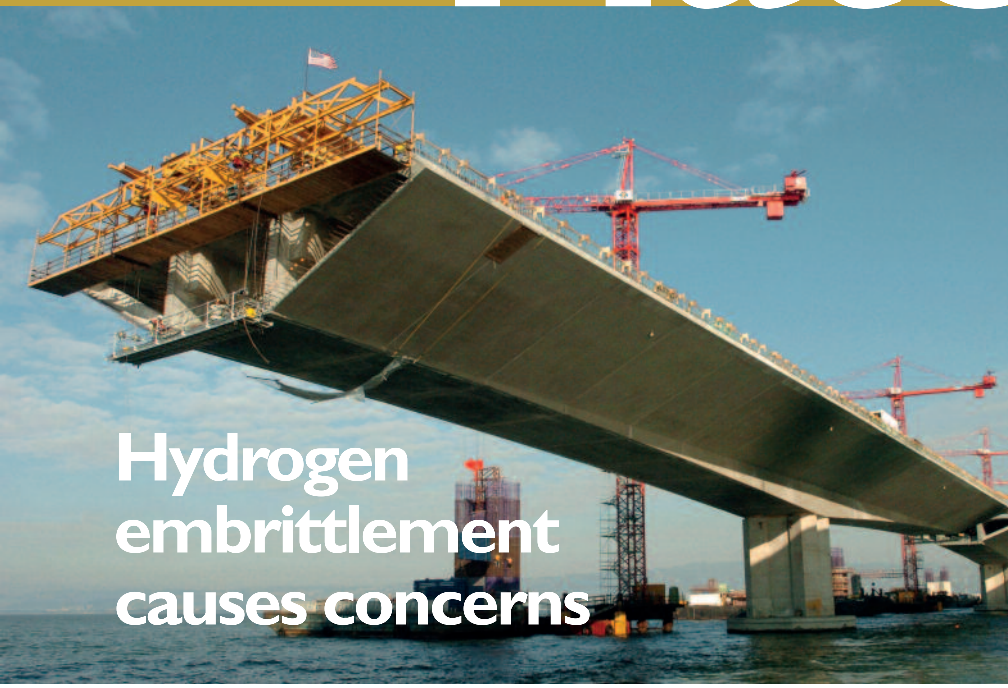
Summer 2013 • A Eureka publication www.materialsforengineering.co.uk

