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CFRP Maserati MC20 roof:

BACM DERIVATIVE DEMONSTRATES AUTOCOMPOSITE SCALABILITY

NOVEMBER 2024

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See p. 36. Source | Maserati

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Changing future outcomes with the materials of the future

SCOTT FRANCIS
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The first few weeks of this past October were a lot to take in. While preparing this issue of *CW*, my hometown in western North Carolina was devastated by Hurricane Helene. Watching the true measure of Helene's destruction in places where I spent much of my youth has brought the topic of climate change that much closer to home for me and I imagine for many of you who may also be from or living in that area.

With the aftermath of Helene as a backdrop, I set out to attend two composites industry events — the National Institute for Aviation Research's (NIAR) ATLAS Composites and Innovation Summit at Wichita State University in Kansas, and *CW*'s own Carbon Fiber conference in Charleston, South Carolina.

NIAR's innovation summit provided a good distraction from the constant feed of images from Helene, offering an inspiring look at the ATLAS center's latest composites innovation capabilities, as well as several newly added facilities since *CW* last toured in 2022. A keynote by Linden S. Blue, vice chairman of General Dynamics, whose career in aviation includes Beech Aircraft, Raytheon Co. and Learjet Corp., offered a reminder of the important work that our industry is involved in from playing a key role in the defense sector to enabling new strides toward renewable energy.

Myriam Yagoubi discusses carbon fiber supply and demand at Carbon Fiber (below) and Linden S. Blue is recognized with an award at NIAR's innovation summit (right). Source (All Images) | *CW*

I left Wichita inspired and made my way to South Carolina for Carbon Fiber 2024, constantly checking updates from Hurricane Milton, which was making its way toward Florida. Networking with conference attendees, I listened to stories of their own experiences through these storms, from stories of travel plans that were affected, to concerns for family and friends, to damage to their homes or businesses. A group of Carbon Fiber attendees even discussed with me about the idea to fabricate lightweight composite bridges for deployment in affected communities.

When natural disasters of this magnitude strike, it is easy to feel helpless. No amount of outreach or donation seem like enough when people have lost their homes, their livelihoods or their very lives. But when I see colleagues in the industry looking to their work and areas of expertise for answers, I become truly inspired.

Many of the themes of this year's conference — and so much of the work being done in the composites industry — revolved around sustainability and the quest for more environmentally friendly solutions for everything from transportation and energy to infrastructure. During the pre-conference seminar, Myriam Yagoubi of Future Materials Group (FMG) spoke about the growth the composites industry can anticipate in the next two decades, with wind and pressure vessels comprising the largest areas of projected growth, making up 51% and 20% of future carbon fiber use, respectively. Additional sessions delved into the topics of wind energy, life cycle assessment of carbon fiber, renewable energy storage solutions and the reclaim and reuse of carbon fiber at the end of product life.

Natural disasters like Helene are reminders that the actions we take as a society have an effect on the world around us — climate change is a reality we have to contend with. In looking to the future of manufacturing, we must continue to explore sustainable technologies and processes that improve efficiencies, reduce waste and lower carbon emissions. We must continue to innovate and work to find new material solutions that can enable advances in transportation, renewable energy and infrastructure. The materials used to rebuild the buildings and bridges that were damaged or destroyed should be considered for their ability to withstand future weather events.

The problems in front of us are existential in nature, and there is a real opportunity to make a difference. Near the end of his keynote address in Wichita, Linden S. Blue broke into a verse of "God Bless America." He had been speaking of hope in the face of war, political unrest and climate change — and then he decided to lead a room full of scientists, engineers and composites industry professionals in song. It was a poignant reminder that the call to meet the challenges head on is a charge for all of us. CW

An outlook on China's carbon fiber market

By Grace Nehls / Senior Managing Editor, *CompositesWorld*, based on the report **by Lin Gang** / General Manager, ATA CFT Guangzhou Co. Ltd.

As of 2023, China is the second largest carbon fiber composites market in the world (with the U.S. still claiming the top spot). This is explained by Lin Gang, general manager of ATA CFT Guangzhou Co. Ltd. (Guangzhou, China), in his recently published global carbon fiber report. Based on his collected data, China consumes approximately 69,000 metric tons (MT) of the world's total 115,000 MT carbon fiber demand and represents 28% of global carbon fiber-reinforced polymer (CFRP) revenue, with Europe, Japan and other countries close behind. Many factors are affecting China's current market position — capacity, price reductions caused by ongoing supply chain challenges, market specialization and more — which are discussed in greater detail below.

As *CW* seeks to form a holistic view of the state of the global carbon fiber market, better understanding the statistics, trends and observations surrounding carbon fiber in China is becoming increasingly necessary. The 70-page report developed by Lin, which studies the carbon fiber market primarily between 2022-2023, sought to open this discourse (see Learn More). *CW* provides a brief overview here of the key discussions, points and conclusions drawn by Lin's research, with commentary from additional sources to provide context and perspective.

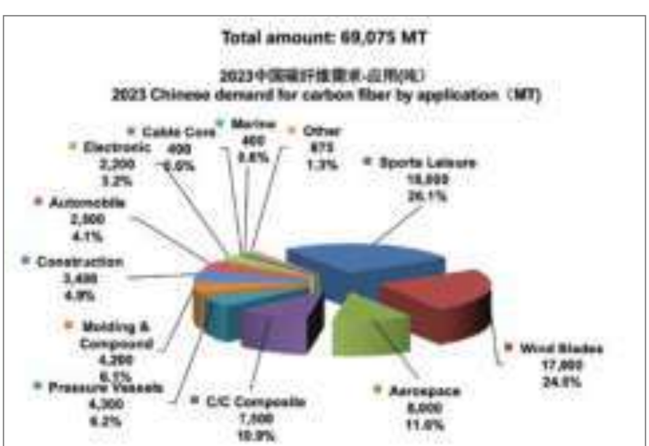
A brief note on Chinese carbon fiber

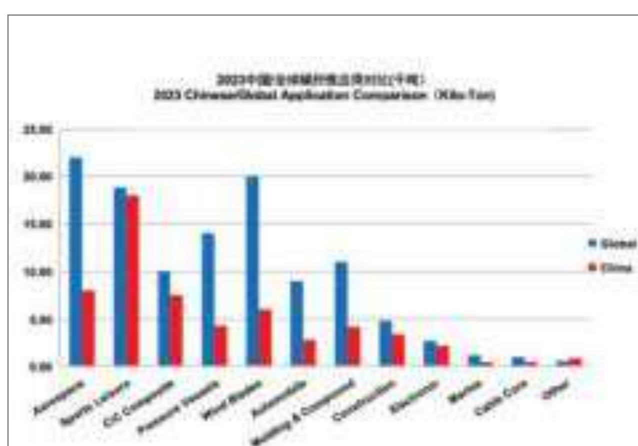
Not all carbon fiber is created equal. Variation in modulus, tow size and other characteristics affect what carbon fiber types dominate certain end markets. Applications like wind turbines use mid-range carbon fiber variants ranging from T300 to T700 (Toray, Tokyo, Japan), while aircraft use high-end variants, like T800 and T1200G.

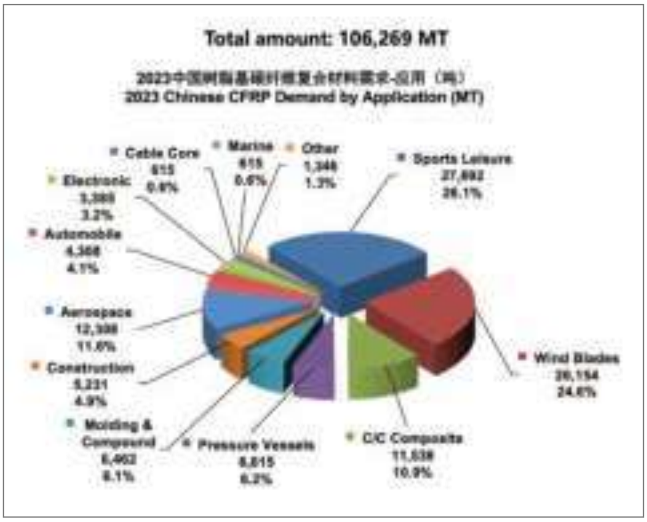
Lin explains that Chinese carbon fiber is understood to be generally on par with the rest of the world. His report notes that Chinese carbon fiber manufacturers have proven their strength in mastering already well-established material technologies, which has enabled the country's carbon fiber to gain share in wind, industrial, automotive and other markets. However, some of his discussion implies that China is weaker when it comes to carbon fiber production for use in high-performance aerostructures (see Figs. 1a and 1b) — an end market where requirements and regulations are much more demanding, thus making long-term experience necessary, but where a significant amount of *high-performance* carbon fiber (such as T800- and T1200G-type) is being produced by other global players. For example, Lin reports that global aerospace "application capabilities" — i.e., the prevalence of global carbon fiber supply in a specific end market — are ~22,000 MT while China lags behind at ~7,000 MT.

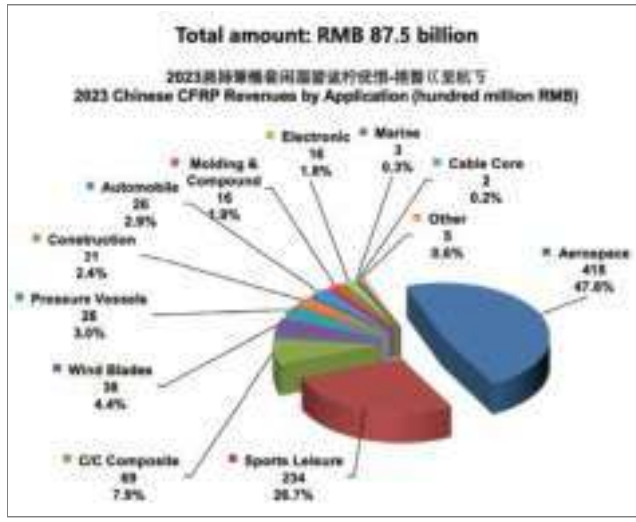
These data are further exemplified by Lin's breakdown of Chinese carbon fiber volume versus revenue by market (Figs. 2a and 2b). While 47.8% of China's 2023 revenue is dominated by aerospace — this includes unmanned aerial vehicles (UAV) and defense (Fig. 3), both of which are large consumers — CFRP *volume* shows aerospace to be only the *fourth* largest in demand at 11.6%; in both cases sports/leisure and wind remain in the top three positions.

FIGS. 1a and 1b Chinese demand for carbon fiber by application in metric tons (MT) in 2023 (left) and a 2023 Chinese/global application comparison in kilotons (KT, right). Source (All Images) | Lin Gang









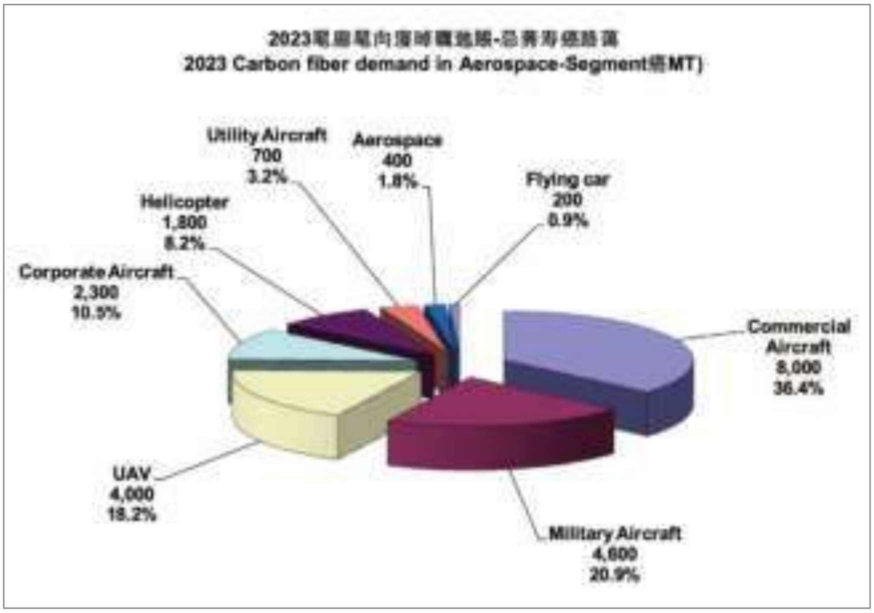
FIGS. 2a and 2b 2023 Chinese CFRP by demand and application in MT (left) and Chinese CFRP revenues by application in hundred million RMB/yuans (right).

Increased capacity, lower demand

Global carbon fiber production demand across all end markets indicates an exponential increase leading up to 2030, and — assuming this trend continues — could reach ~280,000 MT (Fig. 3), says Lin. This outlook is backed by global data acquired by advanced materials M&A specialist Future Materials Group (FMG, Cambridge, U.K.), which mirrors Lin's report. According to FMG, global demand of carbon fiber the last few years is as follows:

- 2021: 115,000 MT
- 2022: 120,000 MT
- 2023: 140,000 MT

FIG. 3 Global carbon fiber demand in aerospace (MT) in 2023.



Where FMG and the report differ, Lin's suggestion is that there is a *decrease* in current demand for global and Chinese carbon fiber. Lin reports a 14.8% decrease between 2022 and 2023 globally (2022: 135,000 MT vs. 2023: 115,000 MT) and a 25.7% decrease between these same years in China (2022: 74,429 MT vs. 2023: 69,075 MT).

Myriam Yagoubi, manager at FMG, believes the discrepancy may lie with the wind industry. "Although growth in demand was slower between 2021 and 2022 [globally], it has picked up again," she explains. "I think our main difference concerns global wind demand. We [regions outside of China] have a more positive view, especially with the demand of Western wind OEMs."

