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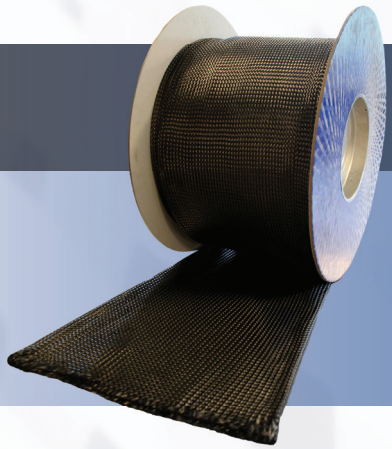
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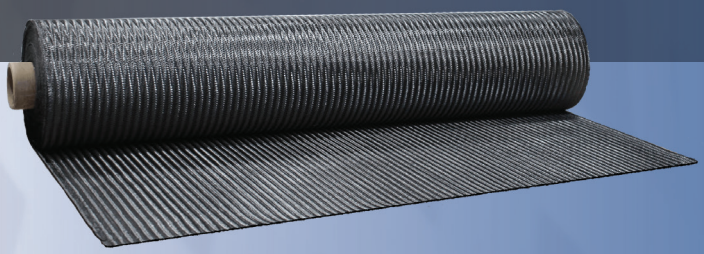
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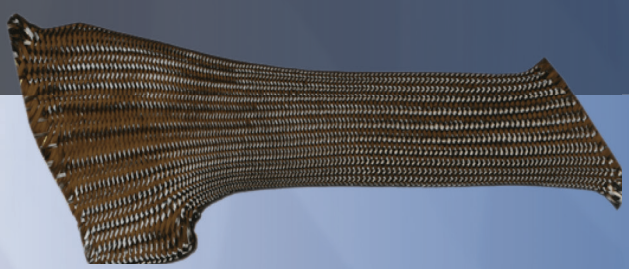
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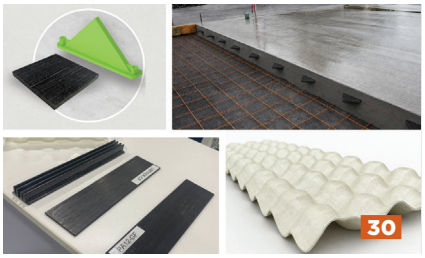
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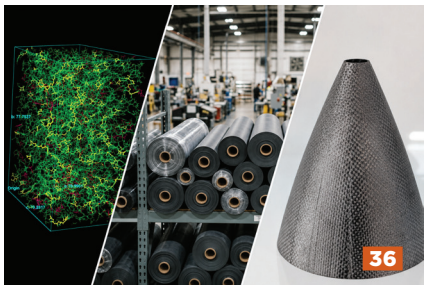
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» ON THE COVER

Traditonally, waterproofing membranes that protect tunnels from water ingress are anchored with steel bolts, but corrosion limits their service life. Oldroyd's new BasaBolt system, shown on this issue's cover, replaces steel with a hybrid basalt/glass fiber composite bolt and rebar, developed with resin partner Olin Epoxy using its low-carbon SustainaLine Litestone system. At roughly one-third the weight of steel, BasaBolt is designed for a 120-year service life and reportedly cuts installation weight up to 70%, reduces concrete use by 12% and lowers CO_2 emissions by 25 tons per 500 meters of tunnel. The system is now completing certification, with first deliveries targeted for 2027. See p. 24. Source | Oldroyd

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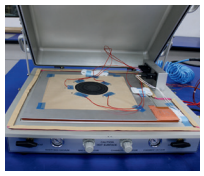
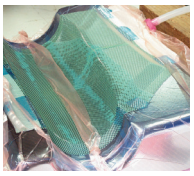
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Composites Industry Demands Speed at Scale



SCOTT FRANCIS
EDITOR-IN-CHIEF
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» Autumn always brings a busy trade show season, and in typical fall fashion *CompositesWorld* kicked it off with back-to-back trips in September. First came SPE ACCE, the Society of Plastics Engineers' annual automotive composites conference in Novi, Michigan. Then came CAMX, North America's largest composites and advanced materials expo in Atlanta. Two very different shows, with one targeting a niche market within the larger composites industry, and yet the conversations and the overarching themes continue to converge. Across both events, the discussion is no longer about whether composites can do the job — it's about how fast, how many and how soon.

SPE ACCE is, by nature, an automotive composites conference and exhibition. Yet as the automotive industry evolves, the conference finds itself exploring an increasing amount of crossover with other sectors — all largely driven by how we define the concept of mobility.

This year's conference theme, "Composites: Advancing Mobility," kept electric vehicles and sustainability at the forefront, but many of the keynotes at the conference told a broader story. Speakers from Shield AI and Joby Aviation shared the stage with General Motors and Michigan's Office of Future Mobility. Joby's talk was titled, fittingly, "Advanced Air Mobility — At the Intersection of Automotive and Aerospace."

That intersection is getting busier. Aerospace manufacturers are working to meet growing commercial and defense demand, qualify processes for next-generation programs, and move eVTOLs, air taxis and other advanced air mobility (AAM) aircraft toward certification. Automotive has spent decades learning to make parts quickly, repeatably and affordably. Each industry increasingly has something the other needs.

Meanwhile, many of the trends displayed and discussed at CAMX 2026 were continuations of stories *CW* has followed for years. What has changed and continues to grow is the *urgency*. High-rate production came up in nearly every conversation, especially in aerospace and defense, and there were several examples from the show floor. Loop Technology and Zünd paired fast preforming with integrated cutting and kitting. Companies like Coriolis showed automated fiber placement (AFP) machines with added AI process tools, Dieffenbacher highlighted forming presses tied to a digital platform and Cevotec offered a retrofit kit that adds robotic layup to existing robot cells. Hexcel, already a supplier for many programs, featured M901, a prepreg that cures in 4-5 minutes, aimed at drone, defense and automotive programs.

Like SPE ACCE, mobility also continues to be an area of focus at CAMX. A panel discussion on the Innovation Stage featuring Airbus, General Motors, FILL, Tensen Group and IACMI tackled speed to market, and Joby led a separate discussion on getting the AAM supply chain ready for production.

The use of composites in infrastructure was another important trend on many people's minds at the show, not to be forgotten amidst the aerospace and defense surge. Data centers and electrification came up repeatedly, with this year's awards making the case for composites in the built environment. The CAMX Combined Strength Award went to large-format 3D printed thermoplastic formwork for nuclear construction from Oak Ridge National Laboratory (ORNL), Kairos Power, the University of Maine and partners, demonstrating the ongoing ramp-up of 3D printing and its increasing role as a rapid, low-cost manufacturing process. Meanwhile, ACE award winners included Strongwell, Frost Engineering and Northstar for composite coastal homes built to hurricane codes; ORNL and partners for water-soluble mandrels used to make Type 5 tanks; and the National Laboratory of the Rockies for a recyclable wind blade resin, PECAN.

In the midst of all the discussion of processes and technologies, these industry events as a whole are always a good reminder that the heart of the composites industry is people. From social gatherings designed to connect young professionals to student poster showcases to networking receptions, conferences and trade shows remain the best way to connect companies and talent.

This year's CAMX keynote speaker, Kevin Gaskell, former group CEO of BMW GB, Porsche GB, Lamborghini GB and Fairline Yachts, reinforced the importance of people in our industry. He argued that the most powerful resource in any business isn't capital or technology. It's human creativity. He framed leadership in three stages — commit, connect and engage — and reminded the room what composites companies really sell: "We're selling trust. We're selling reliability. We're selling confidence."

That struck me as the right message for an industry being asked to scale. Faster presses, smarter AFP heads and quicker-curing resins will get us part of the way. The rest depends on teams willing to decide quickly, learn from what goes wrong and invest their passion. As Gaskell stated, "People's best work has to be given, it can't be taken. We have to invite them to come with us." CW

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Mapping the AI Landscape in Composites: What's Working, What's Missing and What's Next

By Navid Zobeiry / Associate Professor of Materials Science & Engineering, University of Washington

» AI and machine learning (ML) applications in composites have grown significantly in recent years. AI/ML-enabled publications now account for more than 7% of the annual output in major composites journals, with applications extending across material design, processing and manufacturing, mechanics and performance, structural health monitoring and sustainability (Fig. 1). While part of this growth reflects the broader expansion of AI/ML across engineering disciplines, the composites community has also adapted these methods to address challenges that are specific to composite materials and structures.

To understand the current landscape, the University of Washington conducted a comprehensive review of AI/ML applications in composite materials[1]. The study included a bibliometric analysis of publications from seven major composites journals between 2010-2025. From a total of 50,361 publications, a targeted search identified 1,474 AI/ML-enabled papers. This was followed by an in-depth technical review of more than 200 representative studies covering different applications.

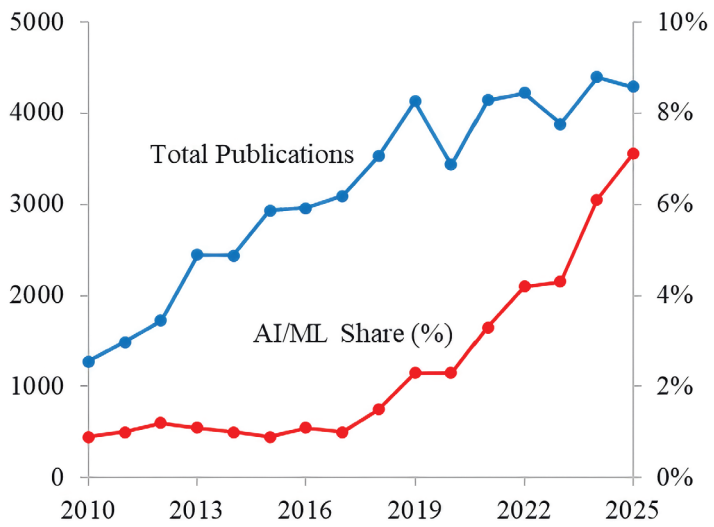


FIG. 1. **Yearly total publications of seven composite journals since 2010, AI/ML-enabled publications as a percentage of total publications.** Source (All Figures) | "Artificial intelligence and machine learning in composite materials: A comprehensive literature review and bibliometric analysis"

The analysis shows a clear change in publication activity around 2019. Before this point, AI/ML applications represented ~1% of annual publications in the selected journals. This share increased rapidly over the following years, reaching ~7.1% in 2025, corresponding to more than 300 papers in that year alone.

Why AI/ML is being used in composites

Despite the wide adoption of composites, significant challenges remain in material development, manufacturing, design, optimization and certification. Major progress has been made in high-fidelity, multiscale and multiphysics simulation tools. However, complex model calibration and high computational cost often limit their applicability for design-space exploration and optimization. The inherently stochastic nature of composites further compounds these challenges.

AI/ML is increasingly used to augment experimental testing and physics-based simulation with fast data-driven models. In many applications, these models can provide near real-time predictions after being trained using experimental or simulation data. This makes it possible to explore large parameter and design spaces that would otherwise require a large number of high-fidelity simulations or experiments.

Beyond accelerating forward analysis, AI/ML is also changing how inverse problems are addressed. In composites manufacturing and structural applications, important quantities such as process parameters, internal material states, damage conditions or spatially varying boundary conditions may not be directly measurable. AI/ML methods can use sparse sensor data or targeted experimental information to infer these quantities. Similar approaches are increasingly used for inverse design, where the objective is to identify material architectures, layups or processing conditions that satisfy a desired response.

Another important area is the analysis of image- and time series-based data. Thermography, X-ray computed tomography (CT), microscopy, digital image correlation, acoustic emission and guided waves generate large datasets that are difficult to analyze manually. AI/ML methods are increasingly used for image segmentation, defect classification, feature extraction and pattern

recognition, enabling automated analysis and, in some cases, in-process monitoring and control.

Composite materials also present a particularly challenging problem for AI/ML. Material and process variability exist across multiple length and time scales. Variability at the constituent and microstructural scales can influence laminate properties and structural response. At the same time, material storage, manufacturing, testing and service introduce different time scales that can influence material state and performance.

Composites manufacturing also involves sequential processes. Variability in raw material state and processing conditions can affect microstructure and defect formation. Uncertainty introduced during an early processing step may therefore propagate and ultimately contribute to panel-to-panel and batch-to-batch scatter in the final part. These characteristics become particularly important when AI/ML is used beyond prediction and optimization to support testing, qualification and certification.

AI across the composites life cycle

The university's review shows that AI/ML has now been applied across the composites life cycle. We organized these studies into four main categories: Material Design & Properties, Processing & Manufacturing, Mechanics & Performance and Structural Health Monitoring & Sustainability. Under these four categories, 17 subcategories were identified (Fig. 2).

In Material Design & Properties, AI/ML is increasingly used to establish structure-property relationships, predict properties from compositional and microstructural features, reconstruct microstructures from imaging data and support inverse design. Recent studies have moved beyond simple property prediction toward microstructure-aware models that use micro-CT, microscopy and related imaging methods to quantify features such as porosity, fiber orientation, tow geometry and phase distribution.

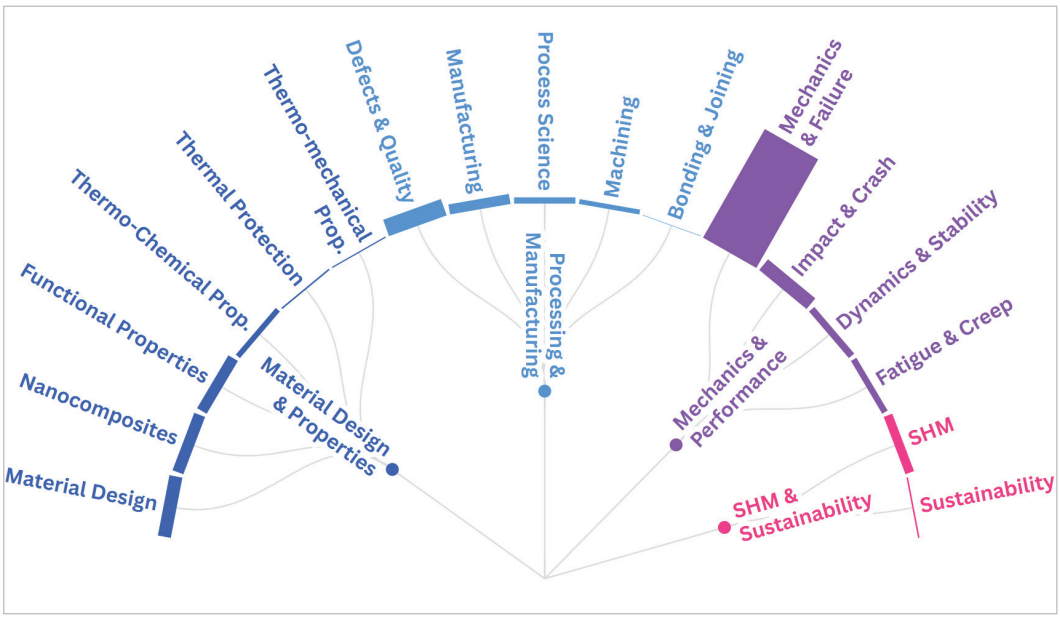
In Processing & Manufacturing, AI/ML is being used for process characterization, process simulation and optimization, in situ inspection, defect prediction and process control. Applications include automated fiber placement (AFP), additive manufacturing, resin infusion, autoclave processing, cure cycle optimization and process-induced deformation. The literature is also moving from deterministic black box surrogate models toward more physics-informed and uncertainty-aware approaches.

Mechanics & Performance has the largest AI/ML footprint. Applications include progressive damage and failure prediction, multiscale modeling, impact and crash response, fatigue, design allowables and inverse identification of material parameters. Much of this work uses finite element simulations to train fast surrogate models for damage prediction, failure envelope reconstruction and performance assessment.

Structural Health Monitoring has a smaller publication footprint, but AI/ML has become an important tool for interpreting acoustic emission, guided-wave, ultrasonic, thermographic and embedded sensor data. Recent studies are moving from damage detection and classification toward damage severity, residual strength and remaining useful life. Sustainability, recycling and reuse currently contain fewer dedicated studies, although there is increasing interest in property screening and process-structure property relationships for recycled and bio-based composites.

These applications show that AI/ML is moving beyond accelerated simulation toward broader integration with manufacturing data, inspection and structural performance. Potential applications include reducing simulation and testing effort, supporting process optimization and control, and enabling earlier detection of manufacturing defects.

FIG. 2. Taxonomy of composites research topics for AI/ML-enabled studies. Segment sizes are proportional to the number of AI/ML-related composite publications from 2010–2025.



Where research activity is concentrated

Although AI/ML now spans the composites life cycle, the distribution of research activity is highly uneven. Mechanics & Failure has the largest footprint, comprising approximately half »

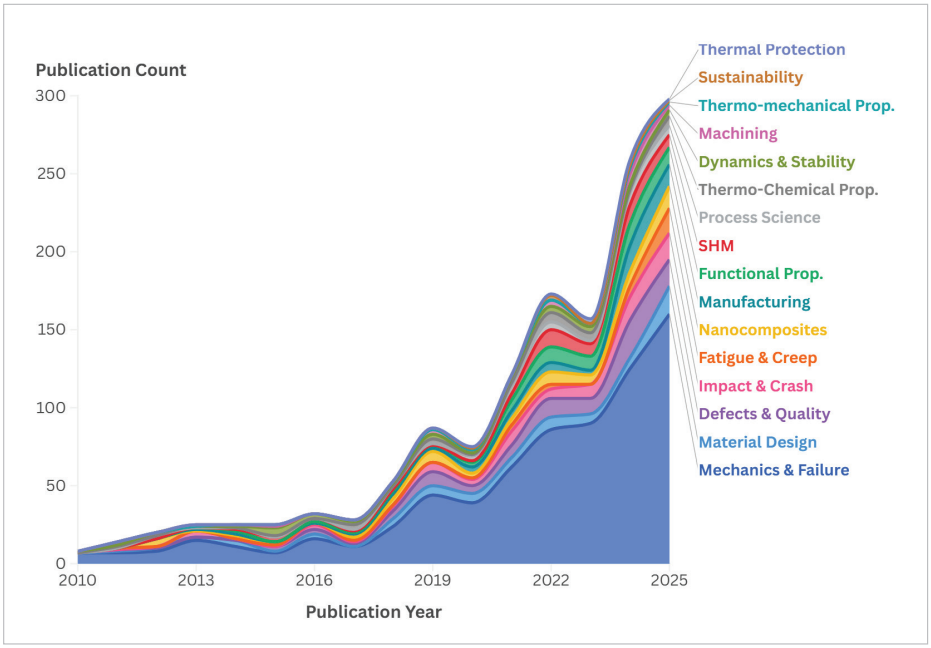


FIG. 3. Annual publication counts of AI/ML-enabled composites studies by topic.

of all AI/ML-enabled composites publications since 2010. In 2025, this category accounted for approximately 54% of AI/ML publications. In contrast, topics such as Bonding & Joining, Thermo-Mechanical Properties, Thermal Protection and Sustainability have much smaller publication footprints (Fig. 3).

The strong concentration in mechanics and failure is not surprising, given the complexity of composite damage and failure and the computational cost associated with high-fidelity simulations. However, several other areas show growing activity and may be particularly important for industrial applications.

Defects & Quality is one example. Vision-based methods are increasingly used for in-process inspection and classification of defects such as gaps, overlaps, wrinkles and twists in AFP. More recent studies are moving from postprocess defect detection toward forecasting defect formation before deposition is complete, creating a pathway to proactive process correction.

Process Science is another area where AI/ML may have a significant impact. High-fidelity thermo-chemical and thermo-mechanical process simulations remain essential, but characterization and computational cost can limit their use for optimization. Recent studies have applied AI/ML to cure simulation, resin flow, process-induced deformation, pyrolysis and kinetics characterization. Physics-informed models, theory-guided approaches and probabilistic methods are increasingly being explored in these areas.

Thermo-chemical properties, thermo-mechanical behavior and thermal protection currently represent smaller but emerging areas of AI/ML-enabled composites research, with increasing publication activity reflecting growing interest in these applications.

What is still missing

Despite the rapid growth in AI/ML applications, a significant virtual-to-real gap remains. A model can achieve excellent accuracy on simulation data or within a limited experimental dataset and still fail to represent the variability encountered in the next material batch, panel or manufactured part.

