Welding instead of gluing: a new era in lightweight construction

Lightweight construction has adapted and optimised itself over time, and materials have become lighter – but stronger – to meet the demands. The next evolutionary step? Allowing different materials to be bonded together to combine their advantages.

Interview

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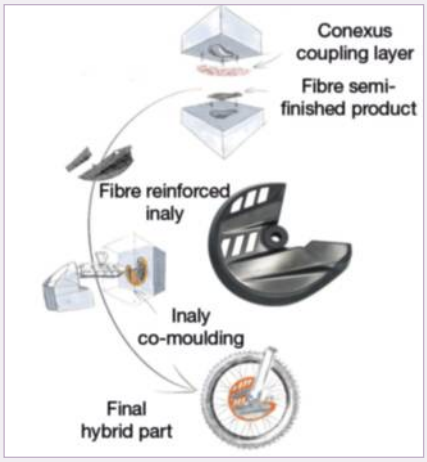
What is special about the Conexus technology and what can it be used for?

Hans Lochner: Conexus technology makes it possible to bond fundamentally different materials, particularly thermosets and thermoplastics. Normally, these 2 types of materials cannot be welded together, but the chemical coupling layer of Conexus turns them into a single unit. The idea stems from the need to create thermoset-thermoplastic joints that are essential for high-performance applications. Conexus also offers significant advantages for thermoset-thermoset joints. For high-volume applications, we see great potential for thermoplastic-thermoplastic bonding in the low-cost segment, where separation by type must be ensured.

What are the advantages of the Conexus joining process over conventional bonding, especially for thermoset-to-thermoset joints?

Dominik Kuttner: Compared to conventional structural adhesive bonding, Conexus primarily eliminates the additional process step of surface preparation of the parts to be joined. Combined with cheaper base joining materials, shorter cycle times and less need for bonding fixtures, the cost-effectiveness of the joint increases. Instead, we create a direct material bond that is lighter, stronger and less susceptible to damage. Conexus offers the advantage of selective separability, especially for thermoset-thermoset joints, which makes it easier to recycle the materials. Another advantage is the smaller joint gap, which results in greater precision and strength of the joint. In addition, there is no weakening of the fibre structure due to the need to drill holes compared to riveted and bolted joints.



Conexus joining example process

How exactly does the joining process work with Conexus technology and what joining methods are used?

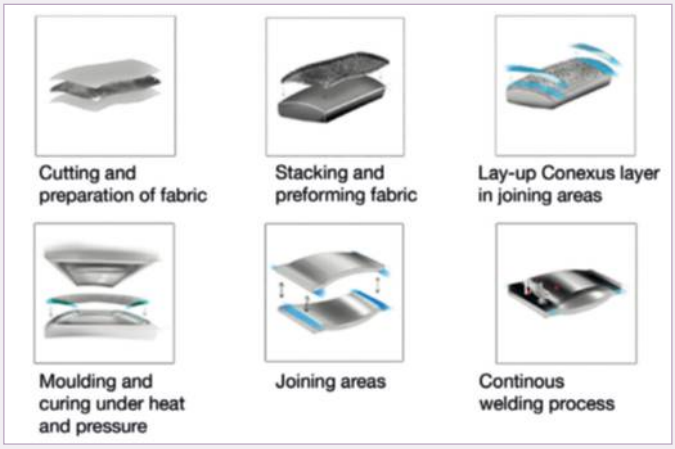
H.L.: Basically, we have the option of hot gas, laser or ultrasonic welding, depending on the application. Hot gas welding [1] heats the chemical bonding layer, allowing it to weld the parts together and form a strong joint. The result is a durable joint that meets the mechanical requirements of today's lightweighting applications. Ultrasonic welding, on the other hand, uses high-frequency sound waves to heat and join materials at their interfaces, also creating a strong and durable joint. Conexus is well-suited for large-scale production due to its compatibility with industry-standard welding processes, which offer significant potential for automation, enhancing efficiency and consistency in mass manufacturing.

What applications do you see in injection moulding?

D.K.: In injection moulding, we can use fibre-reinforced thermosets as inserts or sub-assemblies and overmould them directly with thermoplastics. This opens new possibilities for designing complex components with high strength and low weight.

In which industries do you see the greatest potential for Conexus technology?

