Fibre Reinforced Plastics (FRP): safe products and safe processes

How FRP products make for a safer world

FRP are used across a whole spectrum of industries to make components that are lighter and stronger than those made from traditional materials. FRP also contributes to safety in many aspects of everyday life.

Fire safety

High profile fires over recent years such as the Mont Blanc tunnel, the Channel tunnel and King's Cross metro station, have all highlighted the need for maximum fire safety in materials selected for in-tunnel applications and for mass transit rolling stock. Flame retardant FRP based on unsaturated polyester (UP) resin is ideal for structural applications in fire sensitive areas. Specially developed resins meet the relevant national and international standards for fire retardancy and low smoke emission: including the stringent requirements of London Underground Limited (LUL) tests for flame spread, smoke and toxicity, as well as the Single Burning Item (SBI) test for construction materials. Other areas where fire safety is critical include buses, ships, and public buildings such as hospitals and theatres.

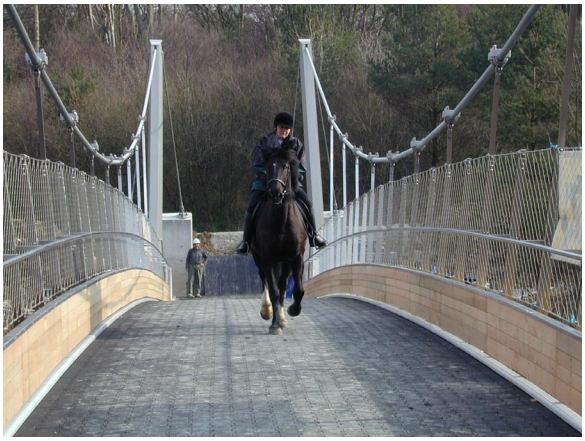
Above: the Eurostar is an typical example of a modern train that makes extensive use of flame retardant composites.

Right: A flame retardant, low smoke, UP resin was used in the SMC moulding of these train carriage seats.

UP resin also offers excellent electrical insulating properties, making it highly suitable for spark guards and arc barriers on electric trains. In these applications an FRP composite is used as a safe alternative to materials like asbestos. Over recent years, UP resin producers have focused on low smoke emission, low toxicity and more environmentally friendly formulations.

Road safety

Composites are making major inroads into the motor industry as well as into road building, road safety, road signage and countless other transport and infrastructure applications.



This particular bridge is designed for horses and foot traffic, but FRP full load-baring road bridges are also being built in a similar way.

- Bridges

FRP is used in bridge construction in the form of pre-fabricated, pultruded box sections that give high strength and rigidity at a fraction of the weight of steel or concrete. Construction time is relatively quick with minimal disruption. FRP reinforcing bars (rebars) are also used as a non-corroding alternative to steel in reinforced concrete.

- Safety barriers and acoustic screens

The desirable combination of stiffness, resilience and durability make composites an excellent choice for road safety barriers. The fibre reinforcement within a composite helps to transmit energy away from the source of impact, maintaining the barrier's integrity even with high speed impacts. Composites, when used in combination with special core materials, give excellent sound absorption qualities and are increasingly used as acoustic screens alongside motorways and train lines.

- Crush cones

Improving passenger safety through properly designed crash management is an important requirement in modern vehicles. FRP is used for crush cones and bumper beams as an effective way of controlling energy release resulting from lower speed impacts.

Safety in FRP processing

As with any manufacturing process, certain health and safety precautions need to be followed in the handling and application of FRP materials.

Styrene reduction techniques

The FRP moulding process is essentially a means of converting an unsaturated polyester resin in combination with reinforcing fibres (usually glass fibre) into structural composites. UP resins are dissolved in styrene which, during cure, reacts to cross-link the polymer into three dimensional chains. Styrene is a very effective monomer for UP resins. As an important chemical it is undergoing thorough risk assessment, which is expected to come to an end mid 2006. PlasticsEurope closely monitors and communicates the outcome of this risk assessment*.

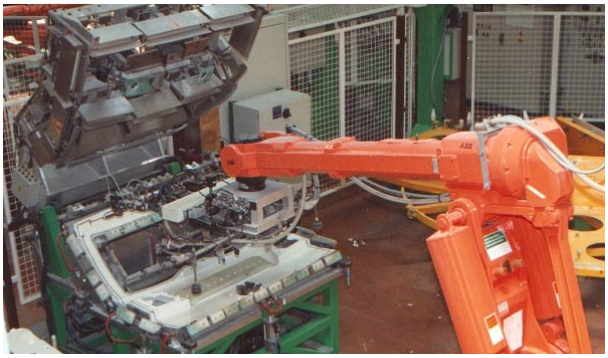
It is the responsibility of each company to obey occupational exposure limits given by national authorities. A recent review (to be published) of the available exposure data shows that since 1970 the average styrene exposure of European open mould workers has decreased by more than 60%.

Styrene emission reduction is achieved by formulating resins that have a lower styrene content (LSC); and by blending in additives to give lower emissions (LSE) when applied to the mould and when left to cure. The development of LSE and LSC resins illustrates the commitment of UP resin producers to minimising any health and safety risks associated with their products.

Closed moulding techniques

The UP resin value chain also takes responsibility for worker safety and environmental stewardship by promoting closed moulding techniques. Traditional methods for producing an FRP part are by applying resin and glassfibre by brush/roller or spray equipment into an open mould. This technique results in the highest level of styrene emission. Although hand lay-up open mould processes are still widely used, there is a steady move towards closed moulding. Resin Transfer Moulding (RTM) and Vacuum Infusion are processes that greatly minimise VOC (volatile organic compounds) emissions. In both these processes, a reinforcement pack is placed into a mould and the resin injected. RTM moulds have a male and female side of equal quality, whereas vacuum infusion typically uses a flexible film as the male mould. Infusion methods tend to be used for large moulds such as boat hulls.

Typical RTM applications include the production of automotive parts such as spoilers and body kits. For higher series part production SMC/BMC (sheet / bulk moulding compound) enables high levels of automated production. In this process a charge of SMC or BMC is transformed under heat and pressure to rapidly form a rigid component. This process is widely used for moulding vehicle parts and for electrical / electronic components.



Highly automated production of vehicle tailgates using compression moulded SMC.

Worker safety clothing and equipment

Operator exposure to VOCs can be monitored on a daily basis by means of badges and by other portable testing kits. As well as the emission of VOCs there are other hazardous materials such as dust resulting from the trimming and machining of FRP parts. It is therefore essential that suitable protective clothing is worn. Gloves, coveralls, goggles, masks and a whole range of other personal protection equipment are available direct from manufacturers or via specialist FRP distributors on a one-stop-shop basis.

Left: styrene monitoring badge. Right: full protective clothing, including a ventilated breathing system, is worn for the gelcoating of this mould.

For more information on health and safety issues related to the use or handling of UP resins visit
www.plasticseurope.org/content/Default.asp?PageID=381
***For more information on styrene risk assessment contact paul-michael.bever@plasticseurope.org**

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