Performance of a surface coating made from liquefied wood

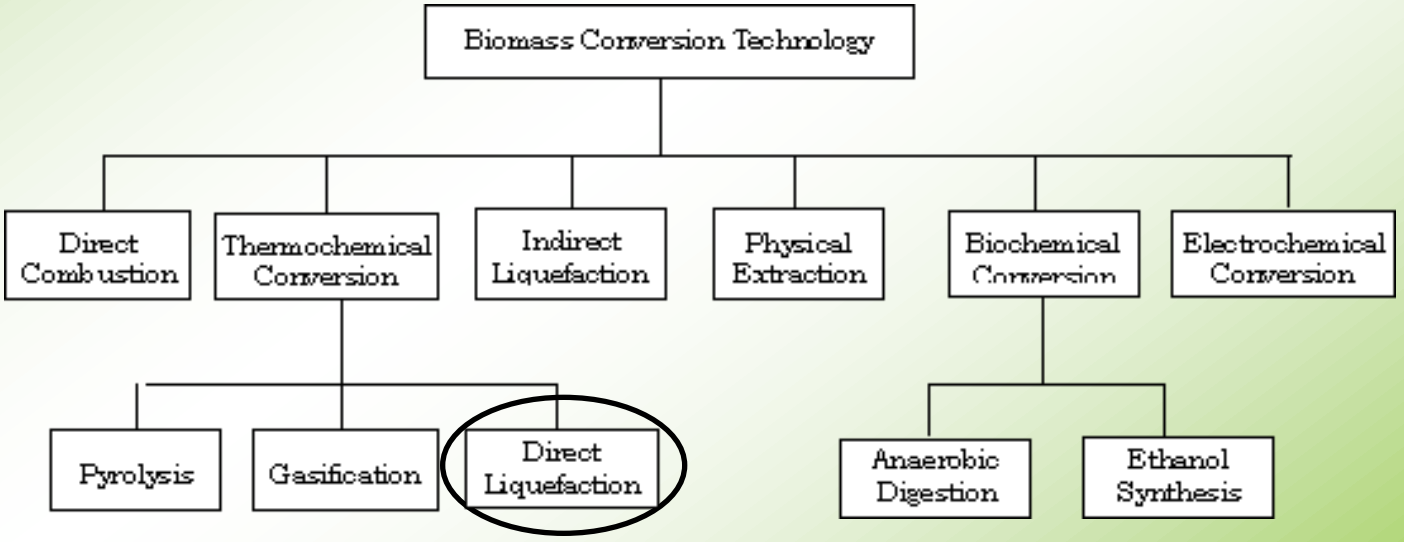
Franc Budija

Institute of Wood Science and Technology, and Sustainable Development, Celovška cesta 268, 1000 Ljubljana, Slovenia, E-mail: franc.budija@iltra.si,

INTRODUCTION

- ***WOOD BIOMASS CONVERSION POSSIBILITIES***

•Biomass can be treated thermo chemically, chemically or biochemically (Küçük and Demirbas, 1997).
•Thermochemical techniques of conversion are nowadays the most commonly used and can be further divided into gasification, pyrolysis and direct liquefaction (Zhong and Wei, 2004).



Picture 1: Classification of biomass conversion technologies.

INTRODUCTION

•What is wood liquefaction?

- ***Powerful technique for transformation of all wood polymers into a liquid stage.***

•What we need for successful wood liquefaction reaction?

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Sulphuric Acid 98%

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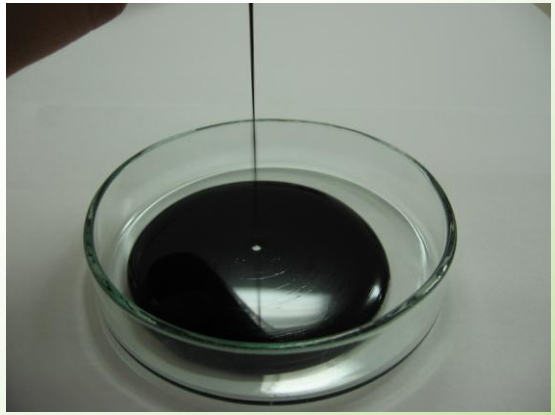
180 °C, 90 min,



+ S. P.