Much of the literature relies on data generated from deterministic finite element or representative volume element simulations, or on relatively small experimental datasets. Models are then often evaluated within the same data space, with performance reported using metrics such as R^2 or RMSE. While these results are useful, they do not necessarily establish reliability when material systems, processing conditions, geometries, loading conditions or service histories change.

This limitation is particularly important for composite materials because variability is inherent to the material and manufacturing system. Material state, batch-to-batch variability, panel-to-panel variability, fiber orientation, porosity, thermal history and process-induced defects can all contribute to scatter in final properties and performance.

Another important limitation is that most studies focus on a single process step, material system, geometry or processing window. Composites manufacturing, however, involves sequential processes in which material and process uncertainties can accumulate and propagate across the process chain. End-to-end models capable of tracking this evolution remain limited. This is particularly important for qualification and certification, where the quantity of interest is not only the expected response, but also its variability and the conservative bounds required for engineering decisions.

Validation also remains an important gap. Random coupon-level splitting can overestimate model performance when coupons from the same panel or batch share process history and defect statistics. Depending on the application, validation should instead consider held-out panels, batches, geometries, loading paths, processing windows or sensor configurations.

Data traceability is equally important. For deployable AI/ML, datasets should preserve information on material batch, processing history, test conditions, inspection methods and service history. Composite response depends strongly on this life cycle history, and models intended for engineering use need to retain that context.

Where the field is moving

The literature is increasingly moving from purely data-driven black box prediction toward approaches that incorporate available physics and uncertainty. Physics integration is particularly important for composites because experimental datasets are often sparse, while considerable knowledge already exists through analytical models, process models, finite element simulations and constitutive relationships. Incorporating this information can reduce data requirements and constrain models in regions where data is limited. However, physics integration does not remove the need for independent validation outside the training domain.

A second major direction is uncertainty-aware AI/ML. For many engineering applications, particularly qualification and certification, a point prediction is not sufficient. Models need calibrated prediction intervals and, where possible, separation of uncertainty associated with limited knowledge from the inherent variability of the material and manufacturing process.

Recent studies are also increasingly combining probabilistic models with sparse in situ sensing, targeted testing and Bayesian updating. These approaches can reduce experimental burden while providing a practical pathway for updating models when new materials, processes or operating conditions are introduced.

Overall, the literature shows that AI/ML is becoming more widely used across the composites life cycle, while composites-specific requirements are also influencing the methods being developed and adopted. The field is moving toward models that incorporate physics, material and process variability, uncertainty and information from real manufacturing and testing.

This is especially relevant when uncertainty accumulates across multiple processing stages, length scales and time scales before appearing as variability in final material properties and structural performance. Accounting for this evolution will be necessary for reliable use of AI/ML in material development, manufacturing, testing, qualification and certification. CW

REFERENCES

[1]H. Fu, A. Eskandariyun, P. Portales Picazo, K.A. Johnson, A. Morton, M. Wynn and N. Zobeiry, "Artificial intelligence and machine learning in composite materials: A comprehensive literature review and bibliometric analysis," *Composites Part A: Applied Science and Manufacturing*, 210 (2026) 110092. DOI: 10.1016/j.compositesa.2026.110092.



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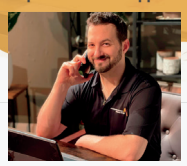
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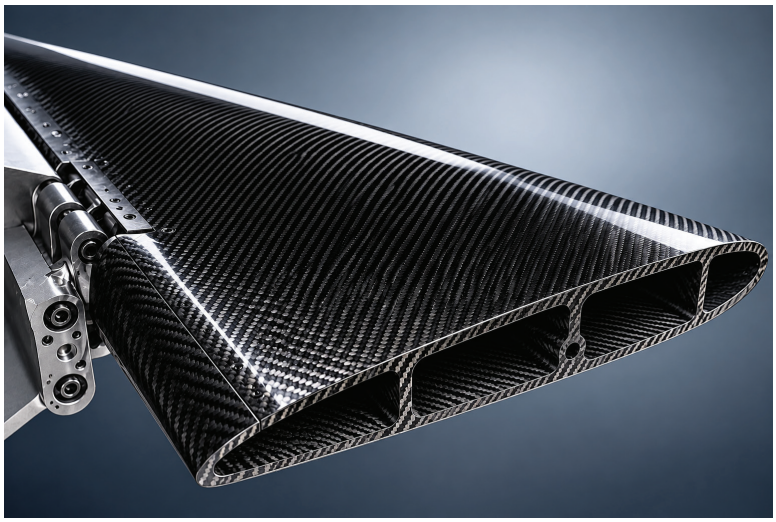
El Segundo: The World's New Aerospace and Composites Startup Capital?

By Yannick Willemin / President, Catalysium

» A few months ago, I wrote about Cambium and its remarkable $100 million Series B. The financing round stood out not only because of its size, but because Cambium increasingly looks less like a conventional materials startup and more like an attempt to build a vertically integrated advanced materials company.

Yet Cambium may be only one part of a much broader development taking place around its home in El Segundo, California.

Nearby Varda Space Industries is building spacecraft and reentry systems, and aerospace and defense startup Hybron is developing a new approach to high-rate composites manufacturing. Radiant is working on portable nuclear microreactors, while companies including Picogrid and CX2 are developing next-generation defense technologies. Composites 3D printing company Roboze has also selected El Segundo for its U.S. aerospace and defense headquarters. Expand the radius slightly, and the concentration becomes even more striking: SpaceX is in nearby Hawthorne, K2 Space is in Torrance and Impulse Space is located in Redondo Beach, alongside companies such as Hadrian and Castelion across the wider South Bay.



Victrex LMPAEK thermoplastic flight control surface showcasing the potential of high-performance, lightweight composite materials in aerospace structures. Source | Victrex

For Simon Waddington, co-founder and CEO of Cambium, that location has played a direct role in the company's development. "Cambium wouldn't be the company it is today if we'd built it anywhere else," he says. "El Segundo packs more aerospace and defense pedigree per square mile than anywhere in the country, with engineering talent, primes and supply chains all within a few miles of each other."

What makes this particularly interesting is that El Segundo is not a new aerospace cluster, but rather an old one being reconfigured.

Long before "hard tech" became an investment category, Southern California was already one of the world's most important centers of aerospace engineering. Douglas Aircraft manufactured aircraft in El Segundo; Northrop and Hughes built important parts of their histories in the region; The Aerospace Corp. was established there in 1960; and today, Space Systems Command maintains a major presence through the Los Angeles Air Force Base.

Then, in 2002, SpaceX began operating from a warehouse in El Segundo before moving to Hawthorne. Its influence on the regional ecosystem has arguably been as important as the rockets and spacecraft it has produced. In its time in California, SpaceX has helped train a generation of engineers, manufacturing leaders and operators around an operating model based on rapid iteration, vertical integration and close interaction between design, manufacturing and testing. Many of those people have subsequently moved into, or founded, other aerospace and defense companies across Southern California.

Where Silicon Valley has historically favored software and other asset-light models, this network is building companies around factories, machine tools, production lines, cleanrooms, test infrastructure and highly specialized manufacturing teams.

For years, venture capital treated that distinction almost as a structural disadvantage. Asset-light businesses were seen as inherently more scalable because growth did not require a proportional increase in physical infrastructure. Manufacturing, by contrast, was assumed to be capital-intensive, slower to expand and therefore less compatible with venture-style returns.

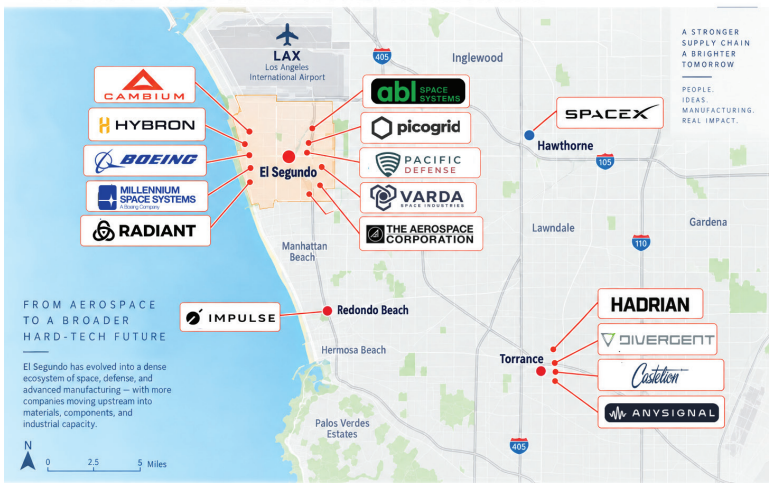
That assumption is now being challenged.

A new generation of advanced manufacturing companies is showing that physical production can also scale; not by avoiding assets, but by combining automation, digitalization, modular capacity and highly differentiated technology in ways that can produce both industrial leverage and venture-scale growth.

El Segundo's manufacturing ecosystem has rapidly developed over the decades, as illustrated by this timelapse of 1960, 2000 and 2026. Source | Yannick Willemin, with the assistance of AI







Both Cambium's $100 million Series B and Hybron's $25 million seed round to produce carbon fiber composite aerospace parts at automotive speeds, are recent examples. Varda and K2 Space have also attracted substantial capital to industrialize ambitious hardware platforms in El Segundo. These companies require significant investment long before they reach volume production, yet venture investors are increasingly prepared to finance them.

This convergence between venture capital and industrial hardware is particularly relevant for composites because many aerospace challenges ultimately become materials and manufacturing challenges.

New focus on speed

Cambium illustrates the point. Following its acquisition of SHD Group, Cambium's new focus is on speed as it expands from advanced materials development into prepreg production and a more vertically integrated composites offering. Hybron, meanwhile, is developing manufacturing technology intended to combine continuous fiber composite performance with production rates and economics closer to those associated with high-volume industries. Varda manufactures its own C-PICA thermal protection material for spacecraft returning from orbit, while Impulse Space has brought the design, manufacture and testing of composite-overwrapped pressure vessels in-house alongside propulsion, machining, avionics and spacecraft assembly. What links these companies is the growing strategic importance they place on materials and manufacturing, treating both as core capabilities instead of downstream purchasing categories.

Aaron Guo, co-founder of Hybron, sees a clear difference in the expectations of this new generation of aerospace customers. "New aerospace customers are focused on production scalability from the very beginning, with early iteration speed being a necessity," he says. Hybron chose El Segundo because of its engineering talent, proximity to aerospace and defense customers, and a community of founders and investors familiar with the broader push toward U.S. reindustrialization.

For the composites supply chain, that emphasis on iteration speed may have important consequences. Traditional aerospace supply chains were built around clearly defined tiers, extensive qualification programs and long development cycles. Those structures created the levels of reliability required by the industry »

and will remain essential. But the emerging model introduces an additional performance criterion: the ability to move quickly.

A new aerospace company may want to design, manufacture, test, modify and test again within a very short period. For its material and process suppliers, that can require a different level of involvement, especially if their technically highest-performing material may not necessarily represent the best commercial solution if introducing it requires years of qualification. Simulation capability, rapid manufacturing trials, engineering support and the ability to adapt alongside the customer can become part of the product offering itself.

Combining speed with industrial discipline

There is, however, a risk of taking the speed argument too far. Jonathan Sourkes, general manager at Victrex Americas, points out that established aerospace companies and the newer generation of "neo-primes" have much to learn from one another. Incumbents can learn from the willingness of newer companies to compress development cycles, retain critical capabilities in-house and make faster decisions with smaller teams. At the same time, newer entrants should not underestimate the knowledge accumulated by the traditional aerospace and materials industries.

> A 70-year-old aerospace engineering ecosystem is reconfiguring for a new era.

Qualification, certification, durability, repeatability and scale remain fundamental. Materials characterization, robust manufacturing processes, quality systems and long-term supply chain management are the product of decades of experience. While developing a prototype may be difficult, producing thousands of conforming components repeatedly over many years is an entirely different challenge.

The most interesting evolution may therefore be neither the replacement of traditional aerospace by startups nor the abandonment of established development practices. It may be the combination of startup speed with industrial discipline. El Segundo provides an unusually concentrated environment in which that combination can develop.

The density effect

Waddington argues that the density of this ecosystem affects Cambium in very practical ways, from recruiting to customer relationships and investment. He also links it to the company's acquisition of SHD, which he says progressed more quickly because many of the relevant people already knew Cambium and understood what the company was trying to build.

However, that same density creates constraints. Industrial space is scarce and expensive, while companies compete intensely for many of the same engineers, scientists and composite technicians. Nevertheless, proximity allows people and knowledge to circulate rapidly, e.g., engineers moving between employers without leaving the region or founders encountering other founders addressing similar problems. Specialized suppliers and manufacturing expertise remain from Southern California's earlier aerospace era, while government customers and procurement organizations are close by.

This is perhaps what distinguishes the current El Segundo ecosystem from the more familiar model of a technology cluster built primarily around a university or research institute. Its foundations — built over decades by established aerospace companies and institutions, then reinforced by SpaceX, and now being reused by a new generation of venture-backed hardware companies — are industrial.

Impact for composites supply chains

For the composites industry, the significance of that extends beyond the number of startups based within a few miles of Los Angeles International Airport. The more important question is what their operating model tells us about the future relationship between materials companies and aerospace manufacturers.

Material performance will remain fundamental, but it will increasingly coexist with demands for faster development, closer engineering collaboration and manufacturing scalability. Vertical integration may bring some capabilities inside the aerospace companies themselves, but it also creates opportunities for suppliers able to become genuine development partners rather than simply upstream vendors.

At the same time, the experience accumulated by established materials and manufacturing companies may become more valuable, not less, as these new aerospace businesses move from prototypes toward sustained production.

El Segundo was already known as an aerospace capital decades ago. What is emerging today is therefore not the creation of an industry from scratch, but a new iteration of an existing industrial ecosystem — traditional aerospace expertise combined with a different culture of entrepreneurship, venture capital willing to finance physical infrastructure and a renewed focus on manufacturing as a source of competitive advantage. CW



ABOUT THE AUTHOR

Yannick Willemin has an engineering degree in materials and mechanics from École Polytechnique de l'Université d'Orléans in France. Over the course of 13 years, he has held multiple positions at SGL Carbon, gaining deep expertise in the composites industry. At the same time, he earned two EMBAs with a focus on finance and entrepreneurship. Afterward, he joined ETH Zurich spinoff 9T Labs as head of business development. Since January 2025, Willemin has been working independently, positioning himself at the intersection of startups, industrial players and investors to drive innovation across the composites landscape with the founding of Catalysium. **yannick@catalysium.ch**


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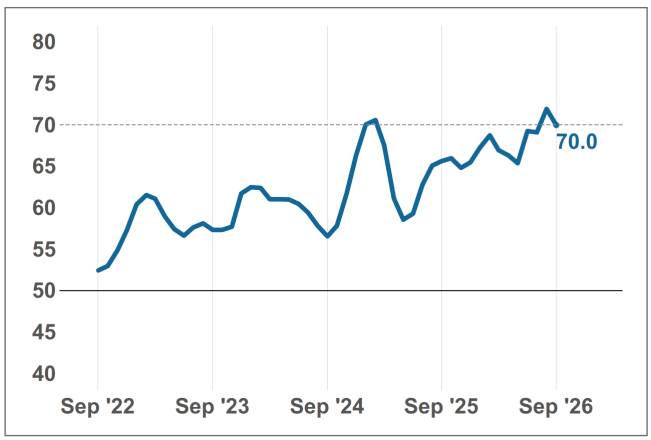
Mike Shirk, senior market research analyst, has been an essential part of GROW Industrial Intelligence for more than 8 years and has led research and analysis in various industries.
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COMPOSITES FABRICATING



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.

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SCORECARD

	Change vs Month Ago	Change vs Year Ago
Supplier Deliveries	▲	▲
Production	▼	▲
New Orders	▼	▲
Backlog	▼	▲
Employment	▼	▼
Exports	▼	▲

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

A single-step hybrid molding process has produced an electric sports car frunk; an NCC-led program finds recycled wind blade glass fiber can match virgin fiber's carbon footprint; GE moves toward first XA102 aeroengine assembly, to include CMC components; Beyond Gravity expands its CFRP satellite dispenser facility; and more.

AUTOMOTIVE

Röchling, Envalior Develop Structural TPC Frunk for Electric Sports Car

Röchling Automotive SE (Worms, Germany) and Envalior (Düsseldorf, Germany) are debuting a composite front truck, or "frunk," for a 100% electric, four-door sports car. The frunk is distinctive in that it doubles as both a storage space and a highly robust structural chassis component. Röchling produced the polypropylene (PP) frunk in a single hybrid molding step; it incorporates Envalior's Tepex organosheets reinforced with multiaxially oriented continuous glass fibers.

In electric vehicles, the frunk occupies the space where the engine sits in a combustion engine car and typically stores items such as charging cables or tools. This frunk in particular measures approximately 1,100 millimeters long, 450 millimeters wide and 370 millimeters high, with Tepex reinforcement in its rear wall and bolted floor sections.

Bolted to the strut brace at its upper flange and to the front axle carrier at the bottom, the frunk acts as a vertical shear panel that stiffens the front axle. According to the companies, its torsional stiffness prevents lateral forces from twisting the front body structure during sudden lane changes, crosswinds, high-speed cornering, off-road driving or racetrack use. This improves road contact and driving stability.

The multilayer organosheet laminate is tailored to the component's direction-dependent mix of tensile, bending and shear loads. It has continuous fibers oriented at 0°/90° in the outer layers, and ±45° in the inner layers. The 0°/90° fibers primarily improve crash performance, while the ±45° fibers support vehicle dynamics under high lateral loads.



"We can produce customized multilayer organosheets in high-volume production with continuous fibers oriented not only at 0° and 90°, but at virtually any angle required," says Klaus Vonberg, sales and project manager, global sales Tepex, Envalior. "This allowed us to engineer a customized organosheet for the frunk whose fiber orientations follow the exact load paths within the component, making it precisely adapted to the load-specific requirements."

Envalior notes that the multiaxial fabric layers withstand high degrees of forming. They resist fiber shifting and remain intact at component corners, which supports a reproducible forming process and consistent part quality.

To manufacture the frunk, Röchling developed a hybrid molding process that combines thermoforming of the Tepex organosheet with injection molding in a single mold. The process yields a finished component that requires no rework.

"Beyond the frunk's design as a highly load-bearing chassis component, the manufacturing process we developed represents another key highlight of the application. Achieving uniform mold filling despite the complex geometry — while simultaneously minimizing weld lines to ensure the part's high mechanical performance — was particularly challenging," says Matthias Schütte, global product manager for structural lightweight design at Röchling Automotive.

Vonberg adds that the hybrid molding process also enables cost-efficient, high-volume integration of additional features. That could allow future frunks to take on more complex geometries and functions while still carrying structural loads.

"In the future, it may be possible to integrate features such as cool boxes, drawers, cargo nets or holders for the charging cable directly into these frunks," Vonberg notes.

SUSTAINABILITY

SusWIND White Paper Charts Path to Low-Carbon RGF

Nearly half of a wind turbine blade's mass is glass fiber. A new white paper from NCC (Bristol, U.K.) concludes that fiber reclaimed from decommissioned blades can achieve a carbon footprint comparable to virgin glass fiber — provided that recyclers move toward lower-energy recovery methods and recover more of the polymer fraction rather than burning it off. The white paper comes from NCC's SusWIND program, delivered in partnership with the Offshore Renewable Energy (ORE) Catapult.

Reclaimed glass fiber from wind turbine blades (WTB) is limited mostly to lower-value applications, the paper notes, because its discontinuous form and reduced mechanical properties make it difficult to work back into new structural blades.

To evaluate a path forward, SusWIND conducted a life cycle assessment (LCA) of a two-phase, closed-loop process: reclaiming glass fiber from WTB waste and preparing it for melting, then producing glass fiber with 50 wt% recycled content by melting that material alongside virgin raw materials in a melt furnace. The analysis weighed three WTB recycling technologies — thermo-oxidative, pyrolysis and solvolysis — using life cycle inventory data for the melting phase supplied by Owens Corning (Toledo, Ohio, U.S.).

