Continental
The Future in Motion

Tires for the Future

We develop sustainability

Sustainability driven by technology

When tires are developed, the main considerations are safety and performance, but resource conservation and fuel economy are decisive aspects too.

In the Research & Development department at Continental Reifen Deutschland GmbH, chemist Dr. Fred Waldner is in charge of the laboratory where all new rubber compounds are initially mixed and tested. Every year, several thousand samples are produced here, "drawing on more than 1,500 different materials," as Dr. Waldner explains. There are high shelves packed with all kinds of dark natural and transparent synthetic rubber, and cupboards containing every ingredient the chemists might need: sulfur, carbon black, various kinds of wax, silica ...

It was in Dr. Waldner's test labs that the first rubber compound based on dandelion latex was mixed. In conjunction with the Fraunhofer Institute, following intensive research work, Continental succeeded in cultivating a type of dandelion that produces large amounts of the latex on which natural rubber in based. This has given Continental a decisive advantage over the competition (see the interview starting on page 6).

Research for sustainability: At Continental's chemistry and physics labs every year thousands of material samples are produced and tested using complex procedures. The aim is to cut fuel consumption and conserve materials while at the same time boosting performance.

It's all in the mix

"You can't replace all of the natural rubber in a tire with synthetic rubber," says Dr. Waldner. The technical advantages and unique properties of the natural product are simply too important. Apply heat to natural rubber and it can be shaped; when it cools down it remains elastic, can be stretched, and will then return to its original shape. The rubber made from this natural product can be elastic or energy absorbing, depending on the composition of the material. "Rubber is one

of the most exciting materials of them all," says Dr. Waldner, who knows what a difference the right rubber compound can make for the functionalities of a tire.

"Along with safety, keeping rolling resistance as low as possible is one of the most important goals of our research and development efforts," says Dr. Andreas Topp, Head of Materials and Process Development at Continental. The idea is to develop a tire with as little rolling resistance as possible so as to cut fuel consumption, but at the same time continuous improvements in braking performance are also essential. These conflicting goals, with more safety on the one hand and more sustainability on the other, have been reconciled in a previously unachieved optimum way in the energy-efficient Conti.eContact tire (see page 5). Here, the tire developers have broken new ground for every component of the tire – carcass, rubber, tire contour, and tread pattern – using all the available options to reach their goal. The Conti.eContact scores not only in terms of its low rolling resistance but also with its short braking distances, even in the wet. In addition, a new tire contour makes for an additional increase in mileage. "Ecotuning" is how the developers describe their task.

Innovative material concepts: Tire developers can draw on over 1,500 different ingredients as they develop rubber compounds for new tires that will offer optimum safety and sustainability.

Retreading truck tires

Through a policy of fostering innovation, Continental is helping to ensure that fuel consumption and carbon dioxide emissions are reduced in everyday driving. But the idea is also to make the tires themselves more sustainable, which also means more durable. “The material that makes the biggest contribution to resource conservation is the material that you don’t use” says Dr. Topp. So at the top of the specifications for every new tire generation come weight reduction and higher mileage. The carcass of a modern-day truck tire, for example, can cover up to 600,000 kilometers. Given the enormous loads and wear to which the tread strip is subjected, however, it cannot match the durability of the carcass. Now Continental has developed a new technology and new processes for retreading truck tires, giving the carcasses a new lease of life by equipping them with new tread.

Continental has been operating its new ContiLifeCycle plant for truck tires in Hanover since the end of 2013. Here, custom-built plant and equipment with integrated hot and cold retreading set global standards in tire recycling – the only way to ensure the required quality standards are achieved. Known as ContiRe or ContiTread tires, when the truck retreads leave the ContiLifeCycle plant they are hard to tell from new tires. At full capacity, the innovative retreading plant can turn out up to 180,000 tires a year.

Even for tires that can no longer be retreaded, the ContiLifeCycle plant has the right technology. The all-new recycling technology developed by Continental two years ago enables much more rubber from used tires to be returned to the production of new tires and retreads. A targeted recycling volume of 4,000 tonnes a year means that a total of around 2,400 tonnes of rubber and 1,600 tonnes of filler materials such as carbon black and silica can be saved each year. And thanks to the simultaneous introduction of optimized production methods, the proportion of recycled material in a new tire can be almost doubled, making for even more efficient use of resources.

