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FEATURE

When haute couture fashion meets biomimetic design

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Complex components in medium to high volume require lean manufacturing technologies that allow for efficient material usage as well as precise and reproducible production. Thanks to 150 years' experience in haute couture embroidery, BIONTEC efficiently produces CFRP components in high volume.

Tackling high cost of composites

Fiber reinforced composites offer many properties that allow a technically better solution compared to metallic materials: These cover, among other things, the high specific mechanical properties, which predestine the material for lightweight construction, but also low thermal expansion, a high degree of vibration damping and the integral design possibilities. However, major challenges lie in the design of the anisotropic material as well as in the often high costs. With the prevailing manufacturing techniques for carbon fiber reinforced plastics (CFRP), an economic use of the material, especially in medium to large quantities, is hardly conceivable.

BIONTEC's novel approach: textile technology and biomimetic design

Based on 150 years' experience in textile technology combined with comprehensive know-how in fiber reinforced plastics the company has developed its own manufacturing process from fiber to finished component for large serial production (Figure 1).

BIONTEC adapted Tailored Fiber Placement (TFP) for high volume production and thus allows an efficient and robust preform manufacturing.

By sewing the reinforcing fiber onto a carrier material the optimum material combination for each specific challenge can be chosen. According to biomimetic design BIONTEC aims to achieve the best performance with minimum material usage by placing fibers aligned to the load path within the net shape of the component. By combining different layers of fiber into one stitched layup preforming can be simplified significantly. For more complex parts, several layups are combined like a puzzle into a three-dimensional stable preform. A high degree of automation reduces costs and typical defects such as gaps, fiber misalignment, wrinkles and so forth.

The component is molded net shape using Resin Transfer Molding (RTM) minimizing machining efforts. Due to infusion optimized preforms and multi-cavity tooling, short cycle times can be achieved without the use of high-pressure RTM systems, thus being the less prone to process induced defects (Figure 2).

Engineered to perform: from idea to serial production

BIONTEC develops components from first idea until serial production. Every single step in development is taken on the premise of enabling efficient production – whether the customer requires 100 or 100,000 parts per year. By using the vast knowledge in textile technology as well as composite production a product designed for manufacturing is obtained (Figure 3).

Wide range of products

The technology is particularly suited for complex parts that are rather limited in size. Parts can be manufactured monolithic, with sandwich cores, or even hollow, depending on the specific requirements. Typically, high tenacity or high modulus carbon fibers are employed but other technical fibers such as glass, basalt or aramid fibers are used for special applications for example in medical technology.

A few fields of applications stand out:

In metrology, especially when it comes to optical handheld devices, weight, stiffness and thermal expansion are drivers for applying carbon fiber composites. With the freedom of fiber steering combined with the automated manufacturing process, superior mechanical performance together with minimal variation can be achieved. Typically these products employ high

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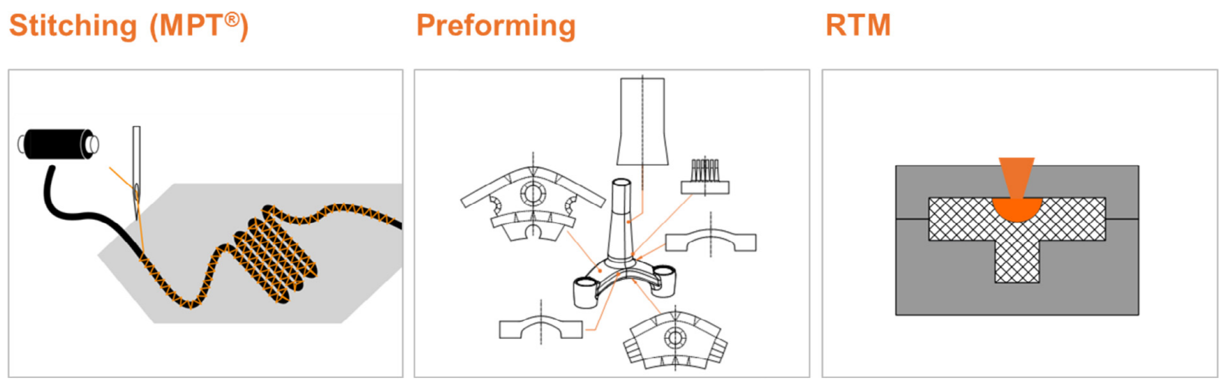

FIGURE 1
Composite manufacturing process optimized for serial production.

FIGURE 2
Net shaped stitched textile, 3-dimensonal preform and molded and machined part – bicycle brake lever for high-end brake systems offering 50% weight saving over forged and milled aluminum levers.

FIGURE 4
Structure for a 3D scanner featuring stiff sandwich structures and high surface quality out of mold.

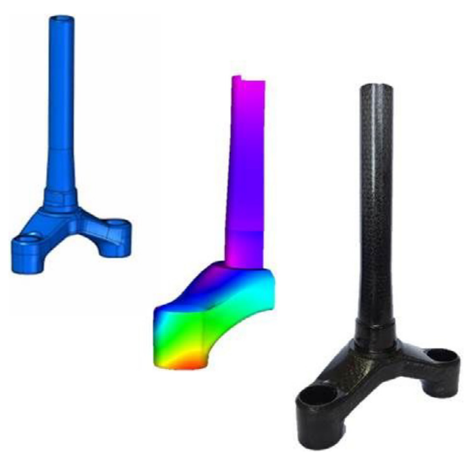

FIGURE 3
Engineering steps from first concept over CAD and FEA to production focusing on performance and efficient manufacturing.

FIGURE 5
Corner cleat designed for a small satellite structure in high volume (>1000 ppa).

modulus fiber and special resin systems reducing process induced deformation such as spring in. Furthermore, the automation and short cycle time of the process allow significantly higher productivity than commonly applied prepreg hand-layup, thus cutting costs by half (Figure 4).

At the other end of the volume range the typical products being replaced are forged or die cast aluminum. Using automation, multi-cavity tooling and fast-curing resins, production rates of 100,000 ppa can be achieved. Key enablers for such high volumes are net shaped preforming and molding in order to reduce material waste and machining efforts to a minimum. Using ideal fiber orientations in a component can increase potential weight savings up to 50 % over aluminum, as several serial production parts from the bicycle industry show.

Other applications are the replacement of milled aluminum or titanium fittings for aerospace and space industry where performance and part consistency can be well met. Such a structure for a scientific space mission in which, besides mechanical performance, thermal expansion, thermal stability and outgassing are the critical qualification criteria, is currently in development. For these purposes a new cyanate ester resin for infusion has been utilized (Figure 5).