Lin and Yagoubi also address the issue of revenue loss from 2022 to 2023. Lin reports that global revenue has shown a 12.3% decrease (2022: $26.61 billion vs. 2023: $22.96 billion). According to Yagoubi, "2022 was a difficult year. Wind demand was down, and other market demands were slowing, but this was off the back of strong demand through COVID-19, so the momentum change was felt strongly by industry. Of course, the exceptional demand seen through COVID (and associated prices increases) was never going to be maintained." In conclusion, FMG is still seeing ongoing growth in global demand at rates quite similar to historical (7-10%).

It might make more sense, then, to consider that *global* demand hasn't decreased — *China*'s demand has. When looking to carbon fiber production by region over the last couple of years, Lin's data show that China has far surpassed its competitors, making up nearly half of global capacity (Fig. 4, p. 8). At the same time, however, the country is seeing *lower carbon fiber demand*. »

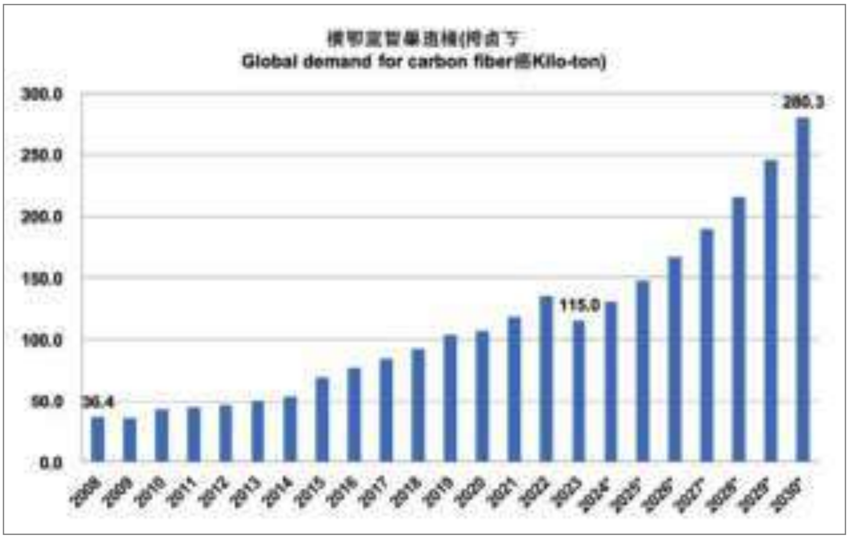


FIG. 4 Global demand for carbon fiber (KT).

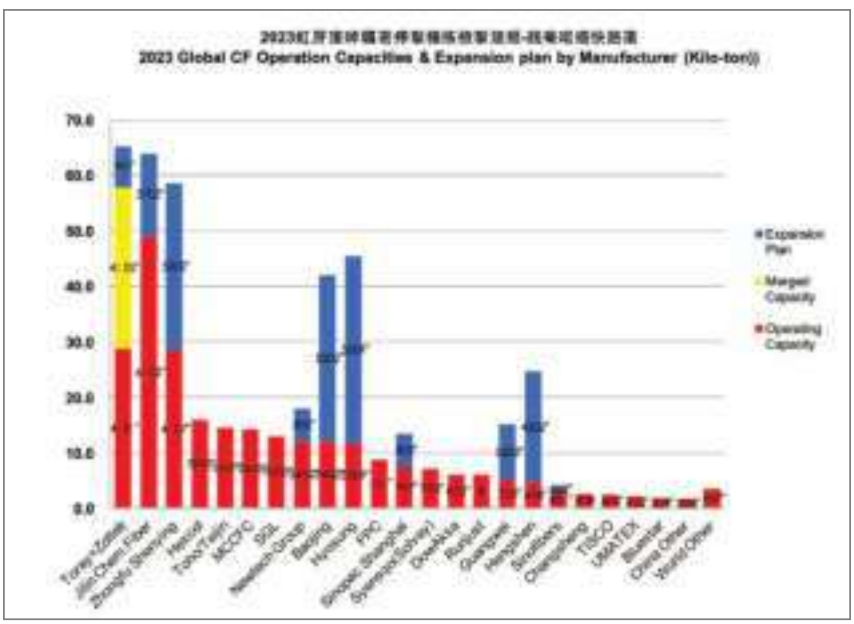


FIG. 5 Global carbon fiber operations, capacities and expansion by manufacturer in 2023.

For comparison, Lin reports that annual demand growth in China, 2021-2023, was:

- 2021: 27.7%
- 2022: 19.3%
- 2023: -7.2%

Conversely, China's *operating capacity* during the same time period ranks it first globally (Fig. 5):

- 2021: 30.5%
- 2022: 43.3%
- 2023: 47.7%

According to Lin, China's 2023 production capacity reportedly reached 138,330 MT, which is 26,280 MT *more* than 2022. In these circumstances, Lin anticipates "a price bloodbath and high inventory." The report points to several potential reasons for this shift.

Market fluctuation

The effects of COVID-19 are still being felt, affecting inventory and demand. A majority of carbon fiber manufacturers between 2022-2023 (minus Japan) have seen a price decline. Lin says China's carbon fiber producers saw prices drop from an average of $33/kilogram in 2022 to $18/kilogram in 2023 (Fig. 6).

It is also important to study how carbon fiber-consuming markets in other countries compare to China. Each country has its own end market specializations based on the carbon fiber variants it provides. Lin states that China's main markets include wind, sports/leisure, carbon-carbon (C/C) composites, construction and electronics, with enormous application potential for automotive (Fig. 1a).

By contrast, carbon fiber supply from countries like Japan, Europe and the U.S. is more prevalent in pressure vessels and aerospace markets — not only do they comprise 31.3% of global carbon fiber demand, but these regions in particular have "deeper cooperation, and more well-developed demonstration of these applications [when compared to China]" Lin says. This has formed a "closed-loop industrial chain," though China's recently debuted Commercial Aircraft Corp. of China (COMAC) C919 hints at China's determination to re-establish itself in commercial aircraft.

Notably, says Lin, aerospace, which took a significant hit starting in 2020, has been in a state of rapid recovery since 2023 and the market for pressure vessels has shown relative stability. This is in direct contrast to C/C composites, where Lin notes that prices have declined, along with weakened demand in wind and a sharp decline in sales for sports/leisure markets after strong growth in 2020 during COVID-19.

Global market, reduced imports

Beyond numbers, Lin also suggests that the current carbon fiber supply situation in China — and perhaps even the world — can be attributed to two key things: a lack of understanding internationally of Chinese carbon fiber manufacturers and geopolitical tensions.

The report generally describes Chinese products (think textiles, toys, housewares, etc.) as "cheap and of good quality" that "have gained [an] extensive reputation internationally." However, for more highly technical products — especially advanced materials like carbon fiber and composites generally — the region has been ignored or overlooked. And for those companies outside of China that *are* using Chinese carbon fiber, it may simply be out of a need rather than a want.

"China's carbon fiber has made significant progress over the past decade," Lin notes, "but it has now caught up with the market's supply shortage and high prices." In other words, carbon fiber production in China has eliminated domestic fiber supply shortfalls, but Chinese carbon fiber producers have lost the ability to maintain relatively high prices.

As shown in Fig. 7, China's domestic production of carbon fiber has indeed increased sharply over the last couple of years, while imported carbon fiber has declined. Since 2022, domestic carbon fiber has become the Chinese market's dominant supply — and if trends continue, will become China's *only* supply in the next couple of years, Lin suggests. Customs data reaffirms this, showing that the export of Chinese carbon fiber is negligible. This significant decline in imports is said to be mainly due to what Lin says is "the enhanced import substitution of domestic carbon fiber and due to the less-than-expected development of the Chinese market."

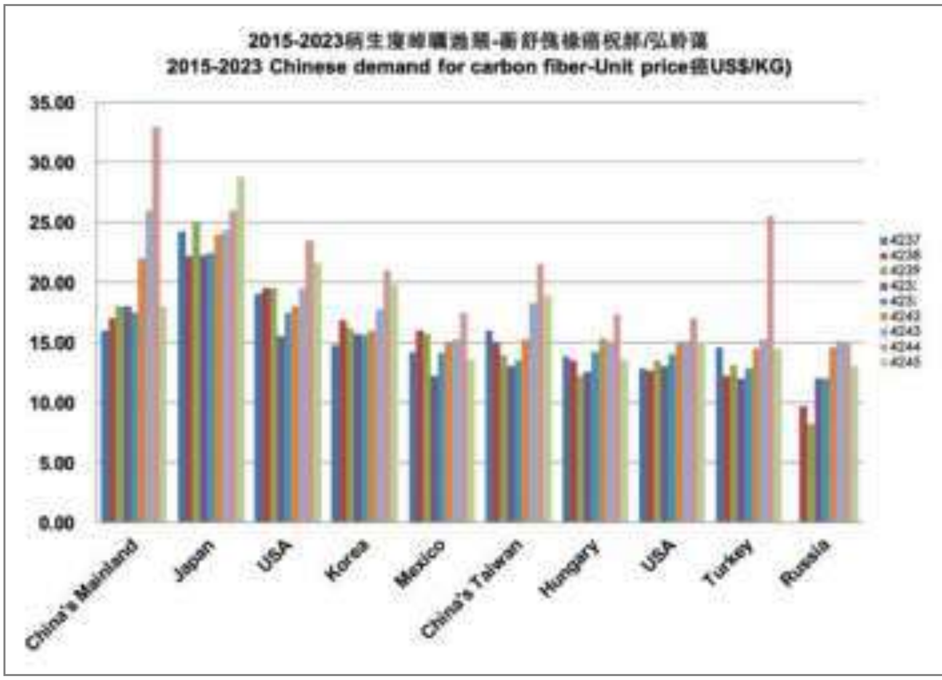


FIG. 6 Chinese demand for carbon fiber by unit price ($US/kg) between 2015-2023.

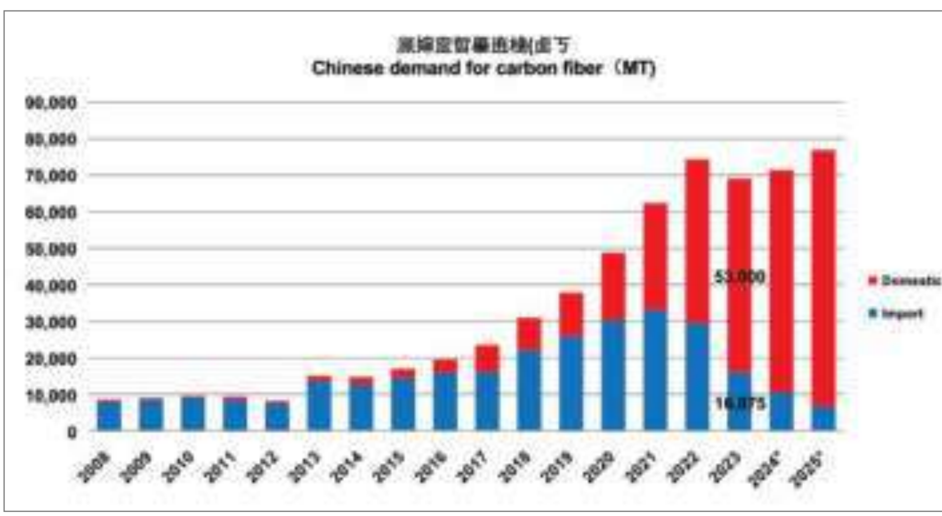


FIG. 7 Chinese carbon fiber demand (MT) between 2008-2025, divided between domestic production and imports.

Geopolitical tensions are also a factor. U.S. tariffs on Chinese carbon fiber, China's ongoing relationship with Russia and China's aggression toward Taiwan make it difficult for real and potential carbon fiber customers outside of China to have faith in consistent carbon fiber supply from Chinese manufacturers.

Lin acknowledges these tensions, which "have already pushed Western clients to evaluate the risk of Chinese carbon fiber," he says. "China's carbon fiber industry has done a good job in working out high-performance, low-price carbon fiber to help customers expand their applications. However, China's serious overcapacity and its involution [a term used in China that could be translated to a 'race to the bottom,' leading to the devolution of an industry plagued by hyper-competition] are not good for the world and could pose serious complications to decades of carbon fiber market development." Should other regions embrace or cut ties with Chinese carbon fiber? This is a headache of a question for the world." »

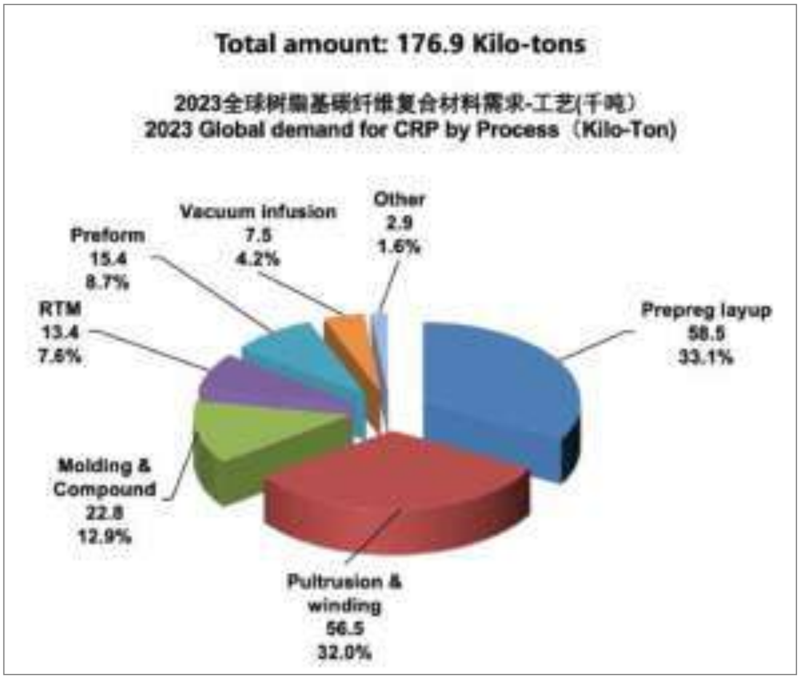


FIG. 8 Global demand for CFRP by process in 2023 (KT).