High end retreads: At the ContiLifeCycle plant, used tires are given a new lease of life. ContiRe tires are only marginally different from new tires and the pioneering technology behind them has already won multiple awards.

Clean production: Unlike any other plant in the world, with its integrated blend of hot and cold retreading for truck and bus tires and its own specially developed industrial-scale rubber recycling plant, the ContiLifeCycle factory is a pioneering facility.

Awards

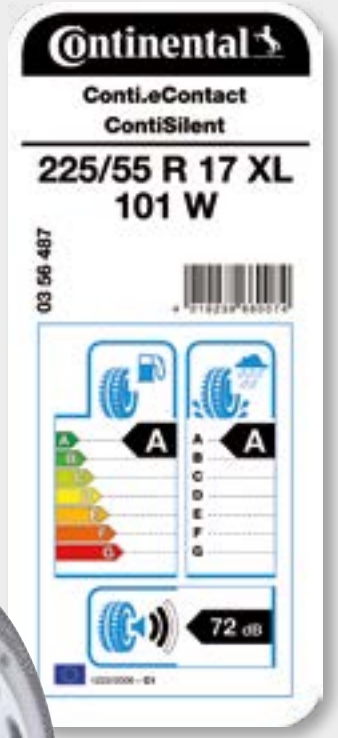
In February 2014, Tire Technology International magazine named Continental “Tire Manufacturer of the Year 2014” in honor of its dedication to tire development at all levels. The magazine’s international panel of experts also commended Continental’s used tire recycling process in conjunction with its truck tire retreading operations.

In addition, the ContiLifeCycle plant forms part of the German Federal Ministry for the Environment’s environmental innovation program, providing further proof that, through its development projects, Continental is setting standards of sustainability and economic efficiency.

tire TECHNOLOGY INTERNATIONAL 2014 AWARDS FOR INNOVATION AND EXCELLENCE TIRE MANUFACTURER OF THE YEAR

UMWELT INNOVATIONS PROGRAMM

Tires for hybrid and electric vehicles



Maximum efficiency through high technology: With the new Conti.eContact, Continental presents its first tire to score a top A rating both for wet grip and rolling resistance on the EU tire label.

"The new vehicle concepts for electric mobility are opening up enormous development opportunities for us, not least in terms of tire design," says David O'Donnell, Head of Global Research and Development for Passenger Car and Light Truck Tires at Continental. "Tall & narrow" tires provide an example of what he means.

For several years now, Continental has had a special line of tires in its portfolio for electric cars, in the shape of the Conti.eContact. The exceptionally tall and narrow design of these 195/55 R 20 tires helps maximize the driving range of the e-cars. Compared to standard tires, the Conti.eContact offers a drop in rolling resistance of up to 30 percent. It is figures like this that convinced Renault to make Continental the original equipment supplier for its agile city car, the Twizzy. For hybrid models such as the VW Touareg Hybrid and the Citroën D5 Hybrid, Continental offers 17- and 18-inch Conti.eContact tires. The redeveloped version of this tire that uses all-new materials has become the first Continental summer tire to be awarded top A grades for both wet grip and rolling resistance on the EU tire label (AA label).

Technical highlights of the first AA-label tire from Continental:

- The Green Chili compound unites maximum grip and minimum rolling resistance to make for top-level safety and handling.
- The tread design features new HydroSipes for optimum water dispersion and the best possible wet braking performance.
- The flexible and aerodynamically optimized AeroFlex sidewall makes for further reductions in rolling resistance and fuel consumption.
- In hybrid and electric vehicles, tire noise is another aspect of special importance. The ContiSilent technology in the new Conti.eContact makes for a marked reduction in interior noise.

Interview

We call every component into question

David O'Donnell and Dr. Andreas Topp have a special responsibility for sustainability at Continental. In Hanover-Stöcken they are both tasked with driving forward research and development work focused on new materials and technologies. Sustainability and environmental protection are two key aspects here. The best example is provided by their joint project with the Fraunhofer Institute, in which they are developing a means of obtaining rubber from dandelions.

David O'Donnell, Andreas Topp, you share responsibility for the development of new tires at Continental, so who is responsible for what, exactly?

