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Influence of pre-treatment on grass pyrolysis for high value products

Chiara Barbiero

Western University, Canada, cbarbier@uwo.ca

Charles Greenhalf

Western University

Franco Berruti

Western University, Canada

Cedric Briens

Western University, Canada

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Influence of pre-treatment on grass pyrolysis for high value products

Chiara Barbiero, Charles Greenhalf, Franco Berruti, Cedric Briens

Institute for Chemicals and Fuels
from Alternative Resources
Western University

The logo for the Institute for Chemicals and Fuels from Alternative Resources (i cfar) features a stylized flame icon in orange and green to the left of the lowercase text 'i cfar'.

Western 

The logo for Réseau Biofuelnet Canada features a stylized leaf icon in green and orange to the left of the text 'RÉSEAU BIOFUELNET CANADA'.

RÉSEAU
BIOFUELNET
CANADA

Major Biomass components:

Cellulose glucose polymer

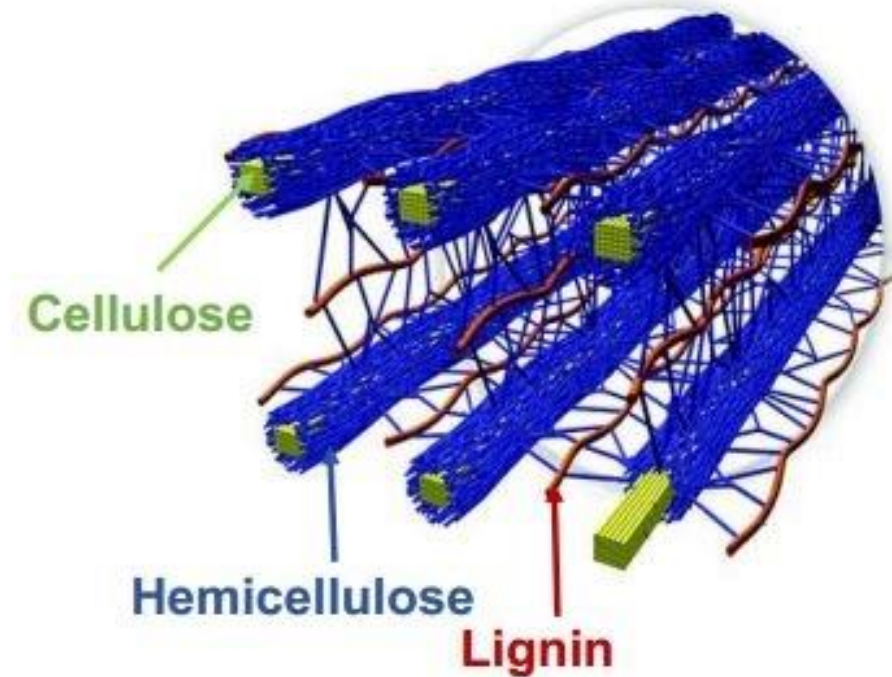
- long chain polysaccharide
- Tightly packed and organized

Hemicellulose complex polymeric network

- 5- and 6- carbon sugar
- connect cellulose and lignin fibers

Lignin amorphous polymer of aromatic compounds

- Composed of phenolic alcohols
- Gives support, resistance and impermeability to the plant
- Holds together hemicellulose and cellulose



Upon rapid heating, the carbohydrates (cellulose and hemicellulose) break down to provide low molecular weight volatile products.

Pyrolysis thermal decomposition of fuel into liquids, gases, and char (solid residue) in the absence of oxygen.

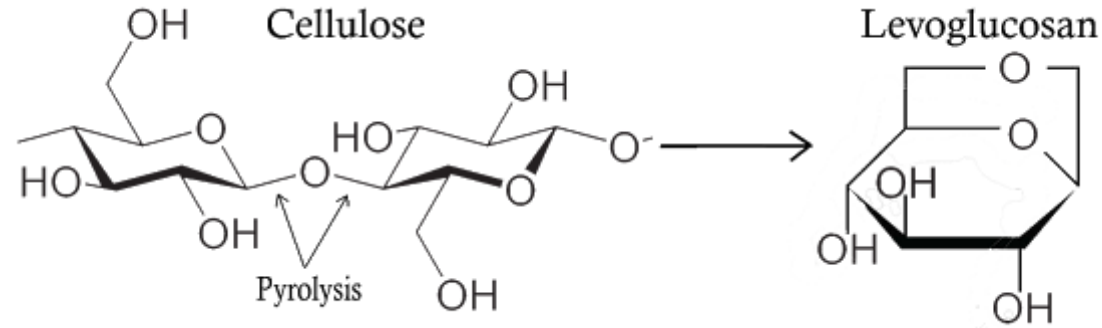


- Gases (non-condensable vapors)
- Liquids (condensable vapors)
- Solids: char and ash