Path forward for Chinese and global carbon fiber markets

"The Chinese market is characterized by comprehensive and low-cost manufacturing capabilities," Lin describes. "For [some] application markets that have [well-established products] [Fig. 8] we have become the strongest in the industry, such as sports equipment, wind power pultruded plates, C/C composites and so on. Of course, this is also a double-edged sword — the business that could make China profitable in a few more years could also experience violent fluctuations. We seriously lack the ability and patience to explore new application ecosystems, which is the biggest difference and gap compared to Europe, Japan and the U.S."

> "China's carbon fiber has made significant progress over the past decade," Lin notes, "but it has now caught up with the market's supply shortage and high prices."

Based on data, Lin says that "production expansion or new construction [of carbon fiber lines], excess production capacity and intense competition" will undoubtedly be the industry's key challenges in the coming years, not just for China but globally as well. Nevertheless, factors like ongoing supply chain challenges stemming from COVID-19 will gradually resolve and the market will recover. "Carbon fiber manufacturers should remain patient," Lin adds.

LEARN MORE

Read Lin's complete report online | short.compositesworld.com/ATA-carbonfiber-report

What does Lin think Chinese carbon fiber suppliers should look to in order to ensure the industry develops healthily and sustainably under such circumstances?

- Strive to bring China into the international carbon fiber supply chain. He suggests that suppliers continue active expansion into other applications through the development of an "innovative ecological chain." Lin says that Chinese carbon fiber suppliers not only need to explore their domestic innovation industry chain, but also actively participate in the construction of the *international* innovation ecosystem.
- Pursue mutual learning and consensus through professional cooperation and public development among China's top 10 enterprises, or risk comprehensive losses in carbon fiber supply chain as a whole. Lin emphasizes that Chinese companies should focus their main efforts on "technology development to reduce [carbon fiber] costs, increase efficiency and stabilize quality."

Uncertain market demand, technological innovation and a rise in production capacity will inevitably lead "to an industry reshuffle," Lin admits, adding that some of these challenges have also stimulated new investors to enter the composites industry. However, he says, nothing can be achieved overnight, and will require great patience, tolerance, resilience and perseverance. CW

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ROSS

Crashworthiness testing of composites: A building block approach, Part 1

By Dr. Dan Adams / President, Wyoming Test Fixtures Inc.

Crashworthiness may be defined as a structure's ability to provide controlled energy absorption and protect its occupants from excessive forces and peak accelerations in a crash. In general, the choice of both materials and geometric configuration influences a structure's crush failure mechanisms and overall energy absorption capability. For most of us, the structures for which crashworthiness is most familiar are our cars and trucks.

Unlike metals, which absorb energy primarily through plastic deformation, polymer matrix composites (PMCs) absorb energy through brittle fracture of the fibers and the matrix. When properly designed, composite structures can remain intact and enable crush failure to occur in a stable and progressive manner. Moreover, in comparison to metals, PMCs have been shown to produce increased energy absorption per unit mass, referred to as *specific energy absorption*, due to their relatively low density and their ability to absorb energy through progressive crush. In general, energy absorption capabilities of PMCs are dependent on the fibers and matrices used, the laminate configuration (ply orientations and stacking sequence) and the design of the composite structure.

Previously discussed in my August and December 2021 *CW* columns, a building block approach is a step-by-step process that serves as a framework for designing composite structures while also reducing risk and cost. An example of a building block pyramid, illustrating the levels of crashworthiness-related testing associated with a composite aircraft structure, is shown in Fig. 1. For composite structures with crashworthiness requirements, the *complexity* of testing and analysis increases while the *number* of tests decreases when moving up to a higher building block level. Currently, the most extensive coverage of this crashworthiness building block approach for composites is provided in volume 3, chapter 16 of the "Composite Materials Handbook-17 (CMH-17)."[1]

In this column, I'll focus on the base level of this building block pyramid, in which a majority of the coupon-level crush testing

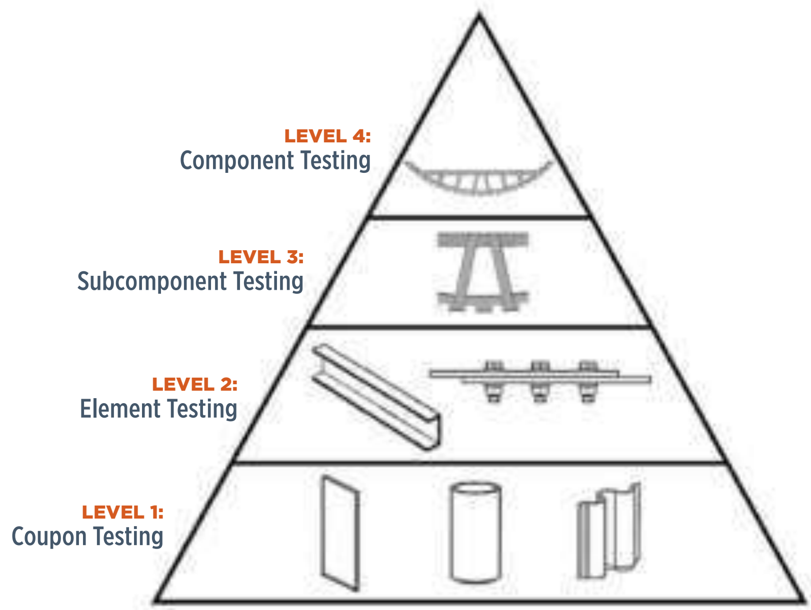


FIG. 1 Building block approach for crashworthiness-related testing associated with composite structures.
Source (All Images) | Dan Adams

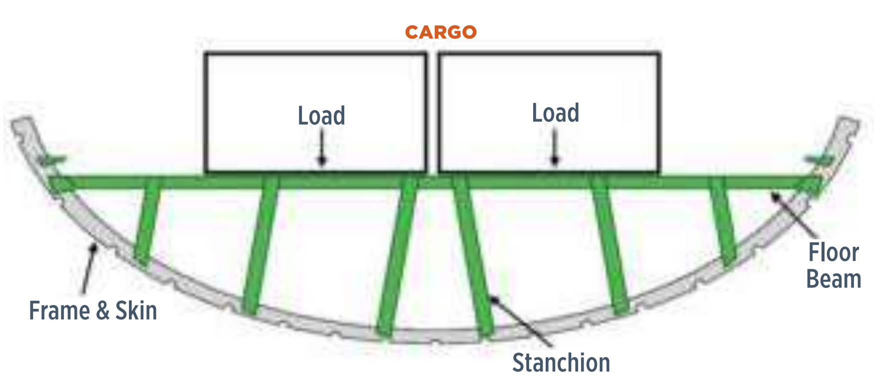
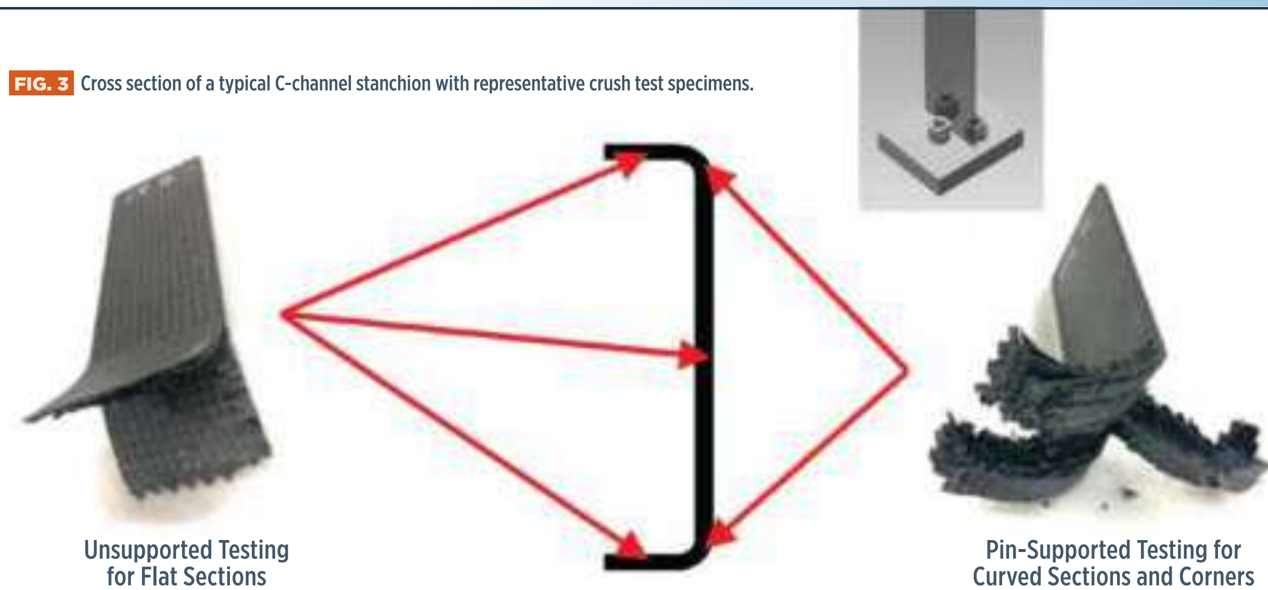


FIG. 2 Cross section of the lower portion of a transport aircraft fuselage.

FIG. 3 Cross section of a typical C-channel stanchion with representative crush test specimens.



is performed for screening composite materials and laminates. These tests provide estimates for laminate crush stress and specific energy absorption (SEA), defined as energy absorption per unit mass of crushed material. The higher levels of this building block include element level, subcomponent level and full-scale level crush testing performed to investigate the crashworthiness of specific portions of a proposed composite structure. These higher building block levels will be discussed in my next column.

Flat-coupon crush testing of stanchion elements

When beginning to assess the crashworthiness of a composite structure, coupon-level test articles are typically chosen to represent key portions of the intended composite crush structure. Within the automotive industry, composite tube segments have been used as coupon-level test articles, following the practice of using tube-like metallic structures that absorb energy when compacted in a relatively stable, accordion-like manner. Such tube segments are *self-supporting* test articles and therefore do not require elaborate test fixturing when performing crush testing.

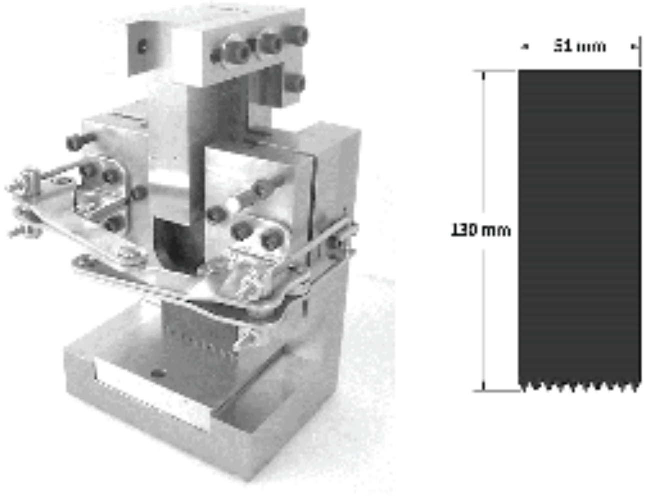
In recent years, the Crashworthiness Working Group of CMH-17 has focused on the use of flat-coupon crush testing to measure laminate-level crush properties and to screen candidate composite laminates for energy absorption. One reason for the use of flat specimens was the intended application: C-channel shaped composite stanchions that support the floor beams in a transport aircraft fuselage as shown in Fig. 2. In addition to serving as structural members during normal aircraft operations, these stanchions have also been identified as principal energy-absorbing structural elements. The cross section of a typical C-channel stanchion, as shown in Fig. 3, is composed of a central web section and two outer flange sections connected through two corner regions. Such C-channel stanchions provide structural stability and permit flush attachment to adjoining flat structures in an aircraft fuselage.

The CMH-17 Crashworthiness Working Group's recent focus has been the crush testing and numerical crush simulation of these composite stanchions. Efforts to date have been devoted to the coupon and element levels of the building block. At the coupon level, flat-coupon crush testing was performed to establish the laminate-level crush response of selected carbon fiber/epoxy laminates. An advantage of using flat coupons is that they can be cut from flat panels, similar to other mechanical test specimens, thus greatly simplifying fabrication. Similar to composite compression test specimens, however, these flat crush test specimens must be supported during crush testing to prevent buckling.

Collaborative research performed by Engenuity Ltd.[2] (West Sussex, U.K.) and the University of Utah[3-4] (Salt Lake City, U.S.) resulted in test fixturing, a common specimen geometry, and a test procedure for flat-coupon crush testing. The Utah flat-coupon crush test fixture[3] developed for such testing is shown in Fig. 4 (p. 14). The upper support of the test fixture end-loads the flat coupon against the fixture base, and the lower support prevents the coupon from buckling. The upper and lower supports are adjustable to permit the crush testing of various coupon thicknesses and gage lengths. Both unsupported and pin-supported test fixture bases (Fig. 3) are used to characterize the flat and curved regions of the crush structure, respectively. The unsupported base enables the flat coupon to crush freely, whereas the pin-supported base constrains the flat coupon from out-of-plane deformation and splaying.

