Eco-Innovation Project

Carbon Black Green Tyre

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Layman’s report

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The issue: turning waste tires into valuable resources and energy

Waste tyres, also known as ‘End-of-Life Tyres’ (ELTs) are among the largest and most problematic sources of solid waste, due to the large volume produced and their inherent durability. In the EU, 3.4 million tons of tyres become waste each year. Most waste tyres go to energy recovery (45%) and to material recycling for low-end applications (41%), such as outdoor flooring (playgrounds, sports areas) and as addition to asphalt. Tyres contain a significant amount of carbon black, typically between 20 and 25% of the total mass.

Black Bear Carbon (further: BBC) has developed a highly innovative process enabling the recovery of high quality carbon black from waste tyres, thereby providing a sustainable solution for a problematic waste stream and preventing pollution related to the production of furnace carbon black. BBC offers a commercially attractive proposition given the high quality and lower production costs compared to furnace carbon black.
**Project overview: objectives, expected results, work plan and partners**

*Objectives and expected results:*

The Carbon Black Green Tyre project is designed to demonstrate that the BBC technology for shredded end-of-life tyres allows producing carbon black grades that are attractive for use in tyres. It is also designed to confirm the substantial environmental and economic benefits that are expected from the technology on the basis of test runs operated so far.

The BBC technology enables the production of carbon black from end-of-life tyres instead of the traditional pathway to produce it from fossil oil, which is a highly polluting process. The BBC process is based upon an innovative pyrolysis process and subsequent milling and pelletizing of the char. The BBC process is able to produce carbon blacks with similar or better material properties than the virgin carbon blacks used in tyres so far, in an environmentally friendly manner.

Main expected results of the project are:

- Development of an operational pilot plant for the production of high-grade carbon blacks using end-of-life tyres as a feedstock;
- Confirmation of the environmental benefits of the BBC technology in comparison to the traditional furnace black process (considerable reductions of oil consumption and emissions of CO₂, particulate matter, sulphur dioxide, nitrogen oxides and volatile organic compounds);
- BBC will have a market share of 0.2% of the European carbon black market and will have supply contracts with 5 customers, and
- A plan for scale up to a full-scale installation and for further replication will be available.

*Summary of the work plan:*

The Carbon Black Green Tyre project aims to realise the first pre-commercial scale pilot plant worldwide of the BBC technology. The project activities aim to build the pilot plant (WP2) and to operate and optimise this pilot plant (WP3), in order to demonstrate that the technology provides robust results and consistent product qualities at pre-commercial volumes. The project encompasses a programme with tyre processing companies to optimise sourcing and preparation of end-of-life tyres (WP4). Furthermore it contains an extensive testing programme in which the carbon black grades produced in the project will be tested in various test programmes of tyre manufacturer TWS (WP5).

The last year of the work programme contains activities to scale-up and replicate the project (WP6). BBC considers that the technology has an important potential to replicate, for two main reasons:

- The similar or better properties of BBC recycled carbon black compared to virgin material.
- The cleaner, more cost-efficient and more scalable production technology, which allows installing BBC plants near end-of-life tyre collection points that are located all over the EU.
The project results will be disseminated all along the project (WP7). Key target audiences for dissemination are the rubber and plastic industry, the waste management sector, investors and policy makers.

The consortium

Black Bear Carbon is a technology start-up company founded in 2010 by three experienced entrepreneurs, with the aim to develop into an innovative producer of carbon reinforcing fillers for tyres, rubber, plastics and coatings. The Black Bear Carbon team has a strong track record in engineering, product development and management of technology companies.

Trelleborg Wheel Systems, as part of the Trelleborg Group, is a global supplier of tyres and complete wheels for agricultural and forestry machines, fork-lift trucks and other material-handling equipment.

The business unit involved in the project is the Agricultural & Forestry Tyres Business Unit; the legal entity involved is Trelleborg Wheel Systems Italia S.p.A.

Dutch Green Carbon VOF (DGC) is a joint venture between BBC and Kargro. Black Bear Carbon and Kargro Group have founded the company Dutch Green Carbon VOF. Kargro is a large tyre processing company, operating plants at several locations including in Nederweert, the location of the DGC carbon black plant. By its participation in DGC, Kargro intends to create a high value outlet for its ELTs.
Results

After thorough investigations BBC decided to build its first plant at full commercial scale with its partners Kargro Group and DGC in Nederweert in The Netherlands. BBC’s pilot plant construction commenced in Q3 2015 and is on schedule to be completed and ready for operation in April 2016. It will be processing 13.2 kilotons of ELTs per year and producing 4.5 kilotons of high grade carbon blacks per year.

