An overview of the role of ligno-nanocellulosics in the biorefinery concept

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Several industrial sectors are constantly seeking alternatives for reducing the world's demand and dependence of petroleum-based products, thus decreasing environmental impact and maximizing the usage of resources. Due to its availability and composition, lignocellulosic biomass is one of the main candidates to be used as raw material for such replacement, as a renewable alternative for the production of bio- chemicals, fuels and products. This does not only add value to- but also decreases the carbon footprint of both, raw lignocellulosics and final materials. Based on the concept of the traditional refining of petroleum, efforts on the development of an integrated biorefinery concept are the main focus of several research groups around the world. With the target of improving to its maximum the profitability of each of the biomass streams, production of nanocellulose is gaining increased attention, since it is a versatile material with superior properties that can increase the application range of lignocellulosic materials.
Obtained by mechanical fibrillation of wood pulps, traditionally by refining, homogenization or a combination of both, the manufacture of cellulose nanofibrils (CNF) usually involves either chemical or enzymatic pre-treatment. Processing method as well as composition of the raw materials, dominate the properties of the CNF suspensions and their effect in the final product. As for the versatility of nanocellulose, they can be produced from a number of lignocellulosic materials, including agroindustrial residues, making a great addition to the value chain of commodities like sugar, ethanol production, among others.
Among its remarkable properties, CNF present high aspect ratio and large surface area with an enhanced hydrogen-bonding capability that allows the formation of strong gels at rather low solid contents (around 2%); while this property can be advantageous in applications such as aerogels, processing and transporting large volumes or water can suppose a major drawback in many cases, limiting the end-use applications of CNF. CNF suspensions also maintain this strong network held after drying forming strong films with high barrier properties against oxygen.

In this contribution, an overview of production of CNF obtained from different raw materials is discussed in terms of properties of suspensions and end-products. The utilization of unbleached cellulose pulps as source for CNF production will be discussed, as well as the impact of the remaining lignin on the CNF final properties. Additionally, an overview of applications of CNF will be presented, with an emphasis in large-scale CNF film production and films properties.

References

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