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Carbon composites continue to find new markets

What does the future hold for composites in transportation markets?

Off the beaten track



Off the beaten track

Liz Nickels

While, in theory, composites can be used for a wide variety of applications, in practice their main uses still tend to center around marine, wind energy, aerospace and racing. One of the lesser known applications for composites is that for manhole or trench covers. Liz Nickels spoke to Fibrelite, a major supplier, about the benefits of using composites and the future of this growing application.

Twenty-six years ago, a petrol (gas) station in the UK had a problem. The station, owned by Esso UK (part of Esso Mobil) wanted to increase the health and safety of its employees because the steel manhole covers they had to lift were very heavy. As well as being a danger to male staff, the covers also weighed too much for female employees – of whom there were a growing number back in the early 1980s. As a result, Esso began to work with Fibrelite, a UK firm based in Skipton, North Yorkshire, who at the time were manufacturing FRP sumps. They responded to the problem by doing something rather unusual – manufacturing a manhole cover using glass fiber reinforced (GFR) composite materials. The prototype proved so successful that Esso quickly adopted the covers as their standard worldwide, and they went on to be specified for the majority of leading petrol stations.

In 2013, Fibrelite was acquired by OPW, part of Dover Corporation, headquartered in Downers Grove, Illinois, USA. While OPW specializes in fluid-handling and the distribution of fuels, Fibrelite now focuses on using composites to replace metal manhole/trench covers among other products. The company opened a manufacturing plant in the US in 2005 and in Malaysia in 2010 and supplies access covers to over 80 countries around the world, with manufacturing in the UK, US and Malaysia.

Internal architecture

The company's manufacturing methodology employs closed mold resin transfer molding (RTM) techniques using long strand multi-direction E-Glass fiber. By changing the internal fiber architecture engineers can manipulate the fiber volume fraction (FVF) to

deliver improved performance even at load ratings as high as F900 (90 ton). Fibrelite commissioned a glass fiber supplier to make woven glass fiber to specified weaving patterns, and this complex weave and additional internal support gives the finished cover structure its strength. The glass fiber is also always supplied to the same specification, ensuring that the ingredients used to make the components are controlled.

According to the company, the strength of the composite comes from three main areas:

- Continuous or long fibers, in contrast to spray laminating and hand lay methods which typically use short length fibers.
- The orientation or direction of the primary continuous fibers that allows the material to carry and dissipate the load.
- The glass to resin ratio in a given sectional volume, maintaining the best ratio as well as consistency, while spray and hand laminating can vary.

Fibrelite reportedly produces the only 90 ton load rated composite trench and sealed covers on the market, due to this reconfiguration of the internal glass fiber architecture. It can now meet the permanent set and test load requirements of BS EN 124, Class F900 when tested in accordance with the Air BP test footprint. This means that the covers are a suitable alternative to traditionally used heavy concrete and metal access covers for areas imposing particularly high wheel loads, such as aircraft pavements, taxiways of civil airports, shipping ports and dockyards, and are also manually removable.

The request for the company to provide F900 heavy duty trench covers initially came from a large dockyard in the south-east of England. Their work inspectors were exploring replacement options for extremely heavy and corroding steel covers that had

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been installed years earlier. The extremely heavy covers required a crane and dedicated lifting equipment, which incurred a financial cost with equipment and manpower to lift the covers every time the ships come into dock.

'With recent statistics attributing over half of injuries (resulting in absence from work) to manual handling it's already known that reducing hazards in this area is a priority on a global scale,' the company said. 'Because of legislation restricting acceptable manual handling weights, we are seeing a global trend towards lighter weight fiber reinforced plastic (FRP) composite manhole and access cover materials, which also have the benefits of ease of handling and corrosion resistance.'

By using lighter materials, operational injuries can be prevented, work sites are made safer and ease of installation and maintenance is made available to utility workers and contractors.

The design of the covers also incorporates up to two lifting points for specially designed lifting handles. These allow the operator to remove the cover without trapping fingers or bending over thus maximizing the safety of the lifting technique. The weight is kept close to the body preventing back injury, one of the main causes of absence from work and personal injury claims.

Non-corrosive properties

Corrosion resistance is another key characteristic of the composite covers. This October, a composite multiport sump system made by Fibrelite was approved by the US California Air Resources Board

(CARB). CARB is one of the two primary standards for vapor recovery in the US.

In the US, gas stations often use multiport covers to increase ease of fuel delivery. A multiport cover has two small covers located within the larger manhole cover, which can be removed to insert the two hoses necessary for fuel delivery and vapor recovery.

According to Fibrelite, corrosion resistance is particularly important for this kind of application, as water and fuel (especially prevalent in petrol stations) cause corrosion, breaking the watertight seal around covers, allowing water ingress into sumps over fuel tanks. Composites also have light, strong, non-corrosive properties which allow them to withstand heavy loads, such as trucks, while still being safely and quickly manually removed when access is required.

In another example, as part of the renovation of a leisure center in Auburn City, Australia, access was required to the air conditioning system and balance tanks for the water set under around the perimeter of the pools. Previously, concrete covers had been used, but the poolside conditions were very hard on the metal that made up the cover structure – the omnipresent swimming pool chlorine and moisture is corrosive to traditional concrete and metal access covers. As a result, the original covers had corroded to a dangerous level, both for those removing them, and patrons walking around in bare feet. Composite covers, however, are chemically inert, so have no reaction to either water or chlorine, meaning that the covers can remain watertight and safe to walk on year on year. They are also lightweight and Fibrelite provided a custom colored solution to blend in with the surroundings.