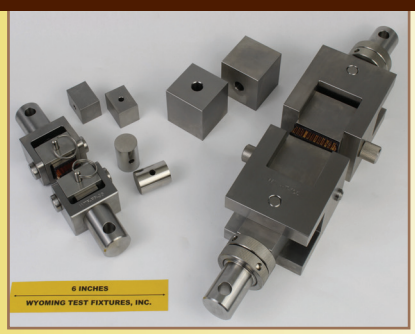
Using publicly available data, the analysis found that glass fiber with recycled content currently carries a higher carbon footprint than virgin glass fiber across all three recycling routes. This is driven mainly by the glass fiber recovery step, since the melting phase itself is actually less carbon-intensive for recycled content fiber. For pyrolysis specifically, the paper points to two developments that could close that gap: energy self-sufficiency in the pyrolysis process, and recovery of a majority of the pyrolysis organics as secondary products instead of combusting them. Modeled together, it was found that these changes could bring pyrolysis-recovered fiber's footprint in line with virgin glass fiber. Full modeling results, target figures and more are laid out in the white paper, which can be read at **www.nccuk.com/media/mqhlw2oy/suswind-greener-glass-fibre-white-paper.pdf**.

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AEROSPACE

GE Aerospace Advances XA102 Adaptive Cycle Engine Assembly for U.S. Air Force

GE Aerospace (Evendale, Ohio, U.S.) continues to advance toward assembly of the XA102 adaptive cycle engine under the U.S. Air Force's Next Generation Adaptive Propulsion (NGAP) program, the company announced in September. The three-stream adaptive cycle engine's hot section incorporates ceramic matrix composites (CMC) to enable higher turbine temperatures versus metal alloys.

"Our team is working with suppliers to procure hardware and test subcomponents as we prepare for assembly of the first XA102 test asset," says Jorge Perez, general manager of Edison Works Advanced Combat Engines at GE Aerospace. "With our learnings from the XA100 program as a foundation, we are well positioned to advance adaptive cycle engine technology and support the Air Force's vision for next-generation propulsion."

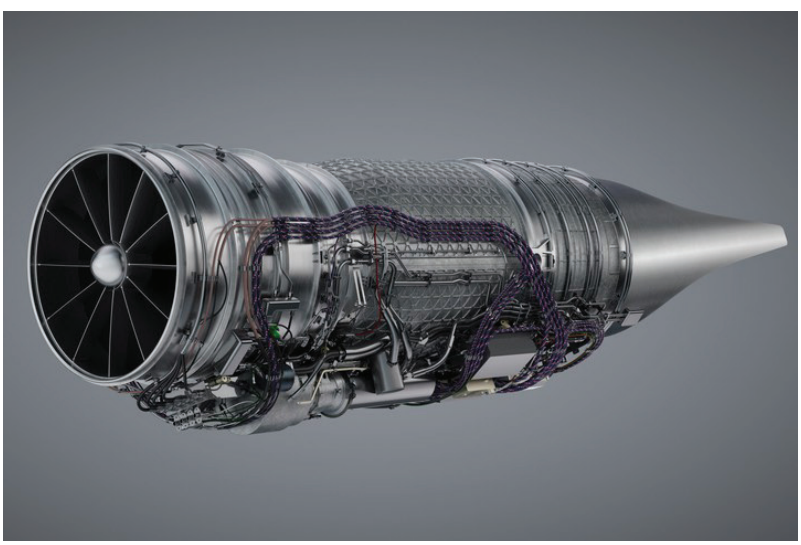
The XA102 was designed from the outset using model-based engineering (MBE) practices with the goal of reducing development time and cost. The company is now extending those model-based capabilities into manufacturing, inspection and assembly, centered on model-based definition (MBD) which conveys complete product definition in machine-readable form for use in downstream manufacturing. The XA102 is the first engine GE Aerospace has built using MBD from design through assembly, replacing traditional 2D drawings with a framework that connects design, manufacturing and inspection through integrated digital models.

GE Aerospace says it is working closely with suppliers to ensure they can use the MBD data in their own manufacturing and inspection processes, and that the approach is intended to strengthen execution across the supply base. Building on experience from the XA100 program, the company is applying lessons learned in adaptive cycle propulsion, thermal management, fuel efficiency and design methods to mature the XA102 ahead of future testing. GE Aerospace reports it has completed demonstrations tied to the MBE practices in the program's first phase.

CMC in the XA102's hot section

Beyond the digital engineering focus of this announcement, GE Aerospace has said separately that the XA102's adaptive cycle design uses new heat-resistant materials, including CMC, to enable higher turbine temperatures and improved performance. The CMC GE has already commercialized is made of silicon carbide (SiC) ceramic fibers reinforcing a ceramic resin. Roughly one-third the density of nickel alloys, SiC/SiC CMC enable engine designs to divert less cooling air from the flow path and run more efficiently at higher thrust.

The XA102's use of CMC builds on more than a decade of GE Aerospace flight validation work. In 2015, GE ran its first non-static set of CMC parts — rotating low-pressure turbine blades — in an F414 demonstrator engine developed for the Adaptive Engine Technology Demonstrator program with the Air Force Research Laboratory (AFRL, Dayton, Ohio, U.S.). The test endured 500 cycles and marked the material's move beyond static components, such as turbine shrouds, into the higher-stress rotating sections of the engine. Since beginning CMC development in the early 1990s, GE Aerospace has invested more than $1 billion in the technology. In 2025, it announced further funding of more than $100 million to scale advanced materials, including CMC, with major upgrades in its CMC production facilities.



CMC components are already established in GE Aerospace's commercial engine fleet. CMC turbine shrouds have surpassed 10 million flight hours in the CFM LEAP engine, with more than 100,000 shrouds produced at a dedicated facility in Asheville, North Carolina. The GE9X, GE Aerospace's largest commercial engine, uses five different CMC parts in its hot section, including components in the combustor and high-pressure turbine.

NEW SPACE

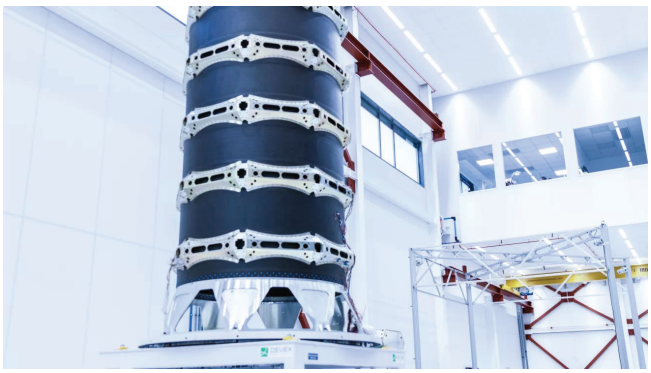
Beyond Gravity Doubles CFRP Satellite Dispenser Output in Sweden

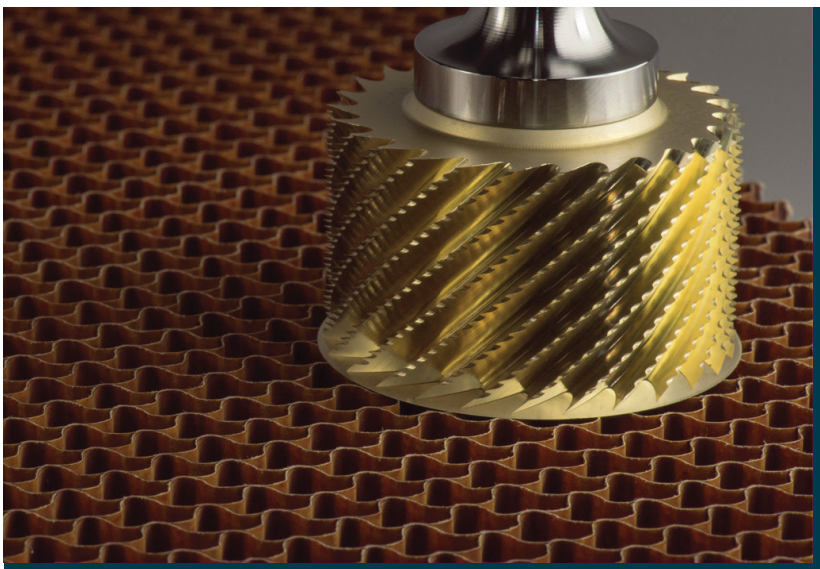
Beyond Gravity (Zurich, Switzerland) has expanded its satellite dispenser manufacturing site in Linköping, Sweden, adding a production hall equipped with a new high-precision milling machine for carbon fiber and aluminum dispenser structures. The site is now able to produce 192 dispenser modules per year — double its current capacity of 96 — with Amazon Leo as its largest customer.

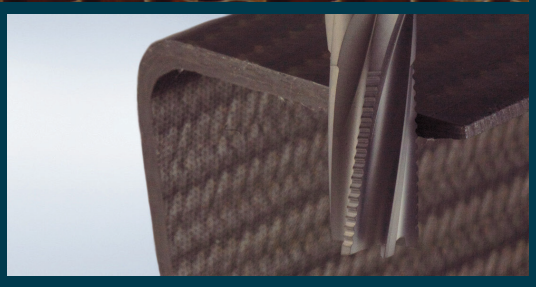
Dispensers hold satellites in place during launch and release them into orbit in a defined sequence. As constellations shift satellite production from one-off builds to hundreds of near-identical units launched dozens at a time, Beyond Gravity notes, the dispenser itself has become a series product. The expanded site's 192-module annual capacity corresponds to approximately 48 flights, depending on configuration.

The new hall sits adjacent to a production building Beyond Gravity inaugurated in 2024 for serial production, and increases the Linköping facility's production area from 12,600 square meters to approximately 15,000 square meters. The milling machine processes carbon fiber and aluminum to tight tolerances and drills the precise holes used for bolts and other assemblies in the dispenser.

In 2022, Amazon awarded Beyond Gravity the largest contract in the company's history to design and manufacture custom, scalable dispenser systems for Amazon Leo, a low-Earth orbit (LEO) broadband network with an initial constellation of more than 3,000 satellites.







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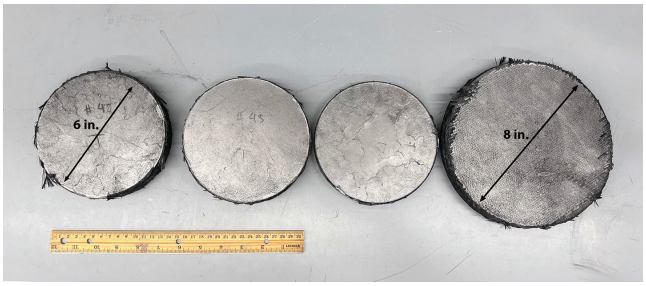
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CERAMIC MATRIX COMPOSITES

Johns Hopkins APL Speeds Up C/C Composite Production

The Johns Hopkins University Applied Physics Laboratory (APL, Laurel, Md., U.S.) has developed a novel manufacturing approach for carbon-carbon (C/C) composites that compresses production timelines from months to days. The technique, called the Field-Assisted Sintering Technique for Carbon-Carbon, or FAST CAR2, uses a single-step densification process in place of the multicycle methods that have long constrained the material's availability and cost.



C/C composites combine carbon fibers with a graphitic matrix and can remain structurally stable at temperatures exceeding 5000°F (≈2800°C), making them central to rocket nozzles, missile nose cones and hypersonic vehicle thermal protection systems (TPS). Conventional production methods densify the material by bathing it in carbon vapor or repeatedly infiltrating carbon-rich resins and burning off non-carbon material — approaches that require multiple cycles over many months to reach usable density. Demand for the material has grown over the past two decades, but supply has struggled to keep pace largely because of that manufacturing bottleneck, according to APL.

Rather than gas infiltration or repeated resin infusion, FAST CAR2 introduces a carbon-bearing material into a fiber scaffold and applies field-assisted sintering technology — a rapid, high-current pressing method — to consolidate it into a dense final form within minutes.

The project team built its first system and produced an initial C/C sample within 3 months. It later produced a 1-inch-wide cylinder in a few days — under a tenth of the time required by conventional methods — and, with access to larger presses, went on to produce several 6-inch cylinders and later an 8-inch cylinder, demonstrating scalability. Microscale analysis found the FAST CAR2 samples nearly uniform with pores just micrometers wide, compared with pores up to a millimeter wide in industry-produced C/C. The samples also passed high-velocity oxygen fuel testing, indicating performance comparable to industry-standard material.

APL is now working with external partners to access larger presses to scale the process further.

AEROSPACE

Albany Engineered Composites Secures Contract Extension on Boeing 787 Components

Albany Engineered Composites (AEC, Rochester, N.H., U.S.), a segment of Albany International Corp., has reached an agreement with Boeing (Arlington, Va., U.S.) to continue composite fuselage frame manufacturing for the 787 *Dreamliner*.

Under the agreement, Albany continues to manufacture about 300 unique composite fuselage frames for the 787 *Dreamliner*, including forward sections 41 and 43 and aft section 47. Albany has produced composite fuselage frames for Sections 41 and 43 since Boeing's original award in 2014.

"We are excited to continue this partnership," says Chris Stone, president of AEC. "Albany is fully committed to supporting the ramp of the 787 program with the consistency, quality and reliability our customers have come to expect from Albany. We remain focused on delivering high-performance components at scale while continuing to advance our manufacturing efficiency and operational excellence across the business."

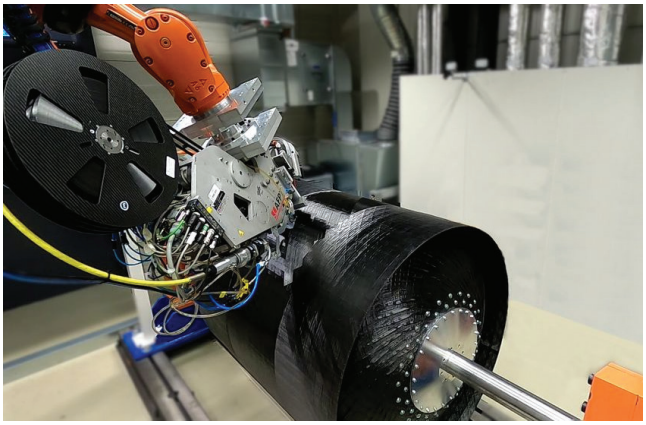
The Boeing 787 work is performed at Albany's facility in Salt Lake City, Utah.



PRESSURE VESSELS

DLR, Omnidea-RTG Build Thermoplastic AFP Cryogenic Tank

The DLR Institute of Structures and Design (Stuttgart and Augsburg, Germany) and Omnidea-RTG GmbH (Stuhr, Germany) have developed a Type 5 liquified natural gas (LNG) tank demonstrator made from carbon fiber-reinforced LMPAEK (Victrex) and manufactured using an in situ AFP process. The 1-meter-diameter tank was built as part of a research project funded by the European Space Agency (ESA, Paris, France) at DLR's Center for Lightweight Production Technology (ZLP) site in Augsburg, and was developed to advance lightweight, high-strength storage systems for cryogenic fuels such as hydrogen and methane.



DLR reports that both tank halves and their joining were manufactured using the same thermoplastic in situ AFP technology, allowing the complete tank structure to be produced in a single, continuous process chain without separate joining operations or specialized molds. The development chain covered structural design of the tank system, material selection, permeability analyses to confirm leak-tightness under cryogenic conditions and mechanical characterization of the joints.

This integrated manufacturing approach can help reduce production costs and manufacturing complexity by eliminating separate joining processes and dedicated tooling, while making more efficient use of existing manufacturing infrastructure.

DLR and Omnidea-RTG present the demonstrator as evidence of the technological maturity and industrial feasibility of thermoplastic AFP for cryogenic storage systems, pointing to potential applications in future space missions and terrestrial uses.

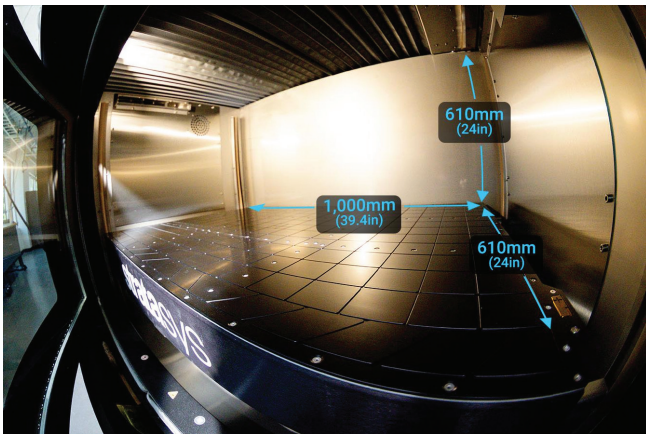
AUTOMOTIVE

Toyota, Rivian Adopt Stratasys FDM to Accelerate Manufacturing Applications at Scale

Toyota Motor Corp. (Toyota City, Japan) and Rivian Automotive Inc. (Irvine, Calif., U.S.) have begun testing a new LFAM system from Stratasys Ltd. (Minnetonka, Minn., U.S., and Rehovot, Israel) that prints carbon fiber-reinforced parts for factory floor tooling and fixtures. The automakers are among the first adopters of Stratasys' F870 FDM system, which the company says is designed for industrial manufacturers, automotive OEMs and aerospace and defense production lines looking to scale additive manufacturing (AM) on the shop floor.

Toyota Production Engineering, based at the automaker's Georgetown, Kentucky, manufacturing complex, and Rivian's plant in Plymouth, Michigan, are each assessing the platform across a range of applications ahead of the system's commercial availability. Early deployments are targeting automotive tooling and production support parts, including large fixtures, assembly tools and inspection gauges.

The F870 offers a 1,000 × 610 × 610-millimeter build volume in a fully heated chamber, which Stratasys describes as the longest heated build capacity in its class. At launch, the system supports FDM Nylon 12CF — a carbon fiber-reinforced material — along with ASA, ABS and a new FDM ABS Draft (gray) material.



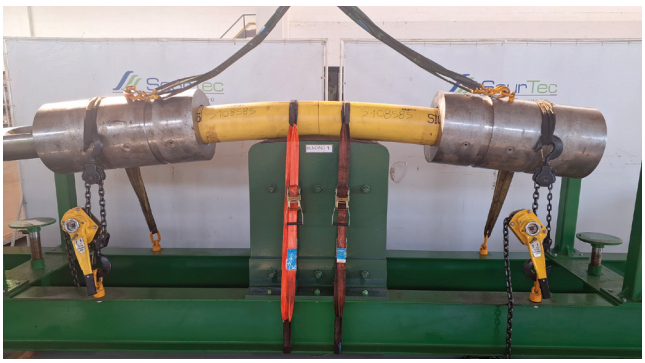
OIL & GAS

Strohm Completes Qualification, Field Trial Program for Ultra-Deepwater TCP Flowline

Strohm B.V. (IJmuiden, Netherlands) has completed a joint industry program (JIP) with Petrobras (Rio de Janeiro, Brazil) and Shell (London, U.K.) for its thermoplastic composite pipe (TCP) flowline solution. The project, comprising a full-scale qualification and extensive offshore field trial, is an advanced initiative to bring TCP flowlines offshore under actual field conditions. According to Strohm, it has significant potential for progressing the deepwater market in Brazil and beyond with a corrosion-free flowline solution that has a 30-year design life.

The JIP program delivers the first fully qualified flowline designed to meet the most onerous conditions of Brazil's presalt, including operation in environments with a high CO_2 content, for a service life of 30 years. Building on Strohm's systematic qualification methodology, the program included system representative testing that validated the interaction between the pipe, end-fitting and sealing interfaces under realistic operating conditions, ensuring a robust and predictable performance throughout the entire system life cycle.

"The project has strategic relevance for the subsea sector in Brazil and beyond, as it decisively solves one of the major pipeline integrity challenges identified in recent years: the risk of stress-corrosion cracking in environments with a high



CO_2 concentration," says Martin van Onna, Strohm CEO. "By using nonmetallic TCP, corrosion is simply eliminated, strengthening system integrity and operational reliability in challenging subsea environments."

Under the JIP, DNV qualified a 6-inch carbon fiber-reinforced PA12 TCP for alternating injection of water and gas (WAG) service for enhanced oil recovery, in accordance with DNV-ST-F119. Following qualification, offshore field trials were successfully completed with a TCP flowline in July 2026, including deep immersion performance tests, as well as subsea vertical connection tests, for a 2027 installation.

AEROSPACE/DEFENSE

Massivit Expands Scope of RapidWings Platform in North America

Massivit (Lod, Israel) is expanding its RapidWings manufacturing platform by delivering composite tooling services in North America. Through the company's collaboration with manufacturing and design firm Artek (Portland, Oregon), the RapidWings platform will provide on-demand, large-format tooling services, prototyping and demonstrations for aerospace and defense customers at the Artek facility, with the aim to significantly accelerate composites manufacturing in North America.



