Biochar Feedstocks and Processing

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Charcoal Applications

- Fuel
- Soil Amendment
- Filtration Aid
- Carbon Sequestration

Charcoal Applications

- Fuel
- Many developing countries rely on charcoal for heating and cooking fuel
- Charcoal from annual crop waste can reduce de-forestation

Charcoal Applications

Carbon Sequestration and Soil Amendment

Charcoal Applications

Filtration & Remediation

A New Type Of Gasification

- Top-Lit, Updraft (TLUD)
  - Thomas Reed, 1985
- Commercial Development
  - Clean simple Biomass Stoves
- Ideal for crop waste and biomass
- Slow, Low Temperature Pyrolysis

What is Pyrolysis?

Torrefaction	• "Toasting" Biomass • Left with uncharred biomass in the center of larger particles • 300°-500° F
Pyrolysis	• Thoroughly Chars Biomass • Controlled by Limiting Oxygen • Occurs at 540° F and above
Burning	• Not desirable, complete combustion • Left with ash • High Temp/ Excess air

Design Goals

- Compatible with different Biomass Feedstocks
  - Wood Chips/Sawdust
  - Rice Hulls
  - Peanut Hulls
- Clean Burning Output Gas
- Self-Sustaining
  - Minimal Energy Input
- Economical
  - Time
  - Equipment
- 30-35% w/w yield

Governing Equation

$$R \approx I*D*(1-M)*F$$

R= Burn Rate (m/s)
I=Fuel Index (m^3/kg)
D= Density (kg/m^3)
M=W.B. Moisture Content (dimensionless)
F= Air Flow Rate (m/s)

Fuel Index Factors

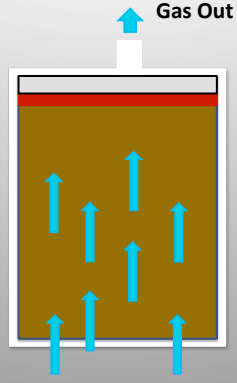
- Particle Size
- Particle Uniformity
- Bulk Density
- Pore Space/Size
- Moisture Content

Experimental Design

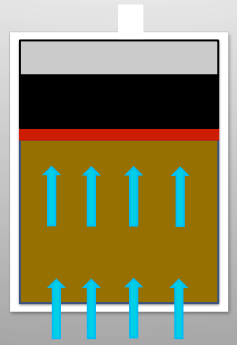
- **Vary:**
  - **Air Flow**
  - **Moisture Content**
  - **Density**
  - **Particle Size**
- **Observe:**
  - **Effect on Burn Rate**
  - **Gas Btu Content**
  - **Properties of the Resulting Char**
- **Develop:**
  - **Equation**
  - **Operating Parameters**

$$R \approx I*D*(1-M)*F$$

TLUD Burn Scenario



TLUD Burn Scenario



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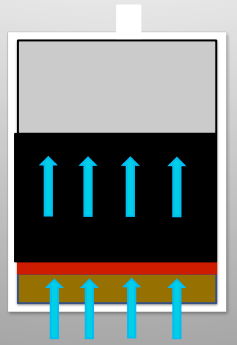

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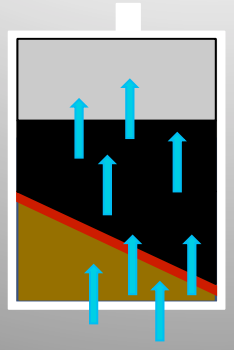
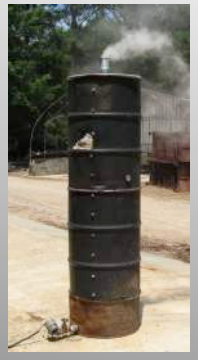


What We Don't Want

Preliminary Bench Experiments



Bench Scale Outcomes

Knowledge Gained

Rice Hulls

- The importance of a [particle size]/[air flow] balance
- Uniform:
  - density
  - moisture content
  - particle size

Wood Chips

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The First Scale Up – B5

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The First Scaleup – B5

Approx. Gas Analysis:

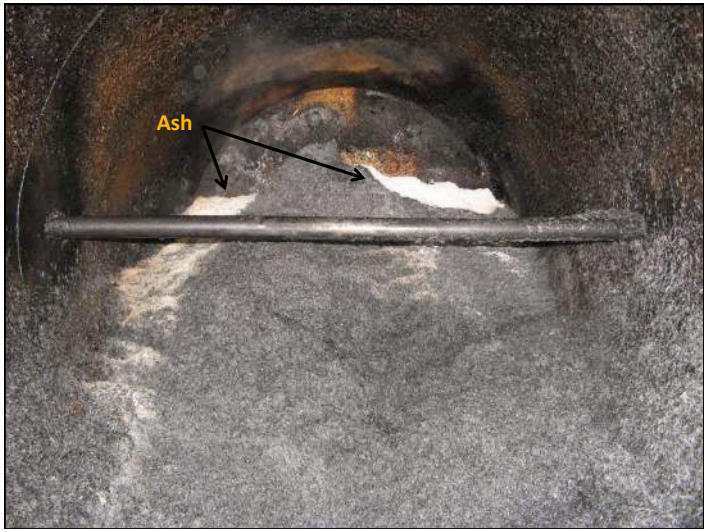
- N 58%
- CO2 15%
- CO 10%
- CH4 13%
- H 4%

125 - 150 Btu/ft^3

Monitoring

- Flow Rate
  - Air Volume Meter
- Weight Monitoring
  - Load cells
  - HOBO recording
  - Weight changes through the entire run
- Collect and Analyze Output Gases
- Temperature Inside
  - Below
  - During
  - Above

Results




Unburned Rice Hulls


Going Commercial – B6

B5 Modifications

B5-Woodchip

B5- Woodchip Biochar

Questions?