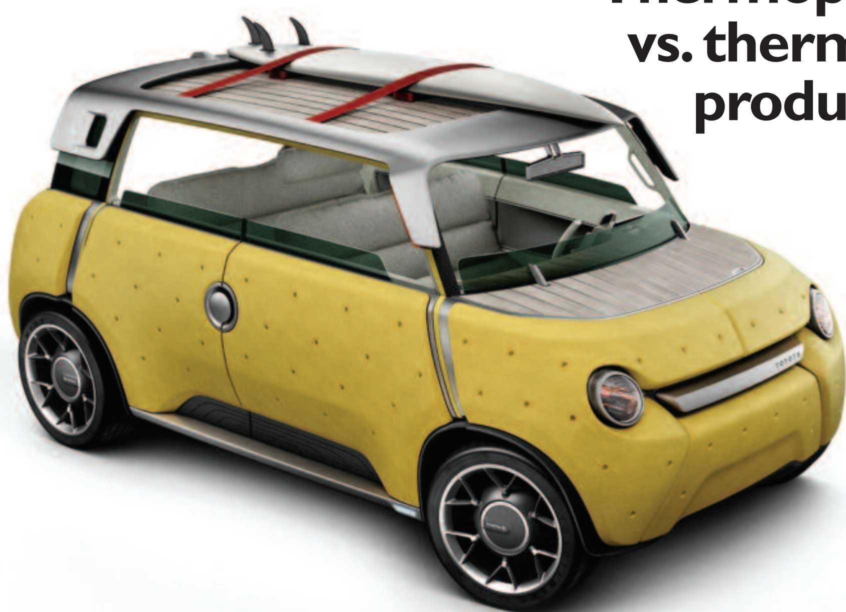
Engineering Materials



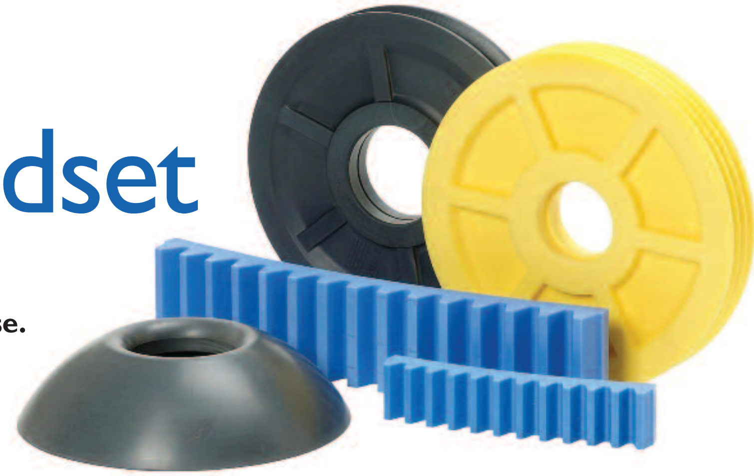
Hydrogen embrittlement causes concerns

The challenge of metal replacement

Thermoplastic vs. thermoset production



Foams drive to the front



Changing mindset

Improvements in the properties of engineering plastics is seeing them increasingly get put to use. So, why are some engineers still hesitant? Justin Cunningham reports.

There are three main drivers for changing materials in the current engineering and industrial climate. The first, and most obvious, is cost. The second is to lightweight. And the third is to increase performance.

These three trends are being driven by rising oil prices, increasing legislation, and also competitive pressures in the marketplace. Gone are the days of any parts being over engineered, today parts are vigorously analysed and re-engineered to optimise price, weight, and performance.

The practical effect of all of this is that many traditional steel parts are being put under review to see if there is a better material. This has prompted plastic producers to come forward with innovations to show the marketplace just what is possible when it comes to metal replacement.

"When engineers changed from making die cast aluminium air intake manifolds to plastic ones, the design driver was that it offered a cheaper solution," says Craig Norrey, head of design (EMEA), at DuPont. "It was, however, also lighter. But, what they didn't expect was a 2-3% increase in power output from the engine. The smooth walls of the manifold actually gave better airflow resulting in the higher performance. If that happens, it is a great reason to change, but it is finding these applications that is critical."

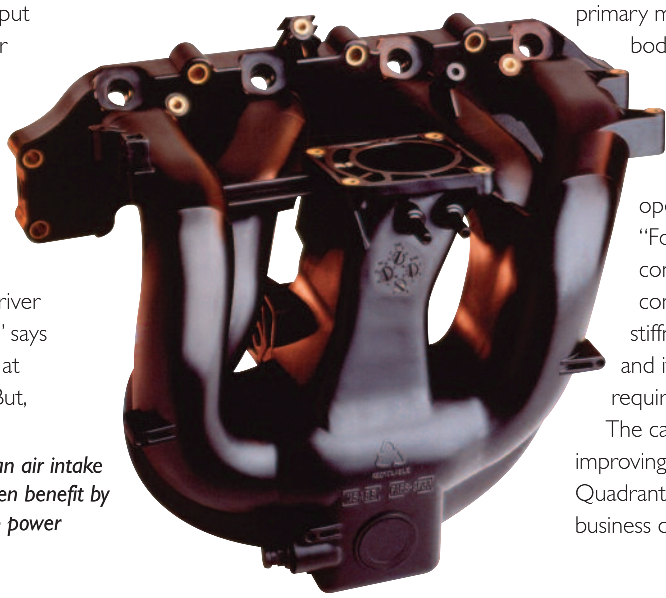
Plastic manufacturers and suppliers have been busy in identifying these kinds of applications in a number of industries. It wants to offer comprehensively superior materials over metal to convince engineers to make the move. It has also been busy innovating by modifying plastic materials that can offer better mechanical performance under hotter, harsher, and dirtier conditions to help open even more market opportunities.

