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# Production of Activated Carbons from Pyrolytic Biochar

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# Production of Activated Carbons from Pyrolytic Biochar

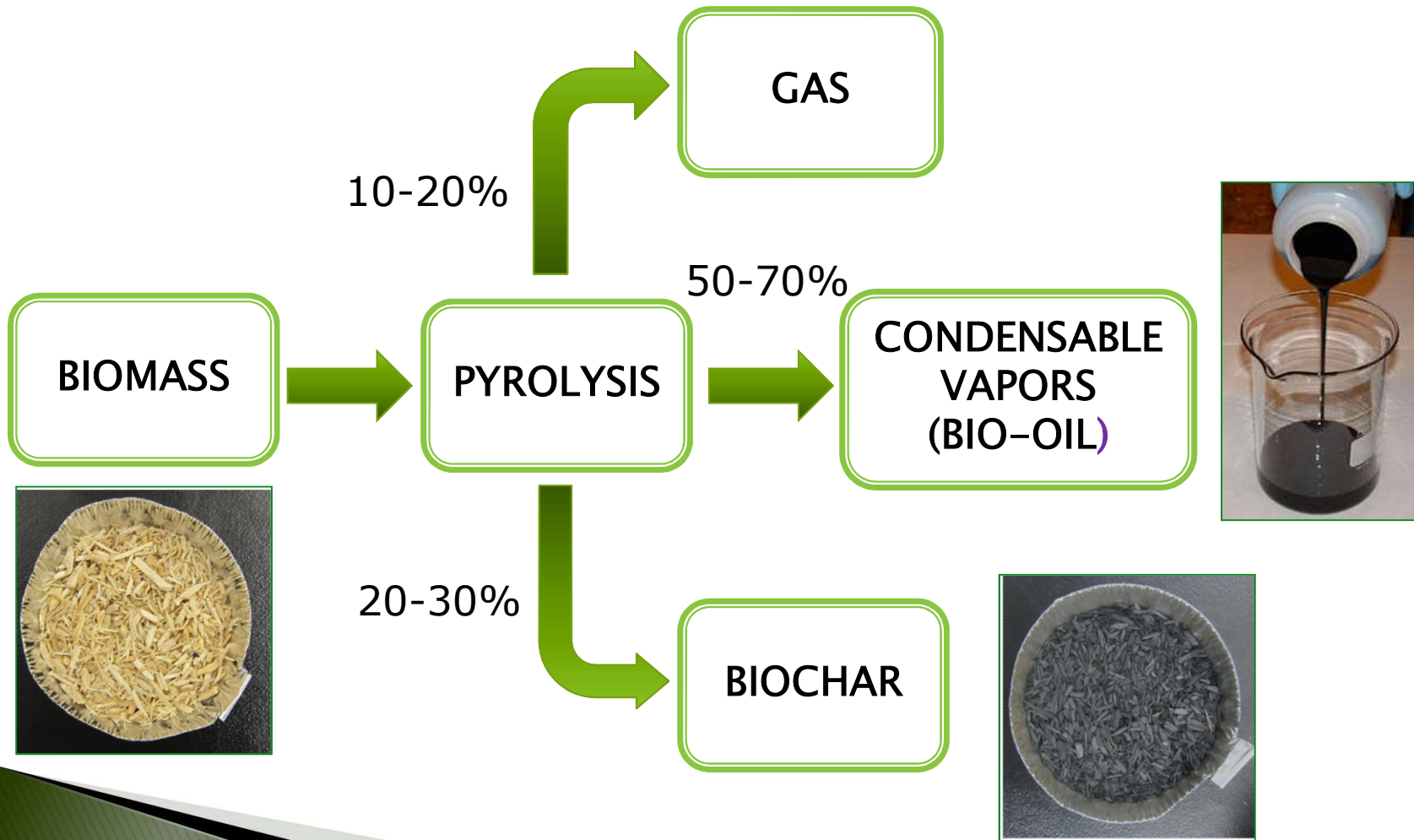
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Ajay Dalai<sup>2</sup>, Rambabu Nedunury<sup>2</sup>,  
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# Biomass pyrolysis



# BIO-CHAR production

**... in the Old Days.....**



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from Alternative Resources**  
Western University

**i<sup>o</sup>cfar**

# Objectives of our Research

- ▶ **Bio-Char production** from a variety of **biomass residues and wastes** using different technologies and under different operating conditions followed by **activation**
- ▶ **Characterization**
- ▶ Studies on the **potential use for adsorption of selected pollutants**

