

## Rolling out the changes

*Transport: Manufacturers are using a variety of chemical additives and new materials to reduce the environmental impact of tyres.*

JOHN DUNLOP had a son who complained that his bicycle was bumpy to ride. So he invented the pneumatic tyre in 1888. Various improvements have been made since then. In particular, Pirelli, an Italian tyre maker, introduced steel-belted radial tyres in 1973, which reduced the fuel consumption of cars fitted with them. Now manufacturers are trying to develop tyres that reduce it still further.

Tyres account for about a fifth of the energy required to power a car. They provide friction, so the vehicle can grip the road, but some of the power supplied to the tyres is lost as heat. Indeed, Michelin, a French tyre maker, estimates that this “rolling resistance” accounts for 4% of the world’s carbon-dioxide emissions. Tyre designers have therefore sought to improve fuel economy by reducing rolling resistance. However, this not only reduces a tyre’s ability to grip, making drivers take corners sideways, it also wears out the tyres more rapidly.

Such disadvantages may now be overcome using chemical engineering and the clever design of new materials made from tiny structures just a millionth of a metre across—dubbed “nanocomposites”—along with “metamaterials” that let engineers build microstructures into tyres. Such innovations could, for example, enable the inner lining of a tyre to have a special coating that helps retain air longer, while the tread would contain a compound that lets it provide the right amount of traction where the rubber meets the road.

Tyre manufacturing is big business—about a billion tyres a year are produced across the world. Over the past few years, some tyre makers have routinely added polyester, fibreglass and silica particles to the mix used to make tyres, in order to increase the durability of the finished item. A modern tyre contains up to 30 different materials, including synthetic polymers such as styrene-butadiene rubber, according to Forrest Patterson, Michelin’s technical director in America.

A “durable security compound” incorporated into the treads of the company’s new Energy Saver tyre helps maintain the tyre’s rigidity, allowing it to grip the road. The performance of tread rubber depends strongly on the quality of the molecular bonds formed by the 14 individual ingredients that go into making the rubber, and Michelin claims to have perfect control of these molecular interactions. Mr Patterson says that the tyres increase fuel efficiency by 8% compared to standard tyres, and will reduce a vehicle’s carbon-dioxide emissions by almost a tonne over the tyre’s lifetime.

Goodyear, an American tyre manufacturer, recently announced that the 2010 model of Toyota’s popular Prius hybrid car will be fitted with its Assurance Fuel Max fuel-efficient tyres, which also contain a special compound in their treads to help reduce fuel consumption. The company estimates that, over the life of a typical tyre, it will save its owner enough petrol to drive more than 4,000 extra kilometres (2,500 miles). The 2010 Ford Fusion and the 2011 Chevrolet Volt models will also be fitted with this tyre.

Chemical suppliers are also getting involved. Lanxess, a German chemicals firm, is selling a nanoparticle rubber additive called nanoprene for tyre treads. It says this will extend the tyre’s lifetime without affecting its rolling resistance or sacrificing its grip. The tiny particles are made from polymerised styrene and butadiene—normal tyre ingredients—but bind better to the silica also found in normal tyres than larger lumps of the same stuff. Toyo Tires, a Japanese tyre maker, has announced that it will use nanoprene in its winter tyres.

Some companies are looking at making more environmentally friendly tyres, using sustainable and renewable biopolymers instead of natural rubber or petroleum-derived synthetic polymers. Among the candidates are Russian dandelion and guayule, a desert shrub found in the southwestern American states and in Mexico, says Joe Walter, a tyre expert at the University of Akron in Ohio.

Food byproducts are also being considered as ingredients for new tyres. Yokohama, a Japanese tyre maker, is promoting a tyre made with oil from orange peel, a waste product from the production of orange juice. The company says its tyres are among the greenest produced, with 80% of their ingredients derived from sources other than petroleum. They are only slightly more expensive than normal tyres, costing about \$20 extra for a set of four. Yokohama is aiming its tyres at hybrid cars and efficient city cars like the Mini Cooper. To prove that orange-oil based tyres can compete with traditional racing tyres, it has also fitted Porsche racing cars with them.

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