost of aerospace manufacturing, improving the economics of space exploration as well as benefiting other market sectors.

Sustainability

Advances in manufacturing also must be accompanied by reductions in environmental impact. Along those lines, in the next session, Jörg Spitzner, founder of Spitzner Engineers GmbH (Finkenwerder, Germany), argued that to meet climate targets, negative emissions technologies are needed. Spitzner's company claims that its patented Blancair wind turbine concept both improves turbine efficiency and removes CO_2 from the atmosphere. Air is drawn into a filter module mounted on the nacelle, where CO_2 is separated for storage and recycling in the production of synthetic fuels and other applications. The cleaned air is released through openings in the rotor blade tips. A

video explaining the concept is available on Blancair's website.

The session organizers also presented a concept for smart eco-efficiency assessment in composites production (DLR), and out-of-autoclave room-temperature, toughened prepregs with fire, smoke and toxicity (FST) capability (TCR Composites; Ogden, Utah, U.S.).

Empowerment through simulation

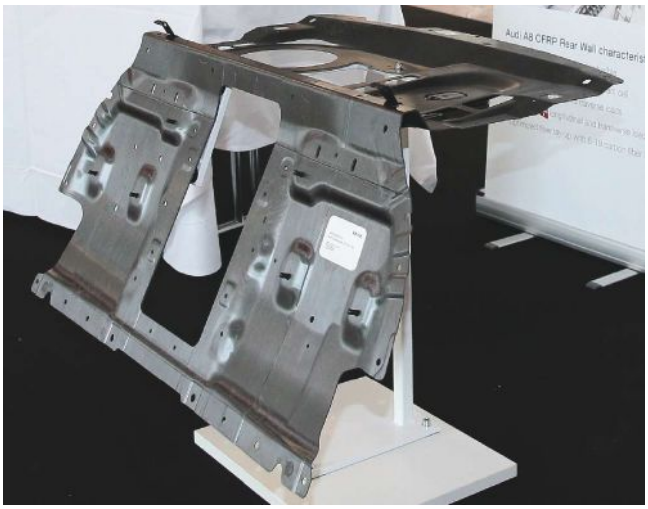
For the remainder of the first day of the conference, attention turned to simulation.

Dr. Lars Herbeck, chief technology officer at Voith Composites (Garching, Germany), discussed how the Voith Roving Applicator automated fiber placement (AFP) machine simplifies the process chain, enabling an efficient automated preforming process with reduced cycle times. He outlined the structural and process simulation performed for the automated manufacturing line that is capable of producing 65,000 components per year for the Audi *A8* carbon fiber-reinforced plastic (CFRP) rear wall.

Mark Bludszuweit from MET Motoren- und Energietechnik GmbH (Rostock, Germany) explained how simulation offers insight into the best way to load parts into an autoclave, enabling optimization of the curing process and greater productivity. A digital twin developed for the largest autoclave at DLR's Stade facility can run in parallel with the real process, or even faster to offer predictions of part behavior.

Further virtual process development topics covered modeling of SMC processes (ESI Group; Chartres-de-Bretagne, France) and process simulation of sandwich panels to understand core crush and prepreg wrinkling issues in the autoclave (Airbus Helicopters; Marignane, France).

Turning to virtual safety modeling, Jochen Rühl of Reichenbacher Hamuel GmbH (Dörfles-Esbach, Germany), part of Scherdel Gruppe, discussed how a simulation-based approach to managing dust and particulate matter produced during machining of CFRP parts has delivered benefits for customers such as Airbus and Premium Aerotec (Augsburg, Germany). Machining simulations and visualization of particulate distributions helps manufacturers comply with tightening health and safety legislation and improves machining results, as well as reduced machine downtime and maintenance, all of which ultimately translates into a lower cost per part.



Automated automotive manufacturing

The Audi *A8* CFRP rear wall, the largest component of the passenger cell, is manufactured by Voith Composites in a highly automated process enabling production volumes of 65,000 components per year. Source | CFK Valley

The simulation session also showcased a Boeing-sponsored project on virtual cost modeling of composites manufacturing, taking into account the complex interactions between design, production and finance to identify cost drivers (Massachusetts Institute of Technology; Cambridge, Mass., U.S.), and a digital factory planning concept based on simulative modeling of optimal composites value chains (Fraunhofer IGCV; Augsburg, Germany).

Award winners

This year, two projects shared the CFK Valley Innovation Award and the €7,500 prize money. First place (and €4,500) went to the MBFast18 mobile robotic systems project, which developed an automated guided vehicle (AGV)-based mobile CNC machining system for large CFRP aircraft parts. »

Mobile machining

The MBFast18 mobile machining concept is composed of an automated guided vehicle, robot and portable CNC machine and offers increased productivity in the manufacture of large CFRP aircraft parts.

Source | Fraunhofer IFAM

Compared to today's expensive, static machining systems for large aircraft structures, smaller mobile robotic systems enable flexible manufacturing and higher productivity.

The MBFast18 system employs a 4.6-meter-long autonomous platform built by FFT Produktionssysteme GmbH & Co. KG (Fulda, Germany), navigation and safety sensors supplied by SICK AG (Waldkirch, Germany), and a 5-axis CNC machine from SAUER/DMG MORI (Suhl and Bielefeld, Germany). A mobile laser tracker developed by the Fraunhofer Institute for Manufacturing Technology and Advanced Materials (IFAM; Stade, Germany) positions the robot precisely. The drilling unit, with a workspace of up to 0.5 square meters, is clamped to the component using vacuum grippers; drilling positions are calculated and transmitted to the machine using software developed by BCT GmbH (Dortmund, Germany). This concept is also applicable to handling and assembly operations and other industries such as wind energy and rail.

Second place went to start-up Hyconnect GmbH (Hamburg, Germany) for its FAUSST metal-composite joining technology. The company is initially targeting the shipbuilding sector, where the joining of composites to metal is a major barrier to more widespread composites adoption. The FAUSST solution employs a hybrid fabric consisting of warp-knitted glass and metal fibers that allows metals and composites to be firmly joined mechanically. The metal fiber side is joined to a steel profile that can be welded to metal structures, and the other side is laminated to the composite component. The patented technology is said to speed up the design and bonding process significantly. Initial prototype applications are currently under test.

Enablement through automation

Day Two saw the award-winning MBFast18 project explored in more detail in presentations from Christoph Brillinger, project manager at Fraunhofer IFAM, and Dr. Gregor Graßl of FFT, who discussed the challenges of developing smart process and plant control systems for multi-robot operations. Jerome Berg, staff engineer at Northrop Grumman Innovation Systems (Clearfield, Utah, U.S.), described the automated manufacture of Airbus aircraft stringers at the company's Utah facility using an in-house developed AFP process, and Uwe Lang of Evonik Resource Efficiency GmbH (Darmstadt, Germany) introduced "Sandwich Technology 4.0," an automated manufacturing technology for high production rates that employs the company's ROHACELL foam core material. A highly automated preforming process for an aircraft nose landing gear door has been demonstrated in a collaboration with DLR and Airbus' technology hub CTC GmbH (Stade, Germany).

Felix Hünecke, head of business development at ABSOLUTE Reality GmbH (Hamburg, Germany), showed how 3D models of buildings can be created, edited and supplemented with images, documents and videos to create virtual environments that can be viewed from anywhere in the world. The company created a 3D tour of a DLR production hall in Stade.

Felix Schreiber, CEO, ARK Group (Aachen, Germany), discussed the process and cost benefits of structured machine data in an automated resin transfer molding (RTM) production line, while Sascha Backhaus of CTC GmbH discussed modular automation in composites manufacturing and the Hybr-iT project, which is developing teams where humans and robots work together with software-based assistance systems.

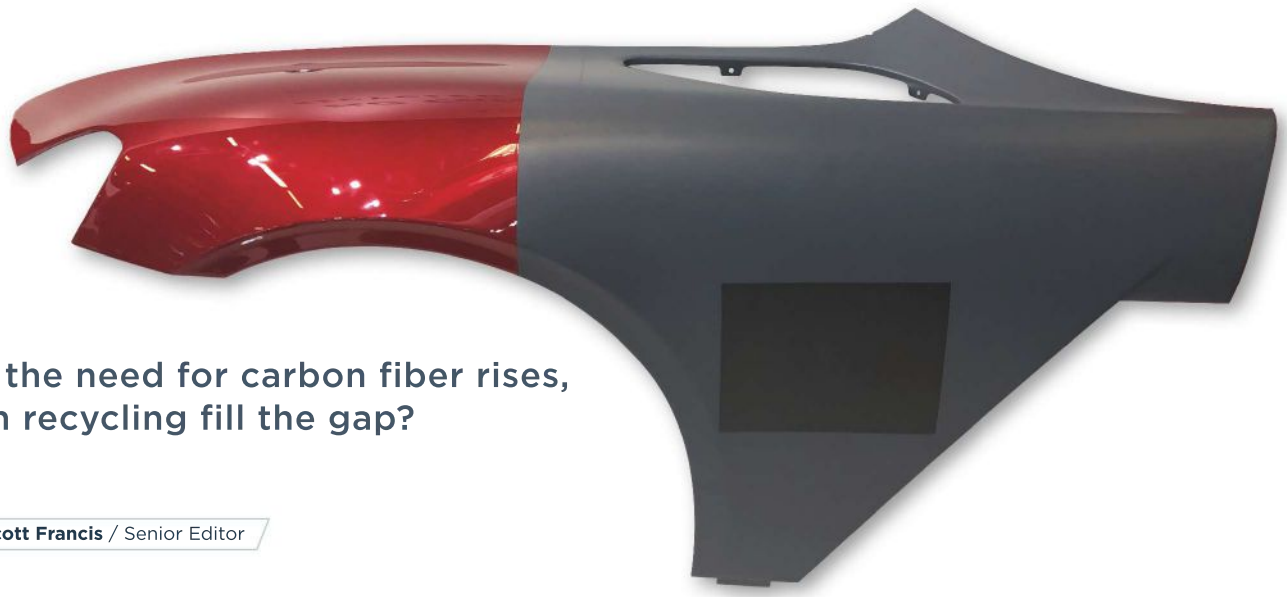
No event about the future factory could neglect the topic of artificial intelligence (AI), and Amir Ben-Assa, CMO of Plataine (Waltham, Mass., U.S.) discussed the opportunities and challenges of implementing AI in composites manufacturing. He presented practical applications of AI, from alerts (for example, production delays or quality problems) to recommendations (for example, optimized material selection). AI-based digital assistants on Google Glass could be another possibility, offering "hands-free" user interaction with AI on the production floor and real-time audio and visual presentation of alerts.