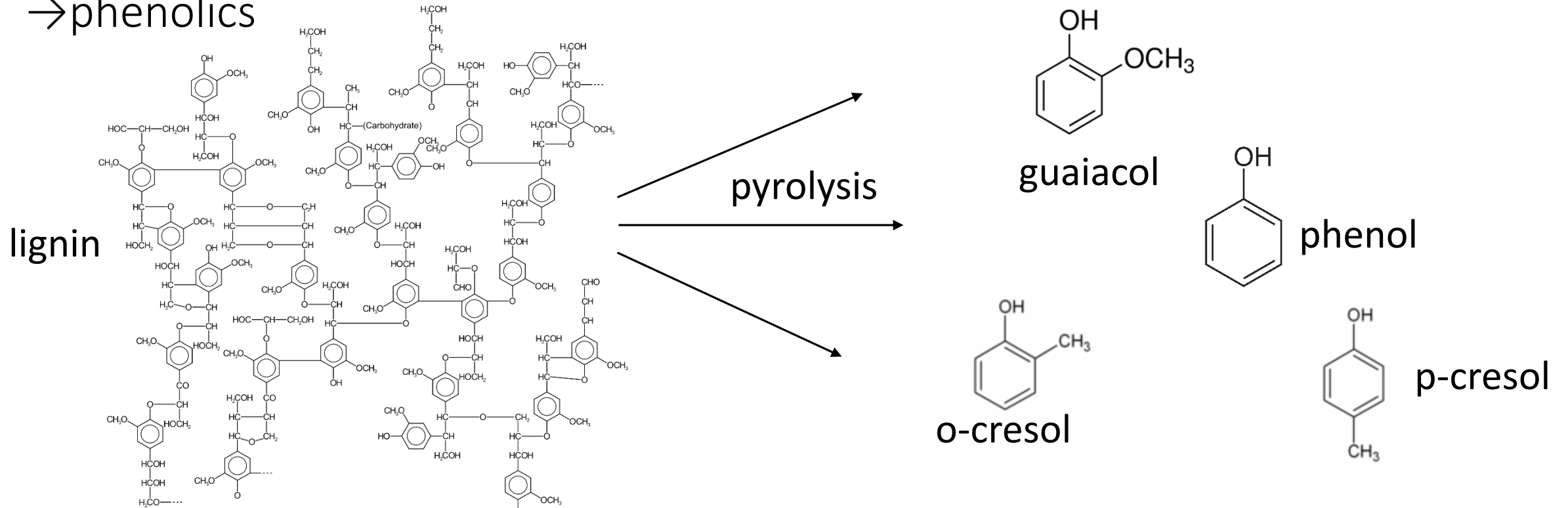
Objectives:

Develop pre-treatment process to maximize valuable products:

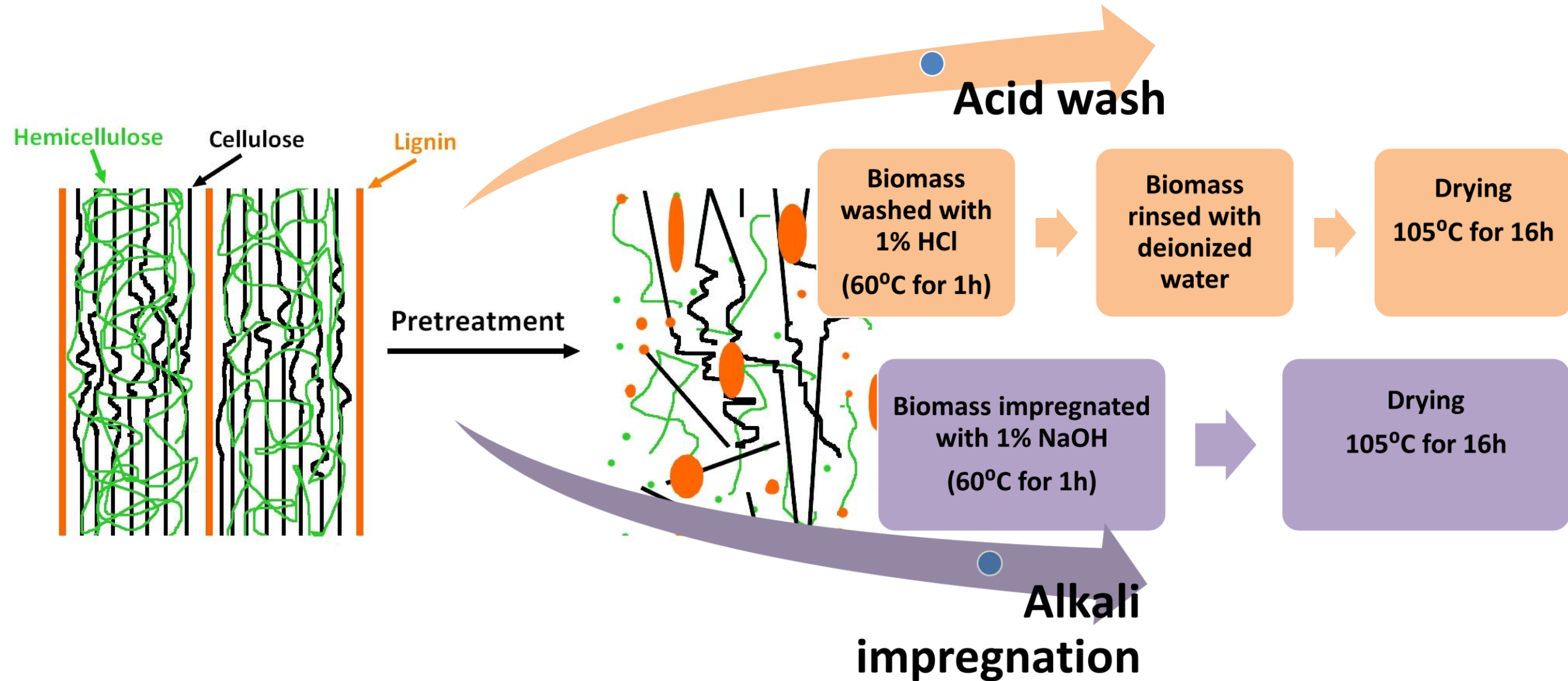
→sugars



→phenolics



Pretreatments process





Biomass: Phragmites Australis

Invasive species that has been damaged Ontario biodiversity for decades.

Impact of Invasive Phragmites:

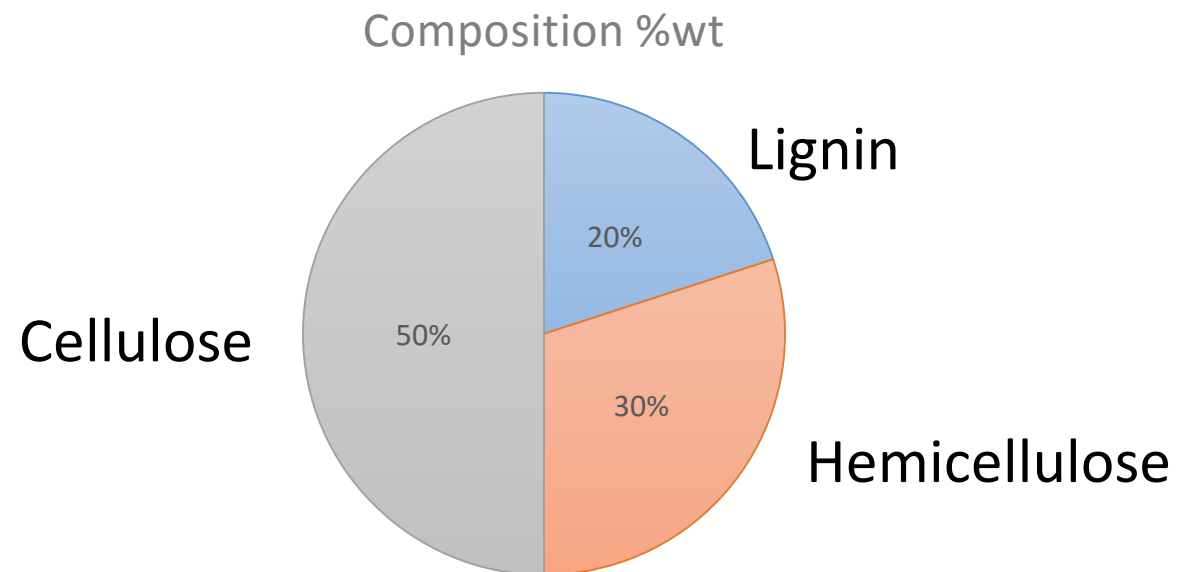
crowds out native vegetation

→ Increases fire hazard

→ grows in stands that can be extremely dense

→ can reach heights of up to 5 metres

We harvested the Phragmites in November.



Experimental setup

Technology: Slow Pyrolysis

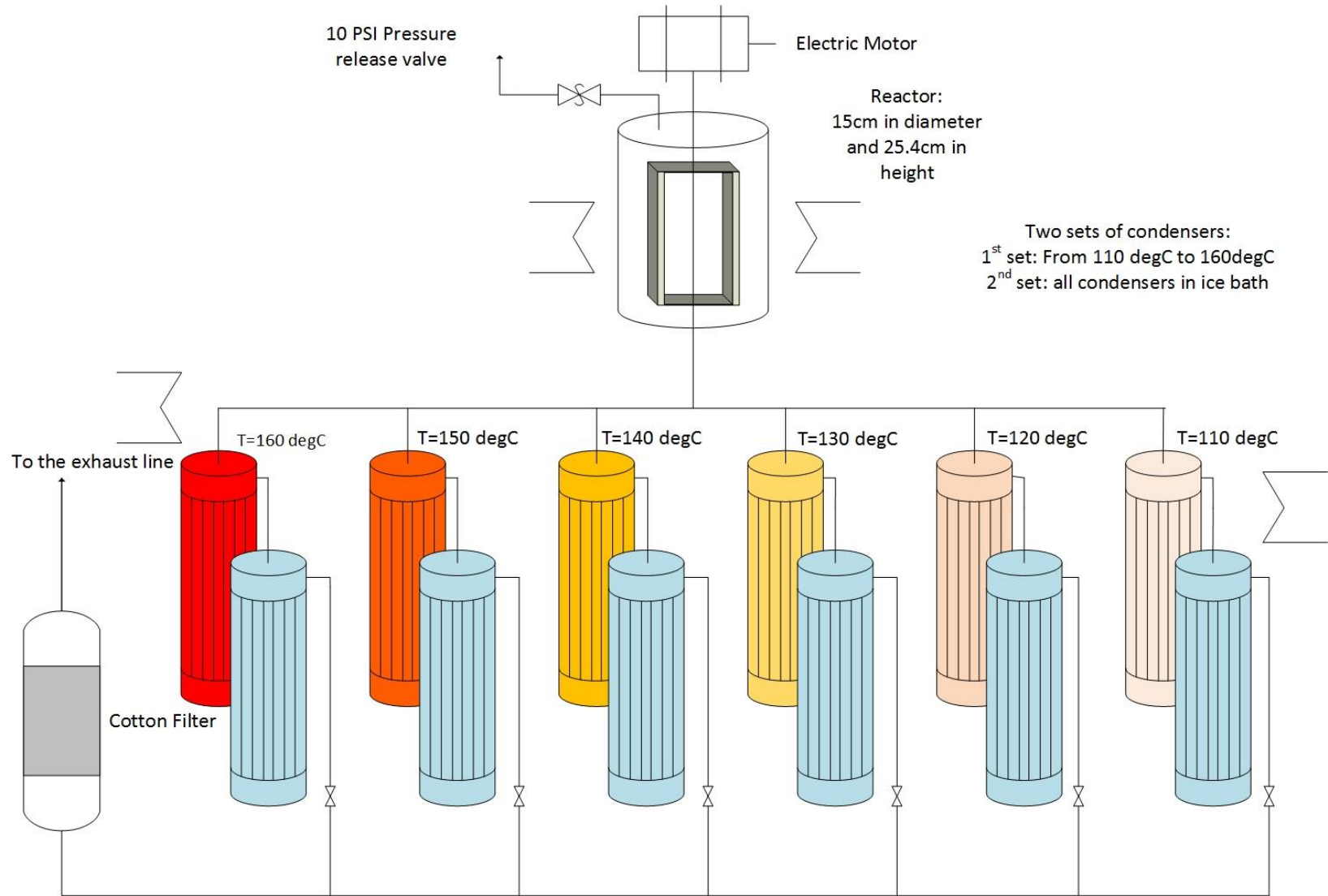
Mechanical Fluidized Bed (MFR)

Pyrolysis conditions:

→ Reactor Temperature = 550 °C

→ Heating rate = 8 °C/min

→ Biomass = 200 g



Front



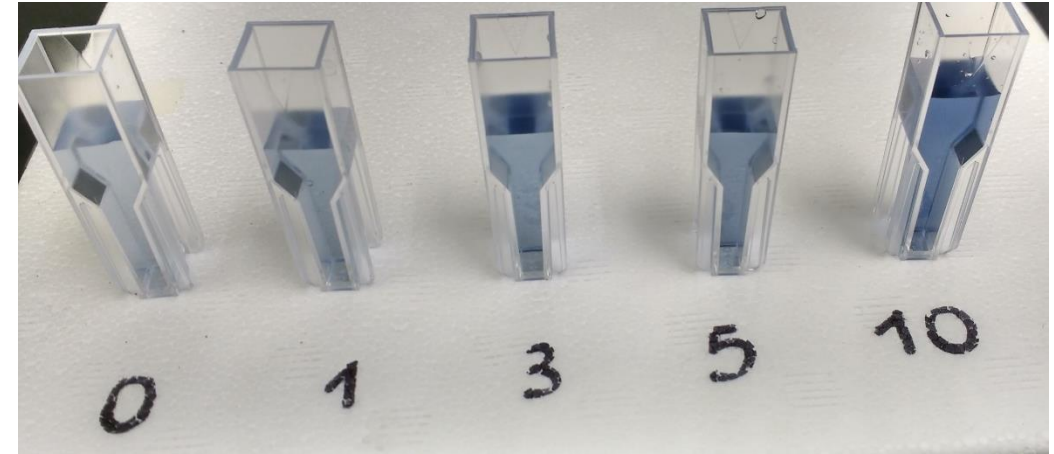
Back



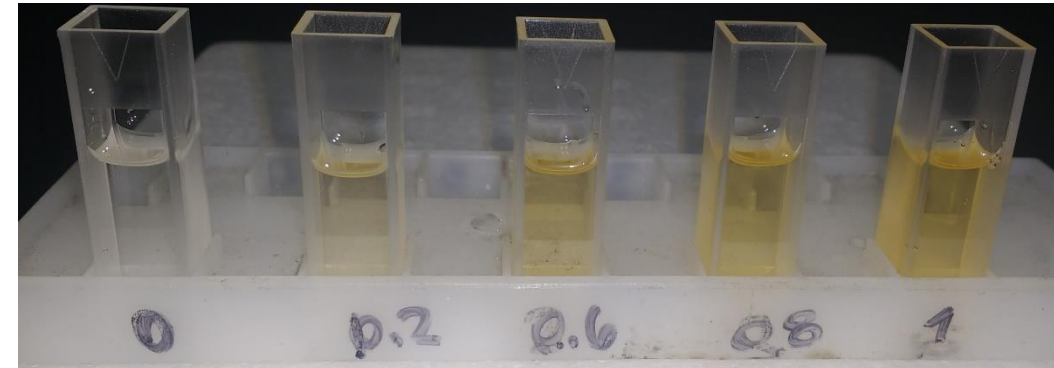
Characterizations performed:

Total Phenolics:

Folin-Ciocalteu method



Total Carbohydrate Analysis:
phenol-sulfuric acid assay



Results and conclusion

Effects of the pre-treatment		
	Total phenolics recovered/ untreated	Total carbohydrates recovered/ untreated
HCl	0.57	1.20
NaOH	1.31	1.12

Total Phenolics: 110°C < T condenser < 160°C

- Small variations in yield and concentration of phenolics → try higher condenser temperature
- With NaOH pretreatment concentration of phenolics in dry bio-oil ≈ 30 wt%

Total carbohydrates: 110°C < T condenser < 160°C

- Much better yield with 120 °C condenser and 130 °C condenser → try lower condenser temperature
- with HCl pretreatment, concentration of carbohydrates in dry bio-oil ≈ 11wt%

Thanks!