At the core of the RapidWings North America operation lies Massivit's Cast-In-Motion (CIM) tooling technology that combines advanced additive manufacturing (AM) with dual-component materials to deliver large isotropic molds, masters, jigs and fixtures, as well as mandrels for hollow composites. According to the company, this provides composites manufacturers with a local, on-demand service that reduces tooling time by 90%.

The RapidWings platform's services include design and digital tooling to tool finishing, full-scale prototypes and demonstrations. Unlike conventional tooling methods that involve modeling foams, tooling boards or 3D printed thermoplastics, CIM technology delivers isotropic production tools that are autoclave-ready and suitable for a range of temperatures.

WIND ENERGY

We4Ce, Adios Technology Combine Commercial Wind Operations Under EProWind

We4Ce (Almelo, Netherlands) and Adios Technology (Enschede, Netherlands) have combined operations under a single unified brand, eProWind. The brand brings together We4Ce's rotor blade engineering expertise and Adios Technology's de-icing capabilities to become a single partner for complete blade life cycle management, from structural design to on-site blade repairs and maintenance.

EProWind offers turbine manufacturers, asset owners and wind farm operators one direct contact to extend blade life and cut maintenance downtime. Operating as the front-facing organization for both companies, it serves as the central commercial platform for complete rotor blade life cycle support, from initial structural engineering, annual yield increase, lifetime extension, as well as damage assessment to on-site blade root repairs and de-icing management. While eProWind leads all client-facing operations, each company's core, field-proven technologies will maintain its recognized market names within the portfolio.

The transition coincides with a planned leadership handover of We4Ce. Bart Nijhuis assumes the role of CEO of eProWind, and Edo Kuipers remains its technical lead.



RECYCLING

InfraBlades Progresses Wind Blade Reuse for Dutch Bridges

In late August 2026, three recovered wind turbine blades arrived at InfraBlades' (Delft) test site in Pijnacker, the Netherlands, to be inspected and tested for their suitability as structural elements. Their next destination, should they pass, are installation as durable, sustainable bridges.

This is the proposition behind the Dutch startup: to give used wind turbine blades a second life as load-bearing elements in infrastructure. "How can the condition and remaining structural capacity of used blades be assessed quickly and reliably?" asks Boris Kloeg, co-founder of InfraBlades. "That is part of our work at InfraBlades."

Wind turbine blade are naturally designed as long-spanning structural elements for high loads and outdoor conditions, which makes them ideal for applications like bridges and other civil structures. "Bridges are actually quite alike, and could benefit from those material properties," explains Kloeg.



The potential could also extend beyond pedestrian bridges. InfraBlades' 2026 design catalogue explores applications ranging from single-span bridges to multi-span and road-bridge concepts. Other applications such as sound barriers or canopies are also considered.

The company is currently working on two Dutch bridge projects. In Rotterdam, InfraBlades is collaborating with the municipality, Haskoning and TU Delft on the 18-meter-long Reefbrug. The project has already progressed through feasibility and preliminary design work, and first material test results have been received.

The second project is a 15-meter pedestrian bridge located in the Pijnacker-Nootdorp business park, De Boezem. Three wind blades will be used for this bridge, and have arrived at the test site. They will also be inspected and tested before being incorporated into the bridge.

Alongside these physical projects, InfraBlades is working with TU Delft on the SMART-Blades project to develop a standardized inspection and testing approach to determine the condition and structural potential of decommissioned blades more efficiently.

Replacing Steel With Basalt/FRP for More Sustainable Tunnels





Oldroyd supplies protective membranes that enable the world's longest and deepest tunnels, like this one in the Faroe Islands. Replacing steel with its composite-based BasaBolt system will now also enable new extremes in longevity. Source (All Images) | Oldroyd

Oldroyd's BasaBolt system uses basalt and glass fiber with Olin's SustainaLine Litestone low carbon footprint epoxy to cut weight, concrete use, construction time and cost, while eliminating corrosion for infrastructure life of more than 120 years.

By Ginger Gardiner / Executive Editor

» In Scandinavia, a region defined by fjords and islands, tunnels are crucial infrastructure. They enable transport previously impossible or else impassable in rough weather, and typically cut travel time from hours to minutes. Over the past decade, tunnel projects have continued to increase in both scale and ambition — from Norway's 392-meter-deep Rogfast, set to become the world's deepest and longest undersea road tunnel, to the Faroe Islands' 11-kilometer-long Sandoy and Eysturoy tunnels that include the world's first subsea roundabout 70 meters below sea level.

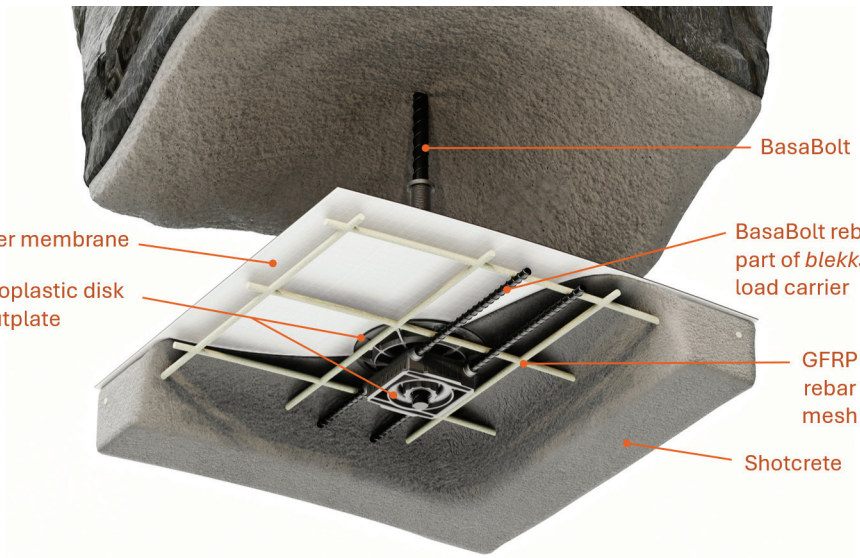
Oldroyd AS (Stathelle, Telemark County, Norway) was the main supplier of the water ingress and frost protection systems for the Faroe Islands tunnels and will deliver 900,000 square meters of such membrane solutions for the Rogfast. The company has developed advanced polymer membrane systems for infrastructure, buildings and industrial applications since its founding in 1994. Essential to protect and preserve the tunnel structure and reduce the need for maintenance and repairs, these systems require anchoring and fixturing, which Oldroyd also supplies. However, this has traditionally relied on steel bolts, which are prone to corrosion.

"We've completed many kilometers of tunnels, using membranes more than 4 meters wide made in our machines," says John Oldroyd Cheetham, Oldroyd co-founder and development manager. "For such tunnels, this membrane is fastened with bolts and washers in a 1.2-meter grid. But when made from steel, these are heavy to install and have a life of only 10-50 years, while our membranes are designed to last 120 years. This is why we wanted to change from steel to composite."

Oldroyd has previously developed technology which not only improved tunnel construction but was eventually adopted as the new standard in the industry. But the company's BasaBolt system is its first foray into composites. Challenging to develop, it required a new mix of materials and in-house production lines to meet technical and cost requirements, as well as improved environmental performance via a low carbon footprint. It wouldn't have been possible, says Cheetham, without resin supplier and partner Olin Epoxy (Clayton, Mo., U.S.). "Our main expertise is thermoplastics, but we had no background in composites," he explains. "From the beginning, Olin committed to help us with this development, not just supplying their SustainaLine Litestone low-carbon epoxy resin system, but also the expertise in materials, processes and environmental sustainability that we needed."

Converting from steel to eliminate corrosion

"We've been producing and installing waterproofing linings for buildings and tunnels for many years and exploring where new development is needed," says Cheetham. "One of our first projects was to make the waterproof membranes [typically made from polyethylene] thinner and stronger, including a reinforcing



Tunnel membrane installations are customized per project, but in general, BasaBolt system installation begins with the basalt/glass fiber composite bolt which is drilled into the tunnel rock. The waterproof polymer membrane is then draped onto this and affixed with thermoplastic washer disks on either side. In the image below, a 12-sided thermoplastic spacer wheel is installed on top of the disk. A GFRP or BasaBolt rebar mesh is then placed atop the spacer wheel, followed by the load carrier, which includes a thermoplastic nut plate (black and yellow below) and two pieces of BasaBolt rebar. The nut plate is then tightened to complete installation before the final layer of shotcrete is applied to the tunnel surface.

mesh. We then changed the color from black to white so installation crews could see what they were doing; the black membranes sucked up all the light." He notes that industry regulations no longer allow the use of black membranes in tunnels. "A few years ago, we started developing technology to move away from steel, because it's heavy, it rusts and it's not very sustainable."

Oldroyd replaced steel with thermoplastic polymer in the two washer disks used with the fastening bolts to hold its membranes to the tunnel's surface. "When made from steel, these would start to corrode and allow water to begin penetrating our membrane," explains Carl Gustav Kremer, head of Oldroyd's product R&D and design. "These were the first components that we converted, and it was a big step for the tunnel industry to use anything other than steel. The weakest part then became the steel bolt. We knew more strength than thermoplastics alone was needed, so we began exploring composites and started the project to develop a new composite bolt in 2019."

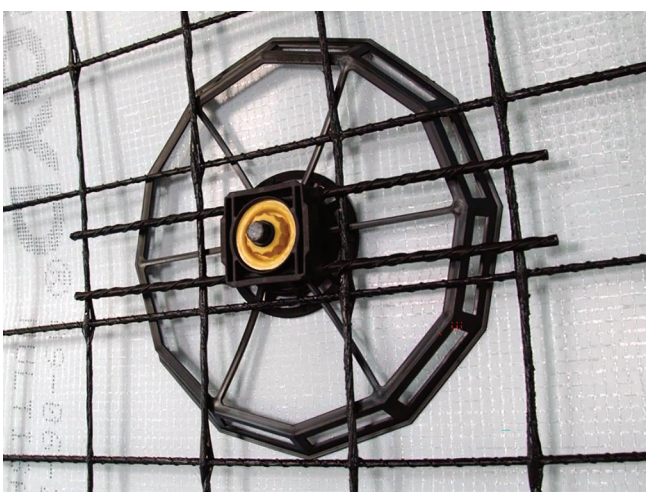
Membrane installation

Before delving into how the BasaBolt composite components were developed, it is important to understand how they are used during membrane installation, which determines key drivers including durability, light weight and improved efficiency and environmental impact during tunnel construction.

The Norwegian Method of Tunneling (NMT) most often uses a "drill and blast" method instead of boring. After the tunnel is excavated and stabilized, its rock face gets an initial layer of shotcrete, typically reinforced with chopped fiber. Rock bolts or dedicated fixing plugs are then drilled into the tunnel surface at a standard spacing.

Precut sheets of membrane are draped over each bolt and secured. In Oldroyd's BasaBolt system, each bolt uses two thermoplastic washers or fixing disks — one on each side securing the membrane and preventing water ingress via the bolt.

Adjoining membrane sheets are overlapped and hot-air or



hot-plate welded. Crews inspect and test the welds. Spacers are applied to the membrane followed by a rebar mesh to help carry the load of the final shotcrete layer.

For the BasaBolt system, this rebar mesh may be glass fiber-reinforced polymer (GFRP), as shown in the diagram at top, or made with hybrid basalt/glass fiber composite as shown in the image above. This installation step also involves another part of the BasaBolt system. "It's like a cross that is mounted to the bolt," explains Kremer. This load carrier is used to transfer load from the rebar mesh within the final shotcrete layer to the bolts. It includes two pieces of BasaBolt composite rebar and an injection molded nut plate made using an engineering-grade short fiber-reinforced thermoplastic. The image above also shows a 12-sided spacer wheel located behind the load carrier. Also injection molded, it is made using in-house recycled materials with zero waste.

These tunnels require thousands of bolts, says Cheetham. "They range in length from 80 centimeters to 2 meters, and one person installs 500-1,000 bolts per shift. In steel, they're very »



Oldroyd worked with Olin to develop an in-house pultrusion system for the BasaBolt composites. The process starts with basalt and glass fiber pulled together from creels (top) and eventually into multiple pullwinding injection boxes (bottom).

heavy, resulting in significant strain in the shoulders and neck of the workers up on the lift during installation. However, the weight of our new composite BasaBolt is one-third that of the steel bolt, which makes installation much easier and allows the crew to carry 3X more bolts at a time on the lift."

Basalt, glass fiber and low-CO_2 resin

Oldroyd knew that fiber-reinforced composites could provide the required corrosion resistance and strength at less weight. The question was which fibers and resin would also meet environmental and cost requirements? "Producing components locally here in Norway and using European products is a major issue for us," notes Kremer. "We knew that we wanted to make the bolt with basalt fiber to resist the harsh environment of the tunnels, and it also provides fire resistance. However, basalt fiber is not produced in Norway, so this would be an expensive part of the system, and we had to develop a way to keep cost down. We knew we could get glass fiber locally, so we developed a hybrid system where the bolt's outside skin is reinforced with basalt while the interior uses glass fiber to make the cost as close as possible to that of steel. We then had to figure out how to make this construction."

The local glass fiber company, which also helped with development, is the Birkeland, Norway, facility previously owned by 3B and now part of the integrated Original Composites & Fiberglass company owned by Praana. For the resin, Kremer notes his team was lucky to meet Olin at JEC World in Paris. "It was our first time at the event. Being new to composites production, we needed help to understand what were the best products to use, but also in terms of environmental sustainability."

Oldroyd selected Olin's Litestone 3000 epoxy system, a series developed for pultrusion and pullwinding. With a low-mix viscosity, long potlife and fast reactivity, these resin systems perform well in applications like rebar and are non-flammable and VOC-free.

"We were immediately very excited when we heard Oldroyd's plans and ideas," says Martino Lamacchia, global segment leader for composites at Olin. "We were able to work with them and validate that our Litestone resin system enables high pultrusion throughput for this specific application but also delivers the strength and chemical resistance needed. Oldroyd also explained that this system should have a low carbon footprint, as the environmental product declaration [EPD] for its components and constituent materials is important to make their products more competitive."

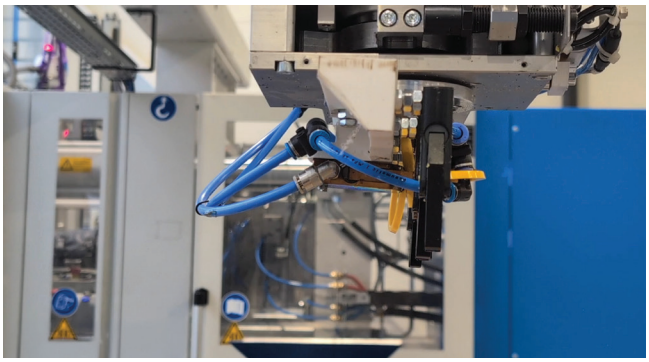
Lamacchia explains that the carbon footprint of a glass- or basalt fiber-reinforced composite is heavily influenced by the matrix resin. "So, we suggested our SustainaLine Litestone resins as a lever to improve the EPD of the BasaBolt parts. Our standard systems already have an advantage in terms of carbon footprint thanks to our vertical integration — many of the feedstocks for our products come from the same site where these resin systems are produced. However, SustainaLine Litestone systems show an even lower carbon footprint that is up to 32% below the industry standard for a pultrusion system." He notes this is enabled by mass balancing and the ISCC Plus (International Sustainability and Carbon Certification) that Olin's Stade, Germany, facility achieved in 2023, which is the same site that supplies Oldroyd.

Process development

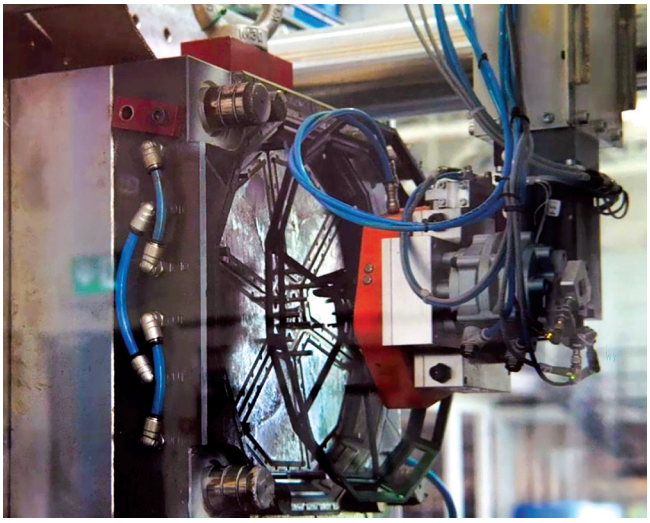
The third piece to Olin's support was process development. "The hybrid basalt/glass fiber construction is very strong and protects the skin from fire," says Kremer, "but it requires a special type of pultrusion, and we needed help to make this process possible. Olin has been very important in developing our in-house pultrusion lines and achieving serial production."

For the bolt, the process uses a pullwinding machine with injection boxes specially developed and supplied by KraussMaffei (Parsdorf, Germany). This hybrid pultrusion process begins by pulling both glass and basalt fibers from spools on a creel into the pultrusion machine. "We can tailor a lot of process parameters including rate and temperature, so we can control cure quite reliably. KraussMaffei and Olin have been essential for us to get this machine tuned for maximum





Oldroyd's commitment to sustainability includes use of hydro and solar power (top) while many of its injection molded products are made from recycled ocean plastic using four KraussMaffei CX 160-750 machines (center) with APCplus (Adaptive Process Control) that continuously monitors the process and automatically compensates for variations in viscosity and material properties to ensure consistent quality.



Injection molding of unreinforced thermoplastic 12-sided spacer wheel.

performance — basically working on-site with us to get the best process possible."

The BasaBolt rebar mesh (also used in the load carrier) is made with the same basalt and glass fiber with epoxy resin as the bolts but with a different epoxy hardener. "The unique design of the bolt requires a highly reactive hardener to process," explains Kremer, "both for the composition and speed of production. The mesh production line requires a different system. Although the pultrusion/pullwinding process for the rebar mesh has been used in Europe, it's new for us and also in Norway for this industry. Thus, the competence we gained from Olin was critical. They helped us experiment with different aspects to optimize how the process lines work and also with how to test these composite components for aging in tunnel environments."

The benefits of BasaBolt

The complete BasaBolt system reduces weight by up to 70% compared to membrane systems using steel, says Cheetham, which corresponds to 30 tons less weight that needs to be lifted per 500 meters of tunnel. "It also makes it possible to have a thinner layer of spraycrete. A lot of the concrete thickness required with steel is to protect the bolts and rebar from the environment and corrosion. The BasaBolt system eliminates that risk."

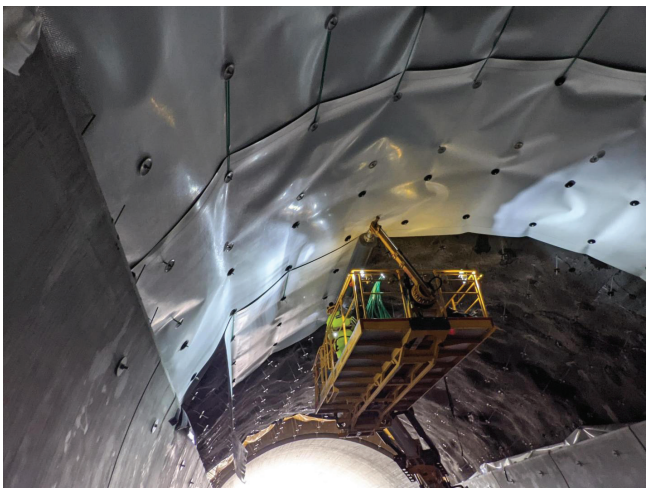
Casting the vault just 1 centimeter thinner reduces the amount of concrete by 12%, corresponding to more than 225 tons less concrete and at least 15 fewer trucks needed on site per 500 meters of tunnel. This also cuts emissions by 25 tons of CO_2 per 500 meters of tunnel and reduces shotcrete spraying time, enabling faster tunnel construction. "This is a huge improvement in sustainability and cost for the large infrastructure companies building these tunnels," notes Cheetham. "These projects are very large, so with one-third of the weight, the reduced number of transport trips also increases speed and efficiency."

