COMMERCIAL-SCALE DEMONSTRATION OF ICM’s GASIFICATION TECHNOLOGY

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Funded 1995
Privately Held
- 350 employees
Core Mission …
- Promote Sustainable Agriculture
- Serve the Renewable Energy Sector
Engineered 1st Gen Ethanol Industry
- 102 Facilities
- 2007: 1 plant /15 days
ICM’s Auger Gasification Technology

- Successfully Developed in the Late ‘70s
  Early ‘80s
  - Tested 250 TPD using MSW & wood wastes
  - Supported by DOE and Boeing
- 2007: 3rd Party Updraft Gasifier at ICM Facility
  - Strategic Goal: provide option to improve carbon footprint and reduce NG dependency … NG trending ↑
    - 102 existing 1st gen. fuel ethanol facilities
  - Poor performance and lacked flexibility
  - 2007-2008 began to search for better platform
- ICM Gasification Technology…
  - Shop fabricated
  - Feedstock flexible
  - Greater control
  - Biochar capable
  - Licensed technology
Better Control
- Mass input
- Low rpm auger
  • Retention time
- Wet gas bypass
  • 10% - 50% mc
- Zoned air input

For Biochar …
- Lower maximum bed temperatures
- Flexible controls

Robust Design
- Small Footprint
  • 7’ x40’ =150 ton/day

Low Energy
- Minimal size reduction
- < 5 hp for auger
- < 15 hp air fan
- Compared to fluidized bed gasifiers <<<< hp

O₂ Blown, Medium-Btu Capable
ICM’S COMMERCIAL DEMONSTRATION GASIFIER – NEWTON, KANSAS

- Feedstock conversion from 50 to 200+ tons/day
- Biochar yields up to 20-30 tons/day
COMMERCIAL DEMONSTRATION GASIFIER

- **New Technology Evaluation**
  - 2008 Goal: Demonstrate for Ethanol Industry – steam-based CHP
  - Gasifier design & component testing
  - Feedstock evaluations & M&EB
  - Engineering data for emissions control
GASIFIER OPERATIONS: MARCH 2009 – SEPT 2012

- 8,400 tons Gasified
- 42 Months in Operation
- 3200+ Hours in Operation
- Two 100 Hr Continuous Runs
  - 100 hours on corn stover
  - 100 hours on wood chips
- 35 Day Continuous Run
  - Wood chips, stover and straw
  - Independent engineer’s review
- 7 Day Continuous Run
  - MSW – Refuse Derived Fuel
  - Independent engineer’s review

Tested Feedstocks

- Wood 4,380 tons
- Corn Stover 1,000 tons
- Wheat Straw 400 tons
- Sorghum Stalks 400 tons
- C & D 200 tons
- Paper Pulp + Plastics 100 tons
- Switchgrass 50 tons
- Corn Bran + Syrup 50 tons
- Auto Shredder Res. 50 tons
- MSW (RDF) 800 tons
- Minimally Processed MSW 200 tons
- MSW (RDF) + Tires 400 tons
- Chicken Litter 220 tons
- Dairy Manure 50 tons
- Manure + Wood chips 50 tons
- Tires + Wood chips 50 tons
BIOMASS GASIFICATION, BIOCHAR CO-PRODUCTION AND OTHER DEVELOPMENTS

HIGH-CARBON BIOCHAR

- Agronomic Soil Amendments and Carbon Sequestration
  - ICM collaborating with agronomic research – 400 tons
    - Iowa State University
    - Kansas State University
    - Midwest Research Institute (MRIGlobal)
    - USDA-ARS
  - Land Reclamation – mine tailings, etc.

- Other Applications at S. Dakota State Univ.
  - Biochar activation
    - Water purification
    - Wastewater treatment
    - Solvent recovery

OTHER DEVELOPMENTS

- Gas Cleanup
  - Preliminary gas cleanup testing on slip-stream
    - Focus on Cl removal for repurposing large coal boilers
    - Low-Btu gas: 150-180 Btu/scf (db)
  - Beginning development for engine platform
    - Working with leading cleanup technology provider
PROGRESS IN FIRST FULLY INTEGRATED COMMERCIAL DEPLOYMENTS

- 150, 300 and 450 TPD Models
  - Model-150 demonstrated in Newton, KS
  - Model-300 based on 80’s demonstration unit

- Low Natural Gas Pricing has Limited the Planned Deployment into Existing 1st Gen. Ethanol Industry

- Currently Initiating Redeployment of our 150 TPD ton/day Gasifier Located in Newton, KS
  - Strategic alliance with large, internationally recognized EPC
  - Two competing sites …
    - Both sites plan to use minimally processed MSW
    - Both sites to deploy 6-7 MWe engine platform
    - Target completion … Q 1-2, 2014

- Initiated Preliminary Engineering
  - 30 MWe WtE facility – steam application
    - Post-recycled MSW, BACT emissions control
  - 190 kpph steam – Advanced Biofuels Facility
    - Ag. residues and wood chip biomass
Questions?

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