O'Donnell: I'm responsible for global coordination of all our research and development activities in the passenger car and light truck sector at Continental. So I'm the one who coordinates the various projects, stewarding the entire process from the initial idea via the planning and testing all the way to the finished product. And it's having the whole picture under control that makes my work so exciting.

Dr. Topp: I focus on the development of the materials and processes. A tire can be made up of 40 or more components, all of which need gearing to one another in every newly developed product. Each individual component has a direct impact on the properties of the tire. The secret lies in blending together the right raw materials in the compounding process, and in the special kind of process management applied.
So from the outset and throughout our development and planning activities we are constantly thinking about how we can actually put our plans into practice at our production plants. My job is to ensure that at the end of the development process we have a tire with exactly the right properties and can start production without delay.

How important is the topic of sustainability in the development of new products compared to other performance characteristics?

O'Donnell: Safety is one of our most important performance factors and always has an overarching part to play. But what really counts is the tire as a whole. One classic example here is the topic of rolling resistance. The higher the rolling resistance, the better the braking performance of the tire will be – an important consideration when it comes to safety. At the same time, though, rolling resistance also has a direct impact on the fuel consumption of a car. If we reduce rolling resistance by roughly ten percent, fuel consumption will drop by 1.6 percent. On average that means a reduction in CO_2 emissions of two grams per 100 kilometer traveled. This is one of the decisive pairs of conflicting objectives in the development of modern tires; one that we are constantly working to resolve.

David O'Donnell
Head of Global Research and Development for Passenger Car and Light Truck Tires (left)

Dr. Andreas Topp
Head of Materials and Process Development in Research & Development tires (right)

What concrete options are still open to us to further optimize a tire?

Dr. Topp: The interplay between design and materials is one of the keys to success here. But the most sustainable material is always the one that you don't use. So we leverage all opportunities to cut down on materials. That not only helps conserve resources but also reduces fuel consumption as there is less weight to be moved around. Our job is to identify materials that are lighter and thinner but offer the same strength and performance. So for example we have introduced new compounds for the tread strips on our tires that cut fuel consumption but nevertheless enhance performance.
But we also try to make full use of the opportunities offered by all other components – even a flange rib has potential in this respect. We call every component into question.

How are new materials developed?

Dr. Topp: Rubber makes up a large proportion of a tire – natural rubber, that is. New properties are often created through the use of innovative kinds of synthetic rubber. And here we have new materials that did not exist just five years ago. Often this involves bonding new chemical functionalities onto the long chains of rubber molecules, endowing them with new abilities. On top of that we also develop new metallic and textile reinforcing materials, innovative networking systems and many other technologies. The field of materials technology is a very exciting place to work right now and is delivering decisive contributions to a continuous improvement in performance characteristics.

Talking of materials development, Continental is currently causing quite a stir with dandelion rubber. What's this all about?

Dr. Topp: The notion of obtaining latex from dandelions has been around for a long time. We've been working on this topic very intensively for the past four years and two and a half years ago we entered into a joint development project with the Fraunhofer Institute with the aim of cultivating suitable plants. The outcome is a dandelion-based rubber that need fear no comparison with the product of the rubber tree in either quality or functionalities.

O'Donnell: We had many different reasons for making this commitment. Even though natural rubber is a renewable product, sustainability remains a key consideration for us. The global demand for rubber is constantly rising. But cultivating rubber trees is only possible in latitudes between roughly 30° north and 30° south – a region also known as the rubber belt. A rubber tree needs up to seven years before it can supply latex suitable for processing. And at this point the inherent slow pace of the system encounters the high speed of the market. This leaves us facing highly volatile prices, monocultures in the producing countries, and long-distances to cover before the rubber reaches us.

What are the advantages of the dandelion? Aren't we going to start seeing monocultures here too, or will they take up agricultural land that would better be used for food crops?

O'Donnell: Dandelions can be grown in virtually any climate zone. And they are relatively undemanding when it comes to the type of soil. So ideally we could grow them on wasteland close to our production sites.

So Continental is planning to grow its own dandelions?

O'Donnell: Yes, we're planning to cultivate some of the dandelions ourselves. We are already working with farmers to test this under real world conditions out in the fields. It's a step that will make us more independent of the market and put us in a stronger position.