Go to **short.compositesworld.com/CCStade201** for the full report, including coverage of DLR's 5th Colloquium on Production Technology. CW

ABOUT THE AUTHOR

Located in Oxford, U.K., Amanda Jacob is a journalist and marketing communications consultant with more than 20 years of experience in the composites industry.

The state of recycled carbon fiber



As the need for carbon fiber rises, can recycling fill the gap?

By Scott Francis / Senior Editor

Sporting rCF

This lightweight Griffin sportscar body panel prototype developed by Gordon Murray Design, Formaplex and TVR combines ELG Carbiso-M recycled carbon fiber, woven carbon fiber fabric and resin infusion.

CW photo | Scott Francis

» The case for recycled carbon fiber is a complicated one. The industry is built on the hope of solving problems — namely, the desire to keep carbon fiber waste out of landfills and to fill a potential gap between carbon fiber supply and demand. It is commonly estimated that around 30% of produced carbon fiber ends up as waste. Meanwhile, as valuable material ends up in landfills, most analysts agree that annual demand for the material could surpass current annual production capacity within the next few years. The average estimated global carbon fiber demand is around 65,000-85,000 metric tonnes per year, with a global nameplate capacity (which is more than actual capacity) of around 150,000 metric tonnes, according to estimates presented by Brett Schneider, president, global fibers, Hexcel (Stamford, Conn., U.S.) and Dan Pichler, managing director of CarbConsult GmbH (Hofheim am Taunus, Germany) at the December 2018 Carbon Fiber conference. As reported by *CW* contributor Amanda Jacob in March, some analysts estimate that carbon fiber demand could exceed supply by about 24,000 metric tonnes by 2022. (See Learn More.)

And while commercial suppliers of recycled carbon fiber (rCF) point to reclaimed and repurposed material as a potential solution to this supply and demand gap, the rCF industry has its own challenges. While the technology to recycle carbon fiber composites has existed for more than a decade and is capable of yielding a product with mechanical properties very near that of virgin material, the composites recycling industry is relatively young and is still in the early stages of developing markets for the materials it produces from recyclate. As confidence in the quality of fiber being produced by recyclers increases, questions about cost and availability have come to the forefront. Perhaps the largest challenge for the industry is the concern over supply chain security.

"The technologies are actually there, and they've existed for quite a while, but the supply chain just hasn't been vetted," says Andrew Maxey, CEO of Vartega (Golden, Colo., U.S.). "Without the right pieces coming together, you can have the best technology in the world, but you're not going to have material to recycle and you're not going to have any products to put it in."

Commercial suppliers often look to the aerospace industry as a source of production scrap and end-of-life material to be used as recyclate, yet while the amount of waste created by the aerospace industry is large in terms of what is going to the landfill, many OEMs and fabricators have been reluctant to rely on it as a steady supply source for a high-volume product line.

On the other hand, some progress is being made. In December 2018, Boeing announced it will supply carbon fiber recycling specialist ELG Carbon Fibre Ltd. (Coseley, U.K.) with cured and uncured carbon fiber waste to be recycled for use in secondary products for other composites manufacturing applications. The agreement is the first formal material supply relationship between a carbon fiber recycler and a major aircraft OEM and seems to be a good portent for the industry.

It's not just about environmental concerns

The argument for using rCF goes beyond sustainability. Reduced cost is also a benefit. For example, ELG Carbon Fibre's rCF costs around 40% less than industrial virgin grade carbon fiber. Other commercial suppliers claim their material is anywhere from 20% to 40% less expensive than virgin carbon fiber. Plus, for many applications there is a need for discontinuous fiber formats — which suggests an opportunity where rCF might offer a more sustainable and economical alternative to virgin material.

"Anywhere the industry is using discontinuous or chopped carbon fiber, recycled [fiber] should be the first consideration," says Maxey. "We spend all this money to make virgin carbon fiber in a continuous format … why do we then take that and go chop it up to put into thermoplastic? If we already have a discontinuous format in those scraps, that's the best material to use, in my mind, for those molding compounds where you're just going to chop it up anyway."

Plus, the quality of rCF being produced has been shown, in some cases, to be on par with virgin fiber. ELG Carbon Fibre, which reclaims carbon fibers using pyrolysis, says its fiber typically retains at least 90% of its tensile strength with no change in modulus. Vartega uses a chemical recycling process and claims that its fiber exhibits the same mechanical properties as virgin carbon fiber. Shocker Composites (Wichita, Kan., U.S.) uses an inline solvolysis process to reclaim the fiber and claims high quality with no apparent damage to fibers.

According to Vamsidhar Patolla, Wichita State University Ph.D. student and founder of Shocker Composites, the challenge is all about getting the cost down to a level comparable to that of other materials such as aluminum. "Processability needs to match the high-volume production scale," he says. Shocker Composites' process offers this advantage because it is an inline process, not a batch process. (See Learn More.)

Given recent improvements over the past several years in rCF processing and fiber quality, commercial suppliers have begun to shift their focus from the downcycling of rCF — the repurposing of high performance material into lower-performance products — and more toward finding appropriate applications that benefit from the material's properties.

"We'll never displace virgin fiber completely, especially in aerospace where there are high strength and stiffness requirements, but people are coming around to the idea that recycled fiber isn't just recycled fiber with weak potentials," says Benjamin Andrews, field technical services engineer with ELG Carbon Fibre. "It has its own benefits that are superior to virgin fibers in some applications. Drapability and surface finish are both better than that of virgin fiber … this isn't just a reusable material; this is a material that has its own benefits."

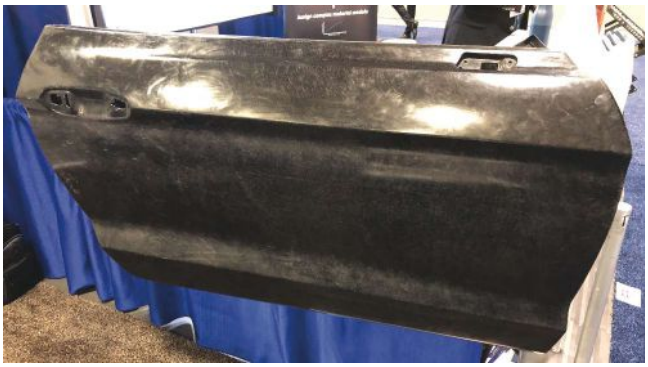
What's up with automotive?

When it comes to markets, the automotive industry seems like it should hold the most potential for using rCF. The material's ability to combine lightweighting with good surface finish makes it a natural fit for body panels, not to mention various interior components. Commercial suppliers of rCF have long looked to the industry with bated breath, hoping for widespread adoption, but a tipping point has yet to arrive. Process time and cost continue to be stumbling blocks for the industry.

Mark Mauhar, CEO of Carbon Conversions (Lake City, S.C., U.S.), argues that these concerns are a bit of an excuse given the progress that has been made, and he feels that the main barrier to »

Recycling carbon fiber

Recycled carbon fiber nonwoven mat from ELG Carbon Fibre. *CW* photo | Scott Francis



Automotive uses for rCF

Prepreg door panel made from Carbon Conversions' re-Evo MCF.

CW photo | Scott Francis

Applications of the P2T process

Example of a tertiary part produced using ProDrive's P2T process.

CW photo | Scott Francis

Compression-molded floorboard

This compression-molded automotive floorboard uses Carbon Conversions' re-EVO MCF nonwoven mat. *CW* photo | Scott Francis

adoption into any market is actually risk aversion.

"Nobody wants to be first to adopt a new material ecosystem," he says. He also stresses that large-scale adoption of rCF by the automotive industry is not necessarily even desirable, pointing out that usage adoption by a dozen major platforms could quickly use consume the global supply of rCF. He says the approach should be to target niche programs, which will, in turn, make the supply chain more robust from a business perspective.

"It pays to be smart about where you put it in automotive," he says. "Picking specific parts on specific models of cars that make sense."

Mauhar is hopeful that automotive will be the first major market space to consume a decent fraction of the available recycled carbon fiber. "In the next 24 months we'll start seeing some movement there," he predicts.

Composites, in general, are working their way into the automotive industry incrementally in parts such as lift gates, front end modules, leaf springs, battery boxes, body panels and chassis components such as tunnels, floors and side pillars. It would make sense for rCF to follow the same trajectory.

One interesting example of such a niche approach is ProDrive Composites (Milton Keynes, U.K.), manufacturer of advanced lightweight composites for applications ranging from automotive and motorsport to aerospace and defense. The company has been collaborating with the University of Sheffield Advanced Manufacturing Research Centre (AMRC, Sheffield, U.K.) and ELG Carbon Fibre on its P2T (Primary To Tertiary) process, which uses a reactive thermoplastic resin for manufacturing recyclable composite components. A plastic monomer is reacted with a catalyst in the presence of recycled fibers to produce a cured laminate, out of the autoclave.

"[We] have demonstrated that recyclable composite panels can be produced at a rate and cost to suit many industries," says John McQuilliam, chief engineer at ProDrive Composites.