Based on initial stress analyses[5], the 16-ply laminate configuration selected for use in the C-channel stanchion consisted of eight 0° plies, four ±45° plies and four 90° plies. From this laminate configuration, five ply stacking sequences were selected for flat-coupon crush testing based on prior crush testing results using similar carbon fiber/epoxy laminates: »

FIG. 4 University of Utah flat-coupon crush test fixture and specimen.



- $[90_2/\pm45/0_4]_S$ — *Stiffest plies at midplane*
- $[90_2/0_2/\pm45/0_2]_S$ — *High SEA in previous study*
- $[90/+45/0_2/90/-45/0_2]_S$ — *Ply dispersion while maintaining SEA*
- $[\pm45/90_2/0_4]_S$ — *Outer 45° plies, high SEA in previous study*
- $[\pm45/90/0/90/0_3]_S$ — *Outer 45° plies, greater ply dispersion*

Based on test results, two laminates were selected for follow-on C-channel testing: $[90_2/0_2/\pm45/0_2]_S$ and $[90/+45/0_2/90/-45/0_2]_S$. Both laminates demonstrated high energy absorption using the unsupported and pin-supported base plates. Note that both laminates have a total of four 0° plies grouped at the laminate midplane, which served to promote fragmentation failure, a high energy-absorbing failure mode, during crushing.

Following flat-coupon crust testing, results were provided to Crashworthiness Working Group members for use in performing initial crush analyses. Such coupon-level crush analyses permitted the estimation of modeling parameters and properties used in modeling progressive crushing at higher building block levels. At the element level, the analysis teams performed crush test simulations of the C-channel stanchion and provided blind predictions of the crush behavior prior to being provided with crush test results. Therefore, these initial numerical analyses provided an initial assessment of the numerical analysis method and the input parameters selected.

A subsequent column will address element-, subcomponent- and component-level testing in a composite crashworthiness building block approach. CW

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Contraction slows for second month, with some indicators improving

ABOUT THE AUTHOR

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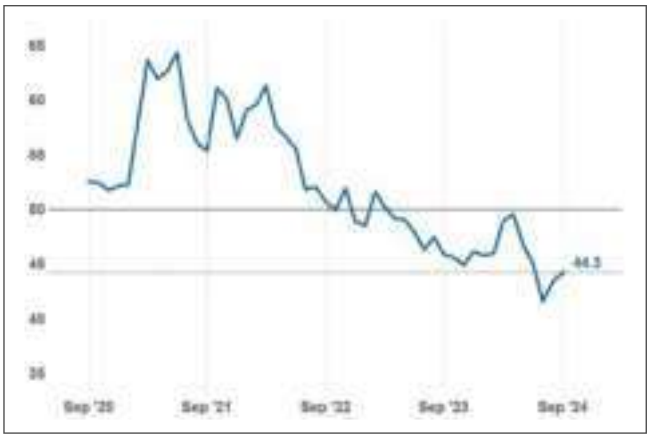
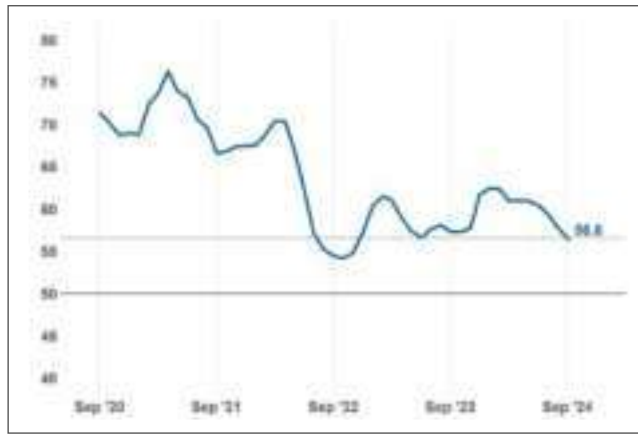
COMPOSITES FABRICATING



The Gardner Business Index (GBI) is an indicator of the current state of composites fabricating considering survey responses regarding new orders, production, backlog, employment, exports and supplier deliveries. Over 50 is expansion. Under 50 is contraction.

FUTURE BUSINESS



GBI Future Business is an indicator of the future state of the composites fabrication market considering industry respondents regarding their opinion of future business conditions for the next 12 months. Over 50 is expansion and under 50 is contraction.

SCORECARD

The Gardner Business Index (GBI) Components Scorecard reports the monthly change rate of primary composites market factors contributing to the overall monthly index reading.

READING THE SCORECARD:

Color indicates *where* a component value falls relative to 50 for the current month. Green is expansion; red is contraction.

Shade indicates a value's distance from 50; the darker the shade, the farther from 50.

Direction indicates a value's change versus the previous time period. Pointing up is always better.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TRENDS

Global automotive manufacturers are preparing for series production of FCEV passenger vehicles; the American Bureau of Shipping (ABS) certifies use of a CFRP repair technique; a roof scoop made of recycled fibers is developed for a rally buggy; a composites company is to supply spar caps to a global wind giant; and more.

AUTOMOTIVE

BMW, Toyota to launch FCEV with composite H_2 tanks in 2028

BMW Group (Munich, Germany), alongside Toyota Motor Corp. (Tokyo, Japan), plans to launch its first-ever series production fuel cell electric vehicle (FCEV) in 2028, offering customers an additional all-electric powertrain option with zero local emissions. Like the *iX* series, BMW confirmed that the FCEV will be using composite pressure vessels for hydrogen storage.

Both companies are driven to advance hydrogen fuel cell technology. "Powered by hydrogen and driven by the spirit of our cooperation, this milestone will underscore how technological progress is shaping future mobility," says Oliver Zipse, chairman of the board of management at BMW AG. "And it will herald an era of significant demand for FCEVs."

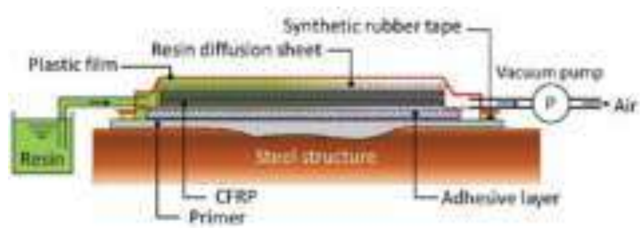
Together, BMW and Toyota aim to jointly develop the powertrain system for passenger vehicles, with the core fuel cell technology (the individual third-generation fuel cells) creating synergies for commercial and passenger vehicle applications. The result of this collaborative effort will be used in individual models from both BMW and Toyota and will expand the range of FCEV options available to customers. Customers can expect the BMW and Toyota FCEV models to maintain their distinct brand identities and characteristics, providing them with individual FCEV options to choose from.

This development comes not long after successful testing of the BMW *iX5* hydrogen pilot fleet worldwide. The new series production models will be integrated into BMW's existing portfolio, i.e., BMW will offer an existing model in an additional hydrogen fuel cell drive system variant. As FCEV technology is another electric vehicle technology, the BMW Group explicitly views it as complementing the drive technology used by battery electric vehicles (BEV) and next to plug-in hybrid electric vehicles (PHEV) and internal combustion engines (ICE).

The pathway to hydrogen mobility includes its use in commercial vehicles and the establishment of refueling infrastructure for all mobility applications, including hydrogen-powered passenger vehicles. In response, BMW Group and Toyota are also supporting the expansion of hydrogen refueling and BEV charging infrastructure.

MARINE

Toray obtains ABS type approval for in-situ VARTM ship repairs



Toray Industries Inc. (Tokyo, Japan), announces that it has became the first in the world to obtain type approval from the American Bureau of Shipping (ABS, Houston, Texas, U.S.) for its vacuum-assisted resin transfer molding (VARTM) process for in-situ ship repairs. This process entails Toray applying carbon fiber-reinforced plastic (CFRP) material to corroded areas often found on metal floating production, storage and offloading (FPSO), and floating storage and offloading (FSO) systems.

ABS is a leading classification society accounting for around half of FPSO and FSO certifications. This approval enables VARTM to be applied to these certified vessels, reducing the time needed for engineering reviews and verification for ship repairs.

FPSO and FSO maintenance is typically performed offshore and uses steel materials. However, welding — or hot work — halts oil and gas production. In 2020, Toray and shipbuilding company Modec Inc. (Tokyo) jointly developed a VARTM repair process for these applications. Toray's Torayca carbon fiber woven fabric — offering high strength and elasticity — is applied to the surfaces of existing steel structures. Then, the fabric is covered with a film, vacuum sealed and injected with epoxy resin that is cured, bonding the CFRP to the structure.

An advantage to this in-situ VARTM process is the ease in transporting the materials and equipment required to specific locations. It can also be used to perform repairs faster and with fewer people compared to steel-based techniques. Moreover, since the procedure does not involve hot work, it minimizes the impact on oil and gas production.

Toray says it will continue to work on its in-situ VARTM process for a range of industrial applications while developing repair and reinforcement technologies for FPSOs and FSOs.

SPORTS/RECREATION

CompPair, Composite Recycling create recycled fiber roof scoop for Objectif Dunes rally buggy

CompPair (Renens, Switzerland) and Composite Recycling (Ecublens, Switzerland) are collaborating on the eco-efficient Objectif Dunes rally buggy for the motorsport sector, introducing a recycled, recyclable and healable composite roof scoop, which channels airflow to the engine for optimal, sustainable performance.

The partnership combines CompPair's HealTech technology with Composite Recycling's recycling processes. The roof scoop, produced with recycled fibers, is designed to match the initial performance of standard parts, as well as enable ultra-fast repair — helping reduce costs, downtime and material waste.

Known for manufacturing buggies with a circular mindset, Objectif Dunes, founded in 1987 by Airbus employees, incorporates discarded scraps and upstream fibers from suppliers into its designs. Its buggies are largely composed of parts from Airbus A350 aircraft, including complex components made from recycled carbon fibers.

CompPair's HealTech technology is said to extend the lifetime of composite parts, offering key advantages while introducing sustainability into the motorsport sector. According to the company, these advantages include:

- HealTech composites enable ultra-fast in-situ repairs, taking 1 minute to restore a damaged part.
- A reduced need for frequent part replacements enables teams to save significantly on materials and repair costs, making racing more economically sustainable.
- Extension of components' lifespans contributes to a more eco-friendly motorsport future, with a reduced need for raw materials and lower environmental impact.
- After repair, HealTech composites maintain their structural integrity to ensure safety and performance standards remain uncompromised.

Composite Recycling intends to pioneer a circular economy in the composites industry with its thermolysis recycling technology. Designed to address the challenges of recycling hard-to-process fiberglass, the technology delivers high-quality fiber and oil outputs that can be reused in the production of new, high-performance composites and decarbonized plastics.

Composite Recycling's thermolysis units, housed in 30-foot containers, can be deployed directly to waste sites, reducing the cost, CO_2 emissions and logistical challenges associated with transporting bulky waste. Its technology is reported to capture and use the gas emitted during the recycling process, producing CO_2 emissions that the company says are 70% lower than traditional fiberglass production. Composite Recycling also offers recycling services for waste management.

WIND

Kineco Exel to manufacture pultruded carbon fiber planks for Vestas

Kineco Exel Composites India (KECI, Goa, India), a joint venture between Exel Composites Plc (Vantaa, Finland) and Kineco Ltd., has announced that it has won the bidding process in India to manufacture pultruded carbon fiber planks for Vestas Wind Systems A/S (Aarhus, Denmark) wind turbines. Planks will be developed in KECI's new facility in Goa, India, which has been optimized to serve wind power industry customers in India and globally.

The parties have started the qualification process of the production facility according to Vestas' specifications, after which KECI will be a qualified supplier of carbon fiber flats for Vestas globally. Deliveries are estimated to begin in the last quarter of 2025.

This agreement is an extension of an existing multi-year contract updated in 2023, and deepens the collaboration between the companies, which started more than a decade ago.

Spar caps, which use carbon fiber planks, are essential structural components within wind turbine blades, providing the strength, stiffness and load-bearing capacity needed to withstand the dynamic forces encountered during operation. As wind turbines continue to increase in size, carbon

fiber will play a crucial role in meeting the demanding mechanical requirements needed for these advancements.

"We are pleased to strengthen our partnership with our long-term customer Vestas and look forward to supporting them in their strategic initiatives," says Kathy Wang, EVP industrial solutions at Exel Composites.

Exel Composites and KECI offer wind turbine manufacturers a comprehensive range of glass and carbon fiber composite components required for the manufacturing of modern onshore and offshore wind turbines. KECI was established in 2021 as a joint venture between Exel Composites and Kineco Group.

SPACE

Orbital Composites wins AFWERX award for Starfighter drone fleet

Aerospace manufacturing company Orbital Composites (Campbell, Calif., U.S.) has been awarded an AFWERX (Washington, D.C., U.S.) Tactical Funding Increase (TACFI) contract to develop and scale production of its modular unmanned aircraft system (UAS), *Starfighter X*. Key aspects of the platform include automation, modularity, speed, versatility and multi-mission capabilities.

Orbital says its patented additive manufacturing compression molding (AMCM) process, which combines robotic, extrusion-based 3D printing with compression molding for low-porosity composite parts, is being leveraged for the *Starfighter X*. The system enables rapid production of complex aerospace components.

The TACFI program aims to accelerate the development and deployment of innovative technologies that address critical national security needs. The contract builds upon Orbital Composites' recent successes, shifting the company's total government contract awards beyond $10 million.

"Our contrarian approach of 'building the factory first' positions us to tackle the challenges of scaled production," says Amolak Badesha, co-founder and CEO of Orbital Composites. "While others focus on prototypes, we've invested in creating a factory that can go from concept to mass production in record time."

