

ABSTRACT

Everything from sugar – 5-HMF as key enabler in bio-based chemistry

10th International Conference on Bio-Based Materials
Maternushaus, Cologne, Germany, 10-11 May 2017

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Zug, 15 November 2016

Global warming, scarcity of raw materials, uncertainty over oil prices and superior performance of bio-chemicals have led to an increased interest in bio-based chemistry. Sugar-derived 5-hydroxymethylfurfural (5-HMF) is considered to be one of the most promising renewable platform chemicals in recent years.

As a pioneer and global technology leader in hydrothermal processing technology, leading Swiss biotechnology company AVA-CO2 developed an innovative, scalable process for 5-HMF production. Since 2013, the process has been implemented at a 5-HMF production plant belonging to subsidiary company AVA Biochem in Muttenz, Switzerland.

5-HMF is a building block for new bio-based polymers and has a large range of interesting applications. Much focus is currently on the synthetic route from 5-HMF to polyethylene furanoate (PEF) via 2,5-Furandicarboxylic acid (FDCA). In the medium- to long-term, PEF would be able to replace petro-based polyethylene terephthalate (PET), due to its superior product properties such as higher gas barriers for oxygen, CO2 and moisture as well as a higher glass transition temperature. This makes PEF an ideal bio-based candidate for the food packaging industry as well as other sectors.

The textile industry has always been innovative and various 'green' initiatives have been seen in recent years. These include processes for producing textile fibres from cellulose, polyester waste, fruit waste or algae. Using bio-based PEF to produce polyester fibres could be a sustainable, future step for the textile industry.

5-HMF also has potential as a replacement for formaldehyde and research projects looking at the substitution of carcinogenic formaldehyde through non-toxic 5-HMF in urea and phenolic resins are under way – showing very promising results. A Swiss Commission for Technology and Innovation (CTI)-funded project launched by AVA-CO2 and Bern University of Applied Sciences with the title 'Development of a formaldehyde-free urea type adhesive for the manufacturing of wood-based panels' is running since January 2016. Formaldehyde-urea resins are widespread – however, the increasingly stringent legal requirements regarding the use of formaldehyde compounds increases the pressure on industry to provide a safer alternative such as 5-HMF. A second CTI sponsored project to replace formaldehyde with 5-HMF in phenolic resins was approved in November 2016.

Sugar based 5-HMF offers fantastic opportunities in the bio-based chemical industry and AVALON's highly scalable HTP technology will for the first time allow the price competitive production of this versatile building block.