The company says P2T allows a composite material to be used three or more times. At the primary part's end-of-life, the fibers and potentially the resin can be recycled, supplying raw material for a thermoplastic secondary part, such as a body panel. When that part reaches its end of life, it can be chopped and remolded into new parts. (See Learn More.)

Meanwhile, Vartega is leading an Institute for Advanced Composites Manufacturing Innovation (IACMI, Knoxville, Tenn., U.S.) project focused on the automotive industry. The two-year technical collaboration is designed to address the challenges of creating consistent recycled carbon fiber-reinforced thermoplastics for use in vehicle lightweighting applications. Maxey says the project is making progress toward a robust dataset that offers a full characterization of materials, from the fiber interface to finished part properties.

Of course, when considering the auto industry, the best bet might be on related emerging technologies. Electric vehicles, autonomous vehicles and connectivity aspects in cars bring new parts and applications opportunities where composites will likely play a large role.

Maxey offers his assessment of where the auto industry is

heading: "There's a lot that's gone on in the past couple of years in the auto industry, where the focus will shift from fuel economy to other priorities depending on what the regulations are and what the [presidential] administration is saying," he says. "[We're] not seeing any major pullback on lightweighting, but maybe the motivation for it evolves. I think what you'll see in the industry is the focus on lightweighting for mobility applications."

Can aerospace close the loop?

The aerospace industry generates the most carbon fiber waste, and commercial rCF suppliers often look to the aerospace industry as a source for recyclate. Excess material, typically uncured thermoset composite prepreg, is collected and the resin is removed via heat (pyrolysis) or a chemical solvent (solvolysis) to yield fiber that is milled, chopped or pelletized.

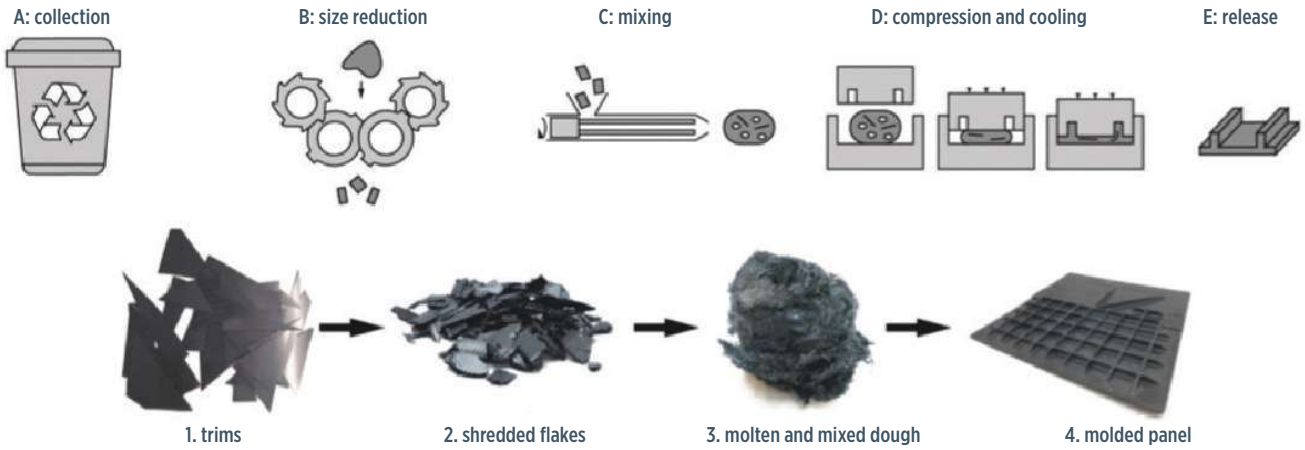
As the industry moves toward increased use of thermoplastic composites (TPCs), that material presents a new set of recycling opportunities. Because thermoplastic polymers can be remelted and reshaped, the aerospace industry has more opportunity to reabsorb some of its own scrap into secondary applications, potentially reusing both fiber and matrix. Thomas de Bruijn, researcher at the Thermoplastic Composites Application Center (TPAC, Enschede, Netherlands) — the *applied* thermoplastic composites R&D center working alongside the decade-old Thermoplastic Research Center (TPRC, Enschede, Netherlands) — points to efforts in the industry being made to recycle the material internally. "From a feasibility point of view, for thermoplastic composites, an in-house approach makes much more sense," he says.

According to de Bruijn, aircraft OEMs are more likely to recycle internally than turn to a commercial supplier of rCF. The main reason for this is traceability. Matching polymer types to a given application becomes much more difficult when the supply is moved out-of-house.

Johan Meuzelaar, engineering stress specialist at GKN Fokker (Hoogeveen, Netherlands), thinks the answer is to try to find as many applications as you can within your own production environment. "If I look at the type of thermoplastic components we make from virgin material, there's a lot of parts in them which we could make recycled," he says. "[We could] certainly use up a significant amount of waste that we're generating."

"We already have the facilities," adds Guillaume Vincent, thermoplastic composites engineer at the TPRC. He explains that recycling internally fits within the normal process chains and that the majority of the equipment is already in place, making it the most affordable avenue. "[It] fits into activities we have in a normal production environment."

De Bruijn, Vincent and Meuzelaar are involved in the TPC-Cycle project, operated by TPAC and the TPRC. The project is aimed at the reuse of production scrap from thermoplastic composites processing for aerospace and high-volume »



From collection to finished product

The TPC-Cycle recycling route. Source | TPRC, TPAC

applications. The objective is to retain the high mechanical properties of thermoplastic composites and to reduce the overall environmental impact at an affordable cost. The TPC-Cycle boasts short cycle times and is said to enable the production of complex shapes.

Several industrial partners, including GKN Fokker, Toray Advanced Composites (Morgan Hill, Calif., U.S.; Nijverdal, Netherlands), Cato Composite Innovations (Rheden, Netherlands), Dutch Thermoplastic Components (Almere, Netherlands) and Nido RecyclingTechniek (Nijverdal, Netherlands), are involved in the TPC-Cycle project, representing different segments in the value chain from material, manufacturing, design and application.

According to de Bruijn, the TPC-Cycle project is now looking into completing cost analyses and life cycle analyses to prove that the process is economically beneficial.

In addition, programs such as the Clean Sky 2 Joint Undertaking (which is funded by the EU's Horizon 2020 programme) are

encouraging R&D that focuses on closing the loop for aerospace scrap. OEMs are looking to the potential of using recycled factory waste for interior parts, access panels, small components and airframe clips and system brackets.

Dr. Bas Veldman, GKN Fokker program manager for the lower half of a thermoplastic Multifunctional Fuselage Demonstrator, is fostering this concept by launching a call for proposals under the Clean Sky 2 program on clips and brackets. An important element in the development of the demonstrator is to reduce environmental impact through the use of factory waste for such products as frame clips and brackets. The demonstrator also aims to replace fasteners with welding, thereby saving materials, energy and cost while contributing to lightweighting.

According to Meuzelaar, GKN Fokker is investigating how recycling technology might be part of the company's fuselage of tomorrow concept. He says the concept will potentially use a lot of thermoplastic composites, which in turn could generate a lot of waste that could be used for recycled bracketry, fittings and nonstructural parts.

"The reason for looking at a thermoplastic fuselage is cost, and we think this is a cost economic production method, which also incorporates recycling," he says.

Meuzelaar says the goal at a high level is to make more affordable and more sustainable products in aerospace. While strides are being made toward series production in thermoplastics, this will also yield waste. But he believes that waste can be commercially viable and says that low-shear mixing/compression molding of recycled carbon fiber TPCs offers design freedom not afforded by traditional laminating with continuous fibers. "You get a lot of additional options to make very interesting non-structural parts like panels, small fairings or system brackets which usually in aerospace tend to be overdesigned in terms of materials used, alloys used [and] the production systems used," he explains.

He believes the opportunity lies mainly in nonstructural parts of medium size and medium complexity, which are still a significant part of the total cost of the larger components.

"We won't make wings out of recycled thermoplastic," says Meuzelaar. "But inside the wing, there are parts we can make that make economic sense."

All of that said, it's a bit far out to »

TPC-Cycle for rotorcraft

Demonstrator access panel for the Bell V-280 Valor tiltrotor aircraft developed using the TPC-Cycle process. Source | TPRC, TPAC, GKN Fokker

Combining rCF with wood

This construction grade cross-laminated timber (CLT) combines thermally modified lumber with recycled carbon fiber from the Composite Recycling Technology Center. Source | The Composite Recycling Technology Center

predict the impact thermoplastic composites will have on the recycling industry.

"Percentage of waste will decrease probably due to new production methods like tape placement or tailored blanks, which probably produce less waste than the current typical nesting and stamp forming processes that we see," de Bruijn says. "But in general I think there will be more thermoplastic waste in the coming years and decades."

And while this interest in recycling in-house is on the rise, there will always be some waste that is not usable and that fabricators will be unwilling or unable to recycle in-house. In such cases, those materials might be reclaimed by a material supplier. Time will tell what the increased use of thermoplastic composites might mean for the supply chain. (See Learn More.)

Additive manufacturing

Additive manufacturing is another area that holds potential for rCF. For example, Shocker Composites has compounded its recycled carbon fiber into 20-40% reinforced ABS filament and demonstrated its successful use with Cincinnati Inc.'s (Harrison, Ohio, U.S.) Big Area Additive Manufacturing (BAAM) 3D printing process.

In addition, Vartega says it is leveraging its carbon fiber recycling technology and material development expertise to advance polymer feedstocks for powder bed fusion additive manufacturing. The company was recently awarded a National Science Foundation (NSF, Alexandria, Va., U.S.) Small Business Innovation Research (SBIR) grant to conduct research and development in the area.

Vartega claims to also be developing a process that will allow thermoplastic powders to be reinforced with carbon fiber while ensuring the materials produce functional parts in infrared additive systems. This advancement reportedly will enable digital manufacturers to realize the full potential of new powder-based hardware platforms to produce parts that perform similarly to injection molded materials at medium-volume production rates.

