The road to biomaterials

~ How biopolymers will reduce plastic production in the automotive industry ~

There are approximately 960,000 Ford Fiesta's registered on Britain's roads. Each of these cars requires 100 gallons or more of crude oil to manufacture the plastic in the car's interior, bodywork, crumple zones and engine components. What's more, this plastic will still be around long after the car has reached the end of its useful lifetime. Here Duncan Clark, head of operations at biopolymer research company Teysha Technologies, explains how automakers can overcome this problem by switching to tuneable bioplastics.

With many carmakers switching to EV production, significant gains are being made in making the automotive industry more sustainable. However, the 120 kilograms of plastic going into manufacturing every car will outlive the vehicle by about 380 years. This poses the question: is the investment in the car worth the environmental cost of producing this much plastic?

Plastics are used by carmakers because they are lightweight, versatile and durable. For example, the plastics in a Ford Fiesta will be used to improve passenger and driver comfort and enhance the safety of the vehicle. Plastic also reduces vehicle

weight, improving the overall fuel economy. But this does not counteract the resource-intensive process of manufacturing plastic, and carmakers should now be investigating sustainable polymer alternatives.

Polyester in car interiors

Plastics Europe estimates that twelve to fifteen per cent of a car's weight is plastic. Some plastic components are built to last the lifetime of the car, including the textiles, dashboard, interior trim and exterior bodywork such as the bumpers. Others are designed to be replaced, including the floor mats and windscreen wipers. Mats, for example, are composed of polyester fibres and will be replaced after a few years of wear-and-tear.

However, polyester production is highly polluting and uses approximately 330 million barrels of oil per year. Common Objective also predicts that 14.2 kilograms of carbon dioxide is produced per kilogram of polyester. If up to 25 kilograms of polyester is used in a Ford Fiesta's interior, that equates to 355 kilograms of carbon dioxide produced in making one car's textiles.

It is understandable why polyester has become a popular choice for car interiors. Seatbelts, for example, are also composed of petroleum-derived fibres and help to protect passengers from serious injury. Safety is unquestionably important, so efforts to find sustainable bioplastics, which meet safety standards, should be a priority.

Plastic bodywork

Plastic composites, like polypropylene, are used in car crumple zones because they absorb more energy on impact than metals. This means that the driver of a modern car with a plastic crumple zone is much more likely to survive a Road Traffic Accident (RTA), than an older car with metal crumple zones.

However, a recent study in Nature Communications estimates that 100,000 metric tonnes of microplastics make their way from crumple zones and vehicle exteriors into our water systems every year. This may be from general wear-and-tear, illegal scrapping and damage left over by RTAs. To put this into perspective, this is the equivalent weight of all 960,000 British-registered Ford Fiesta's surviving in our ecosystems for hundreds of years.

Global carmakers are now working on solutions to alleviate plastic pollution, such as manufacturing vehicles using recycled plastics. But will these efforts go far enough, or is it time to stop producing plastic altogether?

Why recycling doesn't go far enough

Global automotive companies have been experimenting with recycled plastic in their car designs for many years now. Nissan, for example, manufactures the LEAF electric vehicle, which is made from 25 per cent recycled materials. 60 per cent of the LEAF's interior is derived from PET plastic bottles, making it a definite step in the right direction for the automotive industry.

To further this effort, in 2020, students at the Eindhoven University of Technology, Netherlands, proved that manufacturing a vehicle from 100 per cent recycled plastic

and household waste was possible. Plastic bottles and broken household appliances were used to flesh out the car body, windows and interior, most of these fished out of the ocean or dug up from landfill.

Solutions like the ones employed by Nissan and the Eindhoven students are certainly commendable. But recycling infrastructure in many countries is simply inadequate and would not be able generate the materials needed for large-scale car manufacturing. Efforts should now be focussed on improving recycling practices in tandem with halting plastic production altogether. This is achievable by switching to using durable, versatile and plastic-like biopolymers.

A biopolymer future

Biodegradable biopolymers, such as those developed by Teysha Technologies, are showing promise as plastic alternatives. This technology may eventually help steer the industry away from non-renewable, petroleum-based plastics.

The past five years have seen Teysha achieve a landmark breakthrough in its second-generation biopolymer. Made from natural feedstocks, such as starches and agricultural waste, this versatile polymer can be physically, mechanically and chemically tuned to meet the needs of the automotive industry.

Crucially, these biopolymers overcome many of the challenges of existing biopolymers, like the fact that their hydrolytic breakdown can be controlled — and unlike conventional biopolymers, they can be made to biodegrade in nature, and without the use of industrial catalysts.

All plastic elements of a car could make use of biodegradable biopolymers, from carpets to crumples zones. If every automotive manufacturer were to make this transition, the resource-intensive refining of plastics would soon become obsolete.

To find out more about Teysha Technologies, click here.

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About Teysha Technologies: Teysha Technologies is the result of over a decade of research into natural polymer technology. Teysha's natural product polycarbonate platform creates a wide range of polymers with tuneable properties and practical applications to meet the growing demand for sustainable plastics. The platform invention provides the design of synthetic strategies for the development of polymer materials that originate from renewable resources, exhibit novel combinations of strength and toughness, as well as undergo hydrolytic breakdown to biologically beneficial by-products.

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