Advanced Clean Technology for Biomass Conversion to Bioenergy, Fuels, and Chemicals

Tappi International Bioenergy and Biochemicals Conference

Memphis TN
Agenda

- TRI Overview
- TRI Thermochemical Platform Biorefinery Overview
- Projects updates
  - Flambeau River Biofuels, Park Falls WI
  - NewPage, Wisconsin Rapids WI
- Pilot Plant Review
  - System description
  - Test Status
- Meeting Future Challenges
Corporate Overview

- Advanced technologies for the conversion of biomass to bio-fuels, bio-chemicals and renewable power
  - Formed in 1996
  - Proprietary steam reforming gasification system developed with over $50 million of R&D investment from private investor, the U.S. Department of Energy, the California Energy Commission, and the pulp and paper industry
  - Research facilities in RDU and Utah
  - Proven technology currently in commercial operation
  - Commercializing the Integrated Biorefinery Platform
The Thermochemical platform biorerfinery includes:

- Biomass preparation
- Biomass to syngas process
- Gas clean up
- Catalytic gas to liquids process, and/or
- Combined cycle energy plant
- Energy recovery

The Thermochemical platform is exothermic

The Thermochemical platform thermally integrates with an endothermic host process for superior economics.
Example Host- Pulp and Paper Mill

Round Wood → Saw Mill → Saw Dust → Paper Mill → Paper Products

Round Wood

Wood Products
Flambeau River Biofuels Project
Park Falls, Wisconsin

- Over 100 year old paper mill
- Primary employer in the region
- Entrepreneurial leader with bold vision
- Awarded $30 million DOE grant for demonstration biorefinery
- Capacity:
  - 1000 dtpd forest waste biomass
  - 9.5 million gallons per year diesel fuel
  - 7.6 million gallons per year paraffin
  - Steam and hot water to paper mill
  - 5.3 MW electricity
- Thermochemical biorefinery platform; gasification to FT liquids
  - TRI biomass gasification system
  - TRI syngas clean-up system
  - EFT gas to FT Liquids system
- Status; appropriation grade scope and estimate and pilot plant testing underway.
NewPage Corporation: Project Independence
Wisconsin Rapids, WI

- Large, integrated pulp and paper mill
- Primary employer in the region
- Awarded $30 million DOE grant for demonstration biorefinery

Capacity:
- 500 dry tons per day waste wood biomass
- 5.5 million gallons per year FT liquids
- 92 MMBTU/HR tail gas to lime kiln
- Steam and hot water to paper mill

Thermochemical biorefinery platform; gasification to FT liquids
- TRI biomass gasification system
- TRI syngas clean-up system
- EFT gas to FT liquids system

Status; appropriation grade scope and estimate and pilot plant testing underway.
TRI Process Demonstration Unit
Process Demonstration Unit (PDU)

- Biomass Feed System
- Steam Reformer
- Carbon Trim Cell
- Gas Clean Up System
- FT GTL (under Construction)
Biomass Feed System

- Designed to handle wide range of Biomass
  - 230 cuft day bin with live bottom
  - Weigh Screw feed to 1st stage piston
  - 3-stage hydraulic piston system to feed biomass while preventing back flow of gasifier gases
  - Lump breaker
  - High speed biomass injection auger
Steam Reformer and CTC

Proprietary two stage gasifier system capable of 4 tons per day (dry basis) biomass

- **Reformer**
  - Indirectly heated steam reformer
  - Superheated steam fluidizing media
  - Engineered bed materials

- **Carbon Trim Cell**
  - Conversion of carry-over char to trim H₂:CO ratio
  - Fluidized with steam and oxygen
Gas Clean Up

GCU sized for 10% slipstream and includes the following:

- **Primary Gas Clean Up**
  - HRSG to cool syngas to ~ 500°F
  - Venturi scrubber for removal of particulate
  - Gas Cooler for condensation of residual steam
  - Proprietary solvent extraction of tars
  - Scrubber for removal of any trace H₂S

- **Secondary Gas Clean Up**
  - Compressor (25 psig to 440 psig)
  - Scrubbers to remove HCN and NH₃
  - Packed guard beds to eliminate H₂S and COS
  - Particulate filters
Fischer Tropsch Reactor

- Proprietary Emerging Fuels Technology fixed bed technology
  - Three tubes with Cobalt catalyst
  - Tube length identical to commercial scale reactor to facilitate scale-up
  - Forms heavy fraction (HFTL), medium fraction (MFTL) and light fraction (LFTL)
  - Exothermic heat removed via steam generated in reactor cooling jacket
PDU Test Status

- 2380 hours operation on biomass feeders
- 2640 hours operation on gasifier
- 1050 hours combined gasifier and biomass feed systems
- Achieving $\text{H}_2:\text{CO}$ ratios of 2:1 on a sustained basis
- Continuing improvement of biomass feed system
- Primary GCU commissioned
- Secondary GCU and FT systems in final stages of construction
Meeting Future Challenges

- Commercial Demonstration Plants in Development
  - Flambeau River Biofuels
  - NewPage
  - Woody biomass
- Expand available feedstocks
  - RDF
  - Energy crops
- Expand range of products
  - New GTL pathways
- Aggressive technology development
  - Improved reliability of existing systems
  - New technology/patents
Questions?