"You can fill a lorry with composite rebar because you don't go over the weight limit," explains Kremer. "But with steel rebar, you can only fill half or a third of the lorry before it's overweight. So, you get 2-3X as much rebar per shipment, basically."

He reiterates that this light weight means membrane installation is also safer and requires less energy for the equipment and the persons involved but notes another benefit. "Getting the BasaBolt system into tunnels will also be a big step for the industry because we can make the composite rebar mesh the same length as the tunnel arch. This means less overlaps, less binding, less waste and of course faster installation."

"Steel rebar mesh is a standard weight," explains Kremer, "and would be too heavy if you used the full arch width." Kremer notes that Oldroyd customizes the width and length of the membrane rolls it delivers to customers. "Let's say the tunnel is 30 meters across. We will deliver a roll with 90 meters of material — three lengths of the tunnel — to minimize waste. They just cut it three times, which makes the installation more efficient. We will customize the GFRP or BasaBolt mesh in the same way, and we deliver everything they need, which is also important. The only thing we don't supply is the concrete."

Contractors are eager to use this new system for all of the benefits listed above, says Cheetham, but also for the improved sustainability and carbon footprint, which is an important factor »





These images show various stages of membrane installation for the Faroe Islands' Eysturoy and Sandoy tunnels. Once certified for use, the BasaBolt system will significantly reduce installation time and improve sustainability for such projects.

for new infrastructure projects. "Our facility is also part of this and uses hydro power and our own solar power. So, it's a whole package we are delivering: Reduced weight, installation, cost and carbon footprint with the performance from the basalt, local glass fiber and Olin resins, but the initial goal was to extend the tunnel lifetime versus using steel."

He explains that to repair the vault is hugely expensive, requiring closing the whole tunnel. "When steel bolts start to rust away, it's necessary to rip out everything down to the stone and start again with a new installation, which can take up to 2 years in the longer tunnels. The membranes we produce have a lifetime of 120 years, so this is the service life we have designed into BasaBolt, including the bolts and the rebar mesh."

Certification, high volume

Oldroyd is in the process of completing government and contractor approval for the BasaBolt system. "We're hoping to start delivery in 2027," says Cheetham. "So, it's a long process, and you also have to do testing projects with each customer. But we think we will start delivering to actual projects, not just demonstrations, with multiple contractors interested."

"The largest infrastructure companies in Scandinavia and Europe have been working closely with us on this development because they want this product," notes Kremer. "We have completed tests on every component of the BasaBolt system, but this is necessary to ensure safety and safeguard the investment involved in these massive projects."

"We went through the same process when we converted the washer disks from steel to thermoplastic," adds Cheetham, "but now they prefer the thermoplastic disks. They choose our products because of their light weight and the corrosion-free, watertight performance they provide for long life. So, for the BasaBolt system, it's just getting the next step completed, and once it starts being used, the companies and the planning offices won't go back to steel."

As composites in rebar and other infrastructure components gain ground, this could indeed be a huge step. "An average tunnel will need 100,000 units of this complete system," says Cheetham, "while a larger tunnel could require up to 500,000 units." But it could be more as these projects continue to grow in length.

"It's a very high-volume application," Kremer agrees, "but everything's hidden behind the finished surface when you're driving past, so you don't think about what's behind. Each kilometer of tunnel has a bolt every 1.2 meters, so this is huge."

Cheetham adds that Oldroyd has roughly 95% of the tunnel membrane market in Norway, "but we also supply into subway and rail tunnels across Scandinavia and Europe, and in other projects such as waterproofing and helping with fire protection for the basement floors of the British Museum, for example."

Changing an industry

Equally impressive is Oldroyd's perseverance in its goal to change an industry. "The first challenge was just figuring out how to do this," says Kremer, "and then how to combine the materials so that we used only the amount of basalt fiber necessary. Also working with Olin on the process has required years of development to get the best possible performance and stable, robust manufacturing. We're there now, but getting everything to work together was not easy. Injection molding and plastics were easy for us, but composites were completely new."

Cheetham notes the fire performance and testing were also challenging, "and deciding how everything should be in order to use less concrete and still fit the whole system into this small installation space around each bolt while competing with steel in strength was difficult.

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BasaBolt installation steps: (1) Spacer wheel is placed on top of membrane. (2) Composite rebar mesh is placed on top of spacer wheel. (3) Load carrier is attached. (4) Nut plate is tightened onto bolt.

But we're there now. The tensile strength of the composite bolt is double that of steel, the life is more than 2X longer and we're competing with the traditional steel model in cost." They both say their largest achievement is that this system will change the tunnel industry. "We've been through that before with the membranes and then the disks," says Cheetham. "Now, we're changing the installation, and the certification we're obtaining will be for the whole system of how you waterproof a tunnel."

Lamacchia at Olin notes that although the company is very active in composite rebar, "this is the first time we've been part of such an innovative application of rebar in tunnel waterproofing, and we are very proud of that. We think there's a lot of potential going forward. And for us, it's exciting that Oldroyd is revolutionizing this industry in a way that will shape the future, not just by reducing maintenance cost and improving sustainability in construction but also by benefiting the workers involved and the communities that these tunnels connect and vitalize." CW



ABOUT THE AUTHOR

CW executive editor Ginger Gardiner has an engineering/materials background and more than 20 years of experience in the composites industry. **ggardiner@gardner.media**

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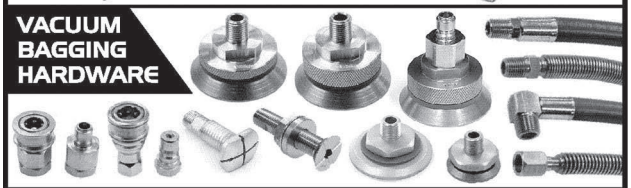
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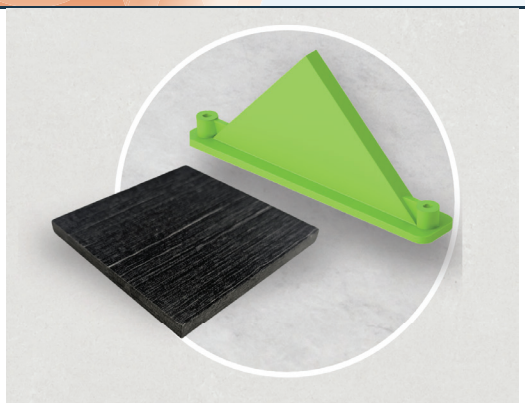
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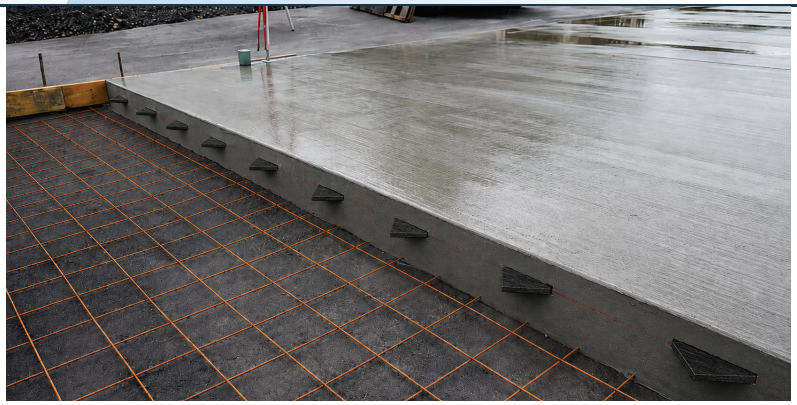


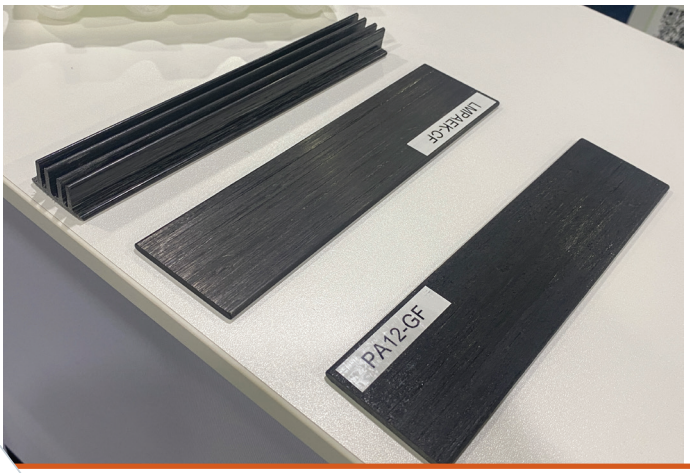


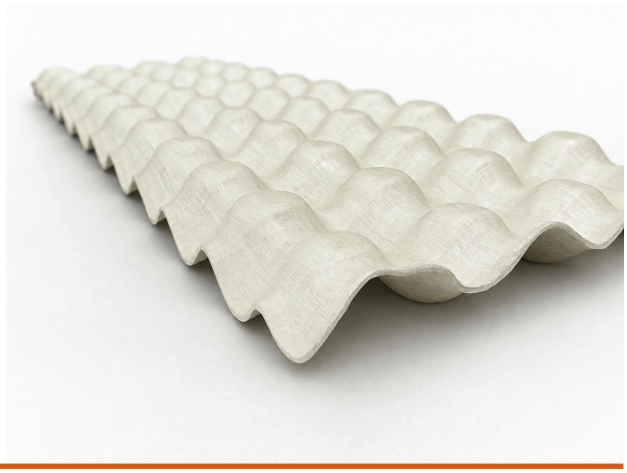
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Unlocking Scalable, High-Volume Continuous Thermoplastic Composites

The first applications of Maine-based startup ReForm Composites' thermoplastic pultrusion process target high-volume construction needs, with ongoing developments in auto, aero and more.

By Hannah Mason / Technical Editor

» The idea of continuous fiber-reinforced thermoplastic composites (continuous fiber TPC, also known as CFRTP) is extremely promising for myriad structural applications, combining the performance benefits of unidirectional (UD) fibers with the reformability and recyclability of thermoplastics. The logistics of manufacturing at scale — with economics that also make sense — is more challenging.

A variety of companies are tackling this challenge in different ways, using different processes. One of these is ReForm Composites Inc. (Hampden, Maine, U.S.), which was established in 2024 to commercialize a novel take on thermoplastic pultrusion by four researchers at the University of Maine Advanced Structures & Composites Center: Cody Sheltra, CEO, Samuel Heathcote, COO, Dr. Philip Bean, CTO and Jacob Clark, director of composites for infrastructure.

In the beginning, "it was all about the technology. We had no thoughts at the time of starting a company," Sheltra explains. "We were originally working on a DOD [Department of Defense] project at the University of Maine, and the goal was to create field-bendable thermoplastic [composite] rebar — an embossed rebar using a thermoplastic matrix instead of vinyl ester or epoxy, so it's able to be heated in the field and reshaped. With the FRP rebar that's on the market now, you can get it bent and shaped, but that has to be done at the factory before the resin cures, and that doesn't really work for expeditionary

LEFT: Starting from university research into field-bendable thermoplastic composite (TPC) rebar, ReForm Composites' pultrusion technology now has the capability to commercially produce a variety of continuous TPC profiles including complex shapes. The company's first commercial product is its Polydowel system for the construction industry (shown in top two photos).
Sources | ReForm Composites except for bottom left, *CW*

applications like in the military. They need to be able to make adaptations in the field."

At the time, Sheltra was an R&D program manager at the university while also pursuing graduate studies in composite material mechanics. "The best [the university] had at the time was that we could create plates on a press and then use a waterjet or table saw to shape them," he recalls. "This would get the fiber and thermoplastic in the right spot, but wouldn't be feasible in a field application, because the rebar could only be as long as the press to begin with, and then scalability is impossible. So we looked to different manufacturing methods in the industry to see what we could do, and we realized that thermoplastic *pultrusion* would make the most sense."



The technology is said to produce simple profiles many times faster than a traditional thermoset pultrusion process. Source | ReForm Composites

Pultrusion is traditionally accomplished with thermoset resins, and involves either running continuous UD rovings or woven fabrics through a resin bath or injecting them with resin, then shaping in a die. Of course, multiple other companies and researchers have worked on pultrusion processes adapted for thermoplastics,

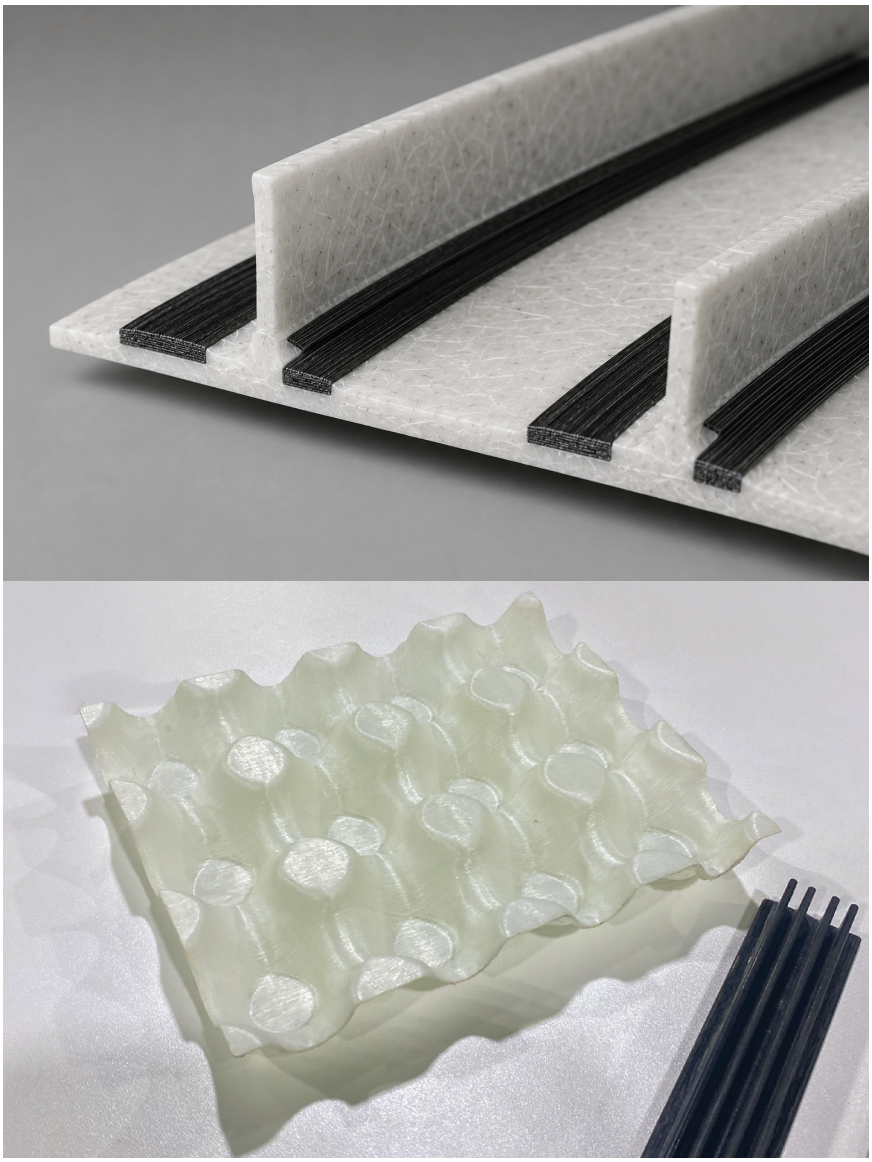
> "For rod profiles and similarly simple sections, each production line has the capacity to produce tens of millions of feet annually."

and Sheltra acknowledges that he and his team learned from these process developments. "The use of thermoplastics in pultrusion has always been hindered by the [problems caused by the higher] viscosity of thermoplastics versus thermosets. Impregnating the reinforcement material with resin gets really difficult as the resin becomes more of a paste than a liquid. There have been a lot of people working on this for a long time, and impregnation has remained a significant challenge."

"Because of this, pultrusion with thermoplastics is historically either extremely slow or produces extremely thin parts, and even when you run it slow, it's still going to be thinner than you'd have with thermosets," he continues. "There are a lot of thin-walled structures made this way, or you can use an acrylic-based reactive system where the resin is a thermoplastic once it's cured, but starts out in a liquid state. These are pioneering systems that have made their way into applications like wind blades, but they also have limitations. You could also use commingled fibers with resin fibers, which many people do, but the pultrusion die heats by conduction one layer at a time, which also can slow the process. Overall, we recognized that we had to figure out a different way to do it."

What they developed at the university was a pultrusion-like, continuous process that manufactures profiles using thermoplastic prepreg tapes instead of dry rovings — eliminating the need to impregnate dry fibers on the line. "We figured that prepreg suppliers have already got the wetting part figured out for us, so what we needed to do is develop a heat transfer process for getting the tapes into the right shape with the right material fill," Sheltra says.

He adds, "It's definitely not as simple as it sounds! For a long time, we found a lot of ways to do it wrong. But once we had the core technology developed — through a handful of different DOD grants — we started to bring the technology to the industry through presentations and trade shows and we saw the same thing every time: Everybody was extremely interested. The typical batch-based processing options for TPC can drive costs up and make scaling to high-volume applications challenging. »



The use of thermoplastics enables new complexities in the pultrusion process, such as compatibility with overmolding (top) and the shaping of complex profiles (bottom). Sources | ReForm Composites (top), *CW* (bottom)

But there just wasn't a feasible way for us to deploy this technology as a university."

It was at this point that Sheltra and the others knew they needed to commercialize what they'd developed. At first, they thought this would look like partnering with a company that would license the technology while they stayed on at the university, but they ultimately recognized that the best way to prove out their vision was to start a company themselves. This decision led to ReForm Composites.

Sheltra credits the University of Maine with providing support and resources to get the team started. "The university has a really strong desire to drive research into commercialization. Programs like the National Science Foundation's I-Corps helped us assess market opportunity, and the university tailored its MIRTA accelerator experience to guide us through starting the business, followed by a pilot incubator and mentoring program to help navigate early hurdles."

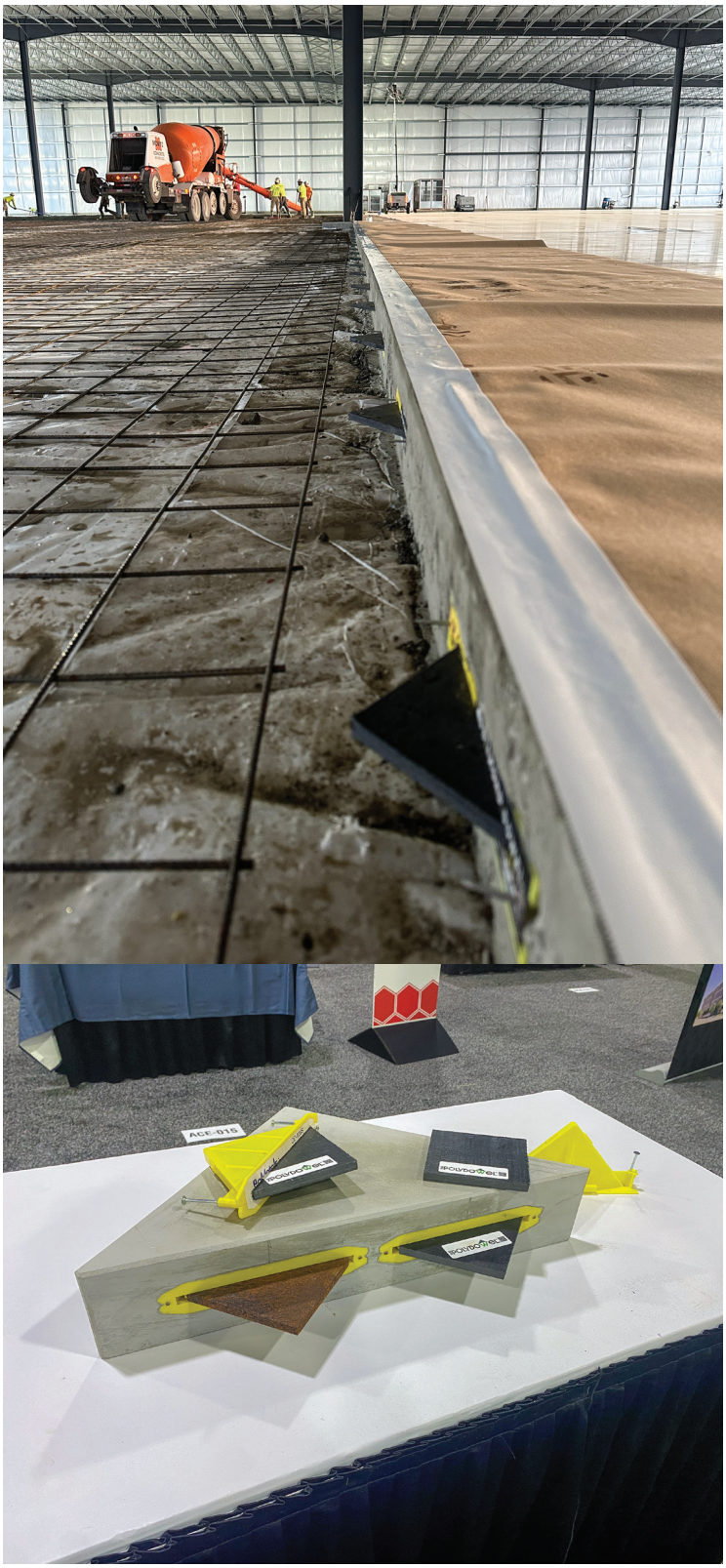
ReForm Composites now operates a dedicated 7,000-square-foot facility with six employees and its first production line — plus space for an additional three lines — including a second that is nearing completion and expected to begin operating later in 2026. "We're starting small and getting the most out of this space while we grow," Sheltra says. "We have products at the R&D stage that would amount to millions of feet a year in production. For rod profiles and similarly simple sections, each production line has the capacity to produce tens of millions of feet annually."

