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Publication date:
2015

GPE – 4th International Congress on Green Process Engineering
7-10 April 2014 – Sevilla (Spain)

LIGNIN VALORIZATION BY HETEROGENEOUS CATALYTIC OXIDATION

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Key-words. lignin, green chemistry, biomass, heterogeneous catalysis, oxidation

Many different technologies to convert biomass into high-value products and fuels in "bio-refineries" have been proposed in the literature to meet present and approaching future challenges such as, global warming, high oil prices and food shortage. In this context, special attention is giving to the conversion of lignocellulosic biomass, which does not compete with food resources and is widely available as a low cost feedstock. Lignocellulose biomass is composed of three main fractions; cellulose (40-50 wt.%), hemicellulose (25-35 wt.%) and lignin (20-30 wt.%). Lignin represents 40% of the energy content of lignocellulosic biomass, and it is the obvious candidate to serve as an available feedstock for the production of basic aromatic chemicals [1].

In green plants the molecular weight and amount of lignin differ, but it is mainly composed of three different monolignol monomers: *p*-coumaryl, coniferyl and sinapyl alcohol [2]. These monomers are connected with various linkages with the most common one being the β-O-4 linkage (Figure 1) [3].

The lignin structure is complex so different model compounds are often used to study lignin valorization. These model compounds contain the linkages present in lignin, simplifying catalytic analysis and present analytical challenges related to the study of the complicated lignin polymer and the plethora of products that could be obtained [2].

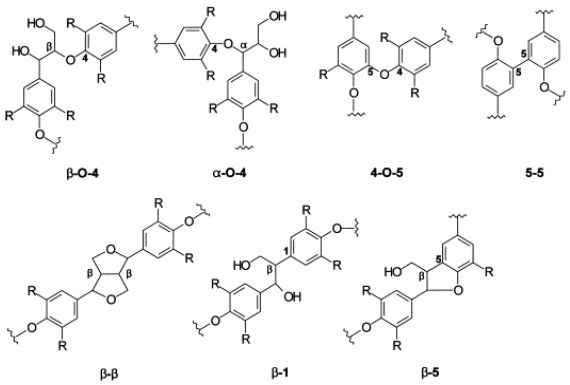

Figure 1. Linkages present in lignin.

For valorization of lignin (and model compounds) heterogeneous oxidative catalysis plays an important role due to the industrial viability of such systems [4]. Lange et al. have reported that the catalytic oxidation products of lignin and lignin model compounds can range from aromatic aldehydes to carboxylic acid originating from oxidation of side chains depending on the reaction conditions [5].

In this work, we have examined the oxidative conversion of several lignin model compounds using numerous heterogeneous catalysts and oxygen as oxidant.

REFERENCES

[1] P.T. Patil, U. Armbruster et al., Energy Fuels, 25 (2011) 4713.
[2] J. Zakzeski, P.C.A Bruijnincx et al., Chem Rev, 110 (2010) 3552
[3] P. T. Patil et al., Energy Fuels, 25 (2011) 4713
[4] Q. Xiang, Y.Y. Lee, Appl. Biochem. Biotechnol., 153 (2000) 84
[5] H. Lange et al., Eur. Polymer J., 49 (2013) 1151