- ***Solvolytic reagents for wood liquefaction could be:***

- ***Phenols***
- ***Cyclic carbonates***
- ***Ionic liquids***
- ***Dibasic esters***
- ***Alcohols***

INTRODUCTION

- ***The use of liquefied wood prepared by the alcohol liquefaction system is manly limited to:***

- ***epoxy resins (Asano et al., 2007; Kobayashi et al., 2000)***

- ***polyurethane polymers (Alma and Shiraishi, 1998; Kurimoto et al., 2000; Kurimoto et al., 2001; Yao et al., 1996).***

- ***All this polymers are multicomponent systems, where liquefied wood is served only as a one component.***

THE AIM OF THIS STUDY WAS:

- ***to characterize the discovered self-crosslinked surface coating.***

MATERIALS AND METHODS

HOW WE PREPARE A SELF-CROSSLINKED COATING

The liquefied wood was prepared at optimal conditions:

- spruce wood : glycerol = 1 : 3, 180°C, 90 min

- A thin film was applied to an aluminium foil and on a spruce wood sample
- Both samples was exposed to drying in a laboratory oven (130°C, 24 h).
- Tesaroll aqua email, Helios, was used as control coating.

INVESTIGATION OF PHISICAL AND CHEMICAL PROPERTIES

- (FT-IR) was used to determine if the film formation from the liquid liquefied wood was just a physical process or there were some chemical reactions involved in the curing process.

ASSESSMENT OF SURFACE RESISTANCE TO COLD LIQUIDS

• According to the SIST EN 12720:97 standard we exposed the coated surfaces of the Systems 1 and 2 to various liquids (Table 1) like:

Liquid	**Time**
Tap water	24 hours
Oil	24 hours
Coffee	1 hour
Ethanol (48 %)	1 hour
Acetone	2 min

FLEXIBILITY

• Flexibility was determined on both coating systems according to DIN 53 155:1971