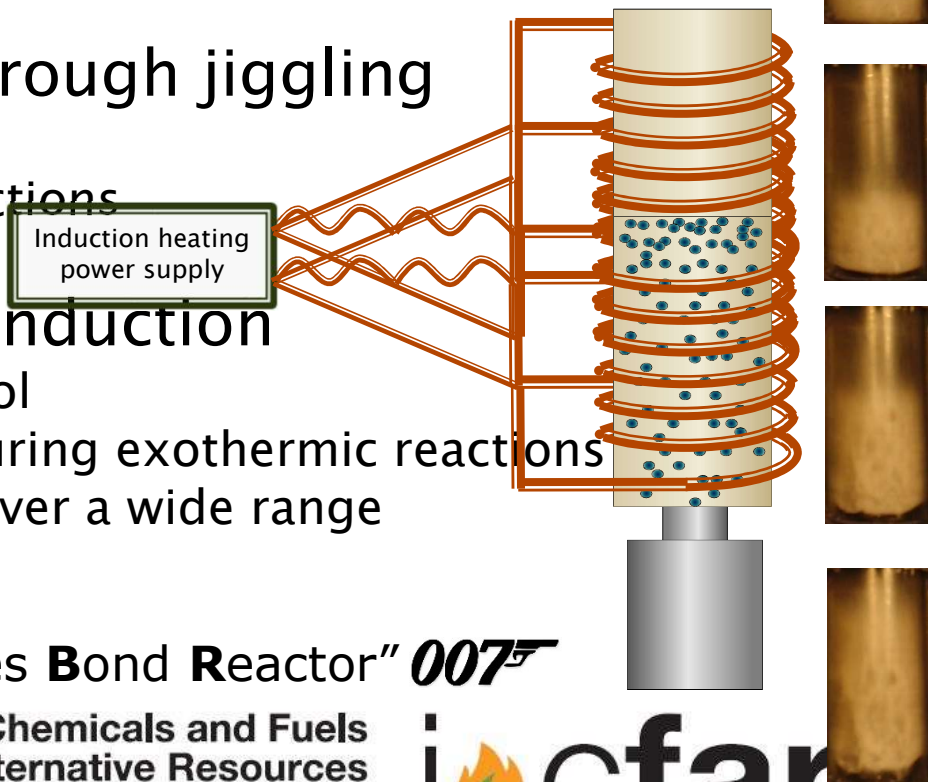


# Biomass selection: 13 biomasses

<b>Energy crops</b>	<b>Crop residues</b>	<b>Seeds</b>	<b>Milling residues</b>
<b>Willow</b>	<b>Wheat Straw</b>	<b>Sorghum</b>	<b>Olive Residue</b>
<b>Miscanthus</b>	<b>Corn Stover</b>	<b>Sunflower Husks</b>	<b>Bagasse</b>
<b>Switchgrass</b>	<b>Canola Straw</b>		<b>Birch Bark</b>
			<b>Lignin</b>
			<b>Maple wood</b>

# The “Jiggle Bed” Reactor (JBR)\*

- Micro-reactor developed for catalyst screening
- Fluidization achieved through jiggling
  - No fluidization gas
  - Ideal to study gas–solid reactions
- Heat provided through induction
  - Excellent temperature control
  - Fast response to changes during exothermic reactions
  - Heating rate can be varied over a wide range