Exterior applications

Panels from a 2019 installation of recycled carbon fiber panels bonded with wood veneer for the Octave 9 Raisbeck Music Center – Benaroya Hall (Seattle, Wash., U.S.). Source | The Composite Recycling Technology Center

"By offering carbon fiber-reinforced polymer powders, manufacturers in sectors like UAV [unmanned aerial vehicles] and medical prosthetics will realize the benefits of fast, complex and customized 3D printing, while ensuring that their material selection will exhibit the structural integrity required for their product," says Alice Havill, chief operating officer at Vartega.

Other applications

Meanwhile, other markets and applications in which recycled carbon fiber can play a role continue to emerge.

The Composite Recycling Technology Center (CRTC, Port Angels, Wash., U.S.) has been exploring use of recycled carbon fiber in a variety of products, from park benches to high-performance sporting goods to composite tubing. The company works with reclaimed uncured prepreg material from Toray Composite Materials America (Tacoma, Wash., U.S.) as well as rCF from ELG Carbon Fibre.

Dave Walter, CEO of the CRTC, points to the construction industry as an area of potential growth. The company recently developed a construction grade cross-laminated timber (CLT) under a patent-pending process that combines thermally modified lumber with recycled carbon fiber. The thermal modification process cooks off the sugars and lignin, providing rot and termite resistance, and then carbon fiber strips are integrated for strength.

The CRTC also uses recycled carbon fiber to create panels bonded with wood veneer. These panels showcase the beauty of wood with a strong, light and flexible substrate for various interior and exterior applications.

A mind change for the industry?

Big changes often happen incrementally, and the relatively young recycled carbon fiber industry continues to slowly push forward. While downcycling of rCF continues, perceptions about the material are beginning to change. Quality of fiber has been proven and processes continue to evolve. Awareness of the necessity to recycle carbon fiber is high and more players are getting involved.

"The ELG and Boeing announcement was a really big deal; it helps everyone move the ball forward [and] to accelerate the supply chain connections," says Maxey.

"We're here to enable and connect the dots," he adds, summing up the industry. "We have this enabling technology that sits in the middle of the supply chain, but its really about connecting that stranded asset in the waste stream to an unmet demand downstream."

The biggest change, according to Mark Mauhar of Carbon Conversions, is that suppliers now want to be part of the solution. "Prior to two years ago, we'd get multiple calls a week from suppliers about getting rid of scrap, but no interest in using the material," he says. "Now, people are starting to walk the walk. Only recently, we are finally starting to see potential customers of reclaimed carbon fiber spend significant resources in cutting molding tools, building prototypes and mock-ups, solving process issues — all activities that are well down the line in terms of commercial adoption."

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Perhaps what it really boils down to is patience. Detlef Drafz, CEO at ELG Carbon Fibre, points out that it's helpful to examine the recycling history for other legacy materials.

"For over 50 years, ELG has recycled raw materials for the stainless steel industry. With metal, it's accepted that you use the scrap even in vacuum furnaces for turbine blades ... it's accepted that recycled metal is a raw material, which properly processed can just be used. That wasn't common in the aerospace application 25 years ago; however, we established a supply chain in order to give the guarantees that the material performs. We do the same here," he says. CW

ABOUT THE AUTHOR

Scott Francis, senior editor for *CompositesWorld*, has worked in publishing and media since 2001. He's edited for numerous publications including *Writer's Digest*, *HOW* and *Popular Woodworking*.

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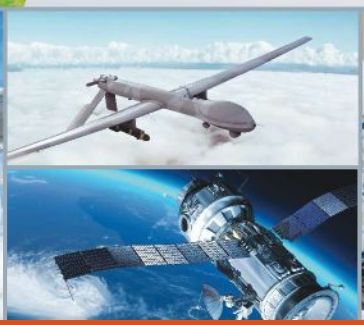

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Plant Tour: Veelo Technologies, Woodlawn, Ohio, U.S.

Advanced materials company evolves from nanomaterials to multifunctional composites and processing solutions.

By Ginger Gardiner / Senior Editor

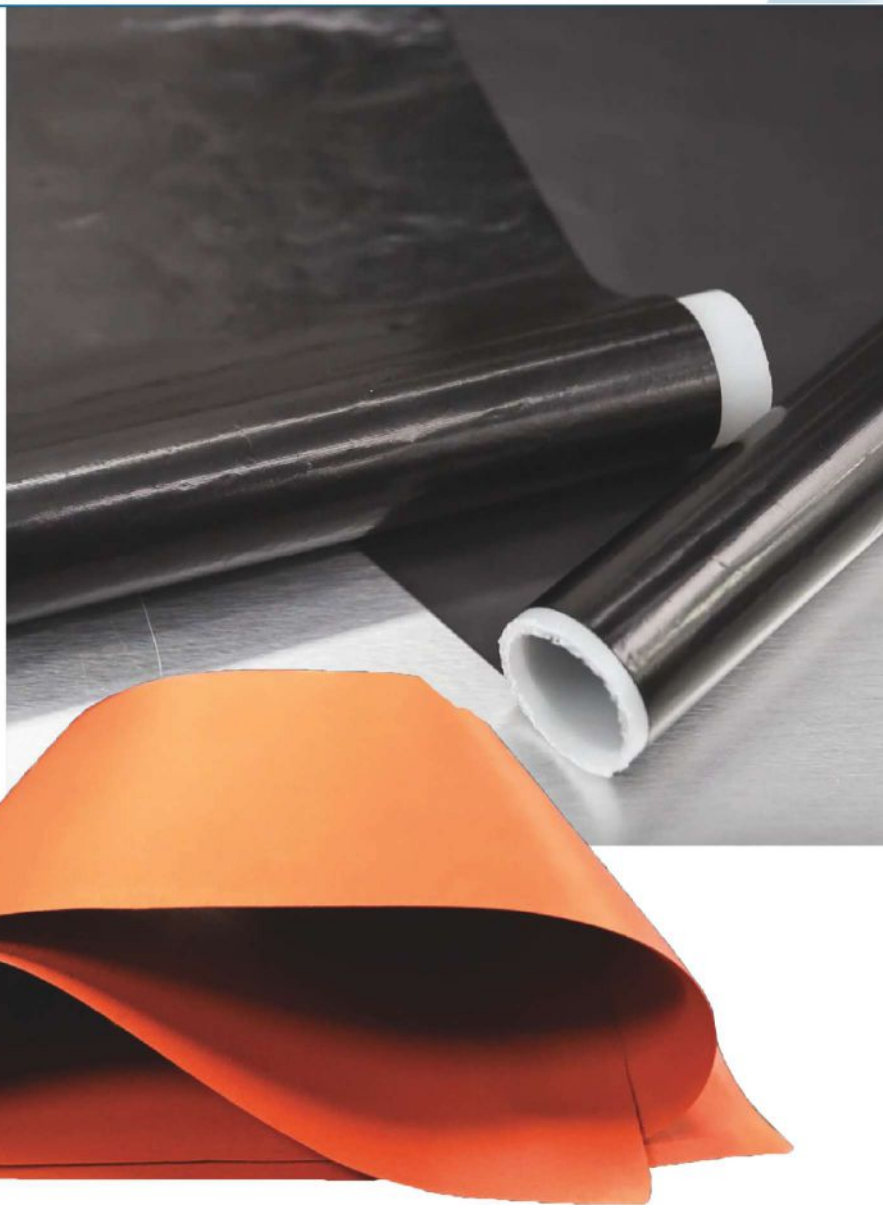
» What do you do when the carbon nanotube (CNT) fiber your company was trying to commercialize doesn't provide the performance needed by your potential customers, which include the U.S. Air Force and Boeing (Chicago, Ill., U.S.)? You pivot, go back to the drawing board, and use your advanced materials and composites processing expertise to develop other solutions. "We often use nanomaterials, but we are by no means a nanomaterials company," says Veelo Technologies CEO Joe Sprengard. "We are an advanced materials company focusing on electrically conductive materials and non-metallic heating solutions. The common thread between our initial focus on developing continuous CNT fibers and sheets and our current portfolio of products — lightning strike protection (LSP) and electromagnetic shielding, heating blankets for efficient composites processing and non-metallic electrothermal de-icing systems — is our ability to develop new materials which not only deliver new levels of performance, but also meet weight and cost requirements."

The company has scaled from four to 24 employees and moved into a new, 20,000-square-foot manufacturing facility in Woodlawn, a Cincinnati suburb located one mile from GE Aviation's headquarters in Evendale and an hour south of the Air Force Research Laboratory (AFRL) at Wright-Patterson Air Force Base in Dayton, Ohio. Sprengard leads *CW*'s tour through Veelo Technologies' new production site, walking through the company's evolution

New site for scaled-up production

Situated outside of Cincinnati, Veelo Technologies' new facility has provided the location and infrastructure needed to quickly ramp production for a large defense contract it won in late 2018.

Source, all images | Veelo Technologies



From nano to multifunctional composites and processing

Veelo Technologies began by developing continuous CNT fiber sheets (top) but has now evolved to use a range of materials in its products for lightning strike protection and nonmetallic heating blankets for composites processing and de-icing systems for aerostructures (middle and bottom).