MEASUREMENTS OF CONTACT ANGLES OF WATER

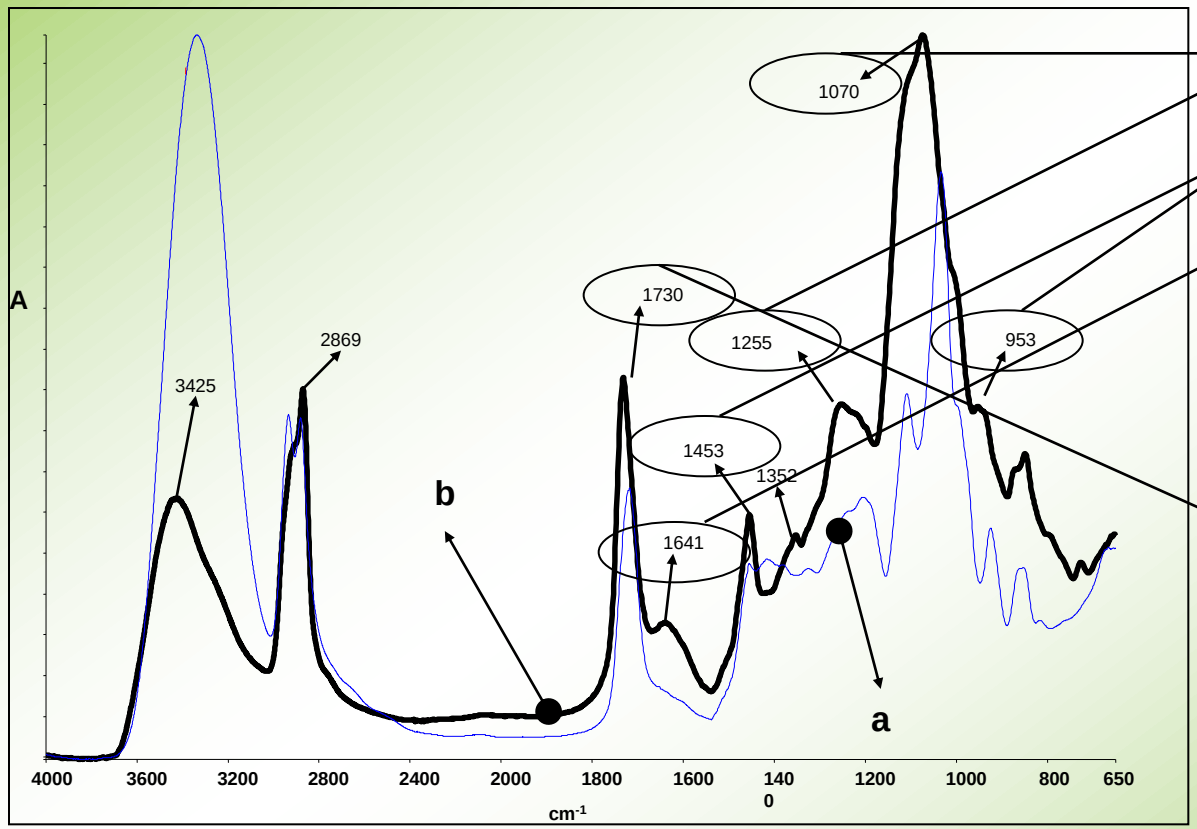
•Sessile drop technique was used to determine the hydrophobic/hydrophilic properties of the surface coatings System 1 and on System 2.
•For each system, there were 20 replications

Measurements of gloss

Gloss of the coating Systems 1 and 2 was measured with the ERICHSEN Glossmaster according to SIST EN ISO 2813. The angle of rays was set at 60˚. Ten measurements were performed parallel to the grain direction.

RESULTS AND DISSCUSION

FT–IR spectra



C-O ether vibrations

C–H deformations

C=C stretch

carbonyl (C=O) stretch in unconjugated ketone, ester, or carboxylic groups

Picture 3: FT-IR spectra of the liquid liquefied spruce wood (spectrum a) and of the cured film of the liquefied spruce wood (spectrum b)