Dr. Topp: One vital factor for the success of this project is a full grasp of everything from cultivation of the crop to obtaining latex from the dandelion roots. That's not to say, of course, that

Monoculture: To date most of the raw material for rubber production has been provided by the rubber tree. In the future, dandelions will provide an alternative to traditional sources.

we're about to become an agricultural company – no, we're a tire manufacturer and automotive supplier, and that's the way it will stay.

How are the plants cultivated? Are you using genetic engineering?

O'Donnell: We make no use whatsoever of genetic engineering. Our production plants are located all over the world and so we need a plant that can be cultivated worldwide, not only legally but also with full social and political acceptance. The varieties we have obtained in collaboration with Prof. Prüfer at the Fraunhofer Institute have shown that this is feasible. By means of hybridization, the traditional way of creating new varieties, we have come up with types of dandelion that are very productive in terms of latex and very well suited to commercial cultivation. And it's not only the Tire Division that will benefit from this, but the other Continental Divisions as well, not least ContiTech.

How far down the road have we come with dandelion research, or are "green" tires still something for the distant future?

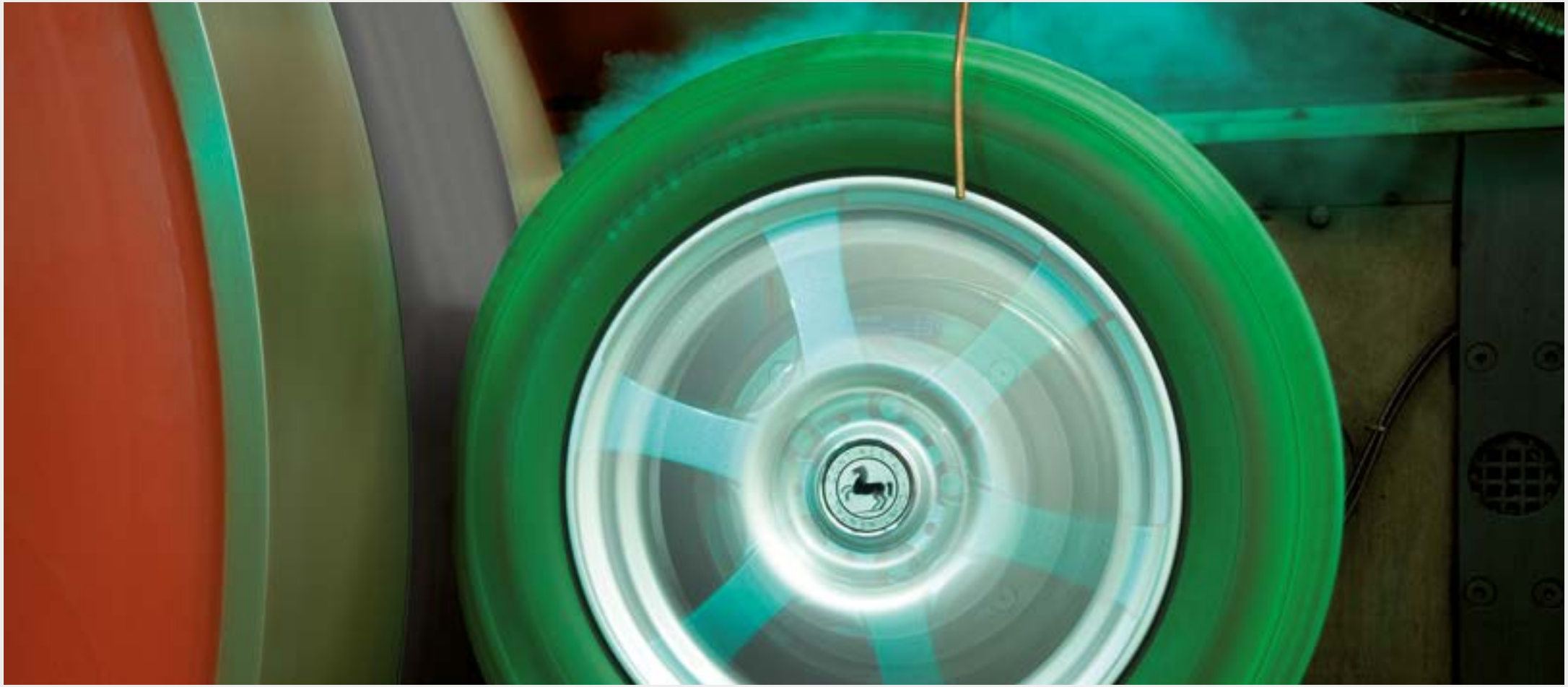
Dr. Topp: We've come a long way. We have already been able to replicate the characteristics of conventional latex and there has been great progress in terms of the latex yield. Unlike the rubber tree, which takes seven years to start producing latex, the dandelion is a semi-annual plant and starts producing latex after just six months. Cultivation under real world conditions is making such rapid progress that we are now focusing on producing seed for large-scale cultivation and industrial production of latex. As we have chosen to dispense with genetic engineering, all of this has to happen in traditional style, so it is going to take a while before we reach the kind of volumes that we need.

