PulPress Technology with ROHACELL®

SOLUTIONS: COMPOSITE MATERIALS
Short cycle times for large volumes

Large volumes at reasonable prices—often that goal is a contradiction in terms when it comes to producing fiber-reinforced composite materials. PulPress technology developed by Evonik in cooperation with Secar Technologies demonstrates how it could be achieved by using a novel continuous process to make sandwich profile components from composites.

A number of technologies are available for manufacturing complex molded parts from fiber-reinforced composites, but they all have one thing in common: cost-effectiveness does not necessarily go hand in hand with the desired level of component complexity. The best example of this is lamination by hand—the oldest method for making composite components. While this method can be used for producing complex geometries, by definition it cannot be automated, which eliminates it as an economical option for mass production.

A greater degree of automation can be achieved with what is known as resin transfer moulding, a process that has attracted some attention lately, not least as a result of the bodies of BMW’s i3 and i8 electric cars, which were made from carbon-fiber-reinforced plastic. Current cycle times are still relatively long, however—much longer than typical times for a BIW (body in white) cell in large-scale automobile production. One alternative is to make elements such as fiber-reinforced plastic profiles via the pultrusion method, even though for a long time, manufacturers could only use this process to produce straight profiles.

It was against this backdrop that Evonik developed a new, highly automated, continuous process for manufacturing components with complex geometries from fiber-reinforced composite materials. The development partner for the project was Secar Technologie GmbH, a company located near Vienna and specializing in the production of components from a variety of fiber-reinforced composites.

Known as PulPress, the new method represents a novel combination of pultrusion and molding processes. In terms of the materials used, development began with Evonik’s ROHACELL®, a closed-pore, high-performance structural foam that serves as the core material in sandwich components. This polymethacrylimide (PMI) foam has proven to be a
lightweight yet strong material in composites such as those used in auto racing, aviation, and athletic equipment (hockey sticks, skis, etc.).

In addition to its low specific weight, ROHACELL® is also thermoformable and highly pressure resistant, with a glass transition temperature of 180°C. These properties make the material perfect for the PulPress method—the development, in other words, has demonstrated yet another application for ROHACELL®. In the PulPress process, the structural foam serves as the core through which reinforcing fibers are woven. Afterwards the resin is introduced for fiber impregnation. Once prepared in this way, the material is fed into a press system, which processes the continuous material at elevated pressure and temperature to create a 3D profile with defined dimensions. The production plant can currently produce sandwich profile components up to 1.20 meters in length in a continuous process.

Photo Caption 1:
Basic principle of the new PulPress process
Fibers are woven through the sandwich core, which is first impregnated with resin and then pressed into the desired shape at elevated temperatures. Thirty sandwich profile components an hour can currently be produced in this fully automated process.

In these components ROHACELL® serves as shaping core material; additionally metal or polymer inserts can be used as well. Evonik and Secar worked together to build the plant, which is capable of a fully automated throughput of 30 components an hour, or one component every two minutes. That rate could be increased still further, for instance by using a resin system that cures faster.

The structural foam core of fiber-reinforced plastic parts ensures that the resulting component will withstand the desired application of energy and force. Measurements taken on a bumper component produced using the PulPress method show that component strength is similar to that of a comparable aluminum part produced using conventional methods—even though the component made of composite material is nearly three times lighter.
Unlike today's processes, in which a structural foam core with fibers is processed into a composite material, the PulPress process involves almost no waste—of either the foam core or the fiber. The process will benefit customers in the automotive industry, the aviation industry, the athletic equipment sector and other industrial markets.

Photo caption 2: High Efficiency
Using the new PulPress method to make complex molded profiles from composite materials cuts costs by 30 to 60 percent per component over other production methods. The resulting components weigh 75 percent less than their steel counterparts.

Photo caption 3: Comparing manufacturing processes
Highly cost effective and highly automated, for highly complex components; the new process makes mass production feasible for complex molded parts made of fiber-reinforced composites.
Photo caption 4:
Complex parts
The compact production line supplies currently complex sandwich profile components up to 1.2 m in length

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