

# ABI BIOCHAR WORKSHOP

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## High Value Biochar Products

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Thermochemical Processing

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# Objective



- Explore alternate strategies to transform biochar (carbonized biomass) to high value activated carbon replacements

# Biochar Value Proposition:

- **Biochar**

- Market price \$500 - \$1500 / tonne (db)
- Product scarcity
- Markets not well established
- Capital intensive equipment

- **Activated**

- Market price \$2000 – 9000 / tonne (db)
- Well defined product quality
- Well established market and applications
- Capital intensive equipment

# Feedstocks

Activated Carbon	Biochar
Coal	Wood
Lignite	Straw
Coconut shells	Pulp sludge
Rice Husks	Manure
Sawdust	
Wood	

# Activated Carbon Applications



- Adsorbents
  - CO<sub>2</sub> capture
  - Hg capture
  - Emission control
  - Water treatment
  - Industrial effluent treatment
  - Desulfurization
  - Decolouration agent
  - Odour control
- Catalytic Supports

# Activated Carbon Production Process

- Activated Carbon
- Carbonization followed by activation in two steps
  - Physical Activation
    - Steam
    - CO<sub>2</sub>
    - Both
    - Air
  - Chemical Activation
    - KOH
    - H<sub>3</sub>PO<sub>4</sub>
    - ZnCl<sub>2</sub>
- Carbonization and activation in a single step

# Physical Activation

- Steam
- CO<sub>2</sub>
- Air
- $C + CO_2 = 2CO$
- $C + H_2O = CO + H_2$
- $C + O = CO$
- Carbon removal to enhance porosity
- High purity activated carbons
- Poor yields
- 800 – 900 °C

# Chemical Activation

- $\text{ZnCl}_2$  (Promotes dehydration)
- $\text{KOH}$  (promotes explosive disintegration)
- $\text{H}_3\text{PO}_4$  (incorporates into the feedstock)
- Alter Tar formation (reduced tar formation)
- High yields
- Require water wash
- Low temperatures (500 – 600 °C)



# Leading Activated Carbon Suppliers



- Cabot – Norit Activated Carbon
- Calgon Carbon & Chemviron Carbon
- Commercially marketed in Three Product Grades
  - Powdered activated carbon; particle size 1-150  $\mu\text{m}$
  - Granular activated carbon; particle size 0.5-4 mm
  - Extruded activated carbon; particle size 0.8-4 mm

# Activated Carbon from Coconut Shells



**Feedstock**



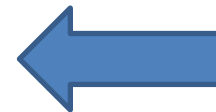
**Carbonization**



**Physical/Chemical  
Activation**



**Granular Activated Carbon**



# AITF

AITF developed:

- Single step carbonization-activation-functionalization
  - Functionalized carbons (biochars) > 500 m<sup>2</sup>/g surface area
  - Functionalized biochars exhibit superior CO<sub>2</sub> adsorption/desorption capacities at ambient temperature
  - Functionalized biochars 30 mg/g CO<sub>2</sub> capture capacity;
  - Compared to 33 mg/g reported for commercial coal-derived activated carbon impregnated with PEI (Polyethylenimine);
  - Commercial coal activated carbon (Darco D60): 20 mg/g;
  - Found to efficient in removing Naphthenic acid and heavy metals from OSTPWs.

# Questions?