Can you already say when Continental will bring to market the first volume-built tire made of dandelion rubber?

O'Donnell: We don't want to set a date. When we have completed the second development stage in the cultivation process the next set of challenges awaits us – these are mainly of an organizational nature, relating to putting the cultivation and production process in place worldwide. But the main obstacles have already been overcome. We think that in three or four years from now a substantial number of our initial "dandelion tires" will be involved in road testing.

Dandelions are one side of the picture – what other aspects of a tire can be produced sustainably?

Dr. Topp: In Research & Development at Continental we're working on other topics too. Many things are conceivable and we're already engaged in a lot of them. For instance, ever since the 1990s we've been using renewable oils such as rapeseed oil in our tire production to cut back the use of mineral oil. And in principle it's also possible to produce synthetic rubber from renewables instead of petroleum. On top of that, last year we opened a plant that uses our own new technology to produce recycled rubber.
So watch this space!



Rubber from the roots

Green tires based on dandelions

The breaktrough in producing rubber based on dendelion is made. Years of research and development lead now into the pilot phase in order to start the industrial production. In cooperation with the Fraunhofer Institut Continental is the world leader in this technology.

Natural rubber makes up between ten and 30 percent of a car tire, while in truck tires the proportion can be even higher. "Natural rubber has some very special properties that cannot be entirely reproduced using synthetic rubber derived from petroleum," says Dr. Andreas Topp, Head of Materials and Process Development at Continental. "Given the quality standards that we apply," he adds, "in many areas there is no alternative to natural rubber."

Today, natural rubber is still obtained almost exclusively from the rubber tree (Hevea brasiliensis) which can only be cultivated in what is referred to as the "rubber belt" around the equator. At the same time, global demand for natural rubber is set to rise in the next few years. In Asia, Africa and South America, vast monocultures are being created and primeval forest destroyed to meet this demand. A rubber tree, though, needs about seven years before it can start producing latex that can be used in rubber production. Market demand is outpacing production capacities, a situation that, in the past, has led to unpredictable price volatility.

Dandelions provide an ecological source of raw materials

So what if it were to prove possible to cultivate a type of dandelion that would produce enough natural rubber to make it worthwhile growing it as a crop? This idea first occurred to scientists early in the 20th century. Since then, there have been numerous attempts and projects, all of which led to nothing. Either the plants failed to yield sufficient latex or the raw material obtained was not of the required quality.

Continental and the Fraunhofer Institute for Molecular Biology and Applied Ecology (IME) have been collaborating in this field for years, two partners who complement one another to perfection: "In Continental we have a congenial partner at our side," says Prof. Dirk Prüfer from the Fraunhofer Institute. While the team at IME in Münster optimize the plant by means of conventional cultivation, the experts from Continental's Research & Development department produce samples of 'natural rubber made from dandelion latex. They analyze the properties of the new raw material and communicate their findings to the biologists, who adapt their cultivation efforts accordingly.

THE FRAUNHOFER IME

Fraunhofer is Europe's largest application-oriented research organization. The Fraunhofer Institute for Molecular Biology and Applied Ecology, IME, has some 300 employees at its German locations in Schmallenberg, Aachen, Gießen, Münster, Frankfurt and Hamburg. Its research efforts cover the fields of health, security, communication, mobility, energy and the environment. As a result, the work of its researchers and developers has a significant impact on the lives of people everywhere. At its Schmallenberg location, the IME pursues research in the field of applied life sciences from molecular to ecosystem level, and maintains close links with the University of Münster, where the type of dandelion for future rubber production was cultivated.