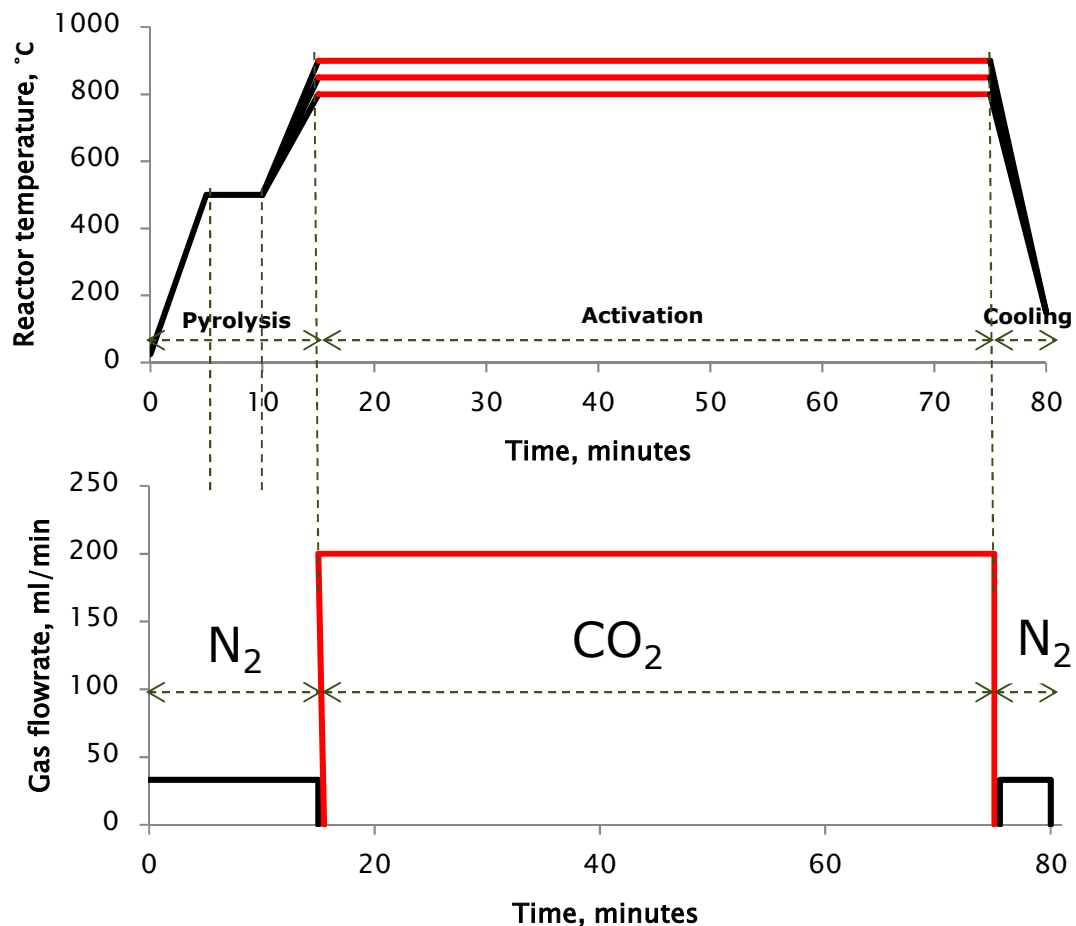
\*...also designated as the “**J**ames **B**ond **R**eactor” *007*

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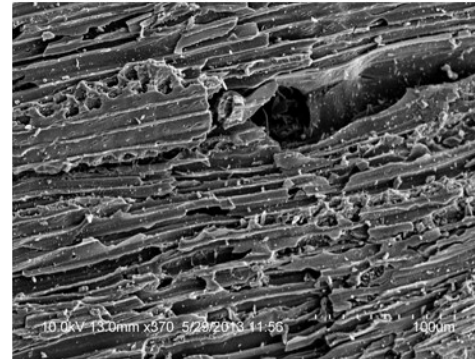
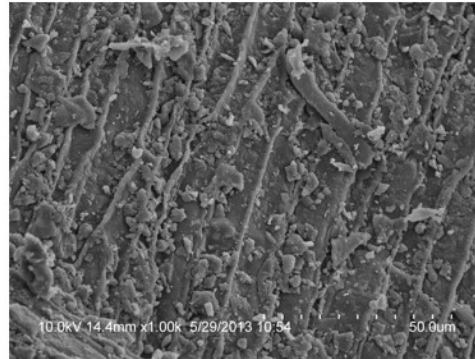
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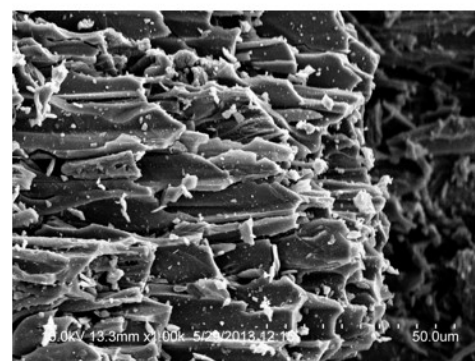
# Experimental procedure: PYROLYSIS and ACTIVATION