Orbital Composites can directly 3D print and fly Starfighter aircraft, while also having the capability to scale to tens of thousands of airframes using the AMCM process. The scalability of these manufacturing processes enables the company to potentially support both DOD Replicator and Collaborative Combat Aircraft (CCA) programs. The company is also in discussion with several prime contractors to accelerate production of larger, more complex aerospace platforms.

CONSTRUCTION

Duplicor biocomposites to advance Netherlands housing construction

Holland Composites BV's (Lelystad, The Netherlands) Duplicor bio-based and fire-resistant composite materials are finding a place in several construction projects around the world, the most recent being biocomposite floor elements for Dura Vermeer's (Hengelo) novel housing concept Aer. What is currently taking shape are two mock-up homes at the site of an old fishing net factory near the Apeldoorn train station (in the Netherlands), set to become future housing options.

The Aer concept represents fast, affordable homes with environmentally conscious building materials. They are made entirely in a factory, with a wood frame construction concept whose shell can be installed in 3-5 days and finished in 2 weeks. Floors, kitchen, plumbing and technical installations are delivered to the production hall where everything is put together. Aer is said to provide an MPG score (an environmental building performance calculation) of less than 0.36 and offer material-related CO_2 emissions of less than 110 eq p/m^2 (or CO_2 equivalent). Moreover, more than 79% of Aer's material volume is bio-based.

The first homes are planned to be on the market starting in 2025. Initially, Aer will be offered for rented social housing, low-medium rented housing and social sale. After that, it will be possible to scale up to multiple types of owner-occupied housing.

Aligned with these developments is Holland Composites' ongoing strategy to convince its customers to step away from the use of synthetic (and often toxic) composite options in their products and incorporate Duplicor prepreg laminates instead, from lightweight façades and fire-safe roof structures to interiors and offshore solutions.

Modular Brands uses LiteSIP composite structural insulation panels to speed construction of houses, roofs and commercial buildings.
Source (All Images) | MDLR Brands

Composite SIPs for more affordable, efficient and sustainable buildings

LiteSIP panels and modules enable framing in days, cutting structural labor and total cost by up to 70% and 30%, respectively, while increasing energy efficiency and durability.

By Ginger Gardiner / Senior Technical Editor

The U.S. is experiencing a housing crisis. Not only is there a massive shortage of homes, but prices are at all-time highs. Productivity in construction has actually been *negative* for about 50 years — U.S. construction companies are getting *less* efficient and delivering *lower* value. But composites can offer a solution. *CW* has written several articles about companies using composites in structural insulation panels (SIPs) for more efficient, affordable buildings (see Learn More).

SIPs typically comprise a foam core — the most common being expanded and extruded polystyrene (EPS, XPS), polyurethane (PU) and polyisocyanurate (PIR) — sandwiched between facings of oriented strand board (OSB) made from shredded softwood and adhesive. Composite SIPs replace the OSB with lightweight sheets of fiber-reinforced polymer (FRP), typically using glass fiber and thermoset polyester or thermoplastics.

SIPs offer much faster construction — assembly in days versus weeks or months — with higher, more durable thermal insulation and strength up to seven times that of today's timber frame houses. And yet they still make up only 1-2% of overall construction and only 8% of self-builds. Modular Brands (MDLR Brands, Chattanooga, Tenn., U.S.) is working to change that. "We are using composite SIPs to revolutionize construction," says CEO Harrison Langley, "with affordable, efficient and sustainable buildings that meet housing and commercial needs."

Real estate meets conservation

Langley's vision grew from a background in real estate and a passion for conservation. For years, he worked with the International Waterkeeper Alliance in Collier County, Florida — an international network of more than 300 nonprofit groups fighting to protect everyone's right to clean water. "I could see that the houses being sold could be built in a better way," he says. "So, I began to research different technologies."

Langley traveled to see Axia Materials' *thermoplastic composite* panels in Korea (Learn More), and also began working with Sulfibra (Iomerê, Santa Catarina, Brazil). "I've found several products to import, the majority using fiberglass composite skinned SIPs," he explains. "They enabled our companies to build quickly, with lightweight, high-performance materials that offer a lot of benefits." This includes PMRVs — park model recreational vehicles designed to provide temporary or seasonal housing — as well as tiny homes, auxiliary dwelling units (ADUs), modular homes and commercial buildings. Langley started MDLR Brands and Boxvana, a trademark of MDLR Brands, in 2018-19 to address these markets.

LiteSIPs, pultruded connectors

The composite SIPs that MDLR Brands use are called LiteSIPs and are made with woven fiber-reinforced skins and foam core. "We can use a variety of materials," says Langley. "It depends on the building's requirements and what the client wants. We can use Sulfibra panels with fiberglass/polyester skins and PIR core, or we can use thermoplastic composite skins on a variety of cores. We typically use glass fiber, but we've also tried carbon fiber and hemp fiber — both work fine. We can also add other layers. For example, we can provide 20-year sun protection or add ceramic powder to the skin when a 1-hour fire rating is required."

MDLR Brands also makes customized LiteSIP panels in-house using hand layup or an automated press system. "Typically, our panel size is 8-feet wide × 10-feet long," says Langley, "but we can go up to 8 feet 10 inches × 40 feet, depending on the materials and panel construction required. We can also make panels in a variety of thicknesses. Our standard panel is 1.2 inches [30.5 millimeters] thick, but our ballistic-rated panels are 6.35 inches [161.3 millimeters ,and we can go up to 10 inches (254 millimeters)] thick."

LiteSIPs can be connected using pultruded FRP beams and C-channels. "We've sourced these from Strongwell [Bristol, Va., U.S.] and Bedford Reinforced Plastics [Bedford, Pa., U.S.]," says Langley. "These have been used in applications like oil rigs for decades. They are a great product — strong and lightweight — and though they're more expensive than steel and aluminum, the maintenance and long-term costs are much lower. We used them in a modular house we built in the Bahamas. It's 2,800 square feet with four bedrooms, three baths and has one of our tiny homes as a guest house, which is 400 square feet with a 200-square-foot loft. Both are built completely with FRP beams and our LiteSIPs on top, rated for wind loads of 255 miles per hour."

Meeting certifications

Langley explains there are typically four levels of regulations that buildings must comply with: city, county, state and federal. "Depending on where you are, all or some of them apply," he notes. "We put one of our homes as a permanent ADU in Los Angeles and had to get city and county certifications, but in

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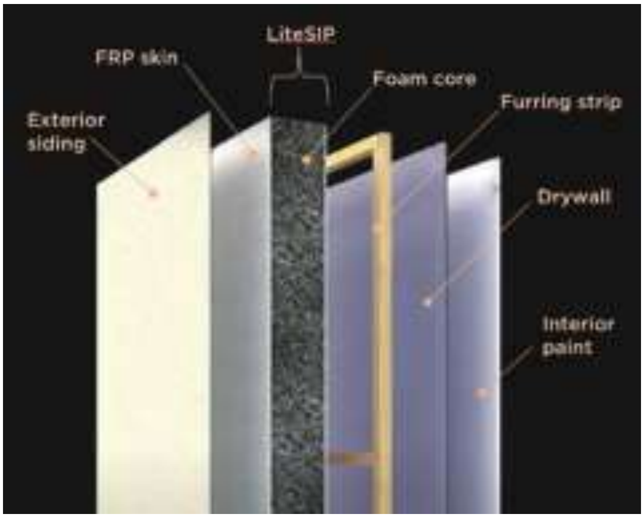
MDLR Brands manufactures lightweight composite SIPs for walls, floors and roofs and can also assemble these into prefabricated modules. Roof panels typically weigh 1.1 pound/square foot (5.4 kilograms/square meter), facilitating handling and assembly.



MDLR Brands uses a variety of premade and custom in-house manufactured SIPs, bonding fiber-reinforced polymer (FRP) skins to insulating foam cores with an array of possible finish options, including exterior siding and drywall interiors.

others, we've just applied to the county and had inspectors stamp the engineer drawings." He adds that the approval process to build with composite SIPs is different depending on where you are in the U.S. "For example, if you're starting in Florida, then it's a real challenge and fairly expensive to complete all the testing required, but it also opens a huge market because many other states will accept those test results.

"We've received approval from Miami-Dade County in Florida for buildings that meet Category 5 hurricanes," Langley continues. This includes testing with the global third-party certifier Intertek (London, U.K.). "We're just finishing TAS 201, 202 and 203 testing with them, which are for structural roof and wall systems in Miami-Dade County." TAS stands for "testing application standard," which include wind, impact and uplift protocols required for high-velocity hurricane zone (HVHZ) buildings in Florida. But they're also frequently approved for use elsewhere in the U.S. as an alternative standard to similar ASTM protocols. "If your products achieve that certification," explains Langley, "then they can pretty much be used anywhere. But you also have IBC testing that's often required at a federal level." International building code (IBC) is used in all 50 U.S. states, as well as the District of Columbia, Guam, Northern Marianas Islands, New York City, the U.S. Virgin Islands and Puerto Rico.

MDLR Brands also had Intertek perform structural testing on its LiteSIP panels in 2017, to ASTM E72-15, *Standard Test Methods for Conducting Strength Tests of Panels for Building Construction*. This included testing of a 4 × 8-foot (3-square-meter), 100-millimeter-thick panel with EPS core and fire-retardant fiberglass skins under transverse load up to 335 pounds/square foot and under axial load and racking shear load to 5,921 and 14,767 pounds (2,696 and 6,698 kilograms), respectively. "The LiteSIP panels outperform standard timber framing in both transverse and racking shear loads," says Langley, "offering higher structural strength and efficiency in a thinner profile."

LiteSIPs have also passed numerous fire tests including ASTM E84. "Usually, the standard is to provide 30 minutes of fire resistance, but we can also make panels that pass 60-minute tests," says Langley. "These tests are important when we work with government or commercial buildings. For example, we built surveillance rooms for the Hamilton County Sheriff's Office [in Jasper, Florida] where we added on to an existing structure. And that was possible because we met the fire resistance and smoke toxicity tests required."

Energy efficiency, durability

These successful test results and certifications are evidence of the high performance that can be achieved with LiteSIP construction. This includes energy efficiency. "We've passed Title 24 tests for energy efficiency on some of our units in California," says Langley. "Effectively, this means you're paying the minimum on your power bills because LiteSIPs maintain temperature so well, and there's no thermal bridging."

Thermal bridging is when heat bypasses insulation in a building, moving through more conductive materials like metal or wood studs. The result is energy loss, which increases heating and cooling bills but also means energy is being wasted. This is exactly what Title 24, part of California's Building Energy Efficiency Standards, aims to reduce, as it pursues a more resilient, affordable, equitable and sustainable energy system.

"With our panels, you have a completely controlled environment," Langley continues. "That's why these panels have been used in hospitals. You can also put a negative or positive pressure on them." The latter are used to prevent the spread of infectious contaminants. Negative pressure rooms use lower pressure to trap potentially harmful particles inside the room while positive pressure rooms maintain a higher pressure to keep possible contaminants out. These concepts are also used in industrial cleanrooms as well as by large agricultural growers, says Langley. "And these panels don't mold or mildew like some construction materials, even when constantly exposed to moisture and cleaning solutions."

This combination of long-term benefits is rare, notes Langley. "We not only maintain higher energy efficiency versus most construction types, but as an owner-operator, you will also have very low maintenance because you won't have to deal with mold, mildew, rot or fire damage, nor corrosion with metal. Because of this, we have been talking with insurance companies to provide lower rates for buildings and even just roofs that use our LiteSIP panels." We'll come back to the roof market below.

Speed of construction, interior finishes

Langley says building with composite SIPs is much faster than stick-built construction. "You're putting up a 20 × 8-foot wall [15 square meters] that weighs 160 pounds [73 kilograms] with just a crew of two to three builders. You don't need a crane, and this size crew can frame an average-sized, one-story house in less than a week. We can reduce labor by up to 70% compared to wood framing."

He notes the modular home in the Bahamas took only 5 weeks from start to finish. "But that included transport to site." Easy transport is another advantage. In this case, nine prefabricated modules were shipped by truck and then ferried to the site, where they were lifted into place by a small crane , assembled and finished. "Almost everything in the Bahamas has to be shipped in from somewhere," notes Langley. "The alternative, using traditional framing, would have been really expensive and taken months. For us, the majority of the actual building process was finished in the first 10 days. The longest part was completing the interior finishes, but even that was much quicker than a standard build."

For interiors, Langley says the most common choice is drywall, which is attached using furring strips — narrow wood strips screwed into the SIP, which the drywall sheets can then be screwed into. "And since the panels are so stiff, we can send them with the drywall already attached," he adds. "We can also print the exterior and/or interior FRP skins with a pattern and then seal it. The result looks like wood or stone or tile. It's a good surface that is easy to clean. Some clients just paint the panels after the installation is completed. We've seen a lot of different approaches." For exteriors, houses are commonly clad with siding.

What about wiring and plumbing? "We can use conduit in the panels to run the wiring chases as well as vents or plumbing down from a second story," says Langley. "We've also run wiring behind the drywall. Overall, it's a really simple method of building. We pretty much build everything with two different sets of products — our composite SIPs and then connectors. Although we prefer to use the FRP connectors to prevent thermal bridging, we can use metal L-brackets as well."

Cost, sustainability, future markets

MDLR Brands advertises its PIR foam-cored composite SIPs at $7.10, $7.70 and $8.30 per square foot for 4, 6 and 8 inches thick, respectively. Its ESP foam-core LiteSIPs range from $8.48 to $13.43 per square foot (2- to 10-inch thickness). Its *Sedona* compact modular building costs $18,500, comprising a 14 × 22-foot structure and 16 × 24-foot roof, while the *Jupiter* A-frame on a 20 × 20-foot pad costs $27,200.