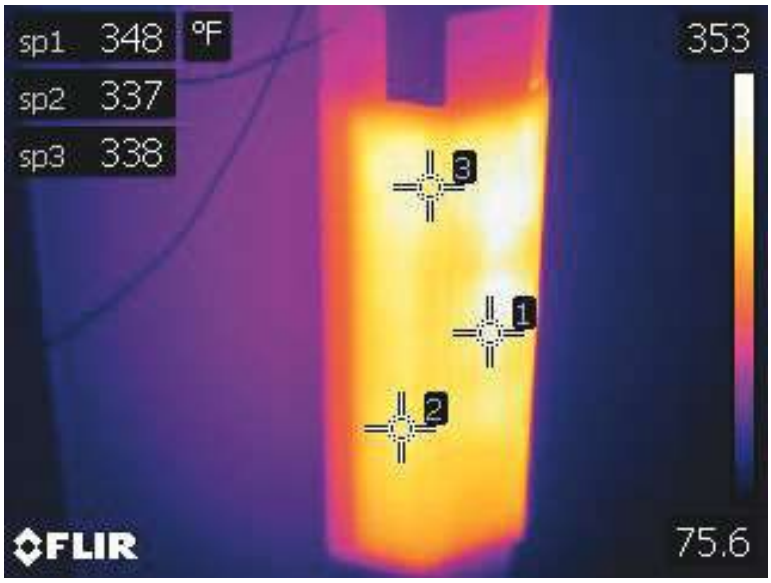
from nanomaterials supplier to advanced broad goods specialist to innovation partner for future composites.

CNT fibers and sheets

Veelo Technologies was originally spun out of the University of Cincinnati (UC) as General Nano. The university had produced the world's longest CNT arrays — 18 millimeters long — in 2007. "AFRL's Materials and Manufacturing Directorate took an interest and began a multi-year evaluation," explains Sprengard, who joined the company in 2009. "For the first three years, we were trying to figure out how to convert these long CNTs into high-strength, macro-scale fibers, which is what AFRL was interested in. But the properties never materialized."

So, the company pivoted, developing a way to convert the CNTs into a continuous sheet. Boeing became interested, eyeing the technology as a potential solution to its need for LSP and electromagnetic interference (EMI) shielding for its composite aircraft structures. "On average, commercial aircraft get hit by lightning every 1,000 hours," says Sprengard. Though carbon fiber is conductive, the matrix resins in composites are not. Thus, the carbon fiber-reinforced polymer (CFRP) aerostructures that Boeing was producing in record numbers for its 777 and 787 commercial aircraft relied on expanded metal foil and other metallic solutions to quickly conduct electrical current to a grounded connection in order to prevent heat damage. "But metal mesh is heavy, produces lots of parasitic weight and can be challenging to process in composite parts," says Veelo Technologies product development engineer Larry Christy.

By 2015, Boeing had an enterprise-wide push to develop a next-generation LSP solution, and General Nano was a key partner. *CW* visited General Nano soon after, in 2016, at its original location in a Cincinnati-based business »



Next-gen LSP for aerostructures

Commercial aircraft are hit by lightning, on average, every 1,000 hours. VeeloVEIL metallized carbon fiber nonwoven meets Zone 1A lightning strike protection (LSP) requirements for composite aircraft at 70% less weight vs. expanded copper foil. Engineered to be processed by automated fiber placement/tape laying (AFP/ATL) machines, VeeloVEIL delivers disruptive conductivity in a single 80-micron thick ply and reduces total LSP materials and processing time by more than 75%.

incubator facility that housed multiple start-ups. Christy led that tour of the company's labs and discussed the technology evolution then in progress. "The effectiveness of metallic LSP and shielding decreases with frequency," he explained. "You need to improve conductivity and reduce impedance but be less than 25 microns thick. However, CNT-to-CNT junctions add resistance within the sheet. From 2014 to 2016, we improved conductivity by 12 times and proved a drop-in solution for shielding at a frequency of 200 [megahertz] MHz with 25% weight savings versus metal. But we still need to reduce thickness."

At this point, the company had developed the ability to produce aligned CNTs on a 5-foot-wide substrate in lengths measuring hundreds of feet. It was also making 20-grams-per-square meter, 2-millimeter thick CNT paper and nonwoven materials — a kind of CNT continuous nonwoven — using a network of toll manufacturing partners with excess capacity on their paper-making equipment. "This approach gives us flexibility," Christy explained, "and allows us to focus on working with our customers to add functionality and to tailor the properties and format of our products." The company had also been asked to make continuous tapes, which it again made using its toll network.

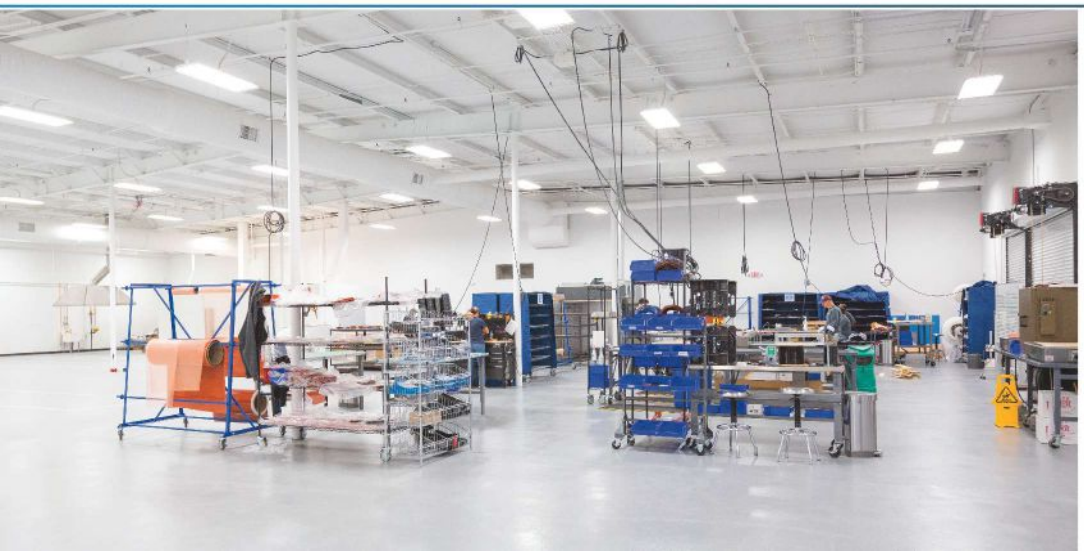
Pivot to high-performance broad goods

This tailorability and willingness to modify its products based on customer requirements was key, as roughly a decade into its existence, the company understood that its future might look much different from its past. Christy explained there were multiple needs, not just for LSP but also for EMI shielding. "You have to tailor the electrical performance for each. The properties of metal mesh are frequency-dependent and go down as frequency increases because of leakage from the holes in the sheet. Our performance goes up with frequency because our products are continuous with no holes and no leakage. CNTs outperform metals at high frequencies, so they are great for high-intensity radio frequency (HIRF) and high-power satellite communications applications. CNTs also have no skin effect, which is an issue with metals." Skin effect is the tendency for alternating current to avoid travel through the center of a conductor, limited instead to its surface or skin, which effectively reduces the cross-sectional area available for carrying current and increases resistance. Christy continues, "But CNTs can't compete at low frequencies. Their conductivity is just not high enough and there is too much signal loss. So, we are looking at hybrids."

"This led to other sheet materials that are not based on nanomaterials," says Sprengard. "We have developed VeeloVEIL, a metallized carbon fiber solution for LSP that is 70% lighter than expanded copper foil (ECF) and meets Zone 1A lightning strike protection requirements." Zone 1A includes the radome/nose, wingtips, nacelles and extremities of an aircraft's empennage and must withstand 200,000 amps of electrical current, as defined by U.S Federal Aviation Administration (FAA) requirements. "VeeloVEIL is four times more conductive and yet half the weight versus other metallized nonwovens," he continues. "This is possible due to the chemistry and materials processing we have developed."

The aerospace industry doesn't currently use carbon fiber veil for LSP, says Sprengard, "because there are no products conductive enough to meet Zone 1A requirements." VeeloVEIL has been engineered to deliver 5-10 milliohms of electrical resistivity (lower resistivity means a more conductive material) at an areal weight of 40-50 grams per square meter, and meets aircraft LSP requirements using a single, 80-micron thick ply. "This makes the material very drapeable, which results in a smooth surface finish without the porosity-filling post-processing often required with ECF products," he notes. "This, in turn, allows manufacturers to use less surfacing resin, which saves material and manufacturing costs. We've been told by the top three aerostructures OEMs that VeeloVEIL allows them to reduce total LSP materials and processing time from more than twenty hours to less than three hours."

VeeloVEIL is supplied in the same product form as ECF, which allows manufacturers to use it without changing their existing



Relocating and ramping production

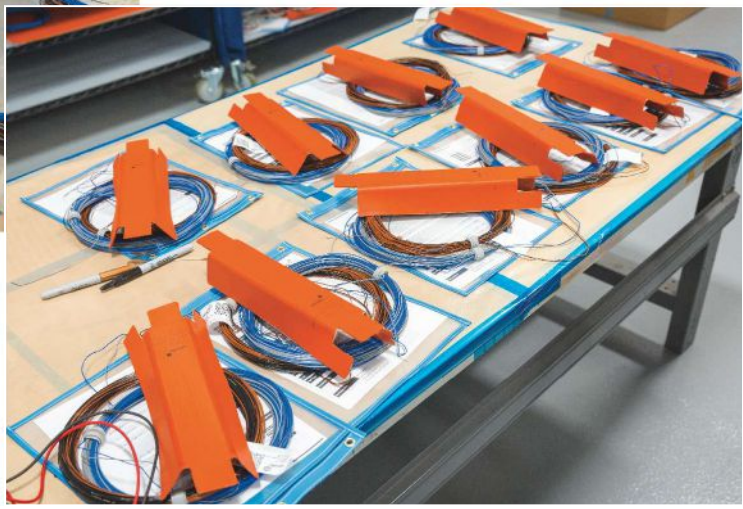
Veelo Technologies' new 20,000-square-foot production hall offers plenty of space to scale up VeeloHEAT Blanket production, which was relocated and ramped to full speed in phase one of the manufacturing transition. Phase two will be completed by 3Q 2019.

manufacturing processes. "All of our electrically conductive materials for aerospace composites are engineered to be processed by [automated fiber placement] AFP machines," says Sprengard. Veelo Technologies is also in the process of integrating VeeloVEIL into a standard surface layer product, working with Tier 1 aerospace prepreggers.

