Case Study

Impact resistant at low temperatures, lightweight and leakproof

Production-ready: Polyamide 6 for the inliners of automotive high-pressure natural gas tanks

Cuts vehicle weight by up to seven percent

Figure 1 Fiber composite-natural gas-pressure tank

Grade: Durethan® Polyamid 6

Producer: Xperion Energy & Environment GmbH
Germany

LANXESS has developed a new high-tech Durethan polyamide 6 for manufacturing lighter, less expensive tanks for cars that run on natural gas. Ultra-strong at extremely low temperatures, this thermoplastic is ideal for the extrusion blow molding of inliners for these high-pressure vessels. The inliners are wrapped in thermosets reinforced with continuous fibers. The result is a plastic tank that weighs only one-fourth as much as a solid steel tank, meaning it reduces total vehicle weight by up to seven percent. This in turn significantly reduces a natural gas vehicle's CO_2 emissions, improving even further its already superior emissions profile compared to gasoline and diesel engines. Based on the new material, Xperion Energy & Environment GmbH in Kassel, Germany, has developed a natural gas tank system that a German car manufacturer is planning to install in production vehicles in the future.

The costs of producing these tanks are lower for several reasons, including the fact that the polyamide liner is blow-molded in a single step that consumes considerably less energy than the processing of sheet steel or aluminum. Furthermore, functions such as the valve port can be integrally molded into the component. In contrast, the forming and welding steps involved in making steel or aluminum tanks are very costly.

As a result of studies conducted at LANXESS of the barrier behavior of different polyamide 6 and 66 grades against natural gas new materials were developed. The study results showed that these materials are 100 times more impermeable to natural gas than high density polyethylene (HDPE). Compared to polyoxymethylene (POM), the barrier effect is about ten times greater. Measurements showed that even after a testing period of six months, no detectable quantities of natural gas had escaped through three-millimeter thick polyamide test plates.

The new material's excellent barrier properties against natural gas make it comparable to its polyamide sister products. What is more, it offers very good low-temperature impact resistance and flexibility, meaning the composite high-pressure tank can be safely operated and filled even at -40 °C.

The production-ready, high-pressure natural gas tank developed in partnership with Xperion has passed all tests required by European automotive

standard ECE R110 for drive systems with compressed natural gas, including pressure pulsation tests with over 50,000 load cycles and drop tests from a height of 1.8 meters.

Natural gas is gaining popularity as a fuel, particularly because it is cheaper and environmentally friendlier than super-unleaded or unleaded gasoline and diesel. For example, natural gas vehicles emit 25 percent less CO_2 than their gasoline counterparts. The CO_2 balance even improves significantly when biogas from renewable sources is added to the natural gas. Because of the high energy content and low price, the range of a vehicle run on natural gas relative to a specific amount spent on filling the tank is much higher – roughly twice as high compared to super unleaded gasoline. And although it is often confused with liquefied petroleum gas (LPG), natural gas has clear advantages thanks to its significantly higher energy content.

GREEN MOBILITY™
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The ability to save weight in vehicles by using plastics such as Durethan®, Pocan® and TEPEX® makes an important contribution to saving fuel and, linked to this, reducing CO_2 emissions.