**Lignin fractionation by means of organic solvents.**

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**Highlights**

* Efficient fractionation method with organic solvents widely used in industry and with low boiling point
* Obtaining of different molecular weight fractions
* Lignin fractionated with different structure and properties

**1. Introduction**

In current times, the utilization of materials from renewable resources has been severely promoted, as well as the revalorization of industrial wastes for the production of high added value materials. Therefore, biorefineries of lignocellulosic materials are key not only for the pollution reduction, but also for the sustainable development, being the means of obtaining fuels, chemicals and renewable materials[1]. For all these reasons, it can be predicted that all the main components of biomass (lignin, hemicellulose and cellulose) will significantly contribute to the global bioeconomy[2].

Lignin is one of the most interesting components of lignocellulosic materials. It is the most abundant aromatic compound on earth as well as having high availability and low price. However, it has great heterogeneity, and its properties, linked with composition and structure, also vary. Consequently, its uses are limited and in order to incorporate lignin in added value applications, its fractionation is an essential requirement to be used as feedstock in the industry[3].

One of the most promising methods is the use of organic solvents. This method allows separating lignin in different fractions to obtain fractions with specific properties by the successive utilization of different organic solvents. Apart from that, it was also taken in consideration the fact that these organic solvents were environmentally friendly and they could be bio-derived[4]. Therefore, the main objective of this work was to study the fractionation of industrial kraft lignin, as well as organosolv lignin, to separate it in more homogeneous fractions and characterize their structure and composition.

**2. Methods**

The fractionation was conducted using two types of lignin, kraft (from local industrial waste) and organosolv (commercial provided by *chemicalpoint*). They were dissolved firstly in ethyl acetate, the organic solvent with the lowest capacity to dissolve lignin. The insoluble fraction was obtained by filtration whilst the soluble fraction (F1) was obtained by rotavaporation of the solvent. The next step was followed with the insoluble fraction with the next solvent with the lowest solubility, ethanol. The same procedure was followed, except for the fact that the soluble fraction (F2) was obtained by precipitation with acidified water. The sequence was finished after using acetone and methanol, respectively, to obtain the two remaining fractions (F3 and F4).

The obtained fractions were analyzed to determine their structural and thermal properties. Gel Permeation Chromatography (GPC) was conducted to know the molecular weight of both lignins and their fractions. Fourier Transformed Infrared was also performed, as well as the spectrophotometric method of Folin-Ciocalteau to calculate the total phenolic content, Py-GC-MS to identify the main components, and the glass transition temperature and thermal stability were determined.

**3. Results and discussion**



 **Figure 1.** Schematic representation of the fractionation process and summary of the results obtained.

Although the kraft and the organosolv lignin have different characteristic, the same tendency could be observed during the fractionation process, obtaining molecules of the smallest molecular weights first and the biggest ones last.

It can also be observed the influence of the fractionation in the total phenolic content, since the molecules with the smallest weight had the largest phenolic content. From the pyrolysis analysis it was noticed that the purity increased after the fractionation method and that he first fractions (F1 and F2) contained a higher syringil derived components quantity.

**4. Conclusions**

It can be concluded that the fractionation method is efficient. First of all, it could be observed that the molecular weights of the fractions increased along the solubility parameter of the organic solvent used. Moreover, the content of phenolic hydroxyl groups diminished, which leads to an increase in the content of condensed compounds.

**References [Calibri 10]**

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