



Toyobo and Avantium partner on PEF polymerization and PEF films

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Amsterdam, the Netherlands – September 1, 2016 – Toyobo Co., Ltd. ('Toyobo') and Avantium announce their partnership on PEF polymerization and PEF films.

Toyobo and Avantium have jointly developed thin films made from PEF, a 100% biobased plastic based on Avantium's proprietary YXY technology for the production of FDCA. These PEF films are about 10 micrometer in thickness (one hundredth of a millimeter) and can be applied for food packaging, in electronics applications such as displays or solar panels, industrial and medical packages. Compared to standard PET films, PEF films have a 10x higher oxygen barrier, 2~3x higher water vapor barrier, improved mechanical strength and are fully transparent. The performance benefits enable new packaging opportunities, such as transparent pouches for soups, sauces or baby foods. The barrier properties extend the shelf life when packaging oxygen sensitive products like meat, fish, dairy products, or fresh pizzas, or moisture sensitive products such as cereals, cookies, crisps, personal care or medical products, and enhance the aroma barrier for packaged cheeses, fish or detergents. The market development of the PEF films in Asia will be performed in collaboration with Mitsui & Co., Ltd. ('Mitsui'), with which Avantium announced a partnership in December 2015. The parties expect to offer samples for packaging tests from 2017 onwards.

Moreover, Toyobo and Avantium are jointly optimizing polymerization processes in Toyobo's existing polymerization assets to produce PEF resin at commercial scale from MEG (ethylene glycol) and Avantium's biobased chemical building block FDCA,. The parties intend to scale up PEF resin production to Toyobo's commercial polymerization lines in Iwakuni, Japan.

'I have been impressed by the innovative capability and drive of the Japanese industry', says Tom van Aken (CEO Avantium). 'Toyobo has state-of-the-art know-how and manufacturing capability in polymerization and thin films. The outstanding performance of PEF offers the potential of replacing complex and petroleum based multilayer packaging solutions, with a biobased and recyclable PEF film, without compromising the high quality standards required by Japanese packaging market. We are proud to work with such an excellent

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partner to scale up PEF polymer and thin film production. These developments support our efforts, in partnership with Mitsui, to introduce 100% bio-based PEF products such as films and bottles to consumers in Asia, making PEF a commercial reality.'

'Using our flexible assets and the know-how of our employees, it is the strategy of Toyobo to stay ahead of the curve in bringing innovative products to the market', states Chikao Morishige, Senior General Manager Plastics Production Technology Operating Department at Toyobo. '100% biobased PEF fits very well with our track record of introducing innovative materials and products to the market. Toyobo is therefore pleased to be working with Avantium and Mitsui to bring high performance PEF based packaging to customers.'

In March this year Avantium announced it is in exclusive negotiations with BASF with the intention of establishing a joint venture for the production and market development of FDCA and the marketing of PEF.

About FDCA and PEF

Avantium has developed the proprietary YXY technology, which enables a catalytic conversion of biobased carbohydrates (sugars) to FDCA (furanicarboxylic acid). FDCA has numerous potential applications as a biobased building block for new chemicals and plastics, such as PEF (polyethylene furandicarboxylate). PEF can be produced from FDCA using conventional industrial production plants.



PEF is a 100% biobased polyester with strong performance benefits over PET, such as a higher barrier to oxygen and CO₂, higher mechanical strength, and a reduction in carbon footprint of more than 50%. These properties of PEF enable improvements to existing bottles and packaging films, for example shelf life extension and lightweighting.



About Toyobo

Toyobo was founded in 1882 as a textile company, when it began its spinning and textile business. Toyobo continued to adapt to the changing needs of the times, drawing on their core technologies in polymerization, modification, processing, and biotechnology to expand business fields and develop high-performance products. For more information: www.toyobo-global.com.



About Avantium

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and bioplastic. Its most advanced products are the building block FDCA and the polymer PEF. Avantium aims to monetize this tremendous value opportunity through selling manufacturing licenses of its patented YXY production process and application fields. The technology basis of Avantium is a unique capability and expertise in catalysis and chemical R&D. The value of its catalysis technology platform is proven by Avantium's Catalysis business, a profitable business of providing advanced R&D catalysis services & systems to the world's largest oil and chemical companies. Avantium offices and headquarters are based in Amsterdam, the Netherlands, and Avantium is operating an YXY pilot plant in Geleen, the Netherlands.

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@Avantium en Japans bedrijf werken samen op gebied van PEF-polymerisatie en PEF-films, oa voor food. #biobased
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