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## LIGNIN DEPOLYMERISATION IN SUPERCRITICAL SOLVENT

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### Introduction

Valorisation of lignin plays a key role in the further integration of biorefinery processes in the pulp and paper industry and for the production of biofuels and biobased materials from lignocellulosic biomass. Today's increased demand for alternatives to fossil based products, such as the production of transportation biofuels and bulk chemicals, increases the interest and the need to improve the techno-economic value of unconverted lignin fraction. Conversion of lignin into chemical feedstocks will positively influence the economic feasibility of a biorefinery resulting in an expected decrease of the production costs of cellulose bio-ethanol and biobased products. In this study organosolv lignin is depolymerised under supercritical process conditions into aromatic phenolic compounds. Supercritical carbon dioxide was selected as the main solvent because of its non-toxic character, industrial experience, good solubility for phenols and easy down-stream processing potential.

### Experimental set-up

Conversion of lignin to aromatic compounds was studied under supercritical process conditions in carbon dioxide based solvents. By introducing solubilised organosolv lignin in a pre-heated reactor at 300-370 °C and 100-300 bar lignin was partly converted to monomeric phenols. During the process the aromatics were recovered by pressure release and subsequent relieve of carbon dioxide. Formic acid was used as acidic catalyst and hydrogen donor to favour formation of stable aromatics. Product characterisation was performed by GC-MS, elemental analysis, FT-IR and Py-GC-MS.

### Results and Discussion

Organosolv hardwood lignin was converted to a total yield of identified aromatic compounds of 10% based on dry lignin. Formic acid increases the yield of aromatics from 7% to 10%. Main monomeric lignin derived products were 2,6-dimethoxyphenol, 4-hydroxy,3,5dimethoxybenzoic acid, 2-methoxy-4-methylphenol and 2-methoxyphenol. During this process a strong competition occurs between depolymerisation of lignin and recondensation of fragments. This leads to a residual lignin fraction representing 40% of the starting material consisting of a substantially reduced oxygen content, improved thermal stability properties and a similar structure to carbon black.

### Conclusions

In supercritical carbon dioxide based solvent hardwood organosolv lignin was converted to 10% identified monomeric aromatic compounds by using formic acid as a catalyst. Further work is needed to improve the overall conversion of lignin to valuable products.

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