**Validation of High Lignin Content Biomass Using Supercritical Water Technology.**

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**Highlights**

* Selective valorization of high content lignin biomass
* Transformation to lignin-cellulose composites
* Transformation of carbohydrate to sugars with a yield of 88%

**1. Introduction**

Lignocellulosic biomass is the most abundant and easily grown biomass form. Being composed of three main biopolymers, cellulose, hemicellulose and lignin, it presents a great source of a wide range of chemicals.

SCWH is recognized as a potential hydrolysis technique to decompose lignocellulosic materials due to its properties, low viscosity and high diffusely that facilitate penetration of water into complex biomass matrix, while its low dielectric constant similar to non-polar organic solvents enhances solubility of organic compounds1. This technique can be used as a pre-treatment for the selective fractionation of cellulose, hemicellulose and lignin or as a reaction medium to directly hydrolyse the polymers into its constituent2.

Defatted grape seed is composed of more than 50% of lignin vs 15% of carbohydrates and thus potential feedstock for lignin and aromatic components contained in lignin structure.

**2. Methods**

Ultra-Fast Supercritical Water Hydrolysis

For biomass fractionation continues pilot plant with a sudden expansion micro reactor was used. The grape seed suspension was pumped up to 26 MPa and instantaneously heated to 385 ºC by mixing it with a SCW stream. The reaction is stopped by depressurizing the product through a high temperature needle valve and therefore instantaneously cooled down. The reaction time was adjusted in the range of 0.16s to 0.65s just by changing the length or the reactor and biomass and water flow.

Analysis

To determine the composition of the raw material and samples Laboratory Analytical Procedure (LAP) from NREL was followed. The analysis used to determine sugar and sugar degradation products is HPLC. The carbon content is determined by Total organic carbon and Elemental Analysis. Gel Permeation Chromatography is used for molecular weight distribution. FTIR and NMR analysis are used to understand the changes in sample structure.

**3. Results and discussion**

Amount of lignin in solid phase increases with the reaction time (Figure 1.) due to hydrolysis of labile fractions, which is also followed with a decrease of sugars in the solid phase and high yield in the liquid phase (Figure 2.). For reaction time 0.32 s the amount of lignin slightly decreases compared with lower reaction time and this could be the possible time point of lignin hydrolysis. Higher reaction time increase the content of lignin that can be due to lignin repolymerization. This behavior is supported by the sugar yield in the liquid phase. For the reaction time of 0.16 s the yield of sugar in the liquid phase is already high and reach 57%. Further increase in reaction time leads just to a slight increase in sugar yield as the main amount has been already consumed. After 0.32 s the yield of sugar again increases as the new amount of sugars inside the biomass matrix is more available. This is followed by an increase of degradation products during the reaction.

 *Figure 1. Composition of solid phase Figure 2. Sugar yield in liquid phase*

**4. Conclusions**

The results of biomass fractionation in SCW show a slight decrease of lignin content in the solid phase at 0.32 s followed with increased sugar yield in the liquid phase that could be due to the lignin hydrolysis and higher availability of sugars at this time. High lignin content in raw material suggests that this biomass could be a great source for aromatic products derived from lignin degradation where more analysis is required in order to determine those products in the liquid phase, while the solid residue could be valorized as lignin-cellulose composites.

**References**

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