

N°747 / PC

TOPIC(s) : Biomass conversion / Homogenous, heterogenous and biocatalysis

Pretreatments, fractionation and upgrading of lignocellulosic biomass to the platform and added value chemicals

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## PURPOSE OF THE ABSTRACT

The largest contribution to emissions of carbon dioxide, air pollution, and acid rain has petroleum usage. Lignocellulosic (LC) biomass is considered to be a sustainable and low-cost alternative resource that can be converted into fuels and chemicals on a large scale. In order to develop an efficient process, the lignocellulosic biomass needs to be firstly fractionated into its main constituents, e.g. lignin, cellulose, and hemicellulose. Pretreatments and fractionation are essential steps in the overall conversion of LC biomass to biofuel or bio-based products, presented in Figure 1 [1].

Flavonoids are one of the extractives from lignocellulose biomass. They can be used in food and pharmaceutical industry, hence to their antioxidant activity. The multi-step process consists of efficient separation, isolation and purification methods. The main step, extraction, can be performed as a classic (water, organic solvent), green (supercritical, deep eutectic solvents) or physical-mechanical assisted (ultrasound, microwave) extraction.

Hemicellulose can be hydrolyzed into monomers, one of them is xylose, which can be further dehydroxylated into furfural, furfuryl alcohol, and levulinic acid, being important platform chemicals. HDO (hydrodeoxygenation) of levulinic acid was studied in a three-phase batch reactor over the solid catalyst (NiMo/?-Al<sub>2</sub>O<sub>3</sub>) in the presence of hydrogen at high pressure in a gaseous phase. A detailed microkinetic model was developed for HDO of levulinic acid [2].

Cellulose can be efficiently converted into its monomer units (glucose units) through the hydrolysis process. Glucose is a biobased precursor to added value products, such as glucaric acid, 5-HMF (hydroxymethylfurfural), levulinic acid, sorbitol, etc, over different heterogeneous or homogeneous catalysts in the neutral, oxidizing or reducing gaseous atmosphere. For example, glucose can be oxidized to the glucaric acid (which is aldaric acid) and further dehydroxylated to adipic acid, which is one of the most important platform chemicals, used mainly for the production of nylon 6,6. This process (HDO of glucaric acid) was studied in the aqueous conditions over a transition or noble metals on acidic or neutral supports, yielding in many partially or completely deoxygenated products of C<sub>3</sub> ? C<sub>6</sub> chain length. A detailed microkinetic model was previously developed for glucose based model compounds (C<sub>6</sub> chain length) with only one functional group (carboxylic acid, a primary or secondary alcohol group, ketones, aldehyde, esters, and ether) [3,4].

Lignin is considered a very promising renewable and sustainable feedstock for chemicals production due to its aromatic highly functionalized structure and abundance. Lignin conversion into value-added chemicals involves three steps: isolation, depolymerization, and upgrading of obtained platform chemicals. Lignin isolation is the crucial one as it defines the structure and reactivity of isolated lignin. The organosolv process is recognized as one of the most environmentally friendly for biomass fractionation which provides 'closer-to-native' lignin structure, i.e. preserves more ether bonds. Therefore several model compounds of lignin have also been undergone to organosolv treatment in order to investigate the influence of solvent, lignin functionalities and

operating conditions on the course and rate of typical lignin bonds cleavage. Additionally, HDO of lignin monomer and dimer model compounds have been performed over various noble and non-noble metal catalysts supported on neutral and acidic supports. A micro-kinetic model was developed and applied for the determination of kinetic parameters (adsorption/desorption/reaction constants and activation energies). Further, a contribution of both considered active sites (metallic and acidic) to the catalytic activity was estimated [5,6].

## FIGURES

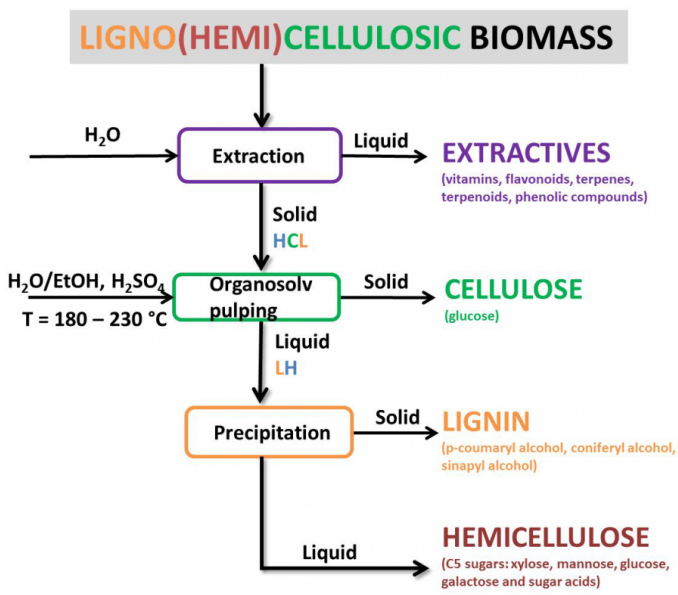


FIGURE 1

Figure 1  
LC biomass fractionation.

FIGURE 2

## KEYWORDS

Lignocellulosic biomass | Fractionation | Upgrading | Added value chemicals

## BIBLIOGRAPHY