PARABEAM

Lightweight, Quick-Heating Glass-Fiber Composite Tools for Composite Parts

Behind every well-made composite part sits a well-constructed tool. And critical to that success is design and material selection. Composite parts can be formed in tools, or molds, made from a wide variety of materials — everything from steel, aluminum, and ceramics to fiberglass, high-density foams, and even wood/plaster models. The choice of the best tooling material for the job depends on many factors.

Demand for bigger

High-performance composite parts and those requiring a high-rate of production are frequently produced on ceramic or metal tooling. However, while these tools allow exacting precision and are extremely durable — standing up to thousands of production cycles — they are also heavy, expensive, and typically require third-party tooling specialists to maintain. **As demand grows for larger composite parts, these expensive, often times cumbersome tools, become increasingly less attractive.**

Boats, trucks, aerospace

Softer tooling materials, such as fiberglass materials and high-density foam, are well suited for open mold processes, including hand lay-up and spray-up, which are used to produce a variety of large composite parts, **such as boat hulls and decks, truck cabs, hot tub shells, and shower enclosures**. Resin transfer molding (RTM), a low-pressure vacuum process, uses fiberglass or electroformed molds that are typically capable of producing up to 10,000 parts.

Smart shrinking

The use of a composite tooling material allows the composite manufacturer the advantage of building tools in house using material similar to what will be used for the finished part. This provides a variety of benefits, not the least of which is a nicely matched coefficient of thermal expansion (CTE) between the tool and the part. **Since shrinkage and thermal expansion of the composite part will be similar to the composite tool**, the part is better able to maintain dimensional integrity during cure.

Composite tools are also lighter, and while composite tooling may be less durable than ceramic or metal tooling, advances in composite materials and design are increasing the capabilities of composite tools.

Technical insights

For instance, a lightweight, quick-heating tool with integrated cooling channels, suitable for either open molding or RTM, can be built using layers of ParaGlass/5 fabric. Mold construction begins with a 0.3-mm/0.012-inch gel coat layer to produce a hard, smooth, and durable molding surface. This is followed by three reinforcing layers — typically a 1.3-mm/0.05-inch thick ply of chopped strand mat and vinyl ester (VE); a 1.5-mm/0.06- inch thick ply of chopped strand mat and specialized tooling resin system (i.e. Nord Composite's Zero Shrink or CCP's OptiPLUS); and a 1.3-mm/0.05-inch thick ply of chopped strand mat and VE. This is followed by two layers of ParaGlass/5 with the neat resin (VE) of the second layer applied at a right angle to that of the first layer. A final ply of 0.5-mm/0.02-inch thick chopped strand mat and VE is then applied.

3D

The **ParaGlass 3D fiberglass material** is woven from E-glass yarn and consists of two deck layers connected by vertical yarns. The z-directional yarns, which are woven through the deck layers, tie them together in an integral sandwich structure, and the deck layer preforms absorb the resin. As the fibers are impregnated, the fabric rises to a preset height, and, in a single step, a complex construction is created with z-axis fibers that pick up the shear and compression/buckling **loads much as a foam or honeycomb core would**. This allows significant weight reduction without sacrificing stiffness to **weight and strength to weight ratios**.

Final advantage

If cooling or heating of the mold is required, the ParaGlass provides a space to introduce cold or heated water (recommended only with an epoxy resin system). Even without an integrated cooling system, the tool reduces preparation time by quickly returning to ambient temperature for production even when stored in a cold environment. Since the entire tool is constructed entirely of glass and resin, the tool is **not susceptible to delamination**.

For more information, please contact sales@parabeam.com