"The metal guys don't worry about temperature or humidity," says Norrey. "So, we have produced a high temperature nylon called Zytel HTN that gives constant stiffness and strength between -40 to +90°C."

Automat Irrigation has recently taken advantage of another grade of Zytel nylon from DuPont when it redesigned a hydrocyclone, an irrigation filtration device. It successfully redeveloped the device, replacing primary metal components including the main body. The new design offers multiple benefits including greater service life, enhanced robustness and lighter weight.

Vijay Warke, vice president of operations at Automat Irrigation, says: "For the last five years we have been converting many of our products and components to plastic... thanks to its stiffness, creep and impact resistance and its ability to cater for the design requirements necessary."

The case of not just replacing, but actually improving, is also a stance shared by Quadrant Engineering Plastic Products. Its business development manager, Paul



Engineering plastics lowered the cost of an air intake manifold and brought about an unforeseen benefit by improving airflow, which increased engine power

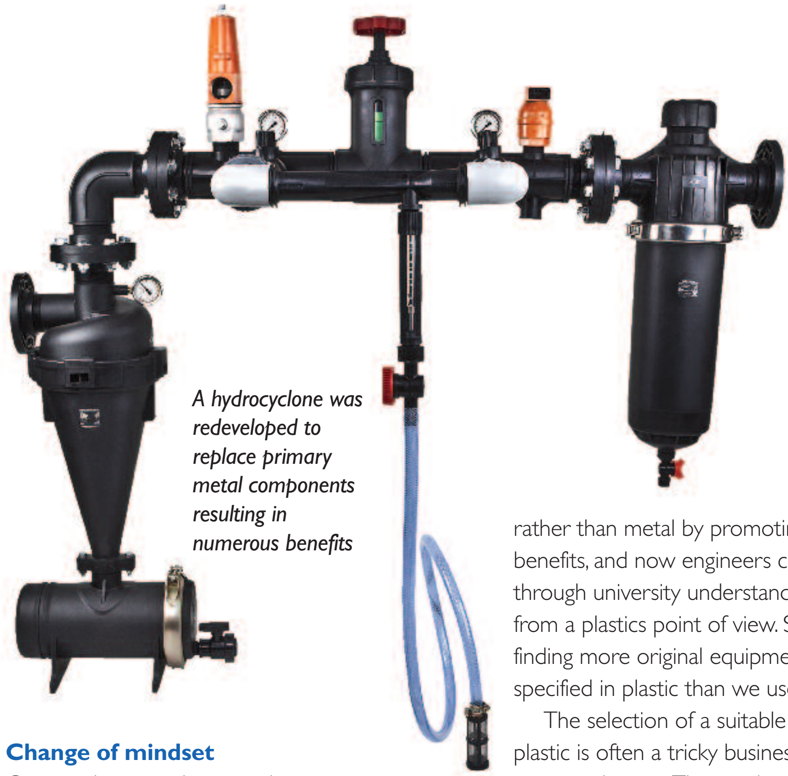
"The use of engineering plastics in many environments is becoming more acceptable," Paul Simmons, Quadrant

Simmons, says: "An additional benefit of having less weight is less stress on the surrounding structure and equipment, and an overall energy reduction in that whole system.

"Take a crane, for example, the large flywheel and cable sheath is a lot of weight at the top, and that needs a lot of power to operate. So if you can reduce the weight of those parts by using an engineering plastic and make it considerably lighter, you reduce power consumption and also the stress on the surrounding structure."

