UNIVERSITY OF FLORIDA

Combined Cooling, Heat, Power, and Biofuel from Biomass and Solid Waste

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Description: The goal of this project is to provide the underlying research and demonstration of a novel technology which would enable the economic utilization of dispersed biomass and solid waste resources to produce electric power, cooling, heat, and transportation fuels. This integrated gasification and power generation system combines University of Florida advances in high-temperature gasification, hydrogen generation and separation, and advanced gas turbine systems. Their integration is expected to result in significant improvements in the cost, emissions, feedstock flexibility, and water requirements, all in a relatively compact, modular plant system. This in turn will enable much greater utilization of renewable energy supplies, helping the development of a sustainable energy supply infrastructure.

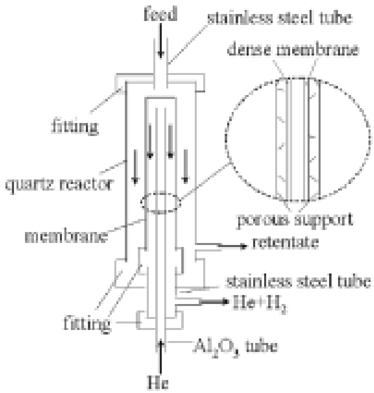
Budget: $576,000
Universities: UF
External Collaborators: Siemens Power Generation, Florida Turbine Technologies, Energy Concepts Co., Nu-Power Technologies LLC, PlanetGreenSolutions Inc., LPP Combustion, LLC.

Progress Summary

I. Flameless Combustion Experiments and Modeling

In order to enable syngas characterization, we have focused on the installation of a well-characterized commercial gas turbine engine, with completion expected by the end April 2011. A complete test plan has been developed for test rig shakedown and operation on simulated syngas, in preparation for coupling to the steam gasification syngas described below. The rig is based on a Capstone C60™ system, designed for multiple fuel sources, including methane, syngas, and a LPP Combustion artificial fuel skid. As a parallel activity, integrated system modeling, PoWER(turbine), absorption refrigeration, and HiTS (gasifier), is continuing.

Fig. 1. Micro-turbine test system photograph



II. Enhancing H_2 Yield Using SCZE Membranes

The membrane converts CO into CO_2 and provides additional H_2. It also separates H_2 out from syngas.

$H_2O + CO \rightarrow H_2 + CO_2 \quad \Delta H_o = -40.6$ kJ/mol

Fig. 2. Membrane experimental system.

III. High-Temperature Steam Gasification

The biomass high-temperature steam gasification involves a thermal-chemical process that employs super-critical high-temperature steam to break down the feedstock to pure hydrogen-rich gaseous bio-fuels.

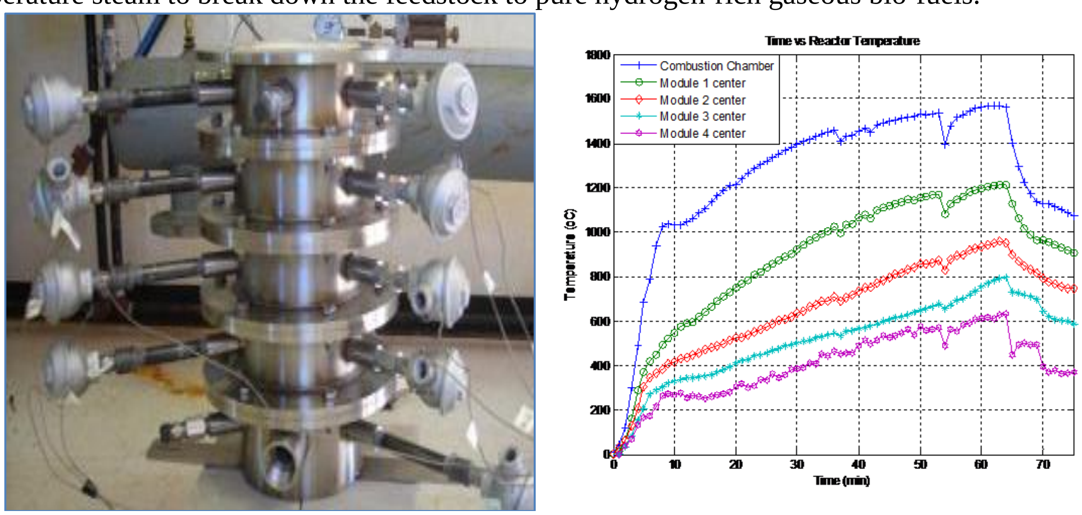
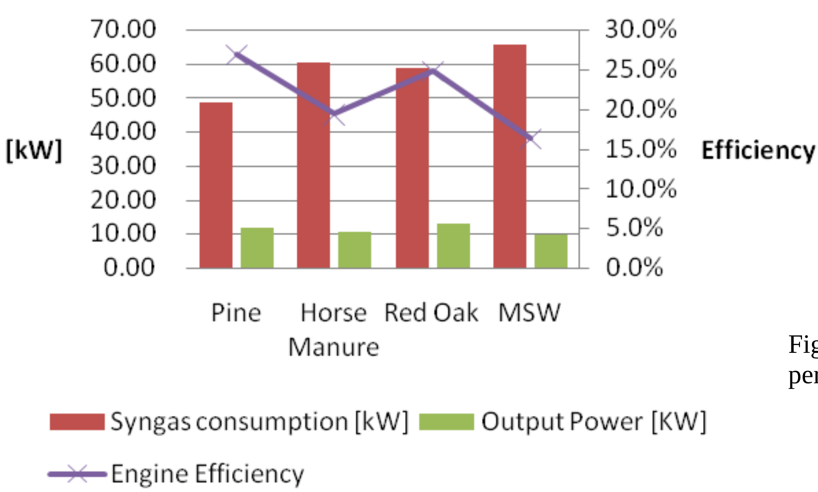


Fig. 3. Experimental System and system temperature profile.



IV. The Biomass Gasification to Power System

Trailer-scale downdraft gasification unit coupled with an IC engine-generator set has been demonstrated to produce power using four different feedstocks. Results are shown below.

Fig. 4. Gasification-power system performance