Production of colloidal lignin particles from biorefinery lignins and application for stabilization of Pickering emulsions

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As the second most abundant biopolymer after cellulose, lignin is an important raw material for future biobased chemicals and materials. Due to their complex structure, the full utilization of the widely available technical lignins streams from biomass processing still remains a challenge. The production of colloidal lignin particles (CLPs) is a possible route for technical lignin valorization towards novel biomaterials with tailored properties.

Various biorefinery lignins have been studied for the production of CLPs, such as sulphur-free kraft lignin isolated from softwood[1,2], hydrolysis lignin obtained from wheat straw[3] and soda lignin obtained from a mixture of wheat straw and Sarkanda grass bagasse[3]. The CLPs thus obtained have been modified by surface modification with either cationic lignin[1] or a thin film of chitosan[2] and exhibited good ability for stabilizing Pickering emulsions. This adsorption process to prepare cationic CLPs is advantageous because it minimizes the consumption of synthetic polymers, and opens new application opportunities for structurally well-defined nano- and microscale lignin particles.

Here, two technical lignins generated during acid hydrolysis of a softwood (SW) and a hardwood (HW) in a biorefining plant were structurally characterized to assess potential routes for CLPs production and modification for further applications. Data from ATR-FTIR and ^{1}H and HSQC NMR highlighted differences in lignin structures including functional groups present, and TGA showed higher thermal stability for SW, indicating higher condensation degree. These lignins were also derivatized to enhance their behaviour in applications. The capacity of the unmodified and modified CLPs for stabilizing Pickering emulsions was studied and compared with that of the cationic and anionic CLPs previously produced.

The use of biorefinery lignins to produce CLPs with tailored properties offers therefore an important route for valorization of a widely available resource. Besides adding value to current underutilized side streams, the tunability of CLPs properties also allows the development of new materials with targeted applications that can efficiently respond to specific needs for biobased materials

References:

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