

Bio-refinery derived furanic humins as basis for sustainable thermosets and adhesives

Furanic humins are by-products obtained from carbohydrate valorization processes. Given the large amount of the carbon input that they can contain, they need to be considered as potential new bio based feedstock. In addition, all these product streams, when marketed at their highest value, deliver an economically viable technology for sustainable biochemicals production [1]. However, only limited valorization options are available; in fact, these materials are nowadays often simply considered as waste and mainly burnt as fuel for their heating value.

Furanic humins, are formed during acid-catalyzed (hydro)thermal conversion of the carbohydrate fractions of biomass, e.g. for the production of furfural and levulinate derivatives. At Avantium, they are a side product of the YXY® process. The YXY® technology catalytically converts plant-based sugar (fructose) into FDCA, the key building block for a wide range of plant-based chemicals and plastics such as polyethylene furanoate (PEF). The furanic humins are by-products of YXY® process currently producing FDCA at the pilot plant in Geleen (NL) and larger quantities are expected from the FDCA Flagship Plant in 2024 in Delfzijl (NL).

Humins are heterogeneous and polydisperse macromolecules, mainly constituted by furanic rings and aldehydes, ketones and hydroxyls as main functional groups. For many years, scientists focused on finding a way to avoid humins formation during biorefinery processes but that appears to be almost inevitable. The attention is now shifting towards ways to make high value-added products from humins to further improve the process economics of biorefineries.

An extensive analysis of the structure and physico-chemical properties of humins was performed to demonstrate that it is possible to obtain a thermoset polymer with different properties based on the treatment used.

With the upscaling of the YXY® process, furanic humins as a new bio based side-stream, will become available in large volumes. Having the potential to form thermoset polymers furanic humins are a valuable feedstock for the adhesives market.

[1] de Jong, E., Gosselink R.J.A. (2014) Lignocellulose-based chemical products. In: "Bioenergy Research: Advances and Applications" (eds. Gupta, V.K., et. al.) Elsevier, Amsterdam, The Netherlands. pp. 277-313. ISBN: 978-0-444-59561-4.