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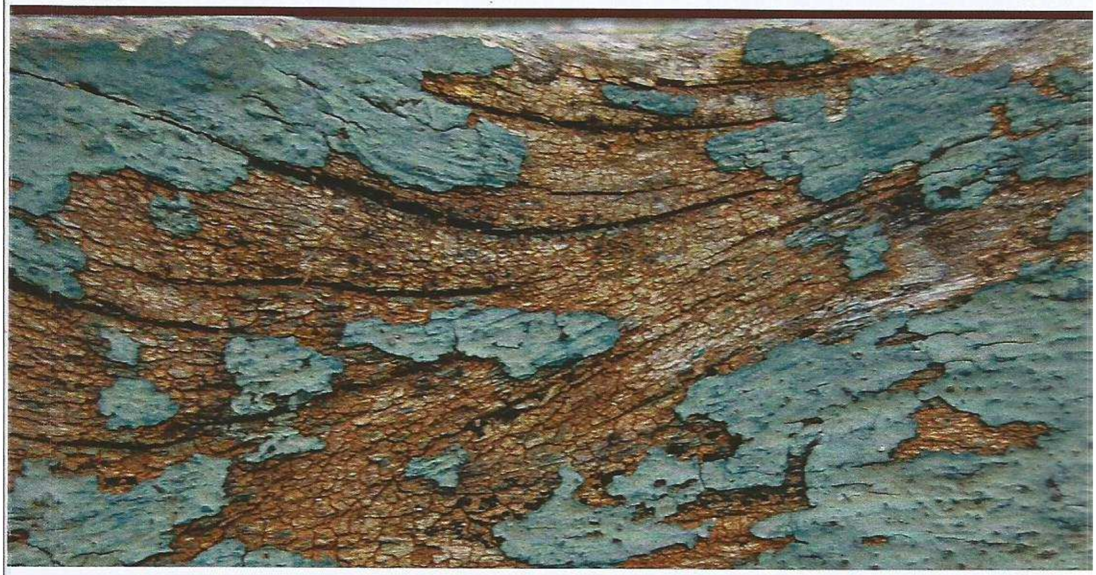
COST Action FP1407 2nd Conference



Innovative production technologies and increased wood products recycling and reuse

Brno, Czech Republic
29 – 30th September 2016

Editors: Andreja Kutnar, Matthew Schwarzkopf, Michael Burnard, Václav Sebera, Eva Troppová

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COST Action FP1407

Understanding wood modification through an integrated scientific and environmental impact approach (ModWoodLife)

Innovative production technologies and increased wood products recycling and reuse

Second COST Action FP1407 International Conference
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Poster Session

LIQUEFACTION OF CRAFT LIGNIN USING DIFFERENT SOLVENTS

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Pulp and kraft paper accounts for about 80 % of the world paper market. As a result, a tremendous amount of black liquor is produced as a waste product of the process. Some chemicals and dissolved lignin are present in the liquor which are in part burned to generate power.

As a natural, aromatic biopolymer, lignin has a tridimensional structure with various functional groups. Among them are phenolic compounds that make lignin a strong candidate to replace petrochemical-based polyols. However, due to the complex structure of lignin it has a low reactivity [1], requiring modification to make it more reactive.

Liquefaction is a thermochemical conversion technique in which lignin is directly converted into a black liquid which is more reactive and can be used as a replacement of fossil-based polyols (e.g. phenolic resin) used in synthesis.

In this study, kraft lignin was precipitated by acidification with sulfuric acid at pH 6 and used without further modification. Polyethylene glycol (PEG) and glycerol (G), or ethylene glycol (EG) and G were using as liquefaction solvents in a solvent:solvent ratio of 80:20 or 90:10 for both combinations of solvents. Liquefaction was carried out putting an appropriate amount of combined solvents in a flask under reflux and heated to 160 °C. Then, 15 % of lignin was added and reacted for 1 h. The influence of different organic solvents, different ratios, liquefaction yield, and the hydroxyl number of the liquefied lignin were investigated.

The results showed that the lowest yield occurred with PEG + G with a ratio of 90:10 and the lowest hydroxyl number was obtained with PEG + G in both ratios (80:20 and 90:10).