# Bio-Char Activation

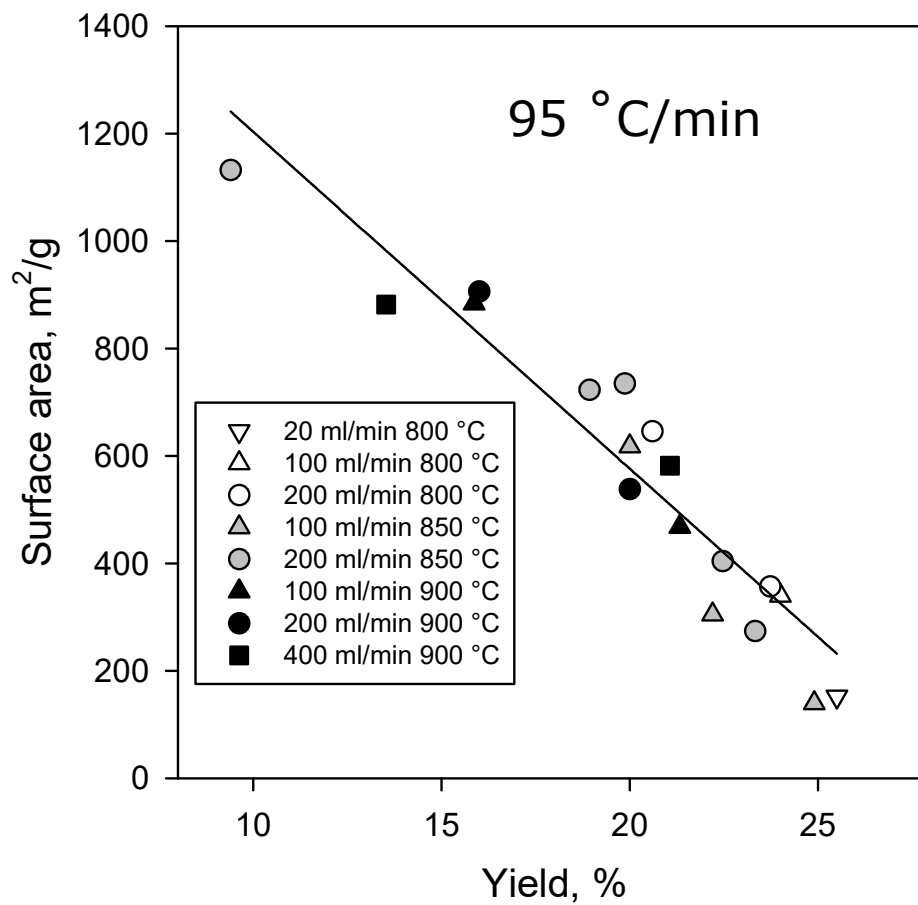


Surface overview for non activated and activated biochar from birchwood



Surface detail for non activated and activated biochar from birchwood

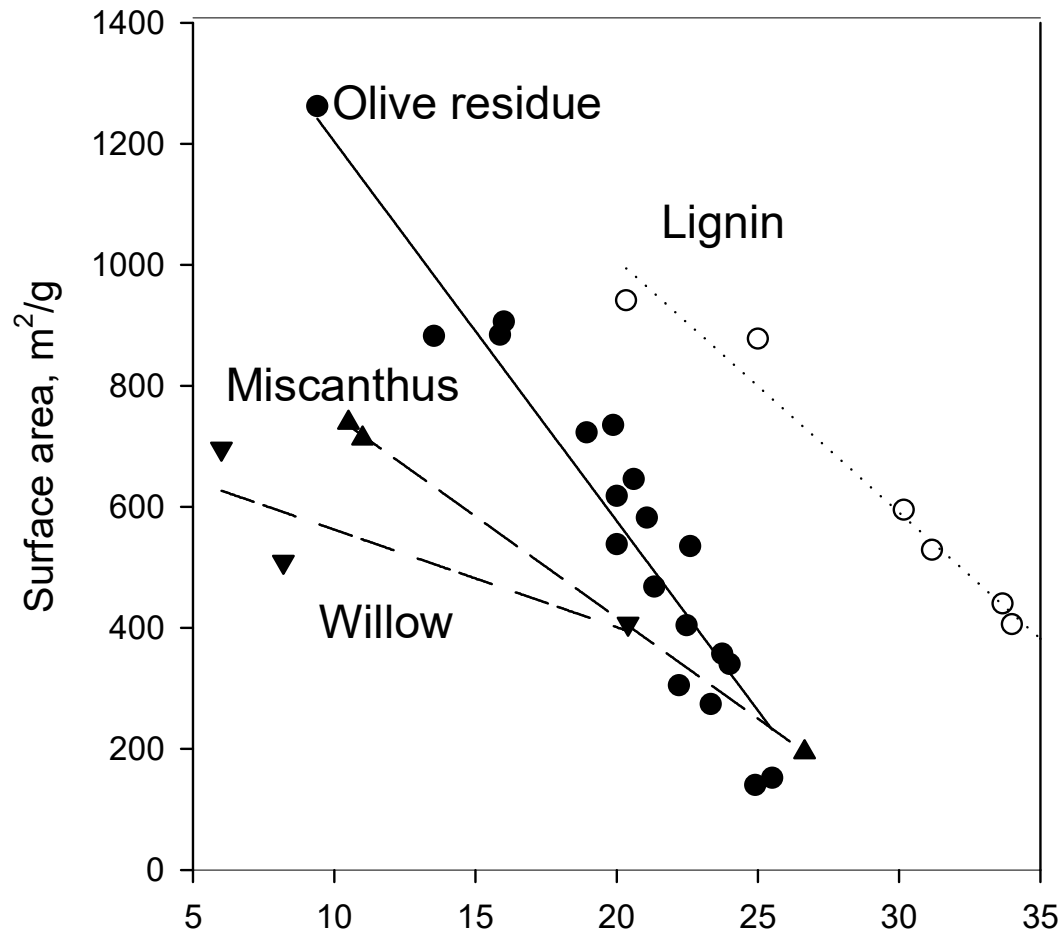
# Slow Pyrolysis + Activation (olive residue)