High-speed, continuous, scalable technology

What do ReForm Composites' continuous fiber TPC processes entail? Sheltra explains, "Our technology essentially is that we've found a way to do thermoplastic pultrusion in a kind of roundabout way, by leveraging off-the-shelf feed materials from companies that make tapes."

The starting UD prepreg tapes can be from a wide range of thermoplastics and fiber reinforcements. Like a traditional pultrusion process, the system is designed to pull tapes continuously along the line, including shaping within a die. The key to ReForm's technology is in the way the part is heated during this process. While the full system isn't able to be disclosed, Sheltra explains it this way: "We've taken all the slowest parts of the process and addressed them in-line on the same machine. Impregnation was a bottleneck, so we're starting with a material that already has resin in it. The heating, cooling and forming methods have been engineered for optimal speed and consistency."

Since moving their technology from a pilot-scale university lab to the full production-scale line, ReForm has worked to prove that its process can produce profiles at the speeds needed to be able to supply parts to customers needing tens of millions of feet of profiles annually. Sheltra says a simple profile can be produced many times faster than it would be on a traditional thermoset pultrusion system. "For larger or more complex profiles, it might not be quite as fast, but we can make them up to half an inch thick or more; we have a



The PolyDowel system installed at an actual job site (top) and on display at CAMX 2026 (bottom). Sources | ReForm Composites (top), *CW* (bottom)

couple of projects investigating a round rod that's over an inch in diameter. Producing these sections at commercially useful rates is a significant challenge with thermoplastics," he says. They're also developing increasingly large and complex profiles, including I-beams.

Commercialization and scale-up: Starting with construction

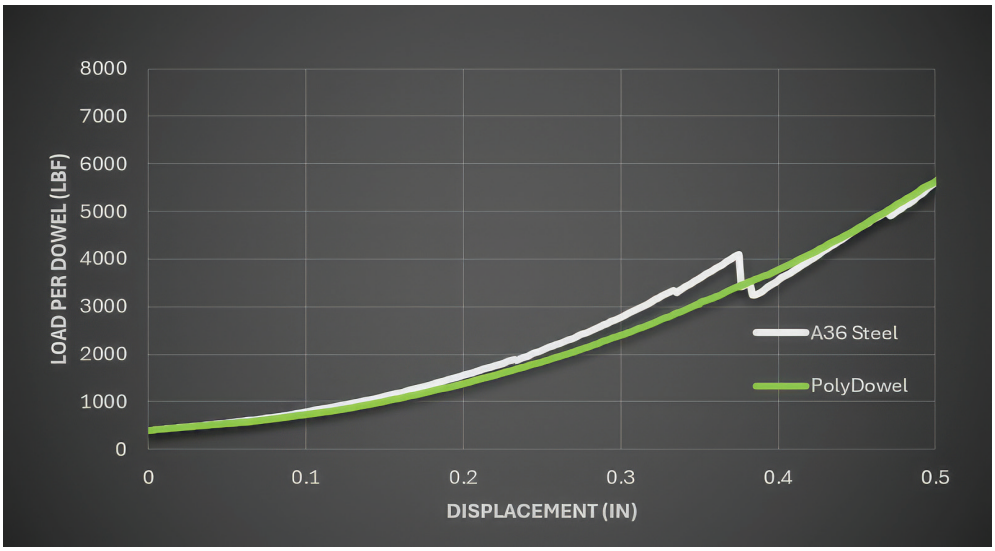
"The hardest part has been figuring out how to take this from research to commercialization in a way that's not going to kill our mission, which is to get this out to more applications and more industries in a scalable, cost-effective way. If we were to come out of the gate with twice the cost of what people are willing to pay, we'd be done before we started," Sheltra says.

Ensuring and demonstrating economic viability, then, has been a large part of the commercialization process. One way ReForm keeps prices competitive is through working with its tape supplier partners, which include Avient (Avon Lake, Ohio, U.S.). "Our supplier partners are interested in working with us on this because we're opening the door to projects that can mean really high volumes of tapes for them, i.e., millions of pounds per year per project. For what we're doing, the value proposition simply has to be different to compete, and our vendors have been really great at working with us on that," Sheltra says.

In targeting commercial applications, the construction and infrastructure market was the natural place to start, stemming from the company's founding on field-bendable rebar research. "We originally thought we'd be a construction products company," Sheltra says, "but then we realized we'd be leaving a lot on the table with what we can do and the different impacts we can have. Construction lets us demonstrate the economics needed for cost-sensitive markets, but the broader goal is to expand the market for TPC through economies of scale, including making high-performance applications more economically feasible."

Construction is also a market that puts the economic feasibility side of commercialization to the test immediately. "The volume is high, and the margins have to be really low. Traditionally, continous fiber TPC are expensive — the processes are batch-based and slow, and most of the research over the years has been in aerospace and defense, not construction. Most of the codes and regulations that *do* pertain to composites in construction are all thermosets. There's a lot we have to do to prove out the technology to put the standards in place," Sheltra says.

ReForm began working on a variety of construction-related demonstrators with companies, but it soon »



■ The PolyDowel has been developed and demonstrated to match the performance and cost point of steel dowels, while significantly lowering weight and adding corrosion resistance. Source | ReForm Composites

became obvious that it needed a demonstrator part that could be spoken about openly with other potential customers.

This led to the creation of the PolyDowel, the company's first commercial in-house-developed product. The PolyDowel is a seemingly simple, continuous fiber TPC dowel for slab concrete construction, manufactured with Avient's Polystrand continuous fiberglass-reinforced thermoplastic laminates precision-cut for minimal scrap. The resulting dowels are installed into concrete structures to maximize durability and corrosion resistance over steel. The first demonstrator was installed in early 2025 as part of a high-traffic entertainment infrastructure project to validate its field performance. Multiple other demonstrators were installed and tested subsequently.

■ PolyDowel is ReForm's first in-house manufactured product, with plans to add additional stock profiles. The company also manufactures custom orders for a variety of industries. Source | ReForm Composites



The PolyDowel product took about 6 months to develop, Sheltra says, and about 18 months overall to reach commercial distribution, which is now handled by construction products distributor White Cap. "The PolyDowels are actually being sold, and that's the biggest part of the story," he emphasizes. "It's not only technically feasible, but cost-comparable to steel. It's also more than just the dowel. It comes in a kit with a sleeve that mounts onto the framework, which together increases its value as a product."

In the case of the PolyDowel, "the joint mechanism requires interaction with a lot of different properties, and when it comes to joint deflection — the one that really matters in this case — the PolyDowel system provides comparable joint-deflection performance to the steel system it replaces," he adds.

PolyDowel is an end-use product created and sold by ReForm. Sheltra notes that more stock profiles and products will also be developed, but the company's main business functions as a B2B manufacturer, offering engineering and research support, simulation and in-house testing as well as production manufacturing.

"We're not only interested in the construction market, but in that space we see a lot of potential for this material progressing further and changing the way building materials are used and also to create more durable solutions," Sheltra says. One goal is to come full circle and commercialize the field-bendable rebar from the group's original research, but this will take a series of validation steps to get there. "With rebar, you're getting into life-critical infrastructure applications, where failure means someone could get hurt. We want to build confidence in the market and prove that this material does perform in service. So we started with dowels, then we'll move to highway baskets and ultimately we'll get to rebar." Here, he refers to

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what are also know as dowel baskets, pre-assembled steel frames that hold steel dowel bars in exact position across joints in concrete highways and pavements.

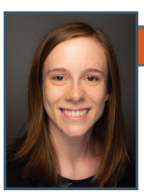
Beyond construction: Aerospace, automotive and more

Beyond construction applications, ReForm is working on R&D projects for various industry customers, including automotive structural components, very small aerospace profiles made with high-temperature materials, Pi-shaped preforms for aerospace structures and hollow profiles for applications in aerospace, as well as oil and gas. "We entered the construction market first because we were most familiar with it, but it's really a first step to

> "The PolyDowels are actually being sold, and that's the biggest part of the story. It's not only technically feasible, but cost-comparable to steel."

demonstrate that continuous fiber TPC scalable to high-volume level is actually possible," Sheltra notes. As with the PolyDowel product, key to each project is ensuring not only technical feasibility but economic viability. In the automotive case, for example, while the continuous fiber TPC version could cost marginally more than the same part in steel on a material basis, the R&D investigation is also considering other areas where its design can reduce costs by eliminating current process steps like coating or welding, or by combining steps to simplify assembly.

"In all of these applications, the benefits of composites are already well established, but what's most exciting to us is that the reformability of the matrix in this material opens up the door for so many possibilities, including reshaping straight profiles into non-linear geometries," Sheltra says. "But the ReForm name is not just about changing the shape of the material. It's also about opening up the door to new possibilities for how composites are made and used." CW



ABOUT THE AUTHOR

Technical editor Hannah Mason has been writing and editing about composites for *CompositesWorld* since 2018. She has a Master's degree in professional writing from the University of Cincinnati. **hmason@gardner.media**

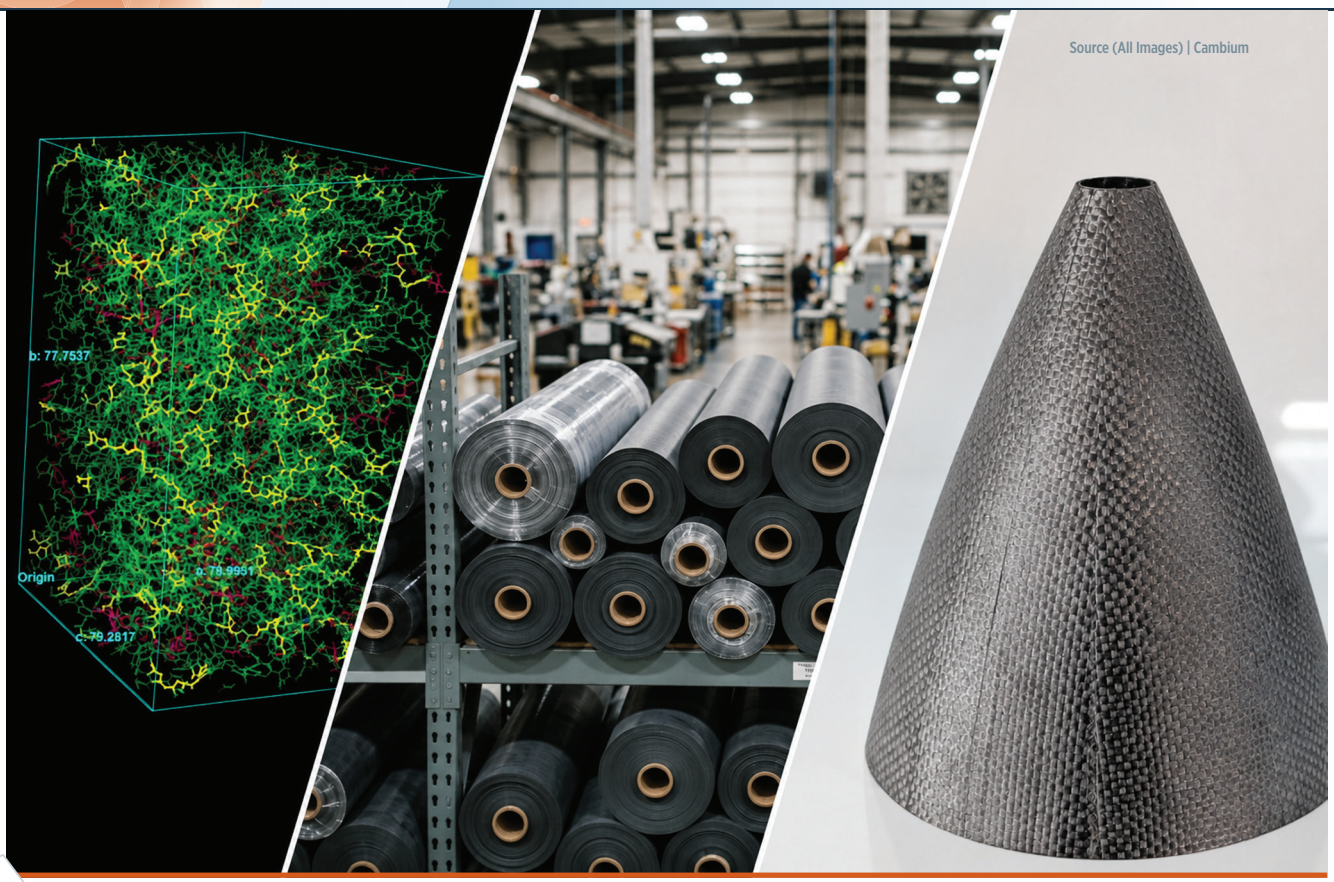
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Cambium, SHD Composites Reimagine a New Future for Composites

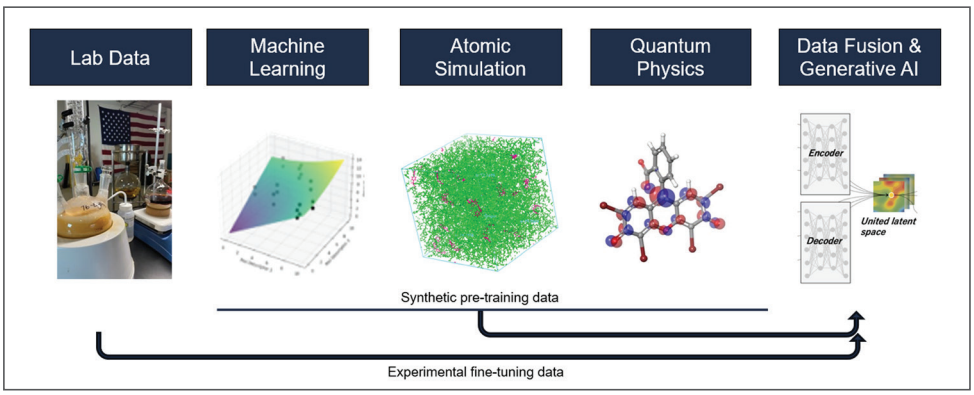
_CW_'s interview with Cambium chief informatics officer Tim Gardner discusses the company's background and bio-enabled approach, inverse design and SHD Composites' role as it seeks broader markets, growth and changing what's possible with composites.

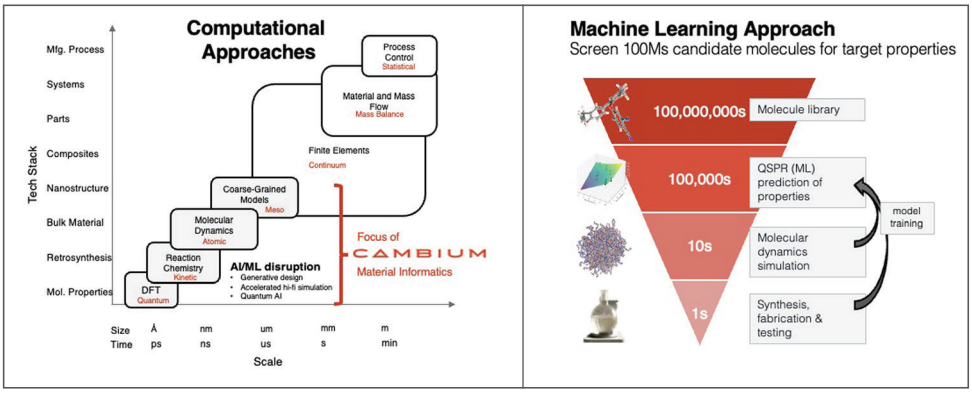
By Ginger Gardiner / Executive Editor

» Cambium (El Segundo, California, U.S.) was founded in 2019 by CEO Simon Waddington and CMO Stephan Herrera, both formerly of biotech firm Evolva. The company currently has 250 employees and develops advanced polymers and composite materials for aerospace, defense and other high-performance sectors, but is also targeting broader markets. Its most recent messaging notes that Cambium integrates AI-driven materials discovery, rapid product development, industrialized qualification and flexible manufacturing into a single operating system, compressing time and cost from invention to qualified production.

Shortly after its founding, it established this domestic production as well as defense-related R&D support including a completed contract with the U.S. Naval Air Warfare Center Weapons Division (NAWCWD) and a DARPA collaboration aimed at replacing structural titanium with ultra-lightweight polymers.

In December 2025, Cambium acquired SHD Composites (Sleaford, U.K. and Mooresville, N.C., U.S.), a company well known for its innovative, high-quality products, agility, customer support and fast response time. Now a Cambium company, SHD has maintained its leadership, adding previous Cambium board director Brett Schneider as president of SHD and Cambium Composites. SHD has also maintained its production sites, including at its U.K. and U.S. headquarters, an additional U.S. facility in Oklahoma and one in Slovenia.





Cambium combines biotech, digital technologies/simulation, machine learning (ML) and AI to accelerate solutions in advanced materials with a focus on manufacturability and affordability while maintaining extreme performance.

In January 2026, Cambium closed a $100 million Series B funding round led by 8VC (Austin, Texas, U.S.), with participation from Lockheed Martin Ventures, Veteran Ventures Capital and MVP Ventures. With SHD Composites, Cambium has now established a global innovation and manufacturing supply chain, and in 2026, SHD Composites announced a slate of new developments, including wide-format prepreg and film lines, new flame-retardant prepregs, a bio-based FST-compliant resin for aircraft seating, a toughened epoxy prepreg with capability up to 200°C and a cyanate ester prepreg, as well as surface films for lightning strike protection with no post-processing after molding. SHD Composites is also quadrupling the capacity of its Mooresville, North Carolina, facility in the U.S.

The recurring themes of high performance, ease of processing and accelerated development cycles for more ambitious composite designs are indeed the central pillars to Cambium's approach. But it has a vision for much more.