"Our material costs are a little more expensive than high-volume timber construction," says Langley, "but we install much more quickly and provide energy efficiency and durability benefits. We definitely compete with standard residential roofs."

The price of wood is increasing because it's becoming a harder resource to get, he adds. "There have been a lot of fires over the past couple of years, and the quality of the wood in number 1 or 2 lumber has decreased significantly. The material properties »

Examples of LiteSIP markets shown here include (top right, clockwise) a roof for a house in the North Carolina mountains, a modular house in the Bahamas and a range of small and tiny homes with high-quality finishes.

are lower, but the standard for construction is increasing — so, you need more and more wood just to meet the minimum standards. This is why you're seeing more complex joists and ties that tend to be thicker and heavier."

As a result, roofs have become a key market. "Our panels actually enable getting rid of truss systems, so that you can have vaulted ceilings," says Langley. "Our 6-inch-thick SIP panels can span 16 inches instead of 12 inches, and they include insulation and three layers of protection already built-in — no further installation of glass wool or spray-foam is needed." He notes this market is growing due to the increase in violent storms and resulting damage. "We can build back roofs more quickly and also stronger than before. That gives us an advantage in residential construction, and we can reduce total costs for commercial roofs by up to 30%. We are replacing five layers with one and connecting directly to the metal structure of those buildings."

Langley sees composite SIPs as not only increasing energy efficiency but sustainability overall. He notes that Sulfibra's PIR foam core uses recycled PET bottles — reportedly 60 bottles in each meter of panel — and adds that his companies are also trying to reuse foam and panel scraps where possible. "And we're also looking at more recycled and bio-based materials," he notes. "We already meet current building standards, but we're working to meet newer green building standards. What the construction industry is doing right now isn't sustainable. We are proving that modularity with advanced materials is a solution, cutting waste and construction speed with less labor, and giving home and business owners more value and control of the building process. We're expanding our modular home builds, with new projects in the Bahamas, as well as growth in Tennessee and Kentucky, while roofs are growing overall in the Southeast. We're developing further automation and see potential for even larger growth in the future." CW

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As a company specializing in natural fiber composites technology, Greenboats GmbH has learned to adapt its product offerings to meet market demands, expanding its portfolio from flax fiber/bio-based resin boats, to high-volume production of sandwich panels, to campers.
Source | Greenboats

Evolving natural fiber technology to meet industry sustainability needs

From flax fiber composite boats, to RV exterior panels, to a circularity model with partnerships in various end markets, Greenboats strives toward its biomaterials and sustainable composites vision in an ever-changing market.

By Hannah Mason / Technical Editor

Bio-based composite materials like natural fibers and plant-sourced resins are no longer the shiny new toys they were a few years ago. As initial excitement and newness evolves into proving out the staying power of bio-based materials for the right composite applications, companies working in this space are evolving with them to provide the solutions the industry needs.

Greenboats GmbH (Bremen, Germany), founded in 2013 by accomplished boatbuilder Friedrich J. Deimann, is one example of how companies have learned to adapt in the natural fiber composites space. Deimann had seen success building boats from both wood and fiberglass composites and wanted to merge the two technologies to build vessels from natural, less toxic materials that maintain the light weight and high performance of composites. Aiming to meet these goals from the start, Greenboats focused on building boats that incorporate as much flax fiber composites as possible.

Jan Paul Schirmer, managing director at Greenboats, came on board early on to run the business side of the company. He says, “When [Deimann and I] started working together, we had a very clear agenda about how we wanted to strive toward sustainability in this space, but we identified a number of issues from the start,” which the team spent the next few years working through.

First, manufacturing with natural fibers can be a challenge. Learning to build infused boat hulls with these materials was a trial-and-error process. “There are so many variables to control," Schirmer says. "You need to avoid moisture and control humidity, natural fibers process at different temperatures and pressures than other materials, and so on."

In addition, he explains that securing a natural fiber supplier that can provide the needed amounts of high-quality, consistent materials is paramount. In 2021, Greenboats began working with Groupe Depestele (Normandy, France), a large flax farming cooperative. "In my opinion, they produce the best flax for composite applications. So this was a very important step for us," Schirmer says.

Regardless of supplier, the relatively high material costs of natural fibers compared to fiberglass are also a challenge, and led the company to think from the beginning about how to reduce labor costs through automation and modular products to balance out total cost per part.

In 2016, the startup built its first 7.5-meter sailing boat, constructed from flax fiber, cork and a bio-based epoxy sourced from linseed oil. "It was Deimann's breakthrough in a way, getting a lot of media attention and winning several awards," Schirmer says. From there, the company began building and selling custom-built natural fiber composite sailboats, and that's still a large part of its business today.

However, Schirmer explains that because natural fiber composite boats are always going to be a premium niche option compared to fiberglass composite boats, he saw an opportunity "to position ourselves as not just a boat manufacturing company, but as a *technology* company" specializing in natural fiber composites.

With this goal in mind, for its second product, Greenboats looked outside the box to modular, natural fiber composite sandwich panels.

Natural fiber sandwich panels, custom parts

"We identified early on that sandwich panels would be the *real* solution to scaling up natural fiber composites," Schirmer says. "The material costs are hard to control, but with these, you can reduce labor and manufacturing costs by producing a high-volume, standardized, easy-to-assemble product."

First, Greenboats tested out production of 1.3 × 3-meter compression molded flax fiber/bio-epoxy panels using a press it already had, and then, after achieving early successes, invested in a larger compression press to manufacture up to 6 × 2.5-meter panels. This system is located at a separate, nearby facility and operated in cooperation with the company's manufacturing partner Fassmer (Berne, Germany).

Using this press, the company is currently able to produce up to 1,000 square meters of laminated skins per day — generally made from a noncrimp woven flax textile and one of 10 or so different resin systems, ranging from 100% bio-based to more traditional non-bio resins — that can be combined with a recycled and/or bio-based foam and low-density wood such as balsa.

"From an economics perspective, this was a great step for us. We went from 50% of a part's cost coming from labor and production to less than 10%," Schirmer says.

Despite its relatively small core team, Greenboats does a lot these days: It can engineer and prototype custom natural fiber composite parts and manufacture series of up to several thousand per year; mass-produce sandwich panels; or even sell the textiles themselves. And yes, the company does also still build boats. "How we see it is that we're experts in natural fiber technology, and we want to support companies where they are in this journey," Schirmer says.

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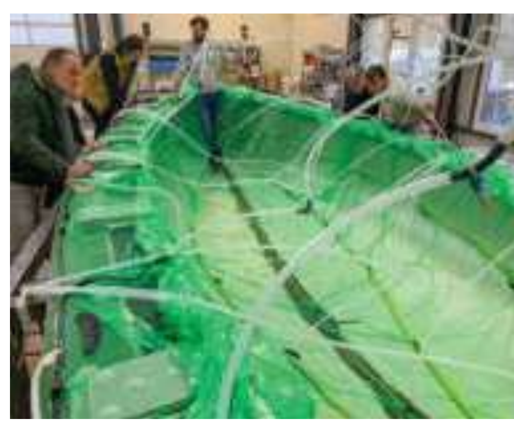

The entire exterior and inner structures for the Flax27 *Daysailer* are built with infused flax fiber composites with a bio-based epoxy and recycled PET foam core. Source | Greenboats

With production partner Fassmer, Greenboats is capable of producing sandwich panels up to 6 × 2.5 meters, suited for a variety of applications from recreational vehicle exteriors, to wind turbine nacelles. Source | Greenboats

Over the last few years, the company has had a hand in developing a number of new parts in various industries, from playground slides, to a wind blade nacelle demonstrator, to wall-mounted electric vehicle charging ports. Then, in 2024, Greenboats launched its latest application, the Greenlander *Sherpa* recreational vehicle (RV).

Greenlander *Sherpa*

The Greenlander *Sherpa* is a premium camper developed by Greenboats with design partner Langefreunde Design Studio (Schwerin, Germany) and manufacturing partner Borco Höhns GmbH (Rotenburg, Germany).

All of the exterior structures for the camper are constructed from Greenboats' flax fiber composite sandwich panels. The company built the first few iterations of the RV, which was presented to the composites industry at the JEC World 2024 trade show in Paris, France, and to the RV industry at the Caravan Salon 2024 in Düsseldorf, Germany, at its own facility. Ultimately, partner Borco Höhns will build the production vehicles using panels supplied by Greenboats.

This product, Schirmer says, represented a way for the company to showcase the potential of its panels and the types of applications they are suited for while also creating a consumer product that fits with Greenboats' premium RV brand. According to him, early feedback from the industry and customers has been very positive.

"With this project, we've started delving into the circular economy as well," he adds. One goal is for customers to be able to return Greenlander *Sherpa* vehicles back to Greenboats at their end of life, and for the company to reuse the composite panels to build new campers or other applications.

A circular economy model

The Greenlander *Sherpa* project led Greenboats to the latest iteration of its business model, which it calls its Circular Structures platform, also launched at JEC World 2024.

Part of the impetus for this platform is economic, Schirmer admits. One way to market a premium natural fiber composite product versus a less expensive option is to add the benefit of full recyclability — customers can return a part or panel back to Greenboats at the end of its life for recycling or reuse.

"Another part of this model is design for recycling — designing components from the outset anticipating how it will be reused for a second or third lifespan," Schirmer says.

Representing a new end market for Greenboats, the Greenlander *Sherpa* was launchd at JEC World 2024 and the Caravan Salon 2024. Source | Greenboats

How does this work, logistically? One method is to sell products with a specific lifespan already in mind — at the point of sale, the client already knows they will return the products to Greenboats after a certain number of years, for example. Another way to do this that Greenboats has considered is to attach sensors to the manufactured laminate for structural health monitoring. "So when a part comes back to the plant, we have data on its structural integrity," Schirmer explains. Either method, or a combination of both, allows Greenboats to plan ahead and anticipate what materials will be returned to them in a given time frame.

What happens to a product when it's returned to Greenboats? Assuming it is structurally sound and undamaged, the company's technicians can simply treat the surface of the laminate to make it look new again and then resell — even to the same client — at a lower rate for a new application. The idea is to create an ecosystem where sustainability is as simple as possible for consumers.

"This is our vision," Schirmer explains. "We have two levels to our sustainability goals. One, we use materials that have a lower CO_2 impact compared to typical materials on the market. That's natural fiber composites, that's bio-based resins and recycled or plant-based core materials. Two, we use every product as many times as it can be used. That's circularity."

Next steps: Continuing innovation, adapting to market changes and challenges

Along with discovering new market opportunities, Greenboats continues to improve its materials and process capabilities. This includes increasing automation, particularly in its panel manufacturing process. "We were able to drive down process costs significantly by investing in the larger press — our costs per square meter are decreased by a factor of 10 compared to the smaller machine. We're really happy with the results," says Schirmer.

Another cost-reduction challenge is improving surface finish. Natural fibers in particular have a tendency toward discoloration during processing. One way to work around this is to paint or coat the part, but Schirmer acknowledges that often, a company wants to show off the look of natural fibers. Varnish is the typical solution, but can be expensive. A big research area for Greenboats is working on integrating clear films into the press on the exterior sides of panels, which Schirmer says would be a less expensive and more efficient option.

In the near future, Greenboats aims to expand its operations with a manufacturing partner in North America, to acquire a second panel press and begin producing panels for a wider customer base.

Beyond boats and campers, Greenboats has produced prototypes or series parts for a variety of customers, including this electric vehicle charging station cover that was on display at the company's JEC World 2024 booth. Source | *CW*

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Pushing limits: Sustainability *and* cost-effectiveness

While sustainability is a concept that many industries are striving toward in various ways and for various reasons, there are still challenges to marketing and scaling up solutions like bio-based material alternatives.

Schirmer reflects back on the hype and excitement around sustainable solutions that followed the industry's return from the COVID-19 pandemic. "Sustainability was exciting, and people *wanted* to get into this field," he says. Many companies took the time and funding to build prototypes with natural fiber materials, but in many cases materials costs led them to choose less expensive options. "Now, it feels like many are simply waiting to see whether government regulations are going to dictate that they *have* to do this."

The challenge is keeping the momentum going with serial products and getting bio-based materials into the *right* applications — leading companies like Greenboats to diversify into new verticals, like the Greenlander *Sherpa* camper. "The market has to offer a combination of performance, cost *and* sustainability. This is where we come in. We know the technology and how to do it cost-effectively," Schirmer says.

Still, the market is moving forward. Many customers come to Greenboats with a 5-year sustainability plan, and they figure out together how biomaterials will be part of that. "We're not at that place where *everyone* wants to try it," Schirmer says, "but we are at a place where we know how to use and scale the technology better than before. The customers using these materials and buying these products see their value, economically and environmentally, and I think that will continue to grow." CW

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The carbon fiber composite roof of the Maserati MC20 is achieved using HP Composites' AirPower technology, a derivative of bladder-assisted compression molding (BACM). Source | Maserati

Bladder-assisted compression molding derivative produces complex, autoclave-quality automotive parts

HP Composites' AirPower technology enables high-rate CFRP roof production with 50% energy savings for the Maserati MC20.

By Stewart Mitchell / Contributing Writer

» In the realm of high-performance automotive manufacturing, carbon fiber-reinforced plastic (CFRP) components have become increasingly crucial for achieving optimal strength-to-weight ratios and complying with stringent efficiency requirements. However, traditional CFRP production methods, such as autoclave curing, often struggle to meet the demands of automotive production rates, consistency and cost-effectiveness. HP Composites (Ascoli Piceno, Italy) has developed its proprietary AirPower technology to address these challenges head-on.

