

Intelligent Tire Alternatives for Better Performance and Sustainability

Tires of the future may look a lot like the tires of today, but they're set to be composed of materials that are substantially more sustainable and affordable compared to the options of today. Whether it's genetically modified natural rubber from trees, plant-based rubber produced from weeds, or recycled rubber manufactured from frozen used tires, scientists are developing a myriad of options to replace conventional tire materials and get us on the road to smarter technologies for the future.

Genetic Improvements for Natural Rubber Tires from *Hevea brasiliensis* Trees

Natural rubber is a latex polymer with abundant characteristics that make it ideal for use in the automotive tire industry. It's highly elastic, flexible, resilient, impact resistant, and is efficient at heat dispersion. Some say it's irreplaceable. As such, even synthetic rubber cannot compare when it comes to natural rubber for tires, especially those used in the aircraft and truck industries.

However, today, the *Hevea brasiliensis* species, the tree species responsible for most of natural rubber production the world, is under increasing stress. Pathogens and fungal diseases threaten growth of these trees, climate change creates difficulties for trees growing in Asia and South America, and challenges related to the breeding of the trees because of the limited genome-based information have all slowed the ability of growers to increase their crops.

As such, many groups are working on advancing the way rubber trees are bred and grown in order to produce rubber specifically designed for the tire industry. Of significant importance has been the mapping of the genome, which is required to accelerate the genetic improvement of the species in order to increase breeding and exploitation of genetic resources.

To make this a reality, The Bridgestone Corporation has been working on the genome sequence for *Hevea brasiliensis*. Bridgestone, along with Genome Informatics Laboratory in the National Institute of Genetics (Mishima City, Shizuoka

Prefecture, Japan), has been tinkering with the genetic makeup of this tree, which is commonly called the rubber tree.

The aim of this genetics research is to facilitate the development of improved breeding technologies and growing methods for the natural rubber tree in order to improve yield, latex rubber quality, and generate better clones of the trees. Their hope is that their research may also lead to advancements in how well the trees fend off diseases and how well they weather stress such as droughts, floods, and challenging temperature changes such as those associated with climate change.

So far, the Bridgestone Group has decoded 1.4 billion base pairs of this tree's genome, which is estimated to cover 90 percent or more of the gene sequence of the species. By identifying chromosome-level information about the tree and characterizing molecular markers for various gene traits, they will be able to produce trees with the specific characteristics that will benefit the tire industry, such as disease resistance, higher latex production, and so on, all of which contribute to higher yields.ⁱ

This is just one of Bridgestone's initiatives aimed at developing more sustainable products for the automotive industry. After all, the manufacture of synthetic rubber tires must rely on oil supplies since it takes about seven gallons of oil to create one tire (five gallons for feedstock and two gallons for energy to create the tire).ⁱⁱ Creating tires with an ever-higher percentage of renewable feedstock, such as that from the natural rubber tree, would reduce the environmental load of the manufacturing of rubber tires. Today a huge percentage of all natural rubber production is sent to create tires and other vehicle components, with 50 percent of all auto tires and 100 percent of all aircraft tires being made of natural rubber.ⁱⁱⁱ Bridgestone hopes to develop tires that are made of materials that are 100 percent sustainably sourced in the future.^{iv}

Plant-Based Rubber Alternatives for New Tire Manufacturing

Yet natural rubber from trees isn't the only way to create sustainable rubber tires. The first prototyped natural latex tires made from Dandelion plants have been produced in Europe, representing a new foray into plant-based tire production. Made from two particular strains of Dandelion – Guayule and Russian to be precise – these new tires have been produced by Dutch tire company Apollo Vredstein.