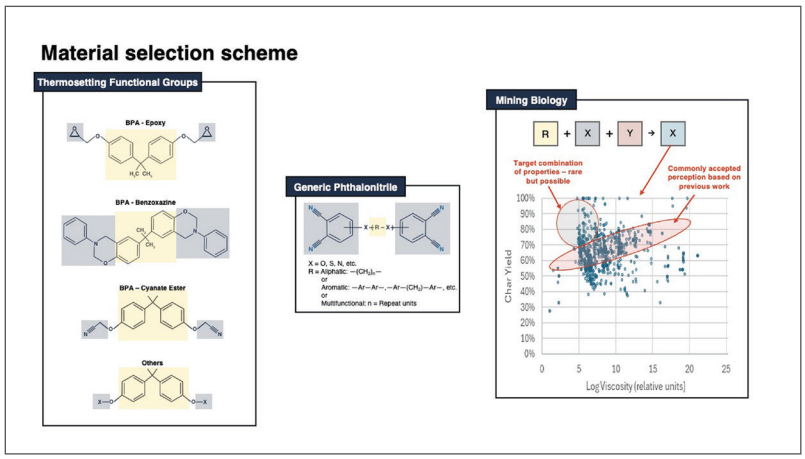
From biotech to bio-enabled composites

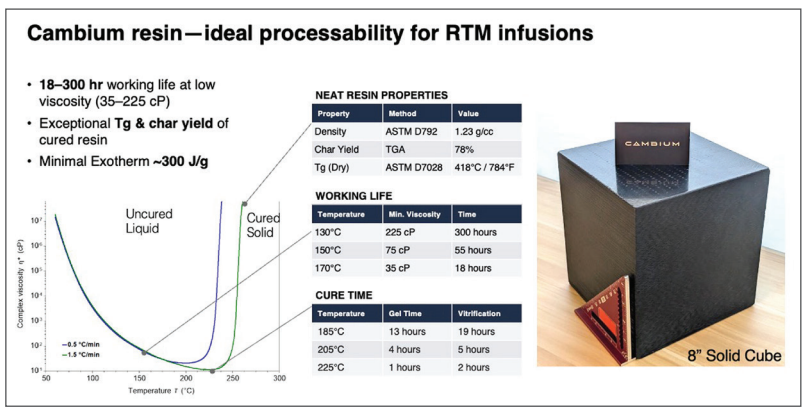
Chief informatics officer Tim Gardner's journey reflects that of Cambium to some degree — moving from biotech to its current "bio-enabled" and AI-focused approach to speed development and innovation in composites and other advanced materials. It also helps to provide a landscape and frame of reference for Cambium, as there really hasn't been a company like this in composites before.

"I joined Cambium in 2024, and am relatively new to composites," Gardner explains, "having spent most of my career in biotech. I actually started in mechanical and aerospace engineering, with an interest in robotics and automation. But I ended up building out capability to biosynthesize chemicals for a company that was genetically engineering yeast to produce oils from sugarcane. We scaled that up to a 1.2 million-liter production volume [tank capacity] in Brazil, but the company struggled economically because it's hard for bio-based materials to compete with the cost of oil-based products."

There are other factors that make bio-based materials production challenging, Gardner adds. "Biology is good at exquisite design of molecules that operate in low-temperature or room-temperature [RT] regimes, but it's difficult to engineer those materials for tailored performance because that requires redesigning cellular enzymes and metabolism — a very hard problem. For example, some of the compounds relevant to high-performance applications like aerospace are toxic to microbes or involve oxygen-sensitive biochemistry that doesn't work under normal bioprocessing conditions."

By the mid-2000s, says Gardner, "I had started to get more interested in the software that underpins effective R&D organizations. What makes organizations capable of being agile and effective at discovering solutions to technical problems? I ended up starting a software-as-a-service company in 2014 that developed cloud-based software for experimental and process design, data integration and analytics." He then sold that company to Siemens and spent the next 3 years at a large company in biotech. "Along the way, I reconnected with the co-founders of Cambium — Stephan Herrera [now chief marketing officer] and Simon Waddington, CEO. We all came from a similar background — bioproduction of chemicals and biosynthesis — and I had gotten to know them through that part of my career. I reached out to Stephan 3 years ago because I saw what they were doing. At the time, Cambium included 'Biomaterials' in its name, but they were really a materials company trying to drive extreme performance in aerospace »





Cambium worked with NAWCWD to develop a combination of bio-based core molecules as precursors and fused those with phthalonitrile (PN) chemistry to create a novel polymer that was easier to manufacture into composites for high-temp applications.

applications. I was inspired because that was essentially where I started my career, and I had always wanted to get back to spacecraft and pushing the boundaries of what was possible."

The co-founders' thesis for Cambium was very simple, he says. "There hadn't really been any novel polymer classes commercialized since the 1980s. They recognized this huge innovation gap in polymer chemistry and also that biology has the potential to create and access trillions of novel chemicals, that wouldn't be possible otherwise, via its exquisite chemical synthesis capability. Thus, there are underserved opportunities — particularly in extreme performance applications in defense, aerospace, automotive and elsewhere — where biology might hold the key to creating these advanced materials."

Gardner was also enthused by Cambium's approach. "Because it was bio-enabled — that could mean bio or synthesis, it was open — they would use whatever methods and technologies were needed to get advanced materials to viable commercial products. It also included a blend of the things that interest me: aerospace, biotech, digital technologies, AI and machine learning [ML]." These all came together as Gardner joined Cambium to be its CIO and develop the company's AI and ML capabilities in computational chemistry, predictive modeling and quantum and atomistic simulation for material design.

Once at Cambium, Gardner notes his close collaboration with the third key player in the company's formation, Andy Guenthner. "He's the scientific founder and worked for the Air Force Research Lab and the Navy, with 30 years of experience in polymer chemistry, polymer physics and material design for extreme performance," he explains. "Cambium recruited Andy to breathe life into its technology. He was then able to partner with a chief scientific officer at the NAWCWD in China Lake, and together they went through a variety of candidates and discovered these novel classes of phthalonitriles [PN]." The result was Cambium's first commercial product for composites.

"Since then," says Gardner, "Andy and I have worked to expand the foundations of the AI and quantum chemistry simulation capabilities that he had started, and to build the general AI capabilities supporting Cambium's overall operations."

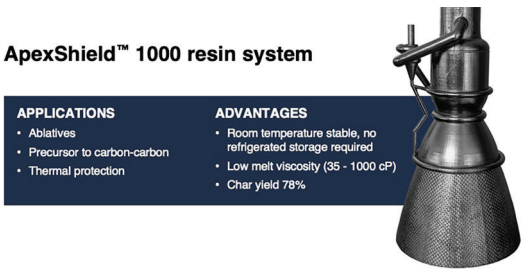
PN and CMC

Gardner notes that PN formulations were developed decades ago by the U.S. Navy. "They just didn't get developed to the point of commercial utility." PN resins have been in development by the U.S. Naval Research Laboratory (NRL) since the 1980s but sat in a chronic underinvestment gap without the funding required to scale up from lab-scale monomer to manufacturable, qualifiable and cost-effective products. Although early PN formulations used the OSHA-regulated carcinogen methylenedianiline (MDA) as a curing agent, later systems moved away in favor of alternative aromatic diamines. The main issue was processability.

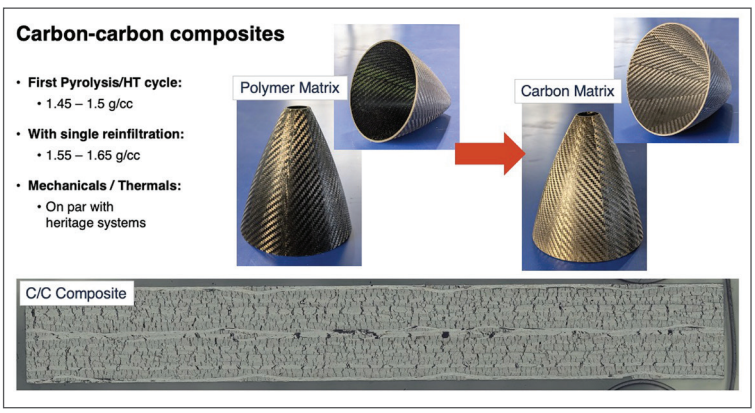
Cambium's opportunity came when defense funding priorities shifted. U.S. hypersonics spending had lapsed after the X-51 program wound down around 2013. But urgency returned after Russia's 2018 unveiling of hypersonic weapons and China's 2021 hypersonic glide vehicle test. These applications require lightweight, high-temperature materials like ceramic matrix composite (CMC) for structures and thermal protective shielding/thermal protection systems (TPS).

"Andy and NAWCWD discovered a combination of bio-based core molecules as precursors, and fused them with PN chemistry," says Gardner. "The result was a novel, high-performance thermoset polymer that could withstand temperatures above 400°C but were processable, with the right viscosity to be manufactured at near RT. They had great potential for composite TPS and possibly structures as well."

With further development, this became ApexShield 1000, he explains, which can operate at extreme temperatures and also be



Cambium has developed ApexShield resin systems to enable faster production of ablative carbon/carbon (C/C) composites for applications like rocket motor nozzles, hypersonic leading edges and re-entry nose tips.



heat treated to form carbon fiber-reinforced carbon (C/C) with a roughly 70% reduction in process time. Such carbide CMC are increasingly sought after for high performance at temperatures above 1600°C, but have traditionally been very expensive and required months to manufacture. Unlike metals and ceramics that weaken when heated, C/C gets stronger as temperature increases up to ~2200°C, allowing it to withstand intense aerodynamic stresses.

C/C composites also function well as high-temperature ablatives. Unlike polymeric ablators (such as carbon fiber-reinforced phenolic), which rely heavily on the resin's decomposition into gas, C/C composites rely primarily on thermochemical ablation, sublimation and radiative cooling. They undergo a controlled degradation to absorb, block and dissipate extreme thermal energy for applications like spacecraft atmospheric re-entry nose tips, hypersonic leading edges, TPS and rocket motor nozzles.

Cambium has also released ApexShield 3000, a PN coating engineered for metallic and composite substrates operating at extreme temperatures, such as in hypersonic flight. It enables electromagnetic interference (EMI) and radio frequency (RF) shielding for electronics and commercial programs requiring wavelength-tunable performance.

"That first molecule that Cambium developed is not a structural composite material," says Gardner, "but it serves a valuable role in TPS because it's easier to manufacture and able to achieve the target performance of ablatives and C/C. That's really key because it gives the U.S. a path for a resilient supply chain and rapid production. Part production drops from 6-9 months down to 1 month. That was one of Cambium's first novel products, but there are plenty of others now, either released or in the pipeline for commercialization."

Use of AI and Schrödinger tools, inverse design

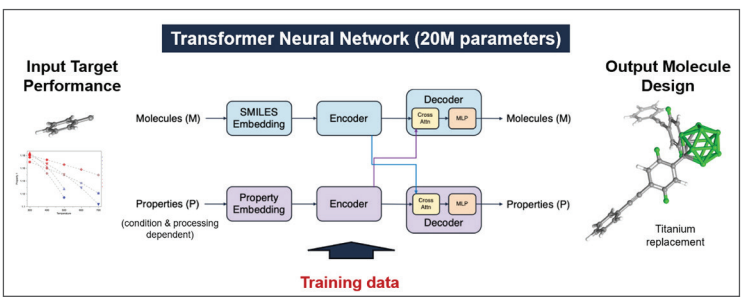
This issue of tackling processability and scalability while maintaining or tailoring performance is complexity. "It's figuring out how to meet all those factors at the same time," notes Gardner. "You solve one and you break another, but there are typically 10 factors, not two. If you iterate through that process sequentially and serially, in the traditional way, it takes years and you can't possibly test all the things you want to. That's where AI, ML and simulation come in. Cambium can now screen millions, if not billions, of molecules."

"We've also been developing inverse design, where you specify the properties you want and with the help of AI and simulation you get a set of perhaps 20 molecules that would likely have those properties. It's the Holy Grail for this type of molecular design," he continues. "We have an AI model, a type of transformer neural network, that is getting close to being able to do that."

As explained in a *CW* article with Schrödinger (New York, N.Y., U.S.), inverse design/development is a key part of the materials informatics (MI) paradigm shift, where ML and AI are used to dramatically reduce the time required to develop new materials and optimize how they are processed (see Learn More): "But it goes even further, not only accelerating the *forward* direction of innovation — realizing properties for suggested candidate materials — but also enabling *inverse* development, where novel materials are suggested based on input of desired properties."

Cambium uses Schrödinger's tools for atomistic simulation and quantum simulation, says Gardner, "but we're agnostic with our computational capability, the same as we are about the source of our molecules. We'll take »

Cambium's fusion AI architecture enables scalable, continuous training on any type of data (chemical, physical, biological) and is being advanced to enable both forward (molecule to property) and inverse design (desired property to output candidate molecules and formulations).



whatever works." He explains that quantum simulation is typically looking at one molecule, the arrangement and energy states of its electrons and how these influence molecular properties.

"The atomistic tool is used in simulating formulations at the scale of maybe 500 molecules — equivalent to roughly 20,000 or 30,000 atoms, depending on the molecule," he continues. "You can then simulate what happens physically, and from that calculate properties. For example, we can screen and identify processability properties like fluid flow, ease of handling and tackiness while maintaining strength and toughness at high temperature."

"But there are certain things that simulation cannot predict yet because there's not sufficient experimental data or physics modeling capability. For example, a fast quantum simulation takes 12 hours for one molecule, which means analyzing a million molecules just isn't possible. That's where ML and AI come in. Instead of literally using physics to predict how things are going to work, we use AI to produce a statistical approximation. It's the same as using ChatGPT or Claude. Those AI models don't literally have cognition; they have a statistical approximation of the world's knowledge and use that to predict the most likely response. Cambium is using AI to do the same thing. We collapse all of the physics into a statistical prediction of how a material is going to behave to complete in seconds what it would take 12, 24 or 72 hours on a typical atomistic simulation. You don't necessarily know why that molecule gives you the desired outcome, or you may only partially understand it, but that doesn't necessarily matter if you can get an accurate prediction nonetheless."

Everything in science is an approximation, notes Gardner. "It's just a question of how perfect an approximation. The neural networks we use can map between molecules and properties in both directions. We do a really good job from molecule and mixture formulation to property. Actually, most of the AI technologies to date have only worked on predicting what a molecule does. We can predict what a *formulation* does, and that's a key advance. Going from property to molecule, we're using this multimodal architecture of property and molecule fused together, and we've succeeded in beating property prediction benchmarks. We're getting closer and closer."

Target markets, moving beyond aero and defense

These accelerated development capabilities are first being applied to resin development in composites, says Gardner, but he adds the most exciting thing for Cambium these days is the acquisition of SHD Composites due to the path it provides toward wider application of the materials being developed.

"Lightweight materials for automotive body panels, for example, must compete with steel's fast stamping of parts, fatigue resistance and all these additional properties that enable safety performance. That's pretty hard to achieve all together, so we still have a way to go before we can replace automotive steel at scale. But a lot of the technologies we've developed to push toughness at extreme temperatures are finding immediate application, such as for thermal insulation—foams that are fire resistant—or side impact panels that can withstand thousands of pounds of intrusion force yet are lightweight. We're increasingly turning our AI technologies toward those types of goals."

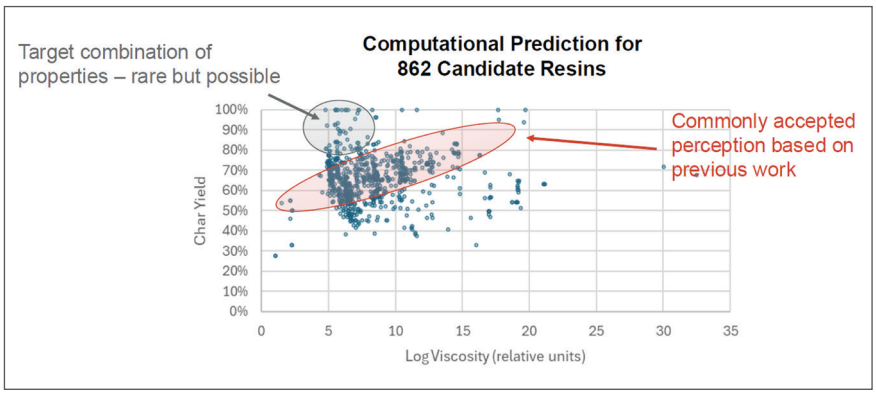
He notes SHD Composites has been serving those types of needs across a range of markets, including aircraft interiors, marine, motorsport and drones, as well as tooling for composites production. "SHD serves myriad carbon fiber and glass fiber composite applications and brings exposure for our AI and computational capabilities in these more conventional performance problems and their manufacturability needs."

He cites Tesla's July 2026 announcement about polymer body panels for its Cybercab vehicles as an example. The company will use a reaction injection molding (RIM) process that integrates color pigment into the polyurethane (PU) polymer mix injected into the mold, eliminating paint and speeding up subsequent

Cambium's acquisition of SHD Composites opens new markets and growth opportunities.



Cambium's screening of >860 candidates for PN resins showed that the commonly perceived trade-off between ease of processing (low viscosity) and thermal performance (char yield) has many exceptions.





Cambium helped USCRPL's Daybreak rocket reach space, using its ApexShield 1000 material to build the "boattail," an aerodynamic shroud for the rocket nozzle.

clearcoating to shrink Cybercab paint cycles from hours to minutes. "This is something we had already envisioned as part of a future casting exercise, but we also see the industry's interest to embed sensors and other multifunctionality. I see tremendous opportunity for Cambium and SHD Composites to create these new technologies for the consumer, where the limitation is often manufacturing more than performance. We're not trying to replace auto body panels tomorrow, but we still see a wide range of opportunities for growth."

But what about defense? "We began by seeking niche markets where high-performance materials are critical, but we are absolutely seeking the broadest set of markets, verticals and types of buyers," says Gardner, "because we're an advanced materials company, not a defense company."

In July 2026, Cambium launched SentinelOps, a tunable solution for laser and directed energy protection that maintains high-fidelity vision needed by commercial and military pilots, firefighters and others. In September, it launched ApexFrame 5000, a PN-based laminating film adhesive for non-structural bonding of polymer films and metallic foils for sustained service up to 315°C and excursions to 427°C.

"Defense is a necessity, but it's also a market that can tolerate costly materials initially and be the first buyer, then help advance R&D, bringing the cost curve down where you can access commercial markets. We have embraced defense for the purpose of filling the gap in advanced material development but we'd love our commercial markets to be 100 times bigger than our defense markets. The economic reality is that defense is actually a small market in terms of volume, and not something that would support all of our long-term ambitions."

What about more products for CMC? "The demand for high-temperature materials is being driven by rocket motors, TPS for space vehicles and satellites certainly," says Gardner. "There are growing opportunities there, and we will continue to pursue those markets through new resins and new processing methods, including with different fibers. We also do a lot of prototyping of parts to help our customers understand the potential of such developments. For example, we helped with the University of Southern California Rocket Propulsion Laboratory's [USCRPL] Daybreak rocket mission to teach them how to build these parts."

"We will keep pursuing those opportunities, but we're looking at other markets as well, which could include automotive," adds Gardner, "but adhesives and coatings also offer a large area of opportunity, and there are other areas where we are already working."

Reimagining the future of composites

What will Cambium look like in 5 years? "We want to be the world's premier and largest supplier of prepregs, composites and advanced materials," says Gardner. When asked if that means current industry leaders will have to take a back seat, he explains, "The advances we're making have to happen. Achieving affordability and manufacturability has been a real obstacle for composites, and it's not just defense markets and commercial consumers that need these solutions, but also the parts manufacturers and supply chains."

He explains how the acquisition of SHD Composites is part of this vision. "They have been so customer-focused and agile, which is why they've been so successful. Building on our shared passion for innovation, we're learning from their core culture and experience to shape Cambium's global culture toward maximum customer responsiveness, agility, speed and delivery on customer needs from material design all the way through part prototyping. We're reimagining the future and already changing what's possible." CW

LEARN MORE

More on Schrödinger | short.compositesworld.com/materials-informatics

Read this article online | short.compositesworld.com/Cambium



ABOUT THE AUTHOR

CW executive editor Ginger Gardiner has an engineering/materials background and more than 20 years of experience in the composites industry. **ggardiner@gardner.media**

Custom Blind Socket Fastener Protects Thin UAV Sandwich Core

BigHead helped design a bonded fastener solution that shifts compressive loads away from a medevac drone's thin composite sandwich panel, avoiding core crush and skin disbond risk.

By Hannah Mason / Technical Editor



A manufacturer of large medevac drones (similar to what is pictured here, though helicopter-sized) required a custom solution for fastening mounting points and fixed equipment to the thin composite sandwich panels used to construct its payload capsule.
Source | Getty Images

Unmanned aerial vehicles (UAV) are increasingly being designed with thin composite sandwich panels to maximize payload capacity and flight efficiency. In cases like medevac drones built to transport critical medical supplies or patients in high-risk emergency situations like combat zones, every gram of payload capacity matters.

These lightweight sandwich structures, sometimes only millimeters thick, can offer exceptional strength-to-weight performance, but because of this thinness, they leave almost no margin for error when it comes to the fastening required to attach these panels to the rest of the UAV. In these structures, even a small tightening force from the fastener can crush the core, and a relatively small loading across a small area can disbond the skins.