Christopher Wengler: Conexus technology offers significant advantages, particularly in the automotive, aviation and aerospace industries. Lightweighting and structural integrity are critical. In addition, the scalability to achieve higher



Conexus joining process

production volumes is key. We also see potential in the sporting goods industry, where weight and durability are critical – same applies to weight-optimised consumer goods.

What about the sustainability of Conexus joints?

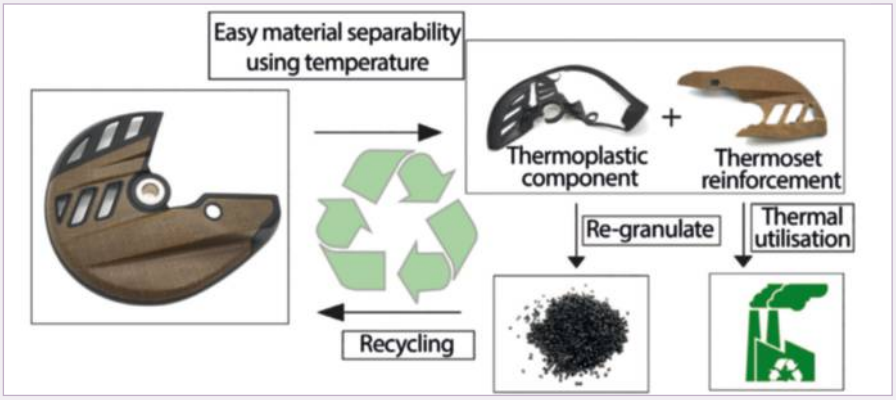
C.W.: Conexus technology makes it possible to separate the joint applying the defined temperature. This enables material separation and recycling of each material and contributes to sustainability. For example, recycled carbon fibres can be used to reinforce thermoplastics, closing the loop.

What is the current technical maturity of the Conexus joining process you describe?

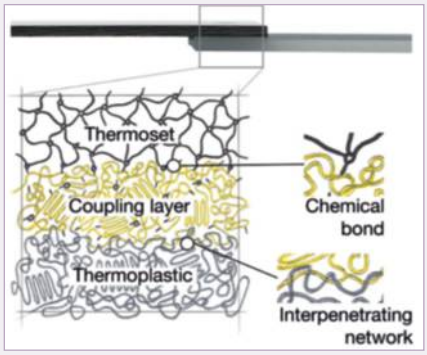
H.L.: The Conexus joining process is well beyond the development stage and dedicated features are being used successfully in volume production. In the automotive industry, in particular, Conexus is already being used in large numbers. One outstanding example is its use in structural and semi-structural vehicle components, where the joining of fibre-reinforced thermoset-thermoplastic hybrids is essential.

D.K.: A particularly impressive success is the application in the field of electromobility. Conexus is used in electric motors as an enabler for sophisticated lightweight hybrid solutions. The technology is opening a new design space for new concept approaches. This application demonstrates not only the versatility of the technology but also its robustness under extreme conditions, which are essential in the automotive sector.

C.W.: The current state of the art is not limited to the automotive industry. We are currently working on an exciting development project to evaluate and prove the potential of Conexus in the aerospace industry. The challenge of lightweighting, robustness and material efficiency in this sector is enormous. With Conexus, we could enter a new era of hybrid lightweighting.



Material separability and recycling with Conexus



Schematic of the connection

H.L.: Overall, Conexus is not a vision of the future, but a proven production technology that is already being used successfully in a broad industrial context. The technology is backed by a strong network of suppliers, development partners, manufacturing partners, specialised toolmakers and state-of-the-art machinery. All of this makes Conexus a real and powerful solution to current and future lightweighting challenges.

What are your plans for the Conexus technology?

H.L.: We are currently working to further develop Conexus technology for metal-plastic composites. These new hybrid materials could revolutionise many industries. We are also exploring the potential of thermoplastic-thermoplastic composites, which can also be recycled through targeted material separation. We also see potential in additive manufacturing for prototyping, where the flexibility and efficiency of Conexus technology are particularly beneficial.

Just as nature's evolution continually refines the most efficient structures, Conexus is driving the next phase of lightweight design by enabling material combinations that were once impossible. As we continue to push the boundaries of what is possible, this technology exemplifies how innovation can lead to more than just improvement – it can redefine the future of lightweight construction. □

More information:
www.ktm-technologies.com/en

Reference:
[1] link.springer.com/article/10.1007/s10443-024-10208-1