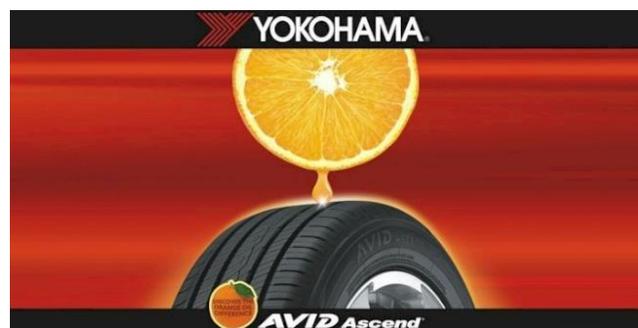
Where formerly all natural rubber relied on the *Hevea brasiliensis* originating from Asia (all natural rubber has to be imported into Europe at the present), giving that region a veritable monopoly on natural rubber, this new type of natural rubber will open up new markets. As part of the EU-PEARLS European project which began four years ago with the aim of developing an alternative to natural rubber, this breakthrough will help to promote latex-producing plants that can be grown in many European countries. The Guayule Dandelion can be grown in Mediterranean areas, whereas the Russian Dandelion is well-suited to northern and eastern areas of Europe.^v

That said, more testing of the prototypes will need to be completed before they can enter production. If this type of natural rubber takes off, it would reduce the exceptional strain on the natural rubber tree populations. And while the materials and manufacturing of tires account for only 12 percent of their CO2 emissions (86 percent of a tire's footprint comes from the fuel consumption of the vehicle), offering the industry a renewable alternative to synthetic tires certainly could help reduce the industry's carbon footprint.^{vi}

Another interesting advancement is bio-isoprene. Whereas synthetic tires are made of isoprene derived from crude oil, bio-isoprene is created by an enzyme from bacteria. Developed by researchers at Michigan State University in the biochemistry and molecular biology department, the bio-isoprene has already been introduced into a line of Goodyear's tires.^{vii}

Other than the base material required to produce natural rubber tires, companies are also playing with plant-based additives to increase a tire's efficiency. Yokohama Tire Corporation, for instance, is infusing their AVID Ascend and dB Super E-spec tires with orange oil. Extracted from the peels of oranges and added to natural rubber, this additive is said to improve the performance characteristics of the Ascend tire.

According to Andrew Briggs, Yokohama director of product planning and motorsports, "There, the orange oil



[Yokohama Orange Oil Technology](#)

technology makes possible the collective benefits of outstanding grip for all-season handling, long treadlife and great fuel economy. It doesn't compromise on one while delivering another. The orange oil is the differentiator. " ^{viii} These tires have been trialed on the racetrack to rave reviews, and have been tested to reduce rolling resistance by 20 percent. ^{ix}

Similarly, some companies are producing tires infused with sunflower oil, including the MICHELIN Primacy Alpin PA3 and the Primacy MXM4. By substituting sunflower oil for petroleum oil, these tires can also reduce the carbon black filler they consume. The plant-based oil also increases traction at low temperatures for better braking and handling in wet conditions as well as light snow conditions. All around, the vegetable oil seems to offer some substantial improvements of petroleum oil-based tires. ^x

Turning to Recycled Powders for Greener Tires

Perhaps an even better alternative to natural rubber and other plant-based materials for constructing tires is the reuse of secondhand tire materials for making new tires. By and large, used tires are burned for energy, or they collect in giant piles around the world becoming mosquito-breeding grounds and fire hazards. Lehigh Technologies aims to change all of that with their recycled tire powders. A green materials company, LeHigh Technologies is looking to monetize waste rubber in order to make greener tires and take care of the stockpiles of rubber around the world.



[LeHigh Technologies MRP for Recycled Tires](#)

The Lehigh process involves producing micronized rubber powders (MRPs) which are created by flash freezing small chunks of industrial waste rubber in liquid nitrogen. These chunks are then ground down in a machine to produce a fine powder that can be blended with virgin rubbers and plastics to produce new rubber.

Though only about 7 percent of a new tire will be composed of MRP (truck tires can contain more), manufacturers that use this material can cut virgin material costs by up to 40 percent, and oil consumption is reduced by 0.8 gallons per pound of MRP used (findings which have been independently verified by Georgia Tech). Already more than 140 million tires on the road contain MRP.^{xi}

Are Plants the Way of the Future for Tires?

The history of the tire centers around trees, but will the future also be focused on plants? If the innovations discussed here are any indication, plants will continue to play a large role in how tires are made and how well they perform. Though it's unlikely we'll see mushroom-grown tires like other car components currently in production, the evolution of tire materials looks to be increasingly green.

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