State & Private Forestry
Technology Marketing Unit

Forest Products Laboratory
Madison, Wisconsin

Small Modular Biomass (SMB) System

Today, a new generation of low-Btu gasifiers with better systems for filtering gas exists. Not only are these new gasifiers more reliable for conventional applications such as driving internal combustion engines, but they also may find suitability for use with Stirling engines, micro-turbines, and fuel cells.

The SMB system is a downdraft gasifier. Wood chips with a moisture content of 25% are fed into a hopper. The hopper feeds a conveyor belt, which takes the chips through a dryer, heated by the excess heat from the internal combustion engine. After the chips are dried to moisture content of 15%, they are fed into the gasification hopper. The chips flow downward through the gasifier (operating at a temperature of 800 ^{o}C). There is limited airflow through the wood chips so the chips are combusted under starved oxygen conditions. The by-products from the combustion are carbon monoxide, hydrogen, hydrocarbons, tars, particulates, and ash. The tars, particulates, and ash are filtered out and the gases (called producer gas) are fed into an internal combustion engine where the gases are mixed with air and further combusted. The output of the internal combustion engine is electricity, some NO_x's, carbon dioxide, and water vapor. Excess heat from the gasification chamber can be used to heat water.

The features of this system are shown below. In the future, portable 50-kW_e systems will be available which could be connected to the grid. Such systems will allow in-woods conversion to grid energy.

Features

- Fully automatic startup, operation, and shutdown
- Closed-loop PLC control of gasifier & engine
- CHP modules from 10 to 25 kW_e
- Non-condensing system, dry gas clean-up
- No liquid effluents, no toxic wastes
- Utilize variety of woody biomass fuels
  - Wood chips
  - Wood pellets
  - Coconut and other nut shells
- Low-cost, high-volume design
- Trailer or skid mounted, simple installation

Specifications

- Electrical power: 10 to 25 kW_e modules
- Thermal: ~215k to 500k Btu per hour (60 to 160 kW_{th})
- Footprint: 2 m x 2.5 m
- Weight: ~800 kg
- Gas: LHV 5 mj per m^3 <10 ppm tars/particulates
- Fuel conversion: ~1.5 kg per kWh (1/2 ton per 24 hours)
- Dispatchable power within 30 seconds
- Full cold startup on wood gas: ~10 minutes
- Turndown ratio: >4:1
- Gas composition (~): 0% O_2, 20% H_2, 20% CO, 7% CO_2, 2% CH_4, balance N_2
- Startup/backup fuel: LPG (propane, butane)

For more information, contact:
Susan LeVan, Program Manager
Phone: (608) 231–9518
E-mail: slevan@fs.fed.us
Website: www.fpl.fs.fed.us/tmu