

Fully recyclable high pressure composite tanks made with thermoplastic resin

With its thermoplastic matrix made of polyamide and a liner made of the same material an innovative pressure tank is fully recyclable, whilst at the same time providing for extremely short cycle times due to an innovative manufacturing process. The concept was developed by the Darmstadt based Engineering Service Provider compoScience GmbH.

Pressure tanks made in CF/EP wrapping technology are state of the art and have been used industrially for many years. Their increasing application as fuel tanks in the automotive sector, however, raises new issues in connection with the recyclability of these material systems. The mixture of thermosetting composite and thermoplastic liner used currently allows only the thermal recycling of the costly CFK material.

An innovative pressure tank concept developed by the Darmstadt/Germany based Engineering Service Provider compoScience GmbH to be showcased at this year's Composites Europe is now promising to provide a solution to this dilemma. With its thermoplastic matrix made of polyamide and a liner made of the same material, the pressure tank is fully recyclable, whilst at the same time providing for extremely short cycle times due to an innovative manufacturing process.

Bonification scheme

The process is essentially not much different from the traditional wet wrapping process using epoxy resin. Standard wrapping equipment merely needs to be supplemented with a temperature-controlled enclosure for the wrapping space and a special system for impregnating the reinforcing fibers.

The really outstanding feature of the process lies in that instead of the conventional high-viscosity polyamide melt, fibers are impregnated with the low viscosity precursor product Caprolactam; polymerization to obtain the finished matrix material does not take place until after placement of the fibers on the winding core. As impregnation of the fibers takes no more time than in the case of conventional thermoset wrapping, manufacturing



Thermoplastic composite tank with cut-trough dome

times are comparable. In addition, the tempering process which is mandatory for thermosets, is no longer necessary. Particularly in the case of large-volume tanks manufactured in high quantities for the elimination of this time and energy consuming temperature process may provide substantial cost benefits.

Goings-on

Currently, a laboratory facility operated by compoScience GmbH, which was adapted to the new wrapping process using Caprolactam allows wrapping and curing of prototypes to be accomplished within just a few minutes.

The mechanical properties of the CF-PA composite, such as strength and stiffness, have been shown to be comparable to those of composites made with epoxy resin. As had been expected, the more ductile thermoplastic composite was even found to be more tolerant under impact loading than its more brittle thermosetting counterpart.

The development team at compoScience is currently working on empowering the process for typical wrapping applications hitherto using exclusively thermosetting matrices. At the Composites Europe show in Düsseldorf/Germany, the company is also hoping to find a project partner to jointly promote the further development of this novel technology.

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