Quadrant has been working with a number of industries to offer improvements through the application of suitable engineering plastics. One application involves aircraft landing gear, which operate at very high loads across a wide range of temperatures. Landing gears experience fluctuations between -40 to +70°C, but near the brakes temperatures can exceed 650°C. In addition there are continuous shock loads and vibration travelling through the materials.

While only a few years ago metals would be used all over, Quadrant has developed a range of materials including its Duratron, Ketron and Techtron that are vibration, chemical and wear resistant, as well as self lubricating to be used in the brackets, bushings, seal rings and wear surfaces of aircraft landing gear to offer many advantages over traditional metal fixtures.



A hydrocyclone was redeveloped to replace primary metal components resulting in numerous benefits

Change of mindset

Getting plastics in the mix when it comes to material specification has no doubt come a long way, with many industries increasingly looking beyond traditional materials. However, many engineers still feel more comfortable designing and working in metals. Changing that mindset remains a challenge.

For many, specifying a different material is risky and potentially costly. Testing and approval of a new material type can be a long process and while many are well aware that an existing way of doing things is probably far from optimum, investment in change is sometimes too difficult to justify to senior management. However, many in the industry feel a corner has been turned.

"The use of engineering plastics in many environments is becoming much more acceptable," says Simmons. "We have been trying to convert people to use a plastic rather than metal by promoting the benefits, and now engineers coming through university understand more from a plastics point of view. So we are finding more original equipment is being specified in plastic than we use to."

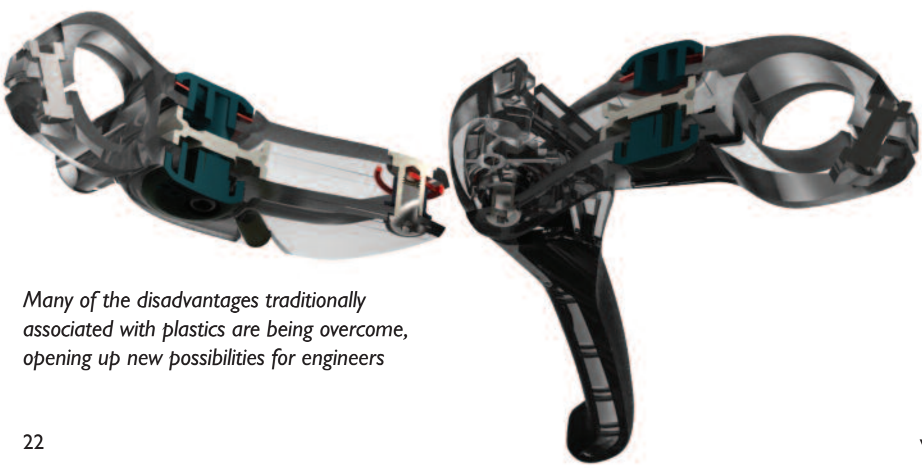
The selection of a suitable engineering plastic is often a tricky business for a given application. The number of different types available can vary greatly in both properties and cost. However, suppliers are keen to help and demystify many aspects of the material by offering advice.

The automotive industry is perhaps one of the strongest markets for metal replacement as it moves towards impending CO_2 targets. This has created a market pull for different materials and that is helping other industries to embrace polymers by solving some of the fundamental concerns.

One big question that is always raised around metal replacement with plastic materials is how to join them. Many production engineers from the high volume world of automotive want to use existing machinery such as welding robotics on an assembly line.

"What DuPont has done here is attach metal welding tabs to the plastic component to enable a spot weld," says Norrey. "However, we've seen moves by the automotive industry to self-piercing rivets as it is a cleaner technology, with no emissions, that can be done cold. At the same time adhesives are starting to be used more often. Both of these are playing in to the hands of engineering plastics as an increasingly viable, and advantageous, material to replace metal."

www.dupont.co.uk
www.quadrantplastics.com



Many of the disadvantages traditionally associated with plastics are being overcome, opening up new possibilities for engineers