

High-strength panels were manufactured from ShotBlocker material and positioned near tanks such as these to protect employees from parts that could possibly fail during pressure testing.

Composite panels shield workers during pressure testing

Alan Johnson of Norplex-Micarta explains how high-strength panels manufactured from a thermoset composite are being used to protect employees in a tank manufacturing plant.

At a facility that manufactures and tests storage tanks, company management took important preventative measures to protect personnel from the possibility of injury by steel plugs being dislodged during high-

pressure tank testing. Protection came in the form of high-strength panels that are positioned near the tank parts that could possibly fail during pressure testing. The panels are made of a composite material that provides excellent impact resistance

but is much lighter than steel. The material also offers major advantages over wood and thermoplastic alternatives, making it a good choice for many applications that require shielding in order to protect personnel and property.

Testing situation

Inside the tank manufacturing plant, large tanks are pressurised to test their ability to handle conditions during use in the energy and chemical industries. During this testing, pressure inside a tank can reach 10 000 psi (nearly 690 MPa), which puts a particularly severe strain on components at junction points between the tank and pipes leading into it. Among these components are small steel plugs that are screwed onto threaded pipe parts. If the threads on these plugs or if the weld points on the pipes themselves fail during pressure testing, the plugs or pipes may dislodge and project through the air at several hundred miles per hour.

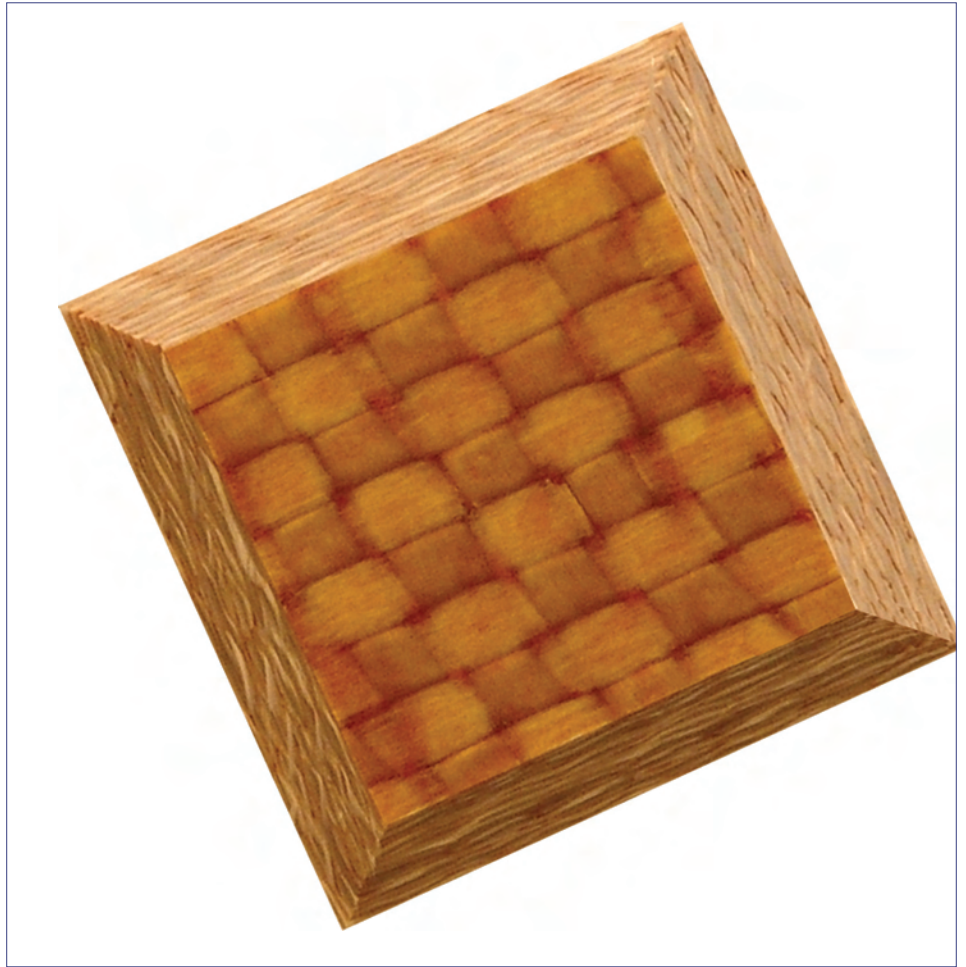
To protect workers from these projectiles, plant management decided to construct assemblies with ballistic protective properties. Measuring 4 ft (1.2 m) wide by 8 ft (2.4 m) high, these panels are supported at the base by a pair of L-shaped steel brackets. Casters attached to the bottom of the brackets allow the panel assemblies to be wheeled into place before the start of pressure testing and wheeled back into storage when testing is completed. The assemblies can completely surround a tank or be positioned only near places most likely to experience a component failure.