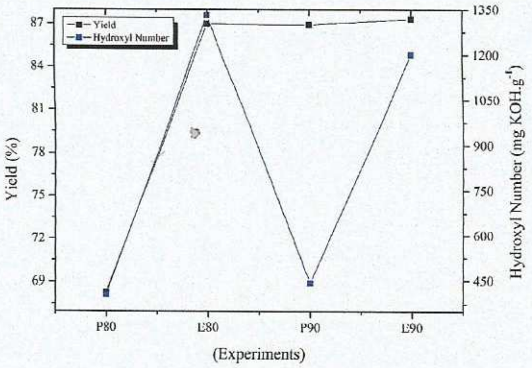

Figure 1: Liquefied lignin with different solvents and solvent ratios. Reaction conditions are 15 % lignin relation solvents, without catalyst, at 160 °C to 60 min.

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[1] Doherty W O S, Mousavioun P, Fellows CM (2011) Value-adding to cellulosic ethanol: Lignin polymers. Industrial Crops and Products 33(2): 259-276.

LIQUEFACTION OF KRAFT LIGNIN USING DIFFERENT SOLVENTS

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Introduction

Lignin is a natural aromatic biopolymer more abundant with various functional groups in its structure. Among them, phenolic compounds that make of lignin a strong candidate to replace petrochemical-based polyols. However, due to the complex structure of lignin has a low reactivity so that some modifications are necessary to make it more reactive.

In this study the kraft lignin was thermochemically converted by liquefaction under reflux in a black liquid much more reactive which can be used without further alterations in the replacement of fossil-based polyols in synthesis such as phenolic resin. Yield, hydroxyl number, viscosity and pH of liquefied lignins were analysed.

Materials and methods

Polyethylene glycol (PEG) or ethylene glycol (EG) and glycerol (G) were using as liquefaction solvents in solvent:solvent (PEG:G or EG:G) ratio to 80:20 or 90:10. The liquefaction was carried out with an appropriate amount of combined solvents and 15% of lignin in a flask under reflux and heating at 160 °C with control temperature for 1h. After cooling in water bath with ice, the liquefied lignin was washed with acetone and filtered under vacumm. Acetone was removed using a rotary evaporator. Yield, hydroxyl number (ASTM D4274), viscosity and pH of liquefied lignins were analysed.

Results and discussion

The influence of different polyhydric alcohols solvents, and different ratios, in the properties of liquefied lignins are shown in Fig 1 and Table 1. The lowest yield was verified in P80 (PEG:G=80:20) and the highest in E90 (EG:G=90:10) with 82.31 and 87.35% respectively (Fig 1).

The hydroxyl number was affected by type of solvent, showing the lowest values with P80 and P90 with 280.12 and 442.65 mg $KOH.g^{-1}$ (Fig 1).

In Table 1 we observe that the polyols with EG:G have the lowest viscosity values than those with PEG:G. However, the different solvents and the different ratios didn't had influence on the pH of the polyols that shown values around 5.

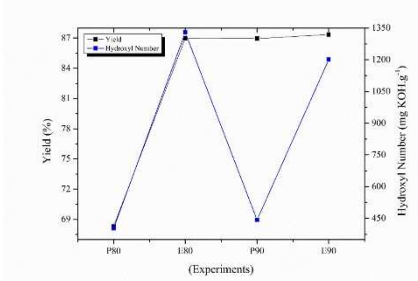

Figure 1: Liquefied lignins with different solvents and different ratio. Reaction conditions are 15 wt% of lignin in relation solvents, without catalyst, at 160 °C to 60 min.

Table 1: Effect of different solvents and ratio in the viscosity and pH of liquefied lignin.

SAMPLE	VISCOSITY (mPa.s)	pH
P80	102.9	5.6
E80	20.4	5.01
P90	88.1	5.82
E90	19.7	4.92

Conclusion

Liquefied lignins with PEG:G as solvents have the lowest values of yield and hydroxyl number and higher viscosity tha those with EG:G.

The solvent:solvent ratio has more influence on e yield and viscosity.

The type of solvent or the ratio had influence on the pH of the liquefied lignins.

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