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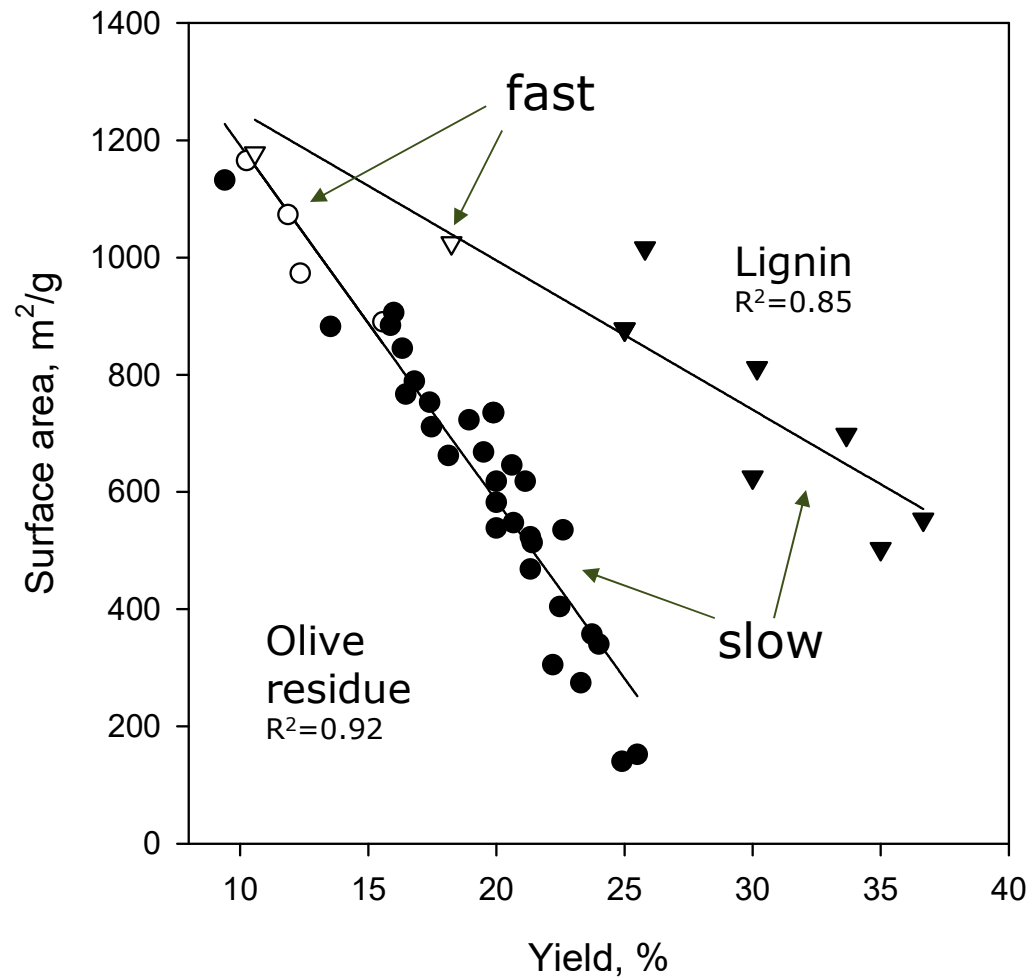
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# Feedstocks comparison

