



HERTY BIOMASS AND BIOFUELS CAPABILITIES

The Herty Advanced Materials Development Center was chartered by the State of Georgia for the purposes of enhancing economic sustainability and accelerating growth by abbreviating the innovation cycle of materials-driven and materials-dependent industries. As a Georgia state agency, Herty is a not-for-profit, fee for service, independent scale-up and commercialization facility.



Figure 1 – Herty Advanced Materials Development Center – Laboratories (left) and Pilot Plant (right)

Herty has leveraged its industry-proven laboratory and pilot capabilities to execute its strategic plan which includes significant emphasis in the biopower and biofuels areas. Herty’s focus is on feedstock with current impact of over \$1.5 billion in alternative energy commercialization projects. Herty provides a hub location needed for rapid cost-effective development of biomass resources for energy production. Dr. Omar Ali, Director of Biofuels and Laboratory Operations, is responsible for all pre-processing and economic modeling activities, including overall project management, coordination, data analysis, and interfacing with customers. He is a chemical engineer with expertise in biofuels and process development management, with almost 25 years experience in the pulp and paper industry working for Paprican, Union Camp, International Paper, Rayonier and now Herty.

Herty has been engaged in a number of cellulosic fuels programs over the past 24 months, and has served as a supplier of development quantities of highly characterized feedstocks. Through these programs, Herty has developed a keen awareness of the importance of numerous physical and chemical characteristics of woody-biomass and has, in parallel, acquired the skills and capabilities to measure and assess many of these physical attributes. Sampling protocols have also been derived to assure that data derived from measurements can be reliable when representing large growth areas or large, disperse populations of biomass sources. Herty has the ability to manipulate and measure particle size and moisture content, and the ability to measure stability, ash content, ash composition (ICP), heating value, thermal properties (TGA, DSC) and bulk density.



Herty has capabilities to evaluate the specific unit operations along the entire feedstock supply chain. Pilot process data collection for each unit operation include yield, material and energy balances, total specific energy use per unit size reduction, feed rates and energy consumption (kWh/ton) where applicable.

- Primary resizing - Efficient chipping/ grinding is necessary to decrease energy costs associated with reducing woody biomass to a (uniform) size for optimal cellulosic ethanol production. For wood chips, drying is facilitated with uniform chip thickness and minimal fines content. Herty has the capability to evaluate chopping, chipping, and grinding options for herbaceous and woody materials. Herty works with machinery companies having access to both harvester-based and yard-based chipping and grinding equipment to optimize primary resizing practices for energy applications. The impact of primary resizing on other processing steps in the supply chain such as drying, blending and secondary resizing can be assessed in terms of operational factors, economics, power requirements and/or fuel consumption per ton, and changes in feedstock specifications.
- Drying – Drying of biomass either at the point of harvest or at the site of the convertor is an important part of the supply chain. Herty has developed a knowledge base in field drying of logs. Also, Herty has purchased a two metric green tons per hour pilot Belt-o-matic dryer from B.N.W. Industries, a leading producer of belt dryers. The Herty dryer is a horizontal, continuous flow, conveyor-type with two pass design, adjustable product depth and design based on hot drying air flowing through the chip bed. The dryer design is based on drying 2 tons per hour of feed material from 60 to 5% moisture content in 30 minutes. The energy consumption for water removal is quantified. Drying studies can measure biomass residence time (e.g., bed depth and belt speed) as well as air flow rate and temperature.
- Secondary resizing – A preferred biofuel feedstock requires consistent particle size and high specific surface area for optimal kinetics, e.g., enzymatic hydrolysis glucose yield. Herty has purchased a Meadows pilot hammermill (5 green tons/hour feed capability) equipped with interchangeable outlet screens suitable for secondary resizing to specific particle sizes. Power consumption is quantified.
- Blending and Storage– Herty has facilities to evaluate the impact of blending and storage of specific biomass materials on feedstock properties. Storage investigations can include effects of covered versus uncovered biomass, pile size, biomass form (piles versus bales), and biomass type, with parameters to be measured including moisture content, heating value, and composition.
- Pressure Digestion Vessel and Blow Tank – Herty has a new pilot batch digester capable of processing various types of biomass (capacity; 0.5 tons green wood chips/batch). The unit is 90 cu. ft., 150 psig, 304 SS, insulated and steam-jacketed, with a sight glass, externally-heated liquor recirculation, an insulated blow line and a blow tank.
- Densification - Herty has available a pellet mill with capacity of 400 lb/hr (various biomass feeds), steam conditioning capability of the feed prior to pelletizing, and interchangeable dies and variable compression ratio.

