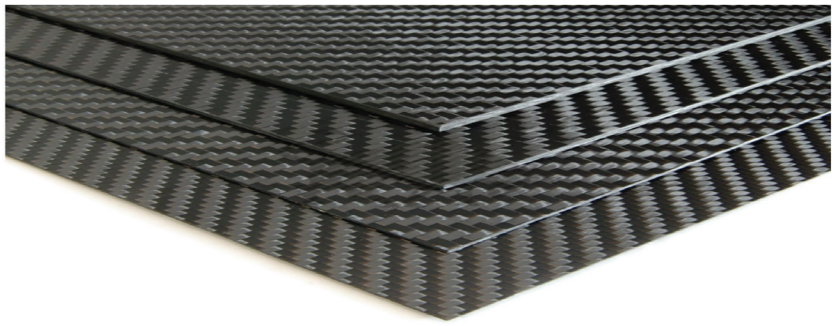
TECHNICAL REPORT

I-CAR NEW ZEALAND

COMPOSITES IN VEHICLE CONSTRUCTION

AN INSIGHT INTO CARBON FIBRE USE



In previous technical articles that focused on methods of vehicle construction, we described numerous advanced technologies that are based on Ultra High Strength Steels (UHSS), Advanced High Strength Steels (AHSS) and new generation aluminium materials. While composites had been mentioned in some of those articles, very little has been said about its use (or non-use) in today's auto body construction.

Carbon fibre as a structural material has substantial benefits – particularly for weight reduction and tensile strength / rigidity, when compared to all other, more conventional metals. Dependent on the type of fibre and resin used, weight for weight, carbon fibre offers 2-5 times more rigidity than aluminium and steel. In some special uni-directional configurations, rigidity and strength can be 5-10 times than of these metals.

Additionally, it has very low heat conductivity (40 times less than aluminium and 10 times less than steel), and therefore is a great insulator in strategic heat management applications.

Carbon fibre composites up until recently, have been used almost exclusively for exotic / bespoke vehicle manufacture or in racing applications. That began to change with the introduction in 2013 of BMW's i3, and to a lesser extent i8, electric vehicle (BEV) platforms. These vehicles make extensive use of carbon fibre for the upper body structure in particular (Carbon Fibre Reinforced Plastic, or CFRP), and in the case of the i3, are manufactured on a mass-production scale and sold in 50 countries (global sales of the i3 as at the end of 2018 were in excess of 133,000 units).

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BMW – CARBON FIBRE DESIGN STRATEGIES - ELECTRIC VEHICLES V CONVENTIONAL PLATFORMS

BMW i8 – CFRP body over Aluminium chassis structure

BMW 7 series on the production line - An amalgamation of metals & composites

WITH ITS ADVANTAGES ABUNDANTLY CLEAR, WHY DO WE NOT SEE OTHER OEM'S USING MORE OF THIS WONDER MATERIAL?

- While the cost of carbon fibre materials has decreased in recent years, it still remains substantially more expensive than conventional metals. According to research done by Jaguar Landrover (JLR), carbon fibre currently costs 20 times more than steel and 10 times more than aluminium when used in automotive applications.
- Production costs are higher even though molding and curing processes have improved dramatically in the last decade or so – Metal parts can be stamped out in seconds, but it still takes several minutes for a carbon fibre part to be moulded and cured.
- Carbon fibre production uses substantial amounts of energy – carbon dioxide emissions from that energy use require large investments in alternative energy sources to meet global standards.
- Parts manufactured from carbon fibre are very wasteful to produce – around a third of the original sheet material is lost to cutting and trimming.
- Carbon fibre can be difficult to recycle - the term "composite" essentially means the combination of several different elements (carbon fibres and a polymer resin). To recover the carbon fibre materials, the resin has to be chemically dissolved or burnt off, and the recovered fibres have a much lower tensile strength.

So, in the current environment, carbon fibre usage for autobody applications will likely continue to be limited to high-end and high-performance vehicles where its advantages can be exploited - and its additional expense recovered...

These articles have been written by Martyn Lane: I-CAR Instructor, Weld Test Administrator and Technical Specialist to the auto body industry