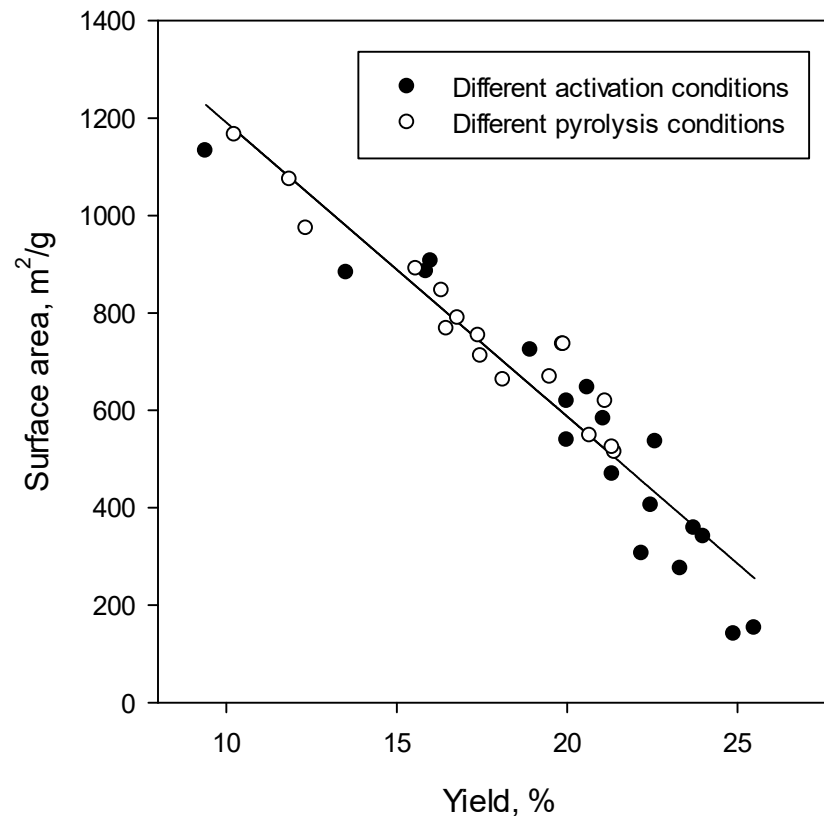


Yield, %  
from Alternative Resources  
Western University

# Slow and fast pyrolysis

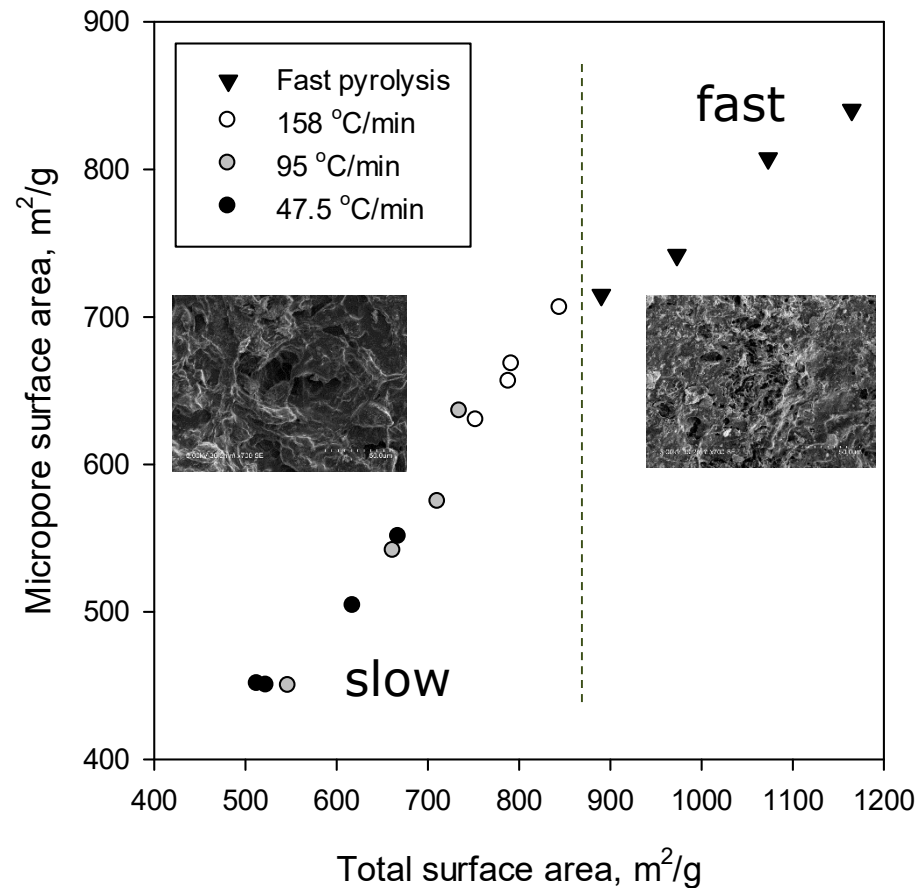


# Universal relationship (olive residue)



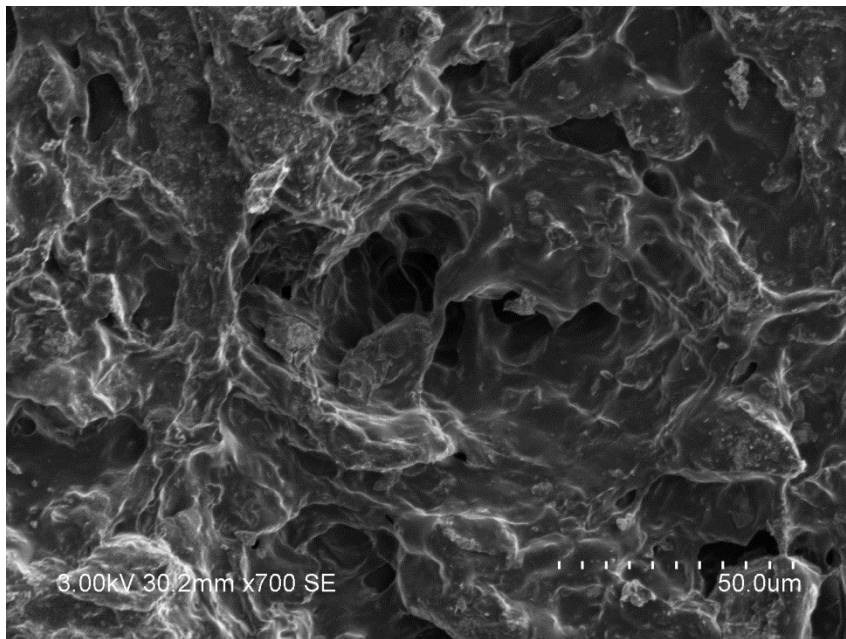
**For every feedstock, a unique relationship exists between total surface area and yield!**