Tailoring conductivity for heating

During development of VeeloVEIL, Sprengard's team realized that the ability to tailor electrical conductivity of its broad goods could also be used for electrothermal heating applications. This opened the door to another of its product families, VeeloHEAT.

"VeeloHEAT is a carbon-based, nonmetallic material that is integrated into aerostructures for de-icing," says Sprengard. Note this is *not* carbon fiber. "Today, aircraft de-icing systems often use metallic wires, which have issues with durability, especially in high-fatigue environments such as rotorcraft. If one of the wires breaks, the system no longer performs. These conventional metal »



More durable and conformable, non-metallic heat blankets

Although wires are used to heat metal tooling in the production of VeeloHEAT Blankets (above) and to deliver electrical current from computerized control units (hot bonders) to the blankets during composite curing and repair, metal wires are not used inside. This enables these non-metallic heat blankets to be produced in 3D shapes without broken wires, shorting and issues in temperature uniformity (hot and cold spots). The carbon-based VeeloHEAT film inside produces temperatures up to 550°F (288°C) with 3% COV at 5 W/in^2.

de-icing systems commonly fail, and must be repaired, which is time- and cost-intensive. We have demonstrated that our products are much more durable, which dramatically decreases downtime for the aircraft." He notes that these products are indeed being used on rotor blades for helicopters and have significant potential for EVTOL (electric vehicle takeoff and landing) aircraft that are currently being developed for urban air mobility and the next generation of transportation.

More near-term, Sprengard says VeeloHEAT products are scheduled to fly on a fixed-wing commercial aircraft in Q1 2020 for early-stage qualification. "The appeal of this technology is no secret," he says, noting that Collins Aerospace (formerly UTC, which will now be part of Raytheon) announced an exclusive license for CNT-based de-icing systems in January 2017. "They know the market well and are positioning themselves for the future. Their investment is a good indication of where this technology is headed," Sprengard adds.

From de-icing to composite processing and repair

Conventional heat blankets have been used for decades to cure relatively small areas — typically less than 1 square meter — of composite structures during bonded scarf repairs. These heat blankets use traditional metal wires embedded in silicone rubber or other materials (depending on the cure temperature required). "Similar to the metal-based de-icing systems, if one wire breaks, heat blankets short and no longer work," says Sprengard. "We have leveraged our carbon-based de-icing product into a nonmetallic heating blanket that has unmatched durability and drapeability, as well as performance." The industry standard for the latter is 3% coefficient of variance (COV), which is a measure of uniformity in heating products, cover-to-cover and edge-to-edge. The VeeloHEAT Blanket exceeds this standard at the typical energy output of 5 watts per square inch.

Veelo's heat blankets can produce temperatures up to 550°F (288°C) and can be net shaped to fit parts and tools. "This capability is possible because of our ability to formulate chemistries and manufacture unique advanced materials with tailored resistivities," notes Sprengard. Veelo Technologies commercialized this technology in 15 months and is now in full production. "We are seeing very good growth in this product line," he adds, "and are now manufacturing large volumes of VeeloHeat Blankets that are used to bond large composite structures out of the autoclave *and* oven, making use of multiple temperature zones and other processing features that our customers have requested."

Manufacturing to meet customer needs

In October 2018, Veelo Technologies received confirmation that it had won a major defense program that required immediate ramp-up. "Thankfully we found a near perfect, move-in ready facility that was already equipped with the infrastructure we needed to hit the ground running," Sprengard recalls. The Woodlawn facility features state-of-the-art environmental control, lighting and wall-to-wall epoxy flooring — features Sprengard notes as standard in aerospace from his tours of customer's operations. "We took no shortcuts — our investment in the highest quality materials and finishes reflects our long-term strategy and vision for the future," he explains. This investment is also seen in the facility's access control and security staffing, necessary for its defense contracts.

The required build-out of the facility was completed in 2Q 2019,

A growing team

Veelo Technologies has scaled from four to 24 employees and evolved from a nanomaterials supplier to advanced broad goods specialist to innovation partner for future composites, recognized by Boeing as Supplier of the Year in 2015.

after which Veelo began relocation of its production lines. "All of our equipment is running at nearly full capacity, which has made scheduling shut-down for moving all of the lines into the new facility a challenge," he concedes. The company completed phase one of its manufacturing transition in July 2019, relocating the VeeloHEAT Blanket line and ramping it back to full production.

The new facility's large, open production hall is accessed from the front lobby. To the right is the VeeloHEAT Blanket manufacturing area. Four 4-foot by 10-foot layup tables are used to layer VeeloHEAT film with other materials onto shaped metal molding tools. These layups are then cured in a 10-by-10-foot oven supplied by JPW Industrial Furnaces (Trout Run, Pa., U.S.). The finished blankets are demolded and connected to electrical supply wires, which enable use with computerized control units (hot bonders) to cure composite laminates and repairs. Each VeeloHEAT Blanket is tested for temperature output and uniformity.

Just beyond the heat blanket production area is the wet chemistry production room. Here, industrial equipment sourced from Silverson Machine (East Longmeadow, Mass., U.S.) and Netzsch (Burlington, Mass., U.S.) is used to mix the advanced chemical formulations used in Veelo's products. Next is the film manufacturing room, which houses a proprietary system for manufacturing Veelo's carbon-based VeeloHEAT film, the key technology inside the VeeloHEAT Blanket. Again moving left is the VeeloVEIL production area. Though empty at the time of this tour, both the 15-inch and 36-inch-wide roll-to-roll manufacturing lines for VeeloVEIL production were moved into the new facility in August. The company is also in the process of designing a 60-inch-wide line to meet future demand. By October, Veelo Technologies will have all of its product lines operating under one roof and ramping toward increased production.

Next-generation solutions

The road to Veelo Technologies' current success has been long, and not always straightforward. "Yes, we started in nanomaterials, and we still maintain a significant expertise in this domain, but none of our customers care if we use nanomaterials or not," says Sprengard. "They only care if we supply a compelling solution that meets their performance and ROI targets. For example, products that enable the next generation of de-icing systems to use less power on the aircraft, which opens new opportunities for air vehicle designs and operational efficiencies."

Sprengard says all three Veelo product families are moving forward, either being finalized into OEM and supplier qualified products lists (QPLs) "or being added as a part number in our customer's supply base." Though the vast majority of what the company does now is for thermoset composites, he notes it is beginning to look at thermoplastic composites and additive manufacturing as well.

Where is Veelo Technologies focused for the future? "Our first priority is to continue delivering on our existing orders and strategic opportunities," says Sprengard. "The market is pushing us to meet new levels of demand, which is great and challenging. Remaining focused is our top priority."

The goals Veelo has set for itself now are just as impressive as its tenacity and forbearance through 12 years of development to reach this point. "If you look at the best aerospace composite suppliers, such as Airtech and A&P Technologies," says Sprengard, "they have a seat at the table early in their customers' development cycles. To be such an innovation partner takes time." He adds, "and commitment." CW

ABOUT THE AUTHOR

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A digital approach to automation

One aerostructures manufacturer's journey from hand layup to AFP.

Source, all images | MRAS

Middle River Aerostructure Systems (MRAS; Baltimore, Md., U.S.), manufacturer of composite aerostructures for commercial and military use, decided several years ago that it wanted to improve its bottom line by automating its manufacturing process. The problem was, where to start? MRAS, which produces mostly nacelles and thrust reversers at its 1 million-square-foot Baltimore facility, was using mostly hand layup. However, the company knew that the next step was to invest in automation, which it hoped would eliminate the variability that comes with hand layup and reduce labor costs at the same time.

With the help of CGTech (Irvine, Calif., U.S.) and Electroimpact (Mukilteo, Wash., U.S.), MRAS began the process of analyzing a variety of available parts that could be redesigned using automation. The companies digitally modeled and simulated the manufacture of each of the candidate parts, enabling a thorough understanding of the cost versus savings. Mitchell Smith, composite process and technology leader at MRAS, notes that this was especially important given the small, relatively lightweight components that MRAS manufactures.

After several iterations, MRAS selected a group of parts to convert within the Airbus A320neo structures it was building. "The high volume and rate of the neo program enabled the cost versus savings equation to work out in favor of [automated fiber placement] AFP. We just had to stay within our [capital expenditure] cap ex targets," explains Smith.

However, budget limitations meant that no new tooling could be purchased, and that only minimal floor space was available. This became the most complex part of the project, since MRAS was already in production using female tooling, while most AFP parts are made with male tooling that does not restrict the use of the large end effectors required to support the automated machinery. The geometry of male tooling is also favorable for material pay-out, which is controlled with tow tension.

"That was actually the biggest constraint," Smith says. "We'd invested millions of dollars in female tooling and we were not going to purchase new tools — looking back, it presented a level of complexity that's hard to appreciate. Male tooling would have made the machine easier to build and the processes easier to develop, but it also forced us to make big technology advancements quickly. In hindsight, that was a good thing, even if it didn't seem that way at the time."

"The bottom line was that we needed to be able to produce a high volume of relatively low-weight product at a high rate with a compact cell and a complicated tool string," Smith notes.

Concurrently with the part selection process, MRAS also began evaluating various AFP machine builders. "We received a variety of machine proposals, and each had their pros and cons, but none matched up to the business case we needed to support," says Smith. "In order to meet the business case, MRAS needed a high-speed AFP machine that supported a rapid tool change out and required minimal staff to run."

Ideally, this machine would also — in theory — operate nonstop, with almost no downtime, to produce the more than 240 components that MRAS manufactures each month. "And even though they didn't have one at the time, Electroimpact was the only company willing to work with us on building one," Smith says.

