

## Road makers turn to Recycled Plastic for Tougher Surfaces

*On the plastic highway*



OF ALL the plastic produced since the 1950s, less than 10% has been recycled. The vast majority ends up being dumped, most of it in landfill. Some is left to litter the natural environment, where it can get into rivers and wash out into the sea (see [article](#)). The plastic-waste problem will worsen before it gets better: some 380m tonnes of the stuff are likely to be made this year. That is more than three times as much as the 120m tonnes of bitumen produced annually, most of which goes into building the world's roads.

There is a connection. Just as plastic is derived from petrochemicals, bitumen is produced as a by-product of refining oil. Both are polymers, which consist of long strands of molecules bound together firmly. It is this characteristic that makes plastic strong and contributes to its great longevity. Such features are also useful for road builders, who use hot bitumen to bind together aggregates made from broken rocks and stones, into what is commonly known as asphalt. All of which has got some people thinking: why not swap one polymer with another?

Recycled plastic is already used to make some products, such as guttering and sewage pipes. Now attention is turning to roads. On September 11th in Zwolle, a town in the Netherlands, a 30-metre bicycle track made from 70% recycled plastic and the rest from polypropylene was opened. It will be used to test a product called PlasticRoad, which is being developed by two Dutch firms—KWS, a road builder, and Wavin, a firm that makes plastic piping—in partnership with Total, a French oil-and-gas firm.

PlasticRoad is prefabricated in a factory as modular sections. The sections are then transported to the site and laid end to end on a suitable foundation, such as sand. Because these sections are hollow, internal channels can be incorporated into them for drainage, along with conduits for services such as gas and electricity. For the Zwolle project, sections that were 2.4 metres long and 3 metres wide were used. These were fitted with sensors to measure things such as temperature, flexing and the flow of water through the drainage channels. A second pilot cycleway is being built in the nearby town of Giethoorn.

### **Smart roads, too**

If all goes well, the inventors hope to develop the idea and make the sections entirely from recycled plastic. Paths, car parks and railway platforms could follow. Eventually, sections for use as actual roads are planned. These could contain sensors for traffic monitoring. In time, the circuits in the plastic roads might extend to assisting autonomous vehicles and recharging electric cars wirelessly.

Prefabricated plastic roads should last two-to-three times longer than conventional roads and cost less, the companies claim, mainly because construction times would be reduced by almost two-thirds. Anti-slip surfaces could be incorporated, too, including crushed stones which are traditionally used to dress road surfaces. The sections, when replaced, can also be recycled. But engineers will be watching to see how the track stands up to wear and tear and if the hollow structure causes resonance, which would make such a road unduly noisy.

An alternative method of using recycled plastic is to mix the material into hot bitumen when making asphalt. A road is about to be built this way on the campus of the University of California, San Diego, to test a number of specialist roadmaking plastics developed by MacRebur, a British firm. Each mix is produced from plastic that is not easily or cheaply recycled and so typically ends up in landfill, says Toby McCartney, who founded the firm in 2015 with a group of colleagues.

MacRebur cleans and sorts the plastic and then grinds the waste into flakes or pellets. The plan is for this part of the process to be carried out in the localities where roads are being laid or repaired, so that local waste is used to produce local roads. Each mix can contain 20 or so different polymers for specific surfaces. One mix, for instance, might be suitable for a bus lane that carries heavy loads. Another would provide some flexibility in an area of turning traffic, such as a roundabout, where lateral forces from vehicles' wheels can stretch the surface causing it to tear. Extremes of heat and cold can also be adjusted for. And because the addition of plastic helps to seal up small holes, which allow water to get below the surface of a road and cause it to break up, the modified asphalt can help to prevent potholes.

The company's plastic mixes have already been used in roads, car parks and airport runways in various parts of the world. One of the oldest projects is a stretch of road in Cumbria, in north-west Britain, which is extensively used by heavy lorries. This used to need resurfacing every six months or so, but with the addition of plastic it is still going strong after two years, says Mr McCartney. When resurfacing is needed, the material can be recycled again.

Cleaning and sorting plastic made out of multiple polymers can be relatively expensive, especially if it is used to make low-value products such as packaging. But using such plastic as a replacement for bitumen is cost-effective, claims Mr McCartney. As an example, he says that a tonne of bitumen might cost around £400 (\$521) in Britain. A recycled-plastic additive for a standard road works out at £300-£350 a tonne. The additive would replace a proportion of the bitumen, so there are savings to be made. At present 5-10% of the bitumen is replaced by the additives, but this could be increased to 25%.

Mr McCartney decided to develop specialist recycled-plastic additives after watching a practice sometimes employed in India to repair potholes. Plastic waste collected by pickers is piled into the hole

and then set alight with diesel to form a molten mass. It is crude and polluting, but it provides a fix of sorts. A number of roads in India are also made by mixing chopped-up plastic into bitumen.

Australia is another country that is starting to recycle plastic into roads. Earlier this year a 300-metre stretch was completed in Rayfield Avenue, Craigieburn, a suburb of Melbourne, using a substance called Plastiphalt. This consisted of recycled material from more than 200,000 plastic bags and packaging, 63,000 crushed glass bottles and toner from 4,500 printer cartridges. All this was blended into 50 tonnes of reclaimed asphalt to create a total of 250 tonnes of road-building material. The road will be monitored to see how it performs.

Stuart Billing of Downer, a firm involved in constructing the road, said that the cost of using the recycled materials was comparable with building a road in the usual way. But the road is expected to last a lot longer and prove better at coping with heavy traffic.

Officials in Craigieburn reckon that the amount of rubbish used to construct the road, all of which was diverted from landfill, is equivalent to what Rayfield Avenue's residents would have put into their recycling bins over the past ten years. One of the biggest complaints to local councils is about the state of the roads, especially potholes. Households in Australia and elsewhere might well do more sorting and recycling of plastic if they knew it could result in a smoother drive.

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