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An Enzyme Technology - Metnin™ - Enables the Full Replacement of Fossil-Based Polymers by Lignin in Polymeric Composites

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Abstract : Lignin is an important component in the exploitation of lignocellulosic biomass. It has been shown that within the next years, the yield of added-value lignin-based chemicals and materials will generate renewable alternatives to oil-based products (e.g. polymeric composites, resins and adhesives) and enhance the economic feasibility of biorefineries. In this paper, a novel technology for lignin valorisation (METNIN™) is presented. METNIN™ is based on the oxidative action of an alkaliphilic enzyme in aqueous alkaline conditions (pH 10-11) at mild temperature (40-50 °C) combined with a cascading membrane operation, yielding a collection of lignin fractions (from oligomeric down to mixture of tri-, di- and monomeric units) with distinct molecular weight distribution, low polydispersity and favourable physicochemical properties. The alkaline process conditions ensure the high processibility of crude lignin in an aqueous environment and the efficiency of the enzyme, yielding better compatibility of lignin towards targeted applications. The application of a selected lignin fraction produced by METNIN™ as a suitable lignopolyol to completely replace a commercial polyol in polyurethane rigid foam formulations is presented as a prototype. Liquid lignopolyols with a high lignin content were prepared by oxypropylation and their full utilization in the polyurethane rigid foam formulation was successfully demonstrated. Moreover, selected technical specifications of different foam demonstrators were determined, including closed cell count, water uptake and compression characteristics. These specifications are within industrial standards for rigid foam applications. The lignin loading in the lignopolyol was a major factor determining the properties of the foam. In addition to polyurethane foam demonstrators, other examples of lignin-based products related to resins and sizing applications will be presented.

Keywords : enzyme, lignin valorisation, polyol, polyurethane foam
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