



Bioenergy Feedstock Characterization Laboratory

Advanced biomass characterization to evaluate feedstock quality for processing and conversion performance

The Bioenergy Feedstock Characterization Laboratory features advanced capabilities for sample preparation, analyzing storage performance and predicting conversion performance.

Compared with other energy products, biomass is highly variable. Chemical and physical attributes differ widely between different types of biomass. But even biomass samples of the same type may differ from year to year, field to field, and from different locations in the same field.

Variability makes it challenging for the nation's bioenergy producers to adequately predict feed-handling and conversion performance of biomass feedstocks. The in-house Bioenergy Feedstock Characterization Laboratory at the Department of Energy's Biomass Feedstock

National User Facility (BFNUF) provides a solution. The laboratory allows researchers to determine the causes of variability and evaluate how biomass characteristics affect processing, conversion and yield.

THE BFNUF IS DIFFERENT

Like a commercial laboratory, BFNUF researchers use standardized, repeatable laboratory techniques to characterize biomass. Data from the laboratory are considered some of the most reliable information available.

Unlike commercial laboratories, the BFNUF characterization laboratory features advanced capabilities for sample

preparation, characterization, analyzing storage performance and predicting conversion performance.

BFNUF researchers specialize in scale up and integration of biomass preprocessing facilities, so they understand connections between material properties, processing conditions and feedstock quality.

With the characterization laboratory's counterparts — the Process Development