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Catalytic oxidation of lignin into aromatic compounds using CuO/TiO2

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PURPOSE OF THE ABSTRACT

The current situation of resources depletion and increasing pollution has increased the research in the fields of biomass and lignin valorisation. Lignin is produced in large quantity in the paper industry that makes it an interesting alternative resource for producing new high added-value molecules. Several interesting compounds can be produced from lignin, mainly aromatics since it is the only biopolymer composed by aromatic monomeric units. In this work, a heterogeneous copper-based catalyst has been used to optimize lignin oxidative depolymerization to maximize aromatic yields.

Technical lignins obtained from different biomasses have been studied. They includes Softwood (Resinous and Pine), Hardwood (Eucalyptus) and Wheat straw. Lignins were extracted by several methods as Kraft, Organosolv and Soda processes. Catalytic oxidizing depolymerisation were conducted in alkaline conditions in the presence of heterogeneous copper-based catalyst. The reaction conditions were stated to 150°C, 20 Bar of air and 1800 rpm. 5%CuO/TiO2 has been used as catalyst. Three main fractions have been obtained from this process: the residual lignin that exhibit various chemical modifications, an aromatic fraction mainly composed by vanillin, acetovanillone and syringaldehyde, and an aliphatic fraction mainly composed by succinic, oxalic and acetic acids.

The catalyst have been synthetized by incipient wetness impregnation, and calcined at 650°C. Vanillin is one of the main aromatic compounds produced. Using CuO/TiO2 catalyst helped to increase the vanillin production from 3 to 5%. A maximal vanillin production was reached after 30 minutes of reaction time. Hardwood and Wheat straw lignins show higher degrees of oxidation producing an important amount of aliphatic fraction (68-55%) compared to softwood lignins (33-46%). Despite higher transformation, the aromatic fraction ratio was not increased. As expected from these biomasses, it showed an important quantity of syringaldehyde. Next, we observed that the extraction method played also an important role. As an example, for Wheat straw, Organosolv extraction led to increased aliphatic fraction ratio with reduced quantity of aromatics compared to Soda process. Similar observations comparing Kraft and Organosolv processes were made. The reaction conditions are being optimized to maximize the aromatic production. All the results will be presented and discussed in more detail.

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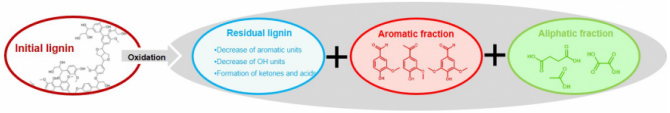
FIGURES



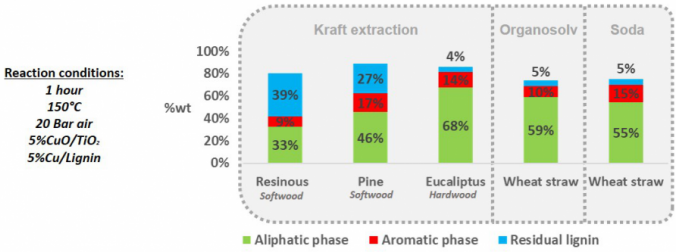


FIGURE 1
Concept of the Phenoliq project

FIGURE 2
Products fractionation after oxidative depolymerization of technical lignins
Catalyst CuO/TiO2, 150°C, 60 min, 20 bar air.

KEYWORDS
Technical lignin | Oxidation reaction | Copper catalyst | biosourced phenols

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