FIGURE 1

A multiport cover has two small covers located within the larger manhole cover, which can be removed to insert the two hoses necessary for fuel delivery and vapor recovery.



FIGURE 2

As part of the renovation of a leisure center in Auburn City, Australia, Fibrelite provided custom colored covers to blend in with the surroundings.

Handling issues

Aesthetic appeal is another benefit, as shown by the company's manufacture of colored trench covers for existing and new camera pits at a leading Premier League stadium.

According to Fibrelite, an important requirement for this customer was that the trench covers were in keeping with the surrounding area. It is possible to mold style logos or other markings permanently into the upper surface of the cover in single or multiple colors. The company says that it can also mold its composite covers in nearly any color or combination of colors, for additional brand or product identification, or to blend in with the color or layout of a facility.

An additional benefit of using composites was a much lighter weight, reducing lifting and handling issues.



FIGURE 3

Aesthetic appeal is another benefit, as shown by the company's manufacture of colored trench covers at a leading Premier League stadium.



FIGURE 4

Fibrelite recently developed a range of bespoke composite trench covers for the platform of a major UK rail station.

The covers are also lightweight. Fibrelite recently developed a range of bespoke, lightweight, composite trench covers to be installed over access hatches in the platform of a major UK rail station to give easier access to services below platform level. The previously installed covers were heavy, concrete infilled covers which proved very difficult to remove and presented serious manual handling issues to operatives. Removing the covers was a costly and time consuming process, with specialist lifting equipment often required.

The company produced composite trench covers in bespoke sizes, supplied with aluminum frames, in larger sizes, which meant that fewer panels were required to cover the openings, reducing the overall cost of replacement. The composite covers come as standard with an anti-skid finish.

Temperature variations

Fibrelite also supplied a range of super light duty trench covers for a specialist wastewater system in the Antarctic. The system is for treating black and grey wastewater before discharging into the sea, including water from sewage, laundry and cooking etc. In harsh conditions in the Antarctic ease of access was critical and the lightweight properties of the composite trench covers were a major benefit – being non-corrosive and not affected by temperature variations was also important.

In the Netherlands, a wastewater pumping station was producing unpleasant odors emanating from a pit, housing two large submersible pumps covered by a pair of thick hinged aluminum covers, bolted in the middle.

Despite the bolts, the previously installed metal covers were not airtight, so a large plastic sheet covered in sand was spread out on top of the covers in an attempt to contain the odors. Maintenance access to the pump necessitated the removal of the sand barrier, plastic sheet and the aluminum access cover with a crowbar.

To help solve the problem, the hinges were removed, and a custom-made aluminum frame was fitted into the existing one and sealed with a waterproof sealant. The frame included a removable center beam to accommodate two composite trench covers, and four retractable supports (two per panel) to hold the safety grids. Both the supports and center beam can be removed to create full clear access, and are secured by stainless steel fittings and cables to prevent them falling into the pit. To contain the odor, a rubber seal was fitted to the frame and the covers secured with four stainless steel bolts to each cover. Plugs were provided for the key housings to complete the seal, and bolt heads covered. According to Fibrelite, composite trench covers can also be used in data centers to help protect networked computers. 'Cloud storage facilities require miles and miles of fiber-optic cabling which is installed in protective but readily-accessible concrete trenches so that impaired sections can be swiftly replaced – or more cables added, as storage companies are incorporating extension plans into their new-builds,' said David Holmes, Technical Director. 'Then, in order to maintain optimum hardware performance, each server room requires additional electrical power and battery backup systems to operate its vital environmental and mechanical controls such as continuous cooling, fire and security alarms. These too require their own cabling in their own identifiable, readily-accessible trench.'



FIGURE 5

In the Netherlands, a wastewater pumping station was producing unpleasant odors emanating from a pit, housing two large submersible pumps covered by a pair of hinged aluminum covers.

‘So taking all this into account, it’s no surprise that designers are specifying from the outset lightweight composite trench covers which can be quickly and easily removed by hand.’

I spoke to David along with Aaron McConkey, Marketing Coordinator and Ian Thompson, Fibrelite Managing Director, about the new technology. ‘Many think of access covers as a simple necessity over a hole in the ground,’ said Aaron, ‘but in fact their manufacture is about continuous innovation to meet the requirements of new markets. Composites have long been familiar in the aerospace and marine industries, but as we’re seeing in applications from doors for the London Tube (lighter, faster, potentially saving up to £4.6 million per year) to the roof of the Arthur Ashe Stadium (size of 17 Olympic sized swimming pool which opens at 25 feet per second) composite materials are enabling established products to perform in ways that couldn’t be conceived with the restrictions of traditional materials.’

‘The time, craft and expertise that goes into every aspect of our covers, from concept design to manufacturing principles, has been developed and refined over the last 30 years,’ added David. ‘Fibrelite use the latest manufacturing technology to provide both performance and quality.’

And what is the future of the technology?

‘While Fibrelite covers are already the industry standard in the retail fueling industry, there are many more industries with immense capability for expansion, from construction to leisure to transportation,’ said Ian. ‘Once you start looking around, you’ll realize that you can’t go far without seeing an access cover!’

Fibrelite; www.fibrelite.com