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A Glance at Biobased and Sustainable Aromatic Polymers for Coatings and Binders

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Abstract

Polymers hold a very important place in chemistry with a worldwide production of about 400Mt in 2020 and applications in all economic sectors, from basic materials for construction or furniture, to the cutting-edge sectors of aerospace or construction and health. Thus, half of the molecules produced by the petrochemical industry - foremost among which is ethylene (160 Mt/year) - are ultimately found in polymers. Green Chemistry, owing to the concept proposed in 1998 by Anastas et al.1, is a chemistry response to the challenges of reducing the environmental impact of our society. This remarkable place of polymers in chemistry is found naturally in green chemistry, and essentially through the use of renewable resources for the development of agro-resourced or bio-sourced polymers.

The objective of using renewable resources is not only motivated by the reduction of dependence on fossil resources and consequently of greenhouse gas emissions at the end of life, but also by the search for new features. Likewise, the reduction of impacts, in particular through the use of less hazardous monomers, is a strong driver for the development of renewable resources.

Among renewable resources, our team has studied the use of vegetable oils for the development of monomers and polymers. In order to improve the thermomechanical properties of polymers from renewable resources, we have also functionalized natural phenols2, such as tannins, vanillin3, eugenol or cardanol to develop various polymers, phenolics, polyepoxides, polyacrylates or polyurethanes. Polyurethane is currently one of the most commonly used polymers in the world for various applications such as rigid and flexible foams, coatings, elastomers, adhesives and sealants. However, isocyanate precursors are very harmful. Thus, in recent years, much research work has been carried out for the design of isocyanate-free polyurethanes (NIPU) s resulting from the reaction between five-membered cyclic carbonates and amines leading to polyhydroxyurethanes (PHU). However, this reaction has a drawback: the low reactivity of the aminolysis of the cyclic carbonate. Our work first made it possible to propose complete reactivity studies in order to determine the influence of the structure of the reactants4. Second, we proposed innovative solutions to allow the development at room temperature of a range of PHUs materials, foams and PHU-hybrids (epoxy, acrylate, silicone, etc.) with increased adhesion properties to meet the properties thermo-mechanics required by potential applications.

References:

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