The following pictures show the final stage of the construction process in January 2016, showing the heart of the installation, the rotary kiln, on the left-hand side:

Environmental benefits

The environmental benefits of the BBC technology in comparison to the traditional furnace black process include 22 kilotons/year CO₂-eq emission reduction per production line of 4.5 kilotons/year carbon black, important emission reductions of particulate matter (50%), sulphur dioxide (78%), nitrogen oxides (67%) and volatile organic compounds (57%). The BBC process not only produces carbon black, but also energy: 1.6 MWₑ and 10.5 MW₢ₐ₉ per ton carbon black. Therefore recycling waste tires into carbon black provides net energy and strongly reduces CO₂ emissions, as shown in the following figure:
**Results**

A plant of 11 ktons feedstock recovers 4.5 kton carbon black and saves 21.6 ktons CO₂.

Energy production:
- 5 ktons high calorific oil & 6MW green electricity

The CO₂ benefits can be capitalized in various ways:
- Sale of CO₂ credits
- Sale of green energy; steam, gas or electricity

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* Source: Life Cycle Assessment by partners for innovation 2014
** BAT: Best Available Technology
The Market – target applications

BBC envisages that it will sign supply contracts with 5 customers as soon as production starts in its pilot plant in Nederweert, and gain 0.2% market share of the European carbon black market. During the project approximately 40 potential customers have tested BBCs carbon black successfully by.

Target applications include use of the carbon black as a pigment in coatings and inks, plastics, reuse for the production of new tires, and the production of technical rubber goods.

A plan for scale up is available, involving the installation of 20 carbon black production lines in the period up to 2021, processing 264 kilotons/year ELTs, producing 90 kilotons/year carbon black, reducing CO₂ emissions by over 400 kilotons/year and providing employment to approximately 400 persons full-time.
The project contributes to important EU policy objectives:

*The Europe 2020 strategy – a resource efficient Europe*

A resource-efficient Europe is one of the seven flagship initiatives of the Europe 2020 strategy aiming to deliver smart, sustainable and inclusive growth. This is Europe’s main strategy for generating growth and jobs, backed by the European Parliament and the European Council.

*The Roadmap to a Resource Efficient Europe (COM(2011) 571)*

The roadmap is part of the European 2020 strategy and outlines how Europe's economy can become sustainable by 2050. It proposes ways to increase resource productivity and decouple economic growth from resource use and related environmental impacts. One of the main elements of the strategy is to turn waste into resource, thereby saving virgin materials, energy and other resources.


This Directive aims to help move the EU closer to a "recycling society", seeking to avoid waste generation and to use waste as a resource. In particular, the Sixth Community Environment Action Programme calls for measures aimed at ensuring the source separation, collection and recycling of priority waste streams. The directive furthermore states that Member States should support the use of recyclate in line with the waste hierarchy and with the aim of a recycling society, and should not support the landfilling or incineration of such recyclate whenever possible.

*Circular economy package*

Recently (November 2015) The European Commission adopted an ambitious Circular Economy Package to stimulate Europe's transition towards a circular economy. The idea is that this will boost global competitiveness, foster sustainable economic growth and generate new jobs. To quote the EU Action Plan:

"The transition to a more circular economy, where the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste minimised, is an essential contribution to the EU's efforts to develop a sustainable, low carbon, resource efficient and competitive economy. Such transition is the opportunity to transform our economy and generate new and sustainable competitive advantages for Europe."

This project is an excellent example of the Circular Economy in practice. Not only because of the environmental advantages and prevention of waste, as is explained in this report, but also as it showcases the need to work together closely with other parties in the supply chain. Both suppliers and customers were involved throughout this project to create a truly circular solution for reuse of resources from ELTs.
About BBC:

The Dutch company Black Bear Carbon BV (founded 2010) offers a breakthrough in the conversion of end-of-life (EOL) tires into state-of-the-art carbon black and green energy. Its challenge in producing a high quality ‘green’ alternative to furnace carbon black was to overcome problems such as high volatile contents, bad smell, high levels of toxic PAHs, low rubber reinforcing characteristics and product variability that hitherto remained largely unresolved, thereby blocking the road to large-scale commercialization.

It has proven innovative state-of-the-art technology and a sound product-market proposition and brings a paradigm shift to the carbon black market, providing for the specific needs of customers in the rubber and specialty market segments and for the pressing needs of the environment.

In so doing we are able to offer the tire collector/recycler a highly profitable solution for converting their waste stream into highly valuable products.

Our challenge therefore is to convert the enormous global waste stream of EOL tires into valuable upcycled products. In Europe alone this amounts to more than 3.4 million tons per year – sufficient to feed approximately 170 Black Bear plants and to reduce CO₂ emissions by around 3.7 million tons per year.