By integrating a derivative of bladder-assisted compression molding (BACM) principles with tailorable material science and process control, AirPower has successfully enabled the production of the Maserati (Modena, Italy) MC20 supercar's complex CFRP roof at a rate of 1,500 units per year, demonstrating its capability to deliver complex, high-quality composite components at niche, automotive-scale production rates.

Enhancing BACM for automotive applications

AirPower technology builds upon the proven advantages of BACM, which has demonstrated its ability to produce aerospace-grade composite structures with fiber volume contents up to 67% and voids as low as 0.2%. The core of the BACM process lies in its use of an inflatable bladder system within a press mold, enabling the application of tailored pressure control throughout the composite laminate and the entire production process.

Traditional BACM machinery consists of a metallic press mold with upper and lower sections and an inflatable bladder on the top section that acts as the counter mold for the

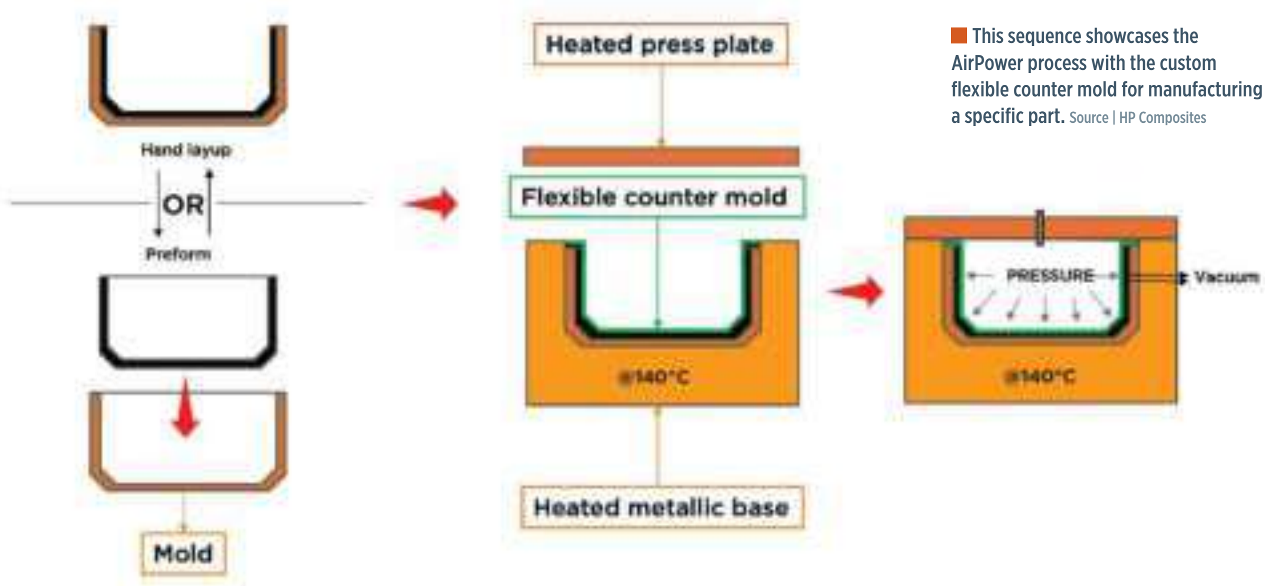
The Maserati MC20 features a body structure that highlights a composite central tub and roof structure, which are connected to two aluminum subframes at the front and rear. Source | Maserati

lower section. HP's AirPower technology enhances this design by introducing a split lower mold design and a custom flexible counter mold that combines the functions of a bladder and a vacuum bag. The split lower mold consists of upper and lower sections, with the lower half being a metallic structure serving as the heated surface, and the upper half being a detachable, thin CFRP shell. This innovative design allows for prepreg ply placement on the upper section without initiating curing while maintaining the lower part at the curing temperature. The shell's CFRP construction ensures proper thermal and residual stress management due to its coefficient of thermal expansion matching the manufactured parts. The flexible counter mold, mounted to the thin CFRP shell, seals to the outer edge of the lower mold when the mold is closed, enabling the provision of air pressure on the top and vacuum on the bottom of the flexible counter mold during manufacturing.

Vincenzo Castorani, R&D project manager at HP Composites, explains: "The lower part of the bottom mold is kept at the part's curing temperature while the upper CFRP section acts as a thin thermal separator from the heat source, allowing us to laminate the piece without starting the curing process until we are ready. By maintaining the mold at a constant temperature of 140°C, AirPower eliminates the need for repeated heating and cooling cycles, resulting in up to 50% energy savings compared to traditional autoclave methods."

Custom inflatable bladder

HP's flexible counter mold is the key component to its AirPower composite manufacturing tool, as it is designed to apply uniform pressure to the composite laminate, even in areas with complex geometries or undercuts. HP Composites custom designs and manufactures its flexible counter molds for clients, controlling »



This sequence showcases the AirPower process with the custom flexible counter mold for manufacturing a specific part. Source | HP Composites

The custom counter mold for the construction of CFRP components using AirPower technology. Source | HP Composites

the thickness, hardness and material composition. A highly tailored synthetic rubber is used, made through custom polymerization of monomers to produce the desired characteristics.

Michelangelo Mastroberti, sales manager at HP Composites, emphasizes the importance of the flexible counter mold design. "The thickness of this synthetic rubber is tailored exactly for that flexible counter mold's role in the pressure application and curing," he states. "The chemistry of the rubber is homogenous throughout, and its design features [thickness and rubber type], geometry and sealing surfaces are adapted to the part it is producing, ensuring the required durability and consistency throughout the production run."

The flexible counter mold manufacturing process begins with the preparation of a solid female mold that matches the desired geometry of the bladder. The mold is designed to accommodate the specific requirements of the composite part being manufactured, including any complex shapes, undercuts or integrated inserts. Next, a measured quantity of the custom synthetic rubber material is then applied into the mold.

The female mold, in combination with the synthetic rubber, undergoes autoclave curing using a specific curing cycle. The sealing portion of the flexible counter mold is crucial for maintaining pressure and vacuum, so it requires special attention.

Once the curing process is complete, the flexible counter mold is demolded and carefully inspected for defects or irregularities, and any excess material is trimmed away. It then undergoes rigorous quality control checks to ensure its dimensional accuracy, surface finish and mechanical properties, as well as pressure testing to validate performance under simulated manufacturing conditions.

The flexible counter mold manufacturing process, while intricate, is designed to be tailorable and repeatable, enabling the production of duplications to support the manufacturing run of composite parts at automotive-scale production rates. HP Composites has developed specialized expertise in flexible counter mold manufacturing, with a dedicated department focused on the design, production and maintenance of these critical components.

Thermal management and energy efficiency

Thermal management is a critical aspect of AirPower technology. The AirPower machinery is heated using electric resistance, with heated cores passing through the upper and lower metallic press structures. An in-house designed power supply system ensures uniform temperature distribution across the mold surfaces. "Recent manufacturing runs demonstrated a 50% reduction in energy consumption compared to conventional inflatable bladder molding processes," explains HP's team. "This increased energy efficiency reduces production costs and contributes to a lower environmental impact.

"While the AirPower technology requires metallic molds and synthetic rubber countermolds, which initially contribute to higher environmental impacts, these are offset by the extended service life of the tooling compared to autoclave molds," HP's team continues. "Additionally, autoclave processing relies on consumable vacuum bags, which must be frequently replaced, leading to additional waste and resource consumption. As the composites industry continues to prioritize sustainability and environmental responsibility, technologies like AirPower will play a significant role in reducing the ecological impact of manufacturing processes while maintaining the high-performance standards required by demanding applications."

Vacuum line connections in the lower mold section of the Maserati MC20 roof mold enable the application of air pressure on the top and vacuum on the bottom of the flexible counter mold during manufacturing. Source | HP Composites

Maserati MC20 roof material development, structural design

HP Composites partnered with Maserati to manufacture the roof of the company's top-of-the-line sports car, the MC20, using its AirPower technology. For this application, HP Composites developed a bespoke CFRP prepreg, featuring a weave architecture engineered to optimize both structural performance and manufacturing efficiency. The result is a high-grammage woven CFRP fabric that allows for fewer plies to be used, accelerating the lamination process, with engineered drapability facilitating the production of the roof's complex geometries.

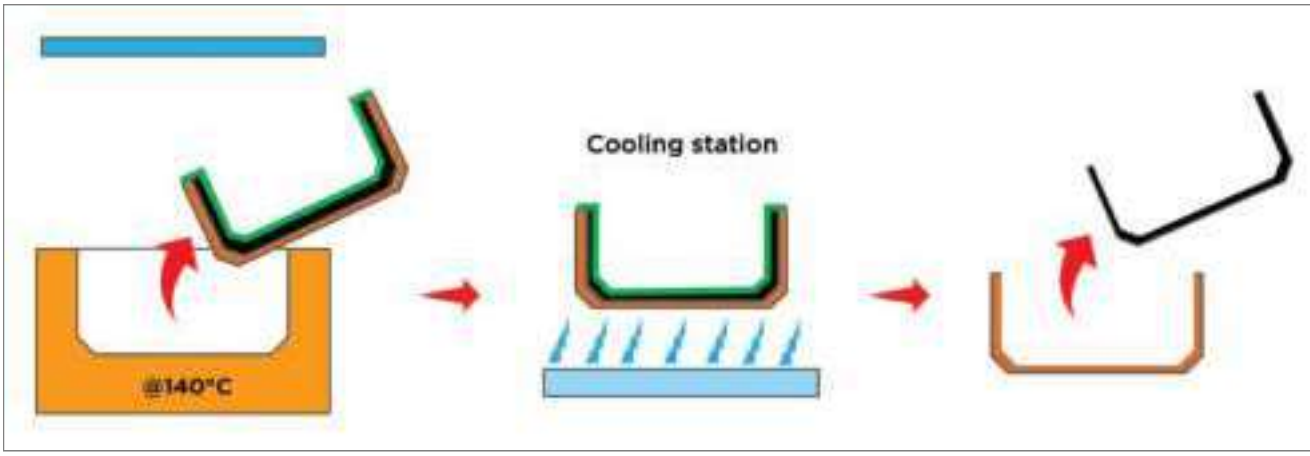
Developing the bespoke CFRP prepreg material involved extensive collaboration between HP Composites and Maserati. The material was characterized through a series of tests to establish its performance characteristics and create material cards. This data enabled the design of the ply book, taking into account the manufacturing process and the need to reinforce critical areas such as the A-pillar and B-pillar.

Gianluca Monsurrò, design lead at Maserati, outlines the design philosophy: "The primary goal was to maximize the integration of the roof with the car's main body, allowing us to minimize the use of materials while meeting performance requirements and creating the lightest possible roof structure." The MC20 roof incorporates a series of aluminum inserts, which play a crucial role in its structural integrity and integration with the vehicle. HP Composites also developed a bespoke lamination process to establish a suitably strong connection between the composite and metallic inserts. This process includes surface treatments to prevent galvanic corrosion and ensure strong adhesion for optimal performance.

■ The stages of prepreg layup for the Maserati MC20 roof structure. In the far left image, the upper layer of the roof structure is laid down. The central image illustrates the bonding phase process with aluminum inserts positioned within the structure. The far right image reveals the interior skeleton layer of the structure.
Source | HP Composites

Manufacturing process optimization

HP Composites designed a bespoke production process for the MC20 roof to ensure effective consolidation and minimal voids. During part consolidation, air pressure above the custom flexible counter mold applies up to 8 bar of pressure onto the top while a vacuum is drawn underneath. The roof construction process involves multiple »



This image sequence illustrates postprocessing of a specific part. Cooling is managed within the mold by separating the lower mold (far left) into upper and lower sections, which prevents a direct thermal pathway between the part being molded and the hot lower section. The part is then removed from the press and further cooling is optimized in a cooling station (center). Once cooling is complete, the CFRP part is demolded from the thermal separator (right).
Source | HP Composites

multilayered CFRP structures bonded together, which must be perfectly matched during the manufacturing process. The firewall is also bonded to the roof structure in the same process.

Thermal management during the demolding process was a critical consideration to ensure the geometric stability of the finished product. HP Composites engineered the AirPower equipment to control the cooling rate precisely, preventing any thermal stresses that could lead to part distortion or damage. The cooling rate was carefully balanced to maintain an industrialized process while avoiding damage to the part. Laying up the prepreg to a fully consolidated part takes just 2 hours. Post-cure operations — including trimming, drilling and surface finishing — are carefully executed to maintain the integrity of the composite structure and its interface with the metallic inserts.

Process control, quality assurance

HP Composites employs nondestructive testing methods, such as thermography analysis and ultrasound, as robust quality control measures. The Maserati MC20 roof was subjected to rigorous testing to validate its structural performance and contribution to the vehicle's overall torsional rigidity and crash safety. The testing regime included cyclic loading to simulate impacts from the road to the main structures of the A-pillar and B-pillar, as well as vibrational tests to understand the bonding between the metallic and composite structures. Castorani notes: "We found that the level of compactness of the laminate and performance was exactly the same as from a far longer and more energy-intensive autoclave manufacturing process."

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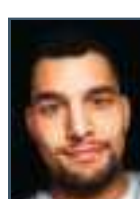
The final roof structure, weighing just 26 kilograms, contributes significantly to the MC20's lightweight design, with the entire vehicle weighing only 1,200 kilograms. The roof's structural integrity performance under crash situations met all the required targets, demonstrating the effectiveness of the AirPower technology in producing high-performance composite components.