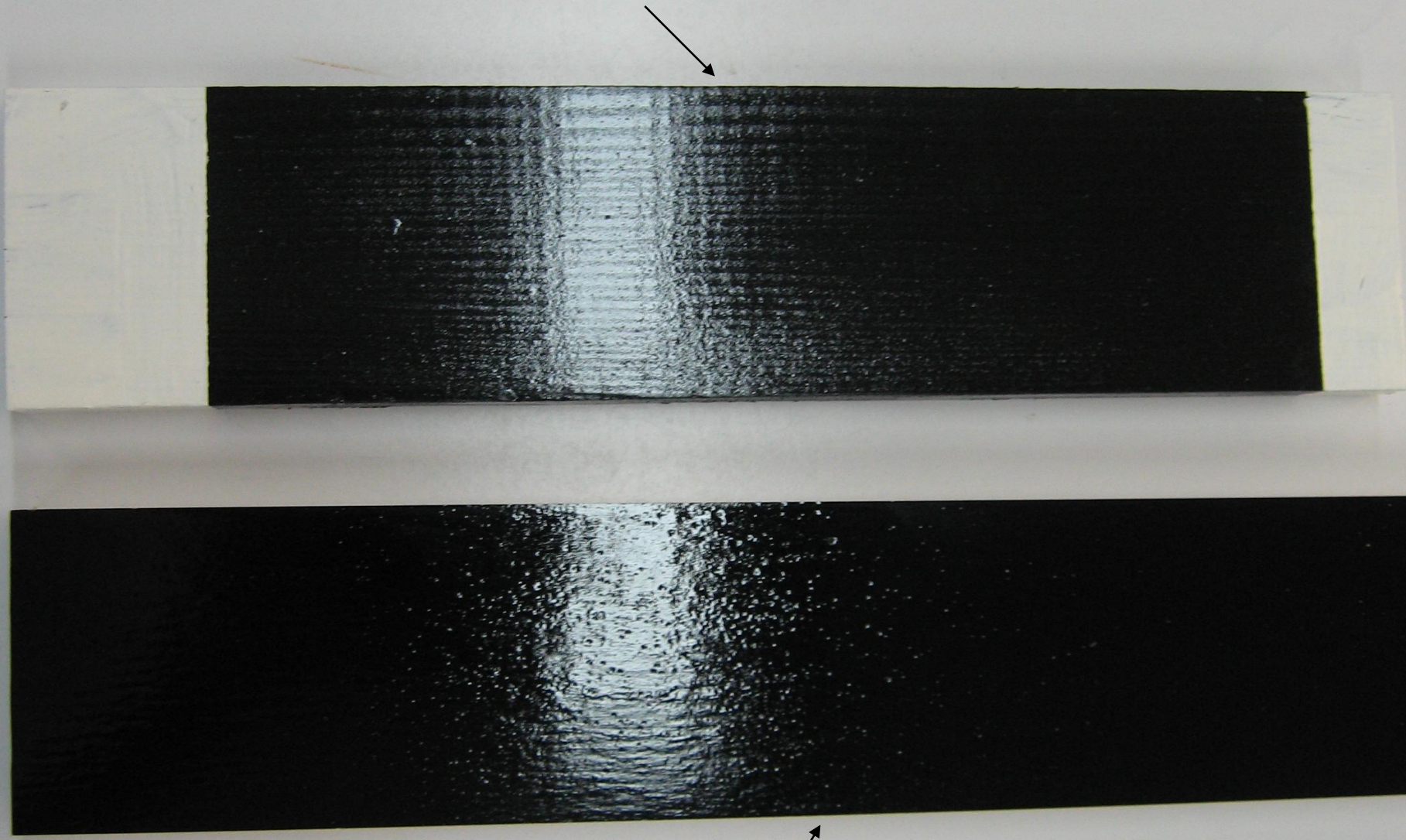
IT IS BELIEVED THAT THUSLY CREATED NEW BIOMATERIAL COULD BE A POLY ETHER KETONE NETWORK

RESULTS AND DISSCUSION

- ***Assessment of surface resistance to cold liquids and measurements of contact angles of water***

Table 2: Average assessments of the resistance of the coating Systems 1 and 2 against various agents, and their gloss and flexibility

REAGENT	EXPOSURE TIME	LW Coating		CONTROL		
		Day light	Dark chamber	Day light	Dark chamber	
TAP WATER	24 HOURS	5	5	5	5	
OIL	24 HOURS	5	5	5	5	NO DIFFERENCES
COFFEE	1 HOUR	5	5	5	5	
ALCOHOL (48 %)	1 HOUR	5	5	3	3	
ACETONE	2 MIN	5	5	4/3	4/3	BETTER
AVERAGE GLOSS (/)		85		50		
AVERAGE CONTACT ANGLE ( )		70.4		84.9		POORER
FLEXIBILITY		1.3		1.1		


TESAROLL EMAIL
CURED LIQUEFIED WOOD

CONCLUSIONS

•The results in this study show that it is possible to liquefy spruce wood in the glycerol solvent and use it as a protective wood coating.

• A self-crosslinking ability of the liquefied spruce wood at elevated temperature was discovered and confirmed with FT-IR investigations.

• FT-IR spectra of the self-crosslinked film indicated that the film formation process was a chemical reaction.

•The coating from liquefied wood had high gloss and superior resistance against cold liquids. Only the average contact angle of water was lower and its flexibility was poorer.

•As you can see my research ideally fits within the scope of the three FP7 calls for proposals where we are seeking the opportunity to cooperate.

Thank you for your attention !