A drone manufacturer ran into this problem with a sandwich panel — made from 1-millimeter carbon fiber/epoxy skins on a Nomex honeycomb core — within the detachable payload capsule of a medevac vehicle for transporting medical supplies. This panel, measuring about 5.5 millimeters in thickness total including the core, needed secure mounting points for fixed equipment within the capsule, but through the company's efforts so far, was not able to tolerate the forces required to create these mounts.

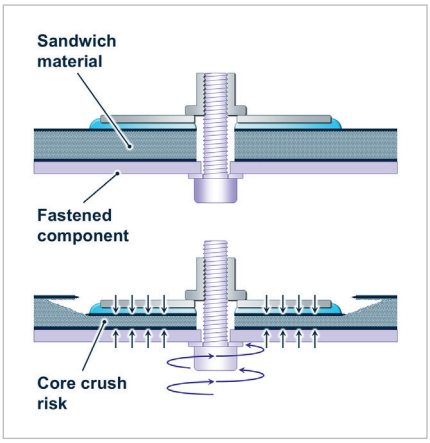
For advice, the manufacturer turned to fastening specialist bigHead Bonding Fasteners Ltd. (Verwood, U.K.). "The customer first approached us for tightening torque guidance on an internally threaded fastener bonded to the back of the sandwich panel. They recognized the risk of crushing the core during assembly, and wanted to understand how to avoid it," says Lawrence Cook, development engineer at bigHead.

In the original configuration, the allowable tightening torque was less than 1 Newton-meter (around 0.7 foot-pound) — a number that is unattainable without specialist wrenches or drivers, meaning even a slight overtightening could crush the sandwich core or cause skin disbonding.

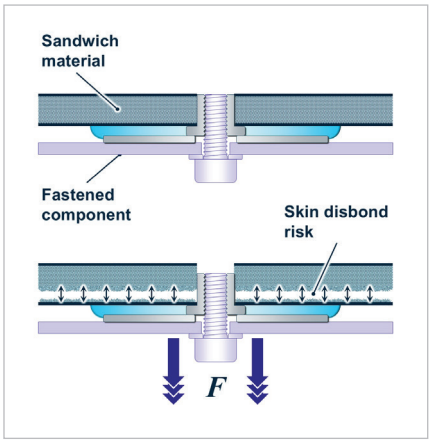
"In short, the fastening configurations they were considering required extremely delicate assembly control, and there was too much uncertainty about whether that level of control was feasible in a workshop, let alone in a service environment," Cook says.

The manufacturer's goal was to build 10 total units — a small number, but the design needed to be right the first time, and within a tight timeline. Most importantly, given the medical nature of the vehicle, the most pressing requirements were simple: "This thing can't fall out of the sky, and we can't have equipment falling off inside."

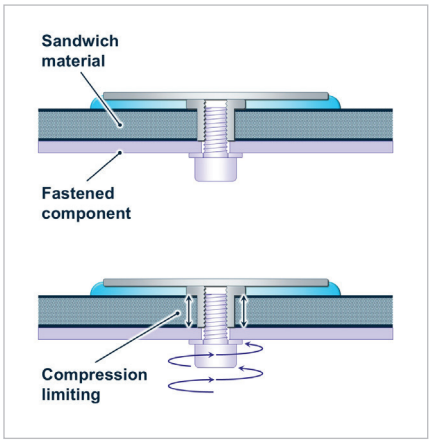
The bigHead team took on the challenge. The company produces more than 400 standard stainless steel fasteners suited to a variety of industries and requirements, but also, as in this case, is able to deliver bespoke, customer-specific designs. Over the next 2 weeks, bigHead evaluated the original sandwich structure, calculated its compressive limits, presented three viable options with clear pros and cons, recommended an appropriate adhesive and matched the thread length to the exact sandwich thickness. The final configuration resolved the company's uncertainties about whether the fastening would be resilient and achievable.



Option 1: Open reverse socket.



Option 2: Open socket.



Option3: Blind socket.

Source (All Figures) | bigHead Bonding Fasteners

BigHead walks through the three options provided for this case:

Option 1: Open reverse socket

ADVANTAGES:

- No standoff between components.
- No risk of skin disbonding.

DISADVANTAGES:

- Core material is compressed during assembly.
- Requires extremely precise torque control (<1 Newton-meter).
- High risk of crushing the core.

UNCERTAINTY:

- Can precise control of preload and tightening torque to the required accuracy be guaranteed?

Option 2: Open socket

ADVANTAGES:

- No compression of the core during assembly.
- Compatible with standard bigHead tightening torque guidance.

DISADVANTAGES:

- Creates a standoff between components.
- Risk of skin disbonding.
- Adhesive overspill must be managed carefully.

UNCERTAINTY:

- Even if the overspill is carefully managed, will the skin still separate from the core under expected loading?

Option 3: Blind socket

ADVANTAGES:

- The fastener takes the compressive load, not the sandwich panel.
- Reduced risk of compressing core material during assembly.
- No risk of skin disbonding.
- Compatible with standard torque guidance.

DISADVANTAGES:

- Thread length must match the sandwich thickness precisely.

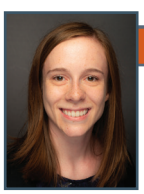
UNCERTAINTY:

- Can fasteners in specialist sizes be obtained without delaying the project?

The customer decided to select option 3. "This was the only option that fully protected the structure while meeting the customer's assembly and performance requirements," Cook explains.

The bigHead team recommended a blind socket with a customized thread length that matched the thickness of the sandwich panel. The configuration was designed to ensure that the fastener — not the sandwich structure — carried all compressive loads; there was no risk of crushing, disbonding or fatigue; internal surfaces were clean and suitable for medical payload equipment; and it is a lightweight, resilient solution aligning with the UAV performance requirements.

Within 6 weeks of working with bigHead, the medevac manufacturer had built a prototype ready for field testing. "The customer told us they were thankful for the clarity the process gave them," says Cook. "This is why we do things differently to other fastener manufacturers. We won't just send you some samples and leave you to figure things out on your own. We're here to help you make confident engineering decisions and achieve successful outcomes." CW



ABOUT THE AUTHOR

Technical editor Hannah Mason has been writing and editing about composites for *CompositesWorld* since 2018. She has a Master's degree in professional writing from the University of Cincinnati. **hmason@gardner.media**

NEW PRODUCTS

» Pultrusion guide

Pul-Tek Publishes Online Technical Guides for Pultrusion

Pul-Tek Composite Profiles (Nanjing, China) a manufacturer of FRP pultrusion profiles and composite products — including fiberglass grating, cable tray systems, handrail systems and custom profiles — highlights the preforming and layup stage of the pultrusion process with a step-by-step technical guide published on its website.



Preforming and layup determine how fiber reinforcements are positioned and shaped before they enter the heated pultrusion die, directly affecting profile geometry, fiber alignment and structural consistency of the finished composite part. The Pul-Tek guide walks readers through the stages for continuous profiles used in grating, cable tray and structural applications.

The company also maintains technical resources on its Pultuder pultrusion line — equipment for producing composite profiles — and on quality control methods in pultrusion production.

All of these resources are publicly accessible via the Pul-Tek website:

- Preforming and layup guide: **pul-tek.com/blog/preformy-i-ukladka/**
- Pultuder pultrusion line: **pul-tek.com/pultuder/**
- Quality control in pultrusion: **pul-tek.com/blog/kontrol-kachestva/**

Pul-Tek Composite Profiles | pul-tek.com

» Curing temperature map

GMI Aero Embeds Real-Time Thermal Mapping in Anita 4.0

GMI Aero (Paris, France) has released Embedded Temperature Mapping Application (Embedded TMApp), a new onboard feature for its Anita 4.0 hot bonder that overlays real-time thermocouple (T/C) readings directly on a photo of a composite repair. The feature is now standard on all new Anita 4.0 units and is available as a software upgrade for existing systems.

Embedded TMApp is designed to help operators correlate temperature measurements with thermocouple (T/C) placement — known as T/C topology — during complex repairs or thermal mapping trials that involve numerous thermocouples. Rather than requiring operators to export data for review elsewhere, the feature displays measured temperatures mapped onto the actual positions of the T/Cs on the Anita 4.0 screen itself, with “hottest” and “coldest” symbols also appearing to flag temperature extremes. GMI Aero says the tool requires no internet connection to operate.

Embedded TMApp runs in parallel with Anita 4.0’s standard temperature monitoring formats — tables, bars and graphs — and operators can switch between views at any time during a cure.

Operation involves two steps. During curing, the operator navigates to the “Thermal Mapping” menu, where measured temperatures are automatically mapped onto the corresponding T/C positions.

GMI Aero | gmi-aero.com/fr



» HP-RTM

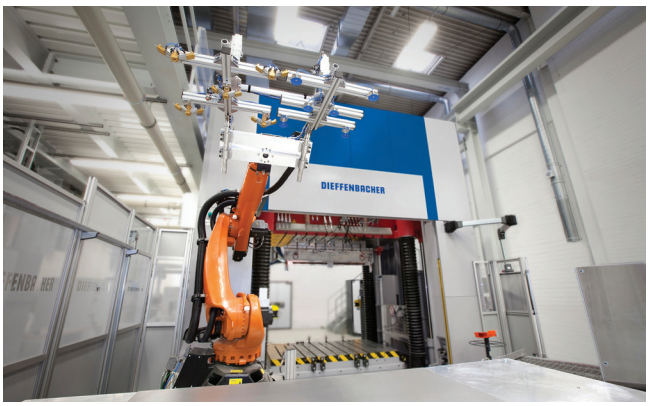
Dieffenbacher Introduces Pressure-Controlled Ultra-RTM Process

Dieffenbacher (Eppingen, Germany and Windsor, Ontario, Canada) is expanding its high-pressure resin transfer molding (HP-RTM) with Ultra-RTM, a pressure-controlled process designed to protect highly delicate materials in composites manufacturing and still maintain cost-effective, reliable mass production.

The HP-RTM process is suited for components requiring high surface quality, strength and stiffness. Typically, HP-RTM requires high pressing forces because mold injection pressures can reach up to 140 bar. However, when processing pressure-sensitive core materials, such as low-density foam cores, honeycombs or complex preforms, excessive pressure can damage these materials or distort the fiber architecture. The Ultra-RTM process eliminates this risk by operating at significantly lower cavity and injection pressures, both below 30 bar.

Ultra-RTM was developed by the Fraunhofer Institute for Chemical Technology ICT (Pfinztal, Germany), as an "RTM process variant for the cavity pressure-controlled production of fiber composite structural components." The process enables cavity pressure to be monitored, adjusted and limited through sensor technology and intelligent press control. Recognizing the benefits of this innovation, Dieffenbacher developed and implemented the corresponding hydraulic press control technology to turn the concept into a fully production-ready process.

Thanks to active pressure control tailored to specific process requirements, sensitive structures such as



foam cores within sandwich constructions and complex preforms can be infiltrated reliably without collapsing or shifting. The targeted control strategy prevents sudden pressure peaks, minimizes void formation and ensures homogeneous fiber impregnation. The process is particularly suitable for automotive and aerospace applications.

Ultra-RTM already has a home on Dieffenbacher's TailoredPress, which combines an economical monolithic press design with the latest Dieffenbacher Evoris Control press control system and an energy-efficient drive concept. The press can be integrated into fully automated production environments at any time. In addition, Dieffenbacher's digitalization solution, Evoris Intelligence, can be seamlessly integrated into the press concept.

Dieffenbacher | dieffenbacher.com/

» Compounds and adhesives

IP Corp. Expands COR-Grip Pro Bonding Product Family

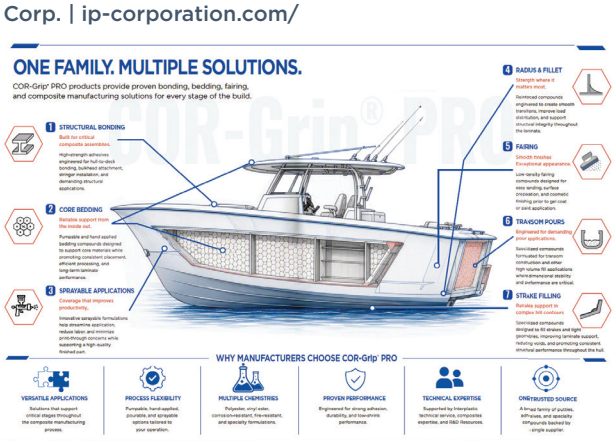
IP Corp. (St. Paul, Minn., U.S.) announces the expansion of its COR-Grip bonding compounds and adhesives under the expanded COR-Grip Pro brand, bringing together a comprehensive family of products designed for the diverse needs of composites manufacturers.

COR-Grip Pro includes application-specific solutions for structural bonding, hull-to-deck assembly, core bedding, radius and fillet formation, fairing, transom construction, sprayable composite applications and specialized fire-retardant and corrosion-resistant requirements.

"Every composites manufacturing application has unique performance requirements," says AJ Aldaco, business manager. "COR-Grip Pro gives manufacturers access to a broad portfolio of proven bonding compounds and adhesives, allowing them to select the right product for the job while benefiting from Interplastic and HK Research's decades of technical expertise and customer support."

Key benefits of the COR-Grip Pro system include engineered compatibility with IP Corp. resin and gel coat technologies, optimal structural performance, improved manufacturing efficiency and enhanced finished part quality.

IP Corp. | ip-corporation.com/



» Creel-free prepreg

Mako Advanced Materials Launches Creel-Free UD Carbon Fiber Prepreg

Mako Advanced Materials (Henderson, Nev., U.S.) announces the availability of creel-free unidirectional (UD) carbon fiber prepreg built around the company's HyperCure epoxy resin system. It targets aerospace, defense, motorsports, medical, marine and sporting goods sectors.



Conventional UD manufacturing requires a large creel setup, which Mako says drives the high minimum order quantities and long lead times associated with standard UD material supply, along with less flexibility for custom weights, fibers or resin formulations. To address this, Mako developed the creel-free process, which starts from carbon fibers already aligned and stabilized for coating, bypassing the traditional creel stage. The company says this allows it to manufacture UD prepregs in smaller batch sizes with lead times comparable to its standard woven carbon prepregs, while also simplifying custom resin substitutions such as HyperCure epoxy, flame-retardant epoxy or other formulations for applications including honeycomb core bonding and sporting goods.

The creel-free UD line is offered with standard modulus T700 and intermediate modulus T800 carbon fibers, with custom widths and areal weights available on request, and select high modulus fiber configurations. Areal weights start at 55 g/m^2, with stitched UD options available at 250 g/m^2 or higher; standard widths include 12", 24", 39" and 50", depending on fiber type.

When paired with HyperCure, Mako reports a complete cure cycle of approximately 9-10 min depending on thickness — matching the cure rate of its HyperCure woven prepregs within the same laminate stack — while maintaining a room-temperature outlife of 30 days.

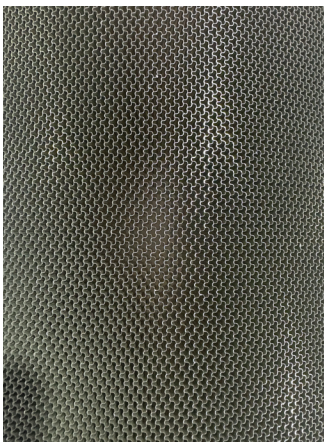
Mako Advanced Materials | makobond.com/

» Vented honeycomb

Hexcel Launches HexWeb Vented Flex-Core Honeycomb

An enhanced HexWeb CRPAA-5052-F80-12.0 Vented Flex-Core aluminum honeycomb by Hexcel Corp. (Stamford, Conn., U.S.) has been engineered to simplify complex composite structure production and still meet the demanding performance requirements of modern space launch systems and aerospace applications.

Traditional heavy-density honeycomb cores often require extensive machining and splicing to create highly contoured composite structures. Hexcel's 12.0 lb/ft^3 Vented Flex-Core reduces those challenges through a distinctive cell architecture that offers greater flexibility and formability than conventional hexagonal honeycomb. The material can reduce or eliminate machining, minimize splicing requirements and lower overall manufacturing costs while enabling larger and more complex structures, the company highlights.



Manufactured from 5052 aluminum alloy and protected by Hexcel's phosphoric acid anodized (PAA) corrosion-resistant coating, the material is capable of service temperatures up to 177°C. A key innovation is its integrated venting capability, which helps composite sandwich structures manage pressure differentials and outgassing requirements encountered during ascent and other demanding aerospace environments.

Beyond launch vehicle applications, the material is also well suited for high-temperature aerospace structures, including engine nacelles, where increasingly complex geometries and elevated operating temperatures continue to drive demand for advanced lightweight materials.

Available in vented and non-vented configurations, the HexWeb CRPAA-5052-F80-12.0 Flex-Core expands Hexcel's portfolio of honeycomb solutions for space, aerospace and other demanding composite applications.

Hexcel Composites | hexcel.com/



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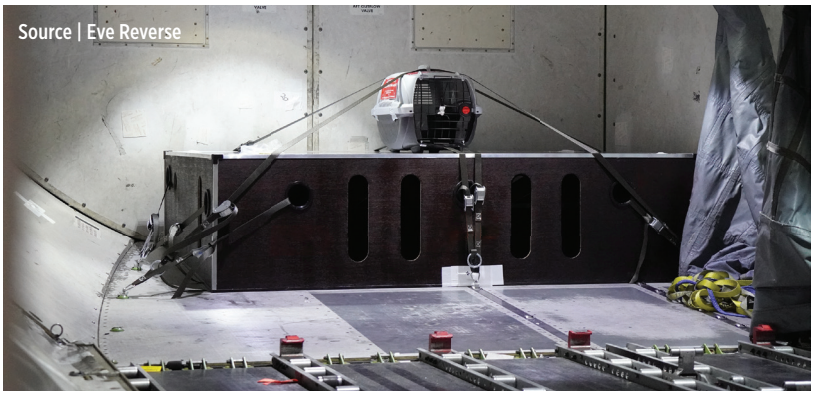
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POST CURE

Highlighting the behind-the-scenes of composites manufacturing

Successful Test Flight Campaign of an Airline Solution With More Than 90% Bio-Based Content



» Eve Reverse (Delft, Netherlands), together with TRPD Consulting & Engineering (Utrecht, Netherlands), have developed and successfully flight tested a bio-based composite sandwich structure (center of image) designed for use as a raised cargo platform in a widebody aircraft.

Cargo platforms must combine low weight with sufficient strength and durability to withstand repeated loading, unloading and in-service handling. This function is traditionally performed by sandwich panels comprising fiberglass-reinforced polyester skins bonded to a lightweight honeycomb core.

The airline cargo container support structure solution developed by Eve Reverse and TRPD uses a comparable sandwich architecture but replaces the conventional composite skins with flax fiber reinforcement and a fire-retardant, bio-based resin derived from agricultural waste. An end grain balsa core provides additional stiffness while maintaining a low overall weight. The structure was manufactured using an out-of-autoclave process, with the panel vacuum bagged and cured in an oven. This production route can reduce the energy requirements and associated costs of manufacturing compared with an autoclave-based process.

A thin aluminum sheet is bonded to the upper surface of the platform to improve wear resistance and provide a smooth, durable surface for cargo handling. Despite the inclusion of this metallic facing, more than 90% of the complete sandwich structure is bio-based by weight.

The first prototype has now successfully completed an intercontinental flight test campaign. Instrumented with sensors, the platform was evaluated under operational conditions during its first in-service trials. Further testing and qualification activities are expected. CW

Show us what you have!

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

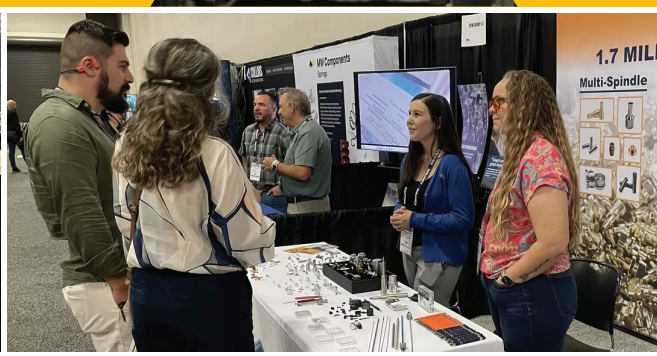
The *CW* team wants to feature your composite part, manufacturing process or facility in an upcoming issue. Send an image and caption to *CW* senior managing editor Grace Stubbins at **gstubbins@gardner.media**.

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