Commercial-Scale Production of Biochar and Energy

Presented by:
Jon Orr | Bert Bennett
Gasification Technology Team
PRESENTATION TOPICS

• ICM’s Biochar Production Technology

• Projects

• Demonstration Results
ICM’S BIOCHAR PRODUCTION TECHNOLOGY

• Key Features
  • Internally-augured, air blown gasifier
  • Feedstock flexibility
  • Produces high quality biochar
  • Low process temperatures
  • No additional thermal energy needed
  • Variety of uses for recovered heat
ICM’S BIOCHAR PRODUCTION TECHNOLOGY

- **Better Control**
  - Mass input
  - Low rpm auger
  - Retention time
  - 10 - 40+ % mc
  - Zoned air input
  - Wide turndown range

- **Lower Energy to Operate**
  - Primary Drivers - Auger & Fans Low HP
  - After Start, No Additional Fuel
  - Lower Bed Temperatures

- **Optimize for Biochar or Energy**

- **Small Footprint**
ICM’S BIOCHAR PRODUCTION TECHNOLOGY

- ICM Models 25, 150, 300 and 450 (based on feedstock input)
- It can produce 3 to 85+ (*) tpd of biochar
- Units built or under construction on 25, 150 and 300 tpd sizes

* NOTE (*) based on 20% dry basis biochar yield (90+% C), from softwood at <15% mc, <1.5% ash, db
ICM’s Large Scale Demonstration Gasifier – Newton, Kansas

- Feedstock conversion from 50 to 200+ tons/day
- Biochar yields up to 20 tons/day
- Operated from March 2009 to June 2012
ICM’S SMALLER SCALE DEMONSTRATION GASIFIER – NEWTON, KANSAS

- Feedstock capacity 5 to 20+ tons/day
- Biochar yields up to 3+ tons/day
- Mobilized
- Enhancements
- In service April 2016
- Demonstrated yields of 15 to 20+% (from DS)
- Total carbon in 89 to 92% (per IBI methods)
• ELEMENT™ will produce ethanol biofuels and feed products, which is expected to have the lowest carbon footprint in US

• Will recover energy from gasifier(s), to be used to produce steam and power

• Will provide operating energy up to 70 MMGPY ethanol

• Will reduce Greenhouse Gases

• **Will produce Biochar**
PROJECTS – PROJECT X

• Project: (not announced)
  • In detailed design phase
  • Based on single 25 tpd gasifier
  • Using chipped forest maintenance material
  • Mitigate forest fires
  • Produce 3 to 4.5 tpd of high quality biochar
  • Use recovered heat to pre-dry feedstock to < 15 wt% moisture
DEMONSTRATION RESULTS

• Continuous Development Path Since 2007
  • Approx 9000 tons of various materials tested on two demo units
    • Successful demonstrations using Woody Biomass, Ag Residuals, Chicken Litters and Dairy Manures, and Refused Derived Fuels (MSW and tires)
  • Numerous continuous demonstration 2007-2018
    • 24h, 100h to 800+ h runs
  • Recent biochar demonstrations
DEMONSTRATION RESULTS – Yield vs Moisture Content

• Biochar Yield and Optimization
  • June 2016, Newton KS
  • 24 hour continuous yield demonstration
  • Gradual increase in feedstock moisture content (15 to 28%)
  • On-the-fly control parameters adjusted to optimize yield
  • Demonstrated yields up to 20+ % dry basis
  • Total carbon in 89 to 92% (per IBI methods)
INDUSTRIAL-SCALE CO-PRODUCTION OF BIOCHAR AND ENERGY

• Opportunities for Heat Recovery
  • Biomass dryers
  • Steam heating applications
  • CHP using steam or ORC turbine

• Biochar & Energy – 150 ton/day
  • Pine: 15% mc, 1.5% ash db, 7280 Btu/lb HHV
  • Max Biochar 90+% C (25.5 ton/day)
    • Dry 50% to 15% (800 to 450 TPD, OR
    • Dry 255 to 150 TPD, plus 30,000 lb/h Steam
  • Max Energy and Low-C Biochar
    • CHP with steam letdown turbine
      • 3 MW power generation
      • dry 255 to 150 TPD
      • 30 MMBtu/h district heating
**Lettuce Seed Germination Tests**

### Bed Temperatures
- **Wood chips**
  - 480 - 540°C
  - 900 - 1000°F
- **Wheat Straw**
  - 480 - 540°C
  - 900 - 1000°F
- **MSW and MSW + Tires**
  - 540 - 650°C
  - 1000 - 1200°F

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**Let: 310 North First Street | PO Box 397 | Colwich, KS 67030**
D: 316.796.0969 | F: 316.796.0570 | icminc.com
SUMMARY

• Active Development Since 2007
• First Industrial-Scale Commercial Plant being Constructed
• Quality Biochars
• Platform Flexibility: Feedstocks, Biochar and Energy, including pathways to activation
Thank You!

**Jon Orr**  
Capital Sales Manager, Gasification  
310 N. First St.  
Colwich, KS 67030  
Direct Line: +1.316.977.6834  
Jon.Orr@icminc.com

**Bert Bennett, Ph.D.**  
Senior Engineer / Principal Scientist  
310 N. First St.  
Colwich, KS 67030  
Direct Line: +1.316.977.6671  
Albert.Bennett@icminc.com

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