From greenhouses to test fields

In the project team, Continental bundles all the necessary expertise from Materials and Product Development. The central steering group is made up of equal numbers of representatives of Continental and IME, ensuring a transparent and direct exchange of information and experiences, and keeping the focus firmly on a solution-oriented approach. "The outcome is something that can perhaps best be called a joint technology start-up," says Dr. Topp. Based on the Russian dandelion a plant is being cultivated that provides a competitive yield. The natural rubber that can be obtained from the roots need fear no comparison with its conventional counterpart. "Dandelion rubber is chemically identical to the product of the rubber tree," says Dr. Topp. Which means that Continental will in future have an entirely new source of raw material at its disposal. On top of which, this dandelion is so undemanding that it will even flourish in soil where potato and cereal crops would yield very little.

Cultivation of the new plants is continuing in greenhouses in Münster. But at the same time initial test fields are being used to try out cultivation of this dandelion in the open air, produce natural rubber for prototypes, and test different means of obtaining seeds. Because a whole lot of seeds are going to be needed, if production of "green" tires is to be launched any time soon.

Local-grown product

The idea is for the dandelions from Prof. Prüfer's laboratory to be grown at suitable Continental sites in Europe, making the Company less dependent on the raw materials market for its rubber. Apart from which there are obvious ecological benefits: the traditional practice of transporting natural rubber half way round the world will be minimized and growing dandelion crops on marginal and poor quality land "just around the corner" will prevent the further destruction of valuable rainforest and jungle in the tropics. Rubber tree monocultures already cover more than ten million hectares in Asia alone.

The project opens up new prospects for the environment, but also for Continental as a company. “We are investing in this project because we are convinced that in the long-term it will enable us to further improve our tire production,” says Nikolai Setzer, Continental Executive Board Member responsible for the Tire Division. “This project provides impressive proof that when it comes to materials development we have by no means reached the end of the road.” Meanwhile, at the Fraunhofer Institute, Prof. Prüfer is already working to reach the final milestone in the dandelion project: “Now it’s time to take this technology beyond the status of a pilot project and bring it to readiness for industrial-scale production.”

Heading for production: As soon as cultivation of the Russian dandelion is assured, tires based on dandelion rubber will be brought to readiness for series production.

GREENTEC AWARD 2014 FOR DANDELION RUBBER

The GreenTec Award 2014 goes to Continental and the Fraunhofer Institute for Molecular Biology and Applied Ecology IME (IME) for their co-development project “RUBIN – Industrial Emergence of Natural Rubber from Dandelion”.

FIVE QUESTIONS...

...for project manager Prof. Dr. Prüfer from the Fraunhofer IME, who heads up the joint project for the production of rubber from dandelions.

Why did you choose to base your work on the Russian dandelion?
There’s nothing new about the idea of using the Russian dandelion as an alternative source of natural rubber. This plant was already supplying latex during World War II and in the post-war period. Today, in view of multiple problems like volatile prices, shortage of natural rubber, and potential threats to conventional natural rubber production such as pathogenic fungi, dandelions can offer a valuable alternative to rubber trees.

Why is this kind of dandelion more suitable than other plants?
Along with the rubber tree and the guayule shrub, the dandelion is the only plant that produces high quality natural rubber. And compared to the other two plants I just mentioned, the dandelion can be cultivated in local climates, so that long-distance transport becomes a thing of the past.

Compared with rubber trees, can dandelions produce as much natural rubber per hectare, for example, or maybe even more?
In our cultivation efforts we are targeting a yield of one tonne of natural rubber per hectare. That would give us a comparable yield.

What are or were the biggest challenges for you in this project?
Cultivating new lines of dandelions was demanding. Initially we only used wild lines as opposed to cultivated ones. The resultant material proved not to be stable in terms of natural rubber content or growth rates.
So first of all we had to cultivate precisely the characteristics that we needed. On top of that, we still have to develop an economically viable extraction process for the dandelion latex.

The new type of dandelion was optimized without the use of genetic engineering. Why was that?
By focusing exclusively on natural cultivation methods, we have no need to contend with negative attitudes towards genetically modified plants. This way we can be sure of public acceptance of the cultivation of our dandelion crops.

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Status as of June 2014

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