Electroimpact's roster of AFP and automated tape layup (ATL) machines rely on programming and simulation software from CGTech. After selecting the machine maker, MRAS spent the next year working with Electroimpact and CGTech to program and validate each component — multiple times, in some cases. As suspected, the U-shaped female tooling proved to be a tight fit for the AFP head, making accurate simulation critical to crash avoidance. Numerous trial components were made at Electroimpact, even before the machine was completely fabricated.

Toward the end of 2018, initial production began, and by the end of January 2019, MRAS was using its new automated process to manufacture nacelle components. Current production is reported to be at or above the planned business case, with significant reductions in labor costs and higher throughput.

Plus, MRAS emphasizes that it did not reduce its workforce by switching to automation. In fact, Smith says the opposite happened: "By bringing this new technology to the business, we have been able to capture new business and have installed additional AFP machines. We have had to hire additional people to handle the growth." He concludes: "It was definitely the right move for us." CW

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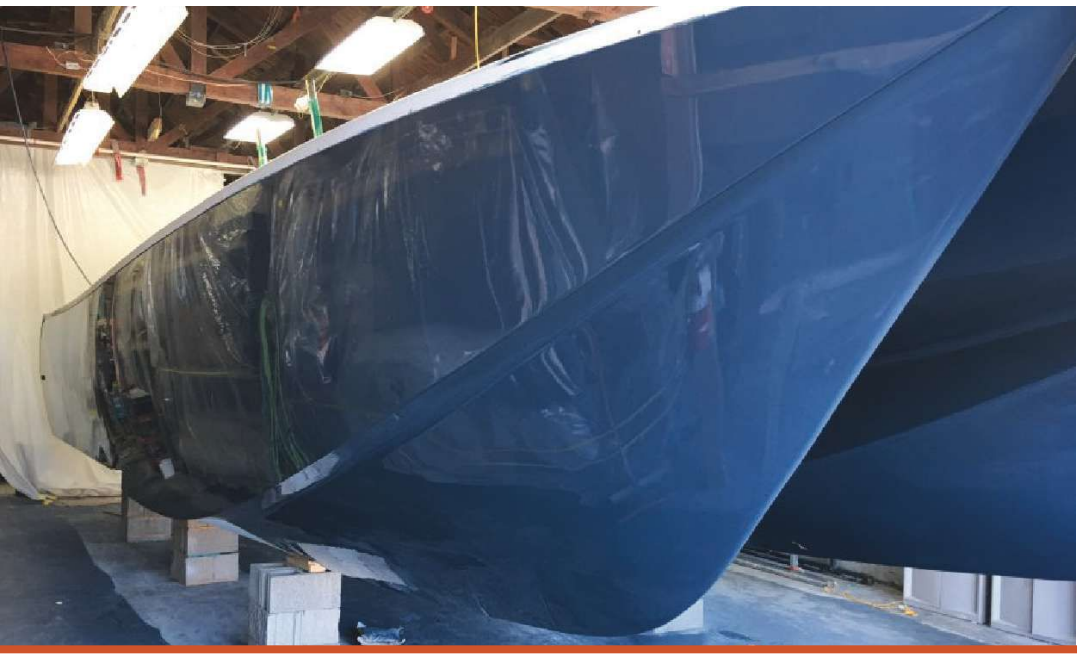
Composite catamaran hits high watermarks

Inspired by design elements found in racing catamarans and employing composite structures in innovative ways, Compmillennia has rolled out a fishing/excursion cat that uniquely combines high speed, great fuel economy and a smooth ride.

By Karen Mason / Contributing Writer



Composite double hull

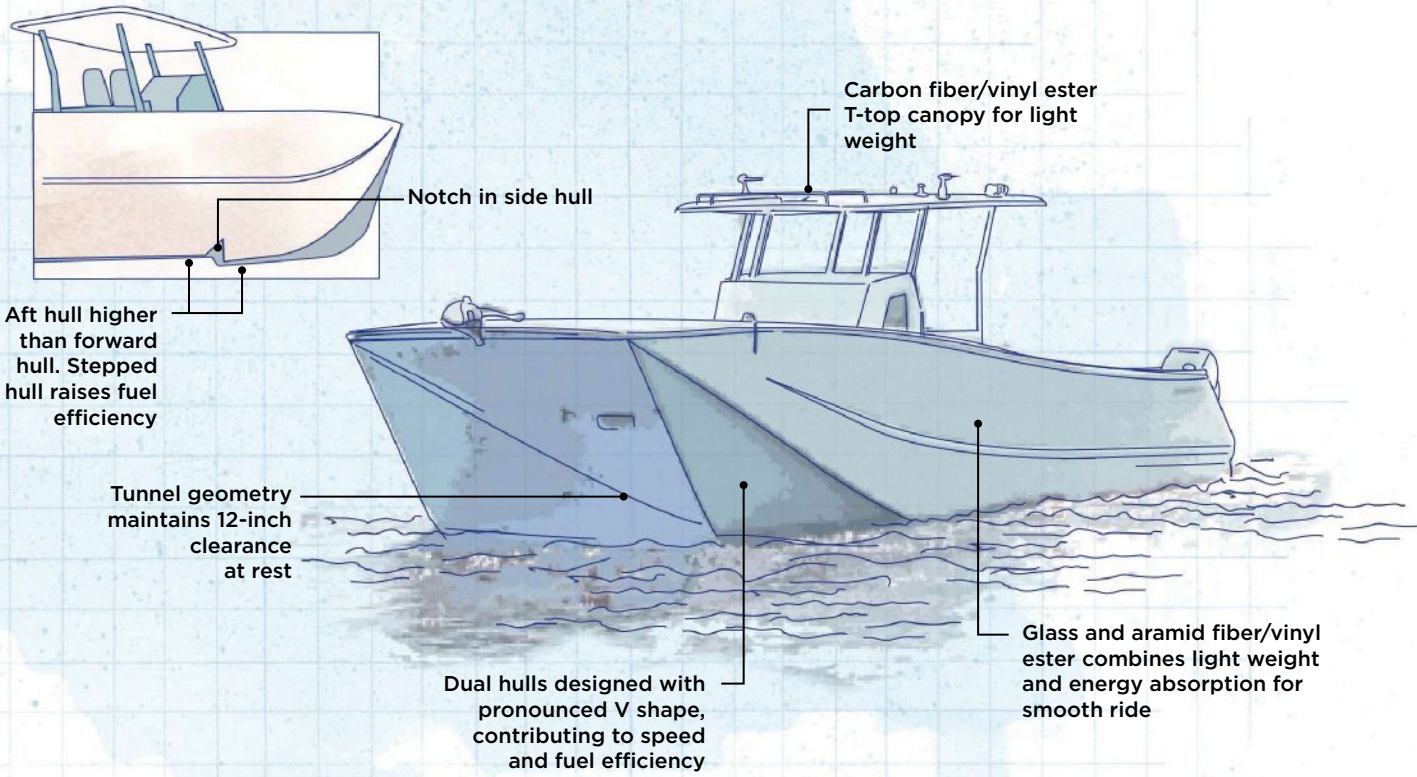
The optimized material choices and design of Compmillennia's 39-foot catamaran fishing boat result in a weight decrease of more than 30% compared to conventional designs, contributing to a dramatic increase in fuel economy. Source | Compmillennia

» "Speed with fuel economy and 'ride' are most valued," sums up Jim Gardiner, general manager of Compmillennia (Washington, N.C., U.S.), about some of his offshore boating customers' desires. When most boat designers discuss these three characteristics, it is in the context of tradeoffs and compromises — sacrificing fuel economy for speed, for example, or speed for ride comfort. So when Gardiner set out to achieve high speeds, great fuel efficiency and an outstanding ride experience, all in one boat, he knew that creative innovation would be mandatory. Composites technology proved essential to Gardiner's success.

The result is the Compmillennia *LIGHTSPEED* Model 1188 catamaran, a 39-foot center console designed for offshore fishing parties of six or eight anglers, or excursions with up to 16 family members and friends. The boat's unusually wide beam — 12 feet for the first in the series and now up to 14 feet — provides excellent stability as well as plenty of room for people and gear. With just two 300-horsepower engines, the double-hulled 1188 offers a top speed of more than 60 miles per hour, nearly matching the top speed of large V-bottom center console boats equipped with triple or quad 300-horsepower engines. "Larger V-bottoms need a lot of engine horsepower to push their length through the water," Gardiner notes, "and more horsepower equals more weight, more cost, larger vehicles to tow and more fuel."

Fast, efficient and comfortable

To achieve the trifecta of speed, efficiency and comfort, Gardiner began his design of the *LIGHTSPEED* 1188 from "a clean sheet of paper," he says, which enabled him to avoid the constraints of "a pure production mentality and fixed tooling." He noticed that in production catamarans, for example, the cockpit is often a separate "tub" with deck sole and hull side liner, a design Gardiner labels "a cup-in-a-bowl structure." To lighten the 1188's structure, Gardiner made the cockpit a more integral component of the vessel, borrowing design elements from large ocean-sailing racing catamarans. The hulls in these racing cats are joined by two transverse beams, with a "deck" created simply by stretching



DESIGN RESULTS Composite high-speed catamaran

- 50% better fuel economy than conventional boats of similar size and speed.
- Achieves nearly the same top speed with two engines as other cats with four engines.
- Comfortable ride arises from long waterline, fine entry, narrow hulls and optimized tunnel width.

Karl Reque / Illustration

high-strength netting material from hull to hull. Gardiner says he replicated the non-racing aspects of this structure "by using the aft and forward bulkheads as the primary transverse structure, allowing the composite deck between to be quite light."

Besides the elimination of redundant structural components found in traditional cockpit designs, light weight is especially evident in the design of the 1188's 8-by-12-foot overhead T-top canopy. This element may carry only electronics and lighting, but it is designed with the structural fortitude needed to provide an upper deck for an optional second steering station. "On other large center console fishing catamarans of this type, that part may weigh as much as 1,000 pounds including support by a substantial welded aluminum pipe frame bolted to the boat," Gardiner explains. The *LIGHTSPEED* 1188, on the other hand, uses an optimized carbon fiber laminate and weighs less than 200 pounds and is bonded not bolted.