Scalability and industry impact

At maximum production capacity, HP Composites can manufacture eight MC20 roofs per day in a two-shift operation. "To produce the 1,500 production run sets per year for Maserati, we needed only eight flexible counter molds in total," says Mastroberti. "To do the same with autoclave technology, you'd need 30-plus molds and a considerable number of autoclaves."

The success of the MC20 roof project underscores AirPower's potential for broader applications in the automotive composites industry. HP Composites is already applying this technology to produce other components for the Maserati group, including side skirts, front and rear diffusers, and splitters. For some of these parts, the company has implemented fast-curing resin systems, further reducing production cycles from a couple of hours to less than 20 minutes.

The scalability of AirPower technology extends beyond the automotive sector. Mastroberti notes that the company is exploring opportunities in satellite and space applications, leveraging the technology's ability to produce parts with varying geometries and complexities without compromising on quality. CW



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APPLICATIONS

CFRP planing head: 50% less mass, 1.5 times faster rotation

Novel, modular design minimizes weight for high-precision cutting tools with faster production speeds.

» Woodworking customers are demanding not only higher surface quality and precision but also higher productivity. Lighter and stiffer tools could help meet these demands, achieving higher speeds. However, current aluminum cutting tools have exhausted their lightweight potential. The German Institutes of Textile and Fiber Research (DITF, Denkendorf) sought to address this in a federally funded joint project, working with the Institute for Machine Tools (IfW) of the University of Stuttgart. After the project, DITF and global woodworking tool producer Leitz (Oberkochen, Germany) produced and tested a prototype. The partners succeeded in demonstrating a carbon fiber-reinforced polymer (CFRP) planing head that reduced mass by 50% versus a roughly 8-kilogram aluminum tool. But instead of simply replacing the aluminum with CFRP, a totally new design was developed using computer simulation.

CFRP planing head reduces mass versus aluminum from 8 to 4 kilograms, enabling rotational speeds up to 18,000 rpm. Source (All Images) | DITF

This virtual development resulted in a modular tool comprising CFRP triangular components that absorb centrifugal forces, and an outer shell that handles bending and torsional loads. Orienting the carbon fiber to handle the loads in these structures further aids in maximizing weight reduction but also achieves a high stiffness and the ability to optimize eigenfrequencies — the natural frequencies at which the system vibrates. This combination improves the tool's dynamic behavior, enabling a rotational speed 1.5 times higher than the previous tool's limit of 12,000 rotations per minute (rpm).

First, numerical simulation was used to develop many concepts. Next, evaluation using finite element analysis (FEA) identified the best final concept. Further analysis defined forces at speeds up to 18,000 rpm, as well as stress and strain fields of each component. The stiffness of the triangles, which bear the centrifugal force during rotation, prevents a change in the outer diameter. Note, these triangles include the carriers for the rows of cutting knives. Thus, a change in the circumference or "fly circle" of the cutting edges during rotation is not allowed because it reduces the precision and surface quality of the wood during planing.

Analysis results enabled final sizing and composite layup of the CFRP components. A 200-millimeter-long triangular tube was produced using wet filament winding with HTA40 E13 6K tow carbon fiber (Teijin Carbon Europe, Wuppertal, Germany) and Epikote RIM135 epoxy (Westlake Epoxy, Houston, Texas, U.S.). The resulting 26-layer tube was oven cured for 12 hours at 84°C with an attached outer metal tool to apply pressure, achieving a constant final wall thickness of 5.5 millimeters. The tube was cut into 13 12-millimeter-wide slices.

The outer shell was made by wrapping 23 layers of dry bindered 245 gsm fabric woven (Teijin Carbon Europe) from 3K carbon fiber around a star-shaped mandrel. Vacuum-assisted resin infusion was also used with Epikote RIM135 epoxy injection resin, and the resulting laminate was oven cured under vacuum for 12 hours at 80°C to produce a 155-millimeter-long part with a wall thickness between 4.8 and 5.5 millimeters.

Fiber content for the triangular and star-shaped tubes was 73% and 72% by mass, respectively. Quality was confirmed using computed tomography, and the CFRP parts — including six 10-millimeter-diameter CFRP rods made by CG-Tec (Spalt, Germany) for further weight savings — were sent to Leitz for processing and assembly. The same knives, screw mounting and aluminum end


The modular design assembled by Leitz comprises CFRP triangular components to handle centrifugal forces and a star-shaped outer shell for bending and torsional loads, all made by DITF, as well as six CFRP longitudinal rods supplied by CG-Tec.

clamping fixtures used in the baseline aluminum tool were included in the CFRP tool design.

The final prototype was tested in operation and monitored with high-speed cameras. No difference in quality was detected compared to the aluminum tool and all rows of knives operated homogenously. This same performance was proven in simulations up to speeds of 18,000 rpm, but testing in actual machines awaits system modifications as no metal tools currently allow such speeds.

Increased rotational speed directly increases production speed. The CFRP tool also improved dynamic behavior for high precision and surface quality. Thus, meeting increased production demands is possible with two machines instead of five. Further, a 50% lighter tool enables the use of smaller motors, which require less power and energy consumption. This concept can also be applied not only to other cutting tools but adapted for many applications where cylindrical structures rotate at high speeds (such as driveshafts) and where such high mass reduction with minimized deflection and vibration could have significant benefits.

This new lightweight CFRP planer head design was recognized with the JEC World Innovation Award in 2024. CW

NEW PRODUCTS

» Customizable thermoplastics processing equipment

Continuous roll ply stacking, tape slitting equipment geared toward thermoplastic part production

Re:Build Manufacturing (Framingham, Mass., U.S.) announces TPX, a new line of slitting and off-axis, continuous roll ply stacking equipment for thermoplastic composite material and component manufacturers. Re:Build's automation team collaborated with Re:Build Oribi, which produces thermoplastic components to design and build customizable composite converting equipment to improve the production efficiency of continuous fiber-reinforced thermoplastic (CFRTP) parts. Through this collaboration, Re:Build has developed and piloted the equipment internally, and now has optimized it for the broader market, equipping customers to bring thermoplastic composite parts to market faster at a reduced cost.

The TPX product family enables manufacturers to slit tape to specified widths and to pre-stack tape into a specified format (width, thickness, roll length, ply shape) to produce tailored, offset laminates with varying ply orientations in a continuous roll. Designed to meet tolerance and volume demands for a range of industries — including aerospace, automotive, energy, and sports and recreation — the TPX portfolio can be customized by Re:Build's automation team to meet any specific application requirements.

The two products offered in the TPX product line include:

- **Tape slitter**: The slitter provides a compact alternative to standard slitting equipment, offering a footprint 65" wide × 138" long × 95" tall and operating at production rates up to 200 ft/min.
- **Continuous roll ply stacker**: The standard ply stacker offers ply orientation options of 0°, 30°, 45°, 60° and 70° (all +/-) and uses ultrasonic tacking for ply-to-ply adhesion. Users can create and build custom ply stacks to achieve the desired material performance while accounting for batch size, timeline, material type and part purpose.

Both systems are built to process commercially available thermoplastic tapes (6-24" wide), but can be customized to meet nearly any requirement, according to the company. TPX equipment also works with a wide range of thermoplastic polymers and any fiber type (continuous glass, carbon, aramid). While the slitter and stacker are independent machines, they can also be used in tandem to further reduce production time, labor requirements and development costs. **rebuildmanufacturing.com**

» Agitated pressure reactor

Fixed-tank dual-shaft mixer improves control for fiber-reinforced composites

Charles Ross & Son Co. (Ross, Hauppauge, N.Y., U.S.) introduces the Ross FDA-50 fixed-tank dual-shaft mixer, a custom-design agitated pressure reactor ideal for processes that require meticulous control over mixing, temperature and pressure in a compact and portable module.

Built to handle a range of formulations and viscosities, the stainless steel type 316 dished bottom vessel and removable dished cover can accommodate internal pressures up to 100 psi, stamped according to ASME Section VIII, Div. I. This mixer is suited for fiber-reinforced composites, depending on the size of the fibers and the viscosity of the product.

The mixer/reactor is equipped with two agitators. The high-speed disperser features two 6" sawtooth blades — one fixed at the bottom and one adjustable along the shaft. It is driven by a 5-hp explosion-proof motor up to 1,760 rpm, creating a vortex into which dry ingredients can be delivered for fast wetting. The disperser is belt-driven with removable drive motor, belt and guard. The two-wing anchor agitator is direct-driven by a 5-hp explosion-proof removable gearmotor up to 45 rpm. The anchor feeds product toward the high-speed disperser blades and confirms that the batch contents are never stagnant in any one area. Dry-running single mechanical seals compatible with various solvents are used on the mixer shafts. **mixers.com**

» Composite molding release agents

PFAS-free water-based release agents improve operational sustainability

Chem-Trend (Howell, Mich., U.S.), a Freudenberg Chemical Specialities Group company, and developer of high-quality release agents, purging compounds, and other process chemicals and additives, presents water-based release agents that are also PFAS-free, such as Zyvax 1070W and the integration of the Mavcoat brand. Designed for a wide range of applications, these release systems are intended to improve overall operational sustainability for composites molding processes.

Originally engineered to meet the rigors of aerospace composite applications, Chem-Trend's water-based release agents are said to be robust, developed to ensure suitability and performance. They are making headway into various other composite molding applications where solvent-based technologies are optimal due to their release performance, fast evaporation rates and film-forming properties.

Solvent-based release agents pose potential health, safety and environmental (HSE) concerns, including fire hazards and significant volatile organic compound (VOC) emissions. Chem-Trend says its portfolio eliminates these issues without sacrificing performance.

"Chem-Trend has been successful in developing and expanding our offering of water-based, PFAS-free technology for the wind, aerospace and advanced composite segments. Using our products, manufacturers are seeing improvements in the shopfloor environment with less odor and easier cleanup, as well as reduced plant emissions," says Dave Fenwick, business development director, composites.

Recognizing the role of advanced composites in e-mobility, which is enabling more innovative automotive part designs, Chem-Trend's technical team is working to solve the challenges of these manufacturers who are looking to maintain a high-quality part that is defect-free, while also extending the life of their molds and enhancing productivity. **chemtrend.com**

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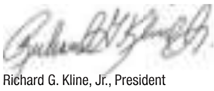


Richard G. Kline, Jr., President

» BMI core

Mid-temp honeycomb serves aerospace thermal management needs

Hexcel Corp. (Stamford, Conn., U.S.) has launched its nonmetallic Flex-Core HRH-302 mid-temperature honeycomb core. The bismaleimide (BMI) FlexCore HRH-302 is designed to sustain service temperatures up to 450°F, bridging the gap between traditional phenolic-based materials and high-cost polyamide solutions. It offers improved thermal capabilities while maintaining similar mechanical properties to existing honeycomb materials.

"The flexibility and thermal performance make it ideally suited for the complex curvatures and increasing heat loads found in next-generation aircraft nacelles," says Bobby Rowe, VP of product management, core and engineered products.

hexcel.com

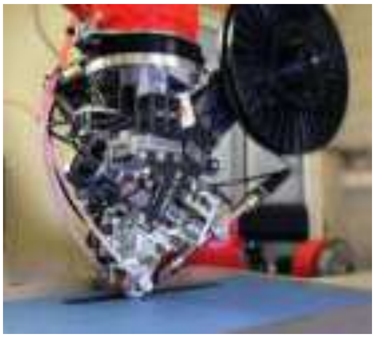
» AFP head

Standalone AFP head made easier with robot, gantry integration

Carbon Axis (La Rochelle, France) releases its automated fiber placement (AFP) head, the XPlace mk3. This is a standalone version that can be integrated with existing robots (from low to high payloads) or gantry systems.

The XPlace mk3 head is highly compact and only weighs 7 kilograms, making it easy to handle and enabling its use for complex composite part production. The AFP head comes with a dedicated controller and cable chain able to communicate with most machines through a Profinet fieldbus (i.e., based on Ethernet). Carbon Axis says that the controller comes Industry 4.0.

The XPlace mk3 head processes thermosets, thermoplastics and dry fiber, with material widths from 1/8–1". Material can be stored in two different configurations, a spool on board or a dedicated mobile creel system. To facilitate continuous placing of thermoplastic materials, it also includes a liquid cooled compaction roller.



In addition, the standalone version is compatible with the company's dedicated AFP software, XLay.

carbon-axis.com

SHOWCASE / MARKETPLACE

SHOWCASE

MANUFACTURING SUPPLIERS

POST CURE

Highlighting the behind-the-scenes of composites manufacturing

Continuous fiber injection reinforces 3D printed parts

» Reinforce3D's (Tarragona, Spain) patented continuous fiber injection process (CFIP) is a postprocessing technology for reinforcing 3D printed parts with continuous carbon fiber and resin.

First, a part with tubular cavities is designed and manufactured via 3D printing or another process. Next, specially treated carbon fibers and liquid resin are injected into these cavities using the CFIP machine, called Delta. Finally, the part is cured at room temperature or in an oven, depending on the needs of the resin used and the limits of the outer component. The Reinforce3D team helps design optimal fiber trajectories to maximize mechanical performance and optimize weight.

This image shows a satellite antenna support demonstrator that combines two 3D printed parts made in polyamide and aluminum. Continuous carbon fibers and epoxy were injected into the optimally designed trajectories (highlighted in green) to add structural reinforcement to the part and to integrally join both parts, providing end-to-end fiber continuity.

Read more about this process and potential applications via the QR code provided. CW

LEARN MORE


Source | Reinforce3D

Show us what you have!

Every issue of *CompositesWorld* concludes with Post Cure, a section highlighting the behind-the-scenes of composites manufacturing.

The *CW* team wants to feature your composite part, manufacturing process or facility in an upcoming issue. Send an image and caption to *CW* senior managing editor Grace Nehls at gnehls@compositesworld.com.

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