To enhance the stability of the assembly, the casters are attached to the ends of the brackets about 2 ft (0.6 m) from the panel centreline. The relatively wide spacing of the casters on both sides of the panel ensures that the assembly will not tip over if the panel is struck by a flying metal object.

The thermoset solution

When deciding on a panel material, management passed on conventional alternatives such as steel, thermoplastic and wood and instead opted for a thermoset composite known as *ShotBlocker*.®

ShotBlocker ballistic resistant panels consist of woven glass fabric impregnated with a high-temperature phenolic resin. Manufactured by Norplex-Micarta, *ShotBlocker* is supplied as a fully cured rigid sheet or a prepreg.



ShotBlocker anti-ballistic material is very lightweight, allowing panels to be easily rolled into place during tank testing.

ShotBlocker can be manufactured to provide different degrees of impact resistance.

ShotBlocker can be manufactured to provide different degrees of impact resistance that comply with UL-752 performance-level standards for ballistic ratings 1-5. For the storage-tank facility, it was determined that Level 1, the lowest of these resistance levels, was sufficient to meet application requirements. Provided by *ShotBlocker* with a 1/4 inch (0.6 cm) nominal thickness, Level 1 resistance is sufficient to withstand the impact of a 9 mm bullet travelling at a speed of 1175 ft/s (358 m/s).

At 86 lbs (939 g), a 1/4 inch (0.6 cm)

thick *ShotBlocker* panel is heavy enough to remain upright if struck by a flying metal part. But, *ShotBlocker* weighs only one-third as much as ballistic steel armour plate, making the composite panels much easier to move into position on the plant floor. *ShotBlocker* is also easier to fabricate than steel, requiring nothing more than standard commercial power tools such as circular saws and drills. In addition, metal prices have been skyrocketing in recent years, eliminating any significant cost advantage over *ShotBlocker*.

Some thermoplastics that cost less than *ShotBlocker* may be able to provide impact resistance sufficient to meet the requirements of the storage-tank application. But the flexural moduli of these materials are so low that a 1/4 inch (0.6 cm) thick thermoplastic panel standing 8 ft (2.4 m) high and supported only at the base would probably be unable to remain upright. Therefore, it



Lighter than steel, ricochet-resistant and readily installed with ordinary power tools, ShotBlocker is an ideal reinforcing substrate for ballistic resistance applications.

would be necessary to increase the thickness of the material to 1/2 inch (1.2 cm) or even 3/4 inch (1.9 cm), which would eliminate any thermoplastic cost advantage – and in some cases make the cost considerably higher than that of ShotBlocker panels.

As for wood alternatives, plywood costs only about one-third as much as ShotBlocker. But as in the case of thermoplastics, a 1/4 inch (0.6 cm) thick piece of plywood standing 8 ft (2.4 m) high is likely to lean or even fall over if it were only supported at the base. Moreover, even 3/4 inch (1.9 cm) thick

plywood does not carry the same ballistic properties as ShotBlocker, but it would be much heavier and cost nearly as much as a 1/4 inch (0.6 cm) thick panel made of the thermoset.

Satisfactory results

With the thermoset panels in place during pressure testing, workers in the tank manufacturing plant do not have to worry about being struck by flying metal objects, boosting both morale and the workers'

opinion of their company. As for the company itself, it effectively eliminated a possible cause of employee injury or death – and did so in a manner that was much more cost-effective than constructing a separate building for pressure testing.

Moreover, if the pressure testing were to be done in exactly the same spot every time, the panels offer the flexibility to be mounted on overhead racks rather than placed on casters. This would allow them to be easily pulled into place when needed and pushed back out of the way again when the testing was finished.

Applications

Offering excellent impact strength and other properties, such as being lightweight, cost-effective and easily installed, ShotBlocker thermoset composite has a clear edge over steel, thermoplastic and wood in ballistic-protection applications. In addition to storage tank manufacturing plants, these applications include courtrooms, bank teller stations, guard stations, armoured vehicles, commercial aircraft, and law-enforcement facilities. In use, ShotBlocker provides performance similar to that of conventional S-glass laminates, which are much more expensive.

Performance similar to that of conventional S-glass laminates.

Consider all the advantages and it is easy to see why this advanced composite anti-ballistic material is protecting people and property in a growing number of commercial, government, and military settings. ■

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