With weight being so central to the *LIGHTSPEED* 1188's design, Gardiner made it the fixed point toward which he tailored the other design elements. That is, he calculated what the boat would weigh based on its structural elements and outfitting, then factored this weight in as he optimized other parameters of the design. For example, Gardiner designed the geometry of the tunnel between the two hulls only after the boat's weight was established — not a simple task, given his goal of preventing water slapping by providing a minimum 12-inch clearance above the surface of the sea at the transom at rest.

At 8,500 pounds (compared to 13,000 pounds for conventional designs), the *LIGHTSPEED* 1188's light weight helps decrease water displacement, which improves fuel economy. Gardiner notes that fuel economy is roughly proportional to the boat's gross weight. But weight is only one factor in fuel consumption; also essential to the 1188's fuel efficiency is its single-step hull design. In the stepped hull, a structural "notch" is positioned high enough on the either side of the hull to reach above the water line when the boat is cruising. Aft of the notch, the bottom of the hull is slightly higher than it is forward of the notch. The step creates »

Catamaran clearance

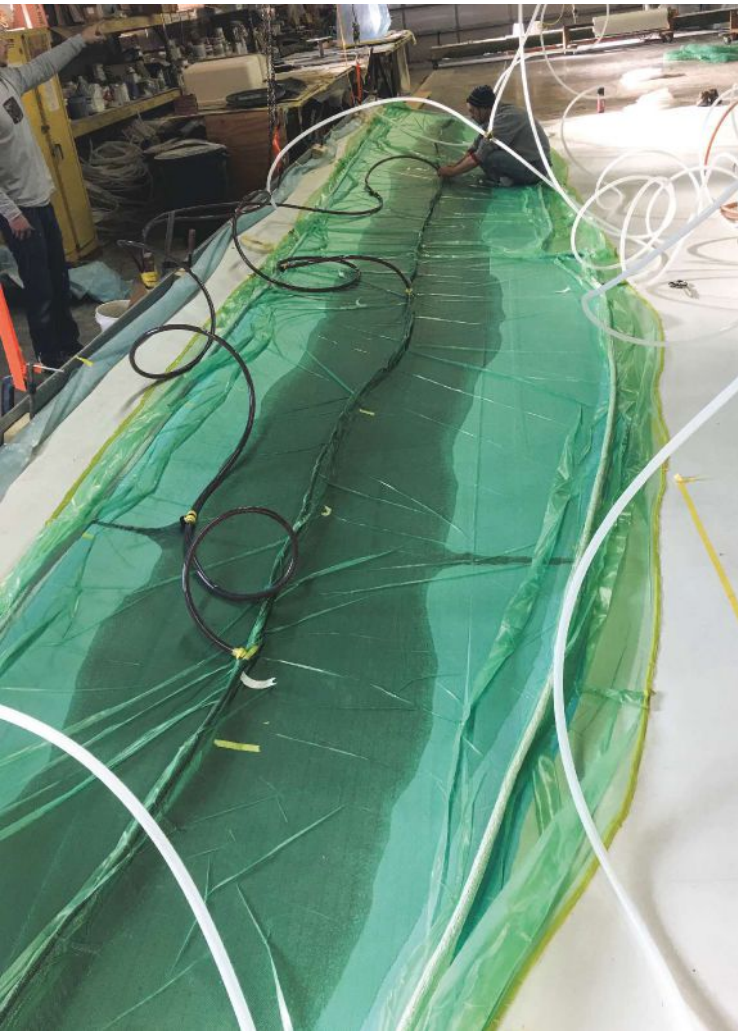
The *LIGHTSPEED* 1188's tunnel design ensures plenty of clearance at rest. Its geometry was optimized only after the boat's weight was determined.

Source | Compmillennia

Modified for quad engines

A recent *LIGHTSPEED* 1188 features a 14-foot beam and hulls wide enough to accommodate two engines each. This model has reached a top speed of 95 mph.

Photo | Todd Liebel



Resin infusion fabrication

Most of the LIGHTSPEED 1188's components are fabricated using hand layup of dry reinforcement followed by resin infusion. Source | Compmillennia

a low-pressure area that sucks air under the boat through the side notches. With more of the hull lifted out of the water, the boat experiences less drag and greater efficiency — as much as 15% greater, according to boats.com.The final result of Compmillennia's efforts to maximize fuel economy? The *LIGHTSPEED* 1188's cruising fuel consumption of 1.5 miles per gallon represents a 50% gain over the 1 mile per gallon typical of other similarly sized fishing boats able to achieve similar top speeds.

As advantageous as a stepped hull is, it adds significantly to the complexity of the hull design — but nothing Gardiner hadn't dealt with before. His decades-long career as a boat designer and builder made the design work less about computer analysis and more about experience-based design decisions. Illustrating this experience, Gardiner recalls, "For 13 years I built a line of lightweight 18-foot fishing skiffs, one per week. This allowed weekly opportunities to experiment with materials and lamination schedules. It was 'seat of the pants' testing; each week, I would take a different employee on each sea trial. Regardless that each boat was built from the same molds, I learned to identify the resin, reinforcing materials and core used in a completed boat just from the ride."

Describing the *LIGHTSPEED* 1188's design process, Gardiner continues, "The design was drafted with pencil and paper, ducks, splines and ship's curves. Buoyancy calculations were performed and a weights-and-moments study performed. From this, modifications were made to the design so that the center of gravity was in the right location and the design 'looked right.'" Only after Compmillennia had built the boat's mold was the design entered into Autodesk (San Rafael, Calif., U.S.) AutoCAD "to memorialize the 'as-built' and make a baseline to further production planning and modifications," he says.

Gardiner believes that a single stepped hull is more efficient than the multiple step hulls more generally seen. Gardiner also addressed trim (running angle), stability and comfort with several design elements. The fuel tank is located at the boat's center of gravity so that the boat's trim does not change as the 425 gallons of fuel capacity is burned off. This also helps with fuel efficiency. The hull laminate, a foam sandwich design using glass- and

Fisherman's dream

The *LIGHTSPEED* 1188 catamaran has attracted boaters looking for speed and fuel economy along with a comfortable ride for their offshore fishing excursions.

Photo | Todd Liebel

Judicious carbon reinforcement

With most of the boat's structure taking advantage of the energy absorption offered by glass- and aramid fiber-reinforced composites, the Compmillennia cat incorporates carbon fiber reinforcement where added stiffness and strength is desired. Shown here is the boat's cockpit sole. Source | Compmillennia

aramid-reinforced vinyl ester, contributes to ride comfort with its ability to absorb energy. In general, the 1188 employs carbon fiber composites for their stiffness and light weight in the canopy and along load paths such as the forward and aft bulkheads, with glass and aramid fiber composites used everywhere else. Like many composite laminate designs, the 1188's design is weight-optimized both because of composite materials' high strength-to-weight ratio and because of their tailorability. The design keeps the laminate thin where it can — typically one or two plies of biaxial, triaxial or quadraxial nonwoven fabrics and some unidirectionals — and incorporates more laminate in areas needing protection against impact damage from debris in the water or docking, and to strengthen resting points when the boat is berthed on a lift.

Advanced composite fabrication

Gardiner's first task in bringing his design to fruition was building cost-efficient molds. Production tooling for 40-foot center console catamarans can cost about $1 million. "As a small composite fabricator introducing a new design to the market," he says, "that would have been an enormous investment." Gardiner chose a different option. "I believed it would be a cost benefit for us to build a plywood hull mold covered with high-pressure laminate as a mold finish," he says. By the end of 2019, Compmillennia will begin building its ninth 1188 hull on these molds, so they have paid for themselves several times over. The company made the rest of the boat's composite components — cockpit sole, decks, console — on its 20- by 80-foot flat vacuum mold, which produces panel surfaces with a near production-quality gel coat finish.

A combination of hand layup and resin infusion are used to construct the *LIGHTSPEED* 1188. The primary glass reinforcement is Vectorply (Phenix City, Ala., U.S.) E-LT 3200 0/90 stitched biaxial fabric, chosen, Gardiner admits, because Compmillennia had a substantial inventory of it from a previous project. For small parts and bonding tapes, the project uses Vectorply E-BXM 1708 and 2408 45/-45 double-bias stitched fabric. The aramid reinforcement also comes from Vectorply, KDB 1308 45/-45 double-bias stitched fabric. Carbon fiber-reinforced components use a range of Zoltek (Bridgeton, Mo., U.S.) unidirectional, woven and 45/-45 stitched products.

For the matrix, Gardiner chose Interplastic Corp. (St. Paul, Minn., U.S.) CORVE8175-60 resin, a high-elongation infusion vinyl ester. Compatibility of vinyl esters with gel coat was a deciding factor. This specific vinyl ester provides good cosmetics with fabric reinforcements, good adhesion to a variety of fiber types, and elongation sufficient to ensure that loads are carried by the reinforcement, not the matrix. Wetting out the fiber is accomplished using equipment from Magnum Venus Products (Knoxville, Tenn., U.S.) and an impregnator from Gougeon Brothers (Bay City, Mich., U.S.).

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Sandwich panels are constructed using several weights of Diab (Laholm, Sweden) Divinycell H or HM foam core. "Higher densities are used in high-load areas such as the keel area and transom that the engines mount to," Gardiner reports.

Progressive design

Compmillennia recently completed the seventh boat in the LIGHTSPEED 1188 series. Design and build aspects have progressed with each new boat in the series, Gardiner reports. Structural modifications have included increased deadrise forward, optimized transom angle, and chine and strake detailing. Wider renditions and a faster quad engine version have also been developed. As the design is tailored to each new customer, keeping the fore and aft center of gravity within a small window (plus or minus 2.5%) is tantamount, both for trim and for ride comfort. CW

ABOUT THE AUTHOR

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