# Impact of pyrolysis conditions on the porous structure (olive residue)

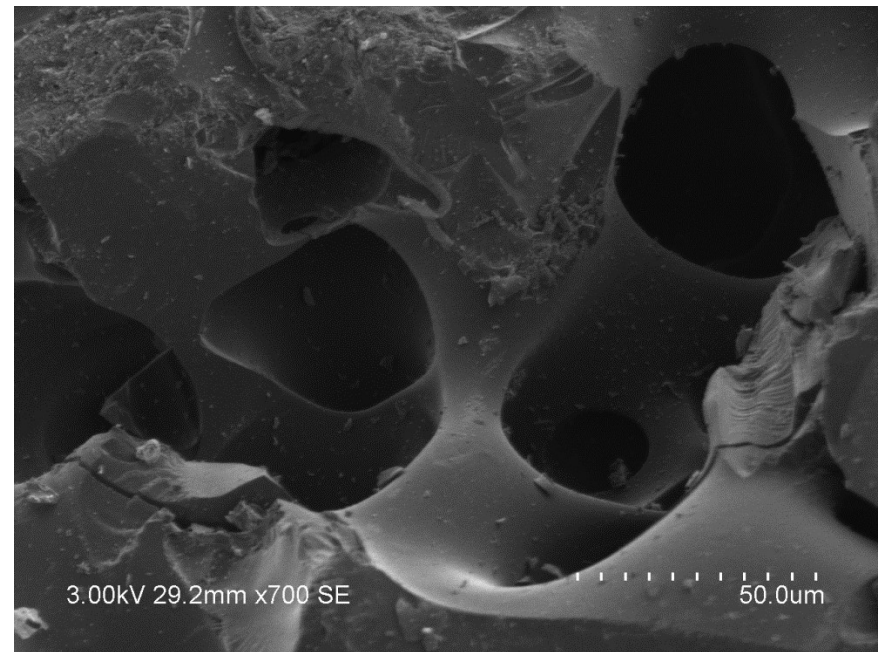


**The distribution of micropores and mesopores depends on the pyrolysis conditions**

# Comparison of activated charcoal from different feedstocks



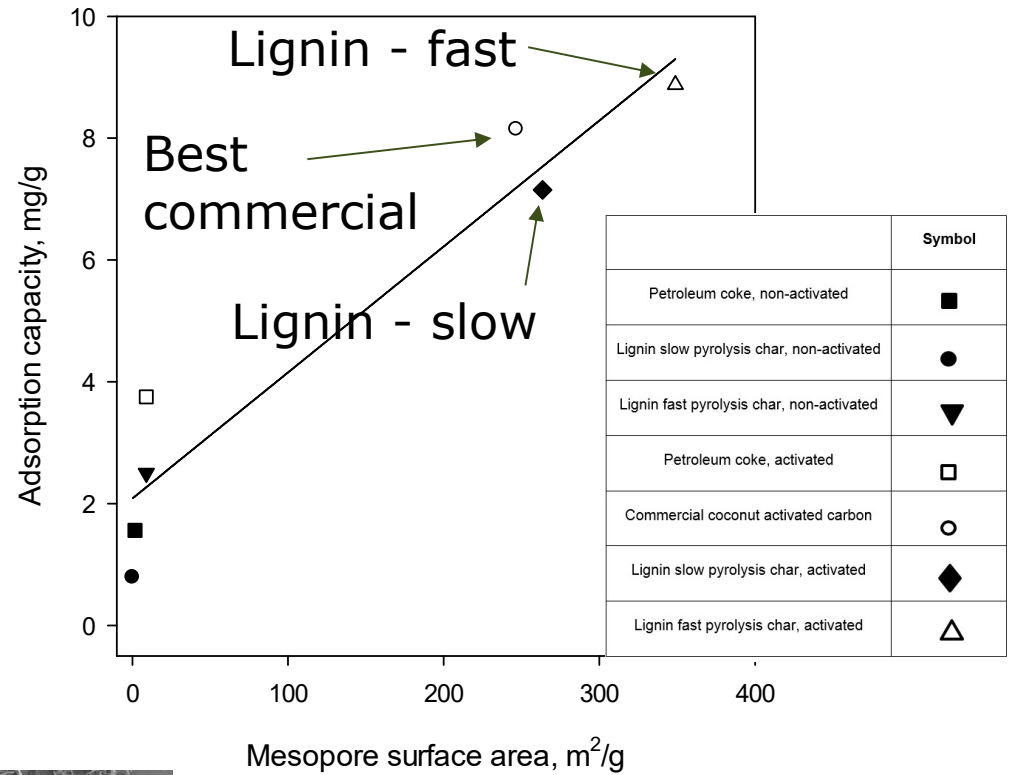
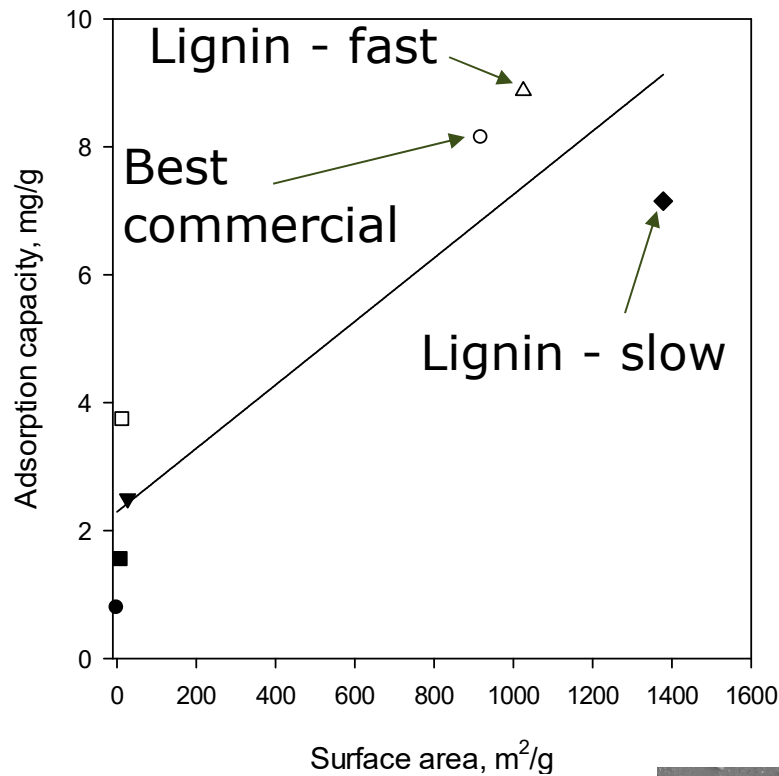
Olive residue  
(more **micropores**)



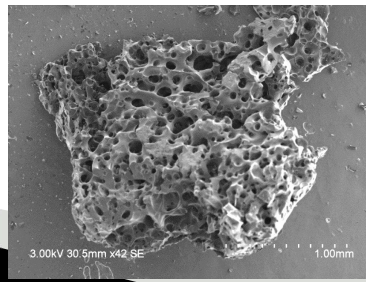
Lignin  
(more **mesopores**)



# Adsorption of Naphthenic Acids



	Symbol
Petroleum coke, non-activated	■
Lignin slow pyrolysis char, non-activated	●
Lignin fast pyrolysis char, non-activated	▼
Petroleum coke, activated	□
Commercial coconut activated carbon	○
Lignin slow pyrolysis char, activated	◆
Lignin fast pyrolysis char, activated	△



Activated lignin bio-char

# Key conclusions

- ▶ Bio-Char is a valuable co-product of pyrolysis of residual biomasses and wastes
- ▶ In order to increase its value, it can be successfully be activated
- ▶ Activation can reduce significantly the mass and increase significantly the porosity: for every feedstock a unique relationship exists between yield and surface area
- ▶ Activated Bio-char is an effective adsorbent

# Acknowledgments



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An ECI Conference

**June 19-24, 2016**  
**Fairmont Tremblant Hotel**  
**Mont Tremblant, Quebec, Canada**



## Timeline

Deadline for 7-page Abstracts Submission:	<b>December 15, 2015</b>
Abstracts Reviews and Selection of Presentations:	<b>February 15, 2016</b>
Submission of Revised Extended Abstracts:	<b>April 15, 2016</b>
Call for Free-Forum Posters:	<b>Ongoing until May 15, 2016</b>