SPECIFIC LABORATORY, PILOT PLANT, AND MODELING CAPABILITIES

Economic Analyses

- Scenario based harvest/ transportation/process evaluation
 - Most cost effective methods for harvest and transportation
- Energy consumption measurement and estimation for biomass feedstock processing
 - Drying, size reduction
- Biomass supply economic analysis
 - Analysis and evaluation of impact of new facilities for production of heat, power, electricity and liquid fuels
 - Thermochemical and biochemical conversion routes
 - Biomass electricity generation
 - Pelletization
- Feedstock availability drain model

Sample Acquisition and Assay

- Representative sampling protocol in production environments
- Characterization of size distribution, bulk density, and thermal properties
 - Size distribution based on chip thickness with Domtar classifier (wt %)
 - Size distribution based on chip length and width with Williams classifier (wt %)
 - Fines content (various size screens, wt %)
 - Specific gravity (bulk density), g/cc
 - Heating value (kJ/kg ((BTU/lb)) – (e2K bomb calorimeter)
 - Thermal analyses (Thermal Gravimetric Analyzer (TGA/ DTA), DSC)
- Measurement of value enhancing and reducing components
 - Moisture content (wt %)
 - Bark content (wt %)
 - Lignin content (wt %)
 - Carbohydrate content (wt %)
 - Ash content (wt %)
 - Ash elemental analysis – Perkin-Elmer Inductively-Coupled Plasma Unit (ICP)
- Compile data and prepare reports



Figure 2 – Herty Bomb Calorimeter

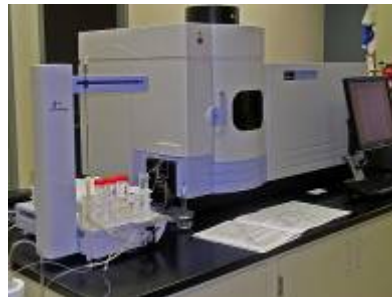


Figure 3 – Herty ICP Unit

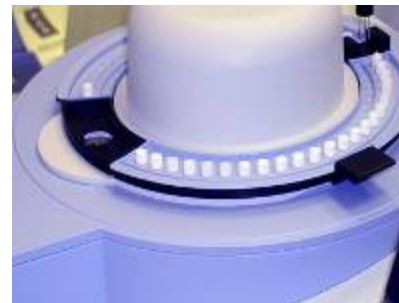


Figure 4 – Herty TGA/DTA



Biomass Supply Chain Organization and Feedstock Production

- Standard feedstock preparation and supply in trucks or supersacks
 - Sampling
 - Characterization
 - Chain of custody operations
- Biomass size reduction and drying capabilities for any given size or moisture content
 - Commercial chipping, grinding capabilities
 - Pilot belt dryer, Belt-o-matic, 2 tph 2-pass
 - Pilot hammermill, Meadows, 5tph, choice of screens
- Biomass processing
 - Densification – pilot pellet mill, 400 lbs/hr
 - Biomass conversion – pressure digestion vessel, 0.5 tons/batch, 150 psai digester with insulated blow tank
- Process testing and equipment and process development
- Integration and facilitation of work between partners in both public and private sectors



Figure 5 – Trial Commercial Chipper at Herty



Figure 6 – Herty Pilot Belt Dryer



Figure 7 – Herty Pilot Hammermill



Figure 8 – Pilot Pellet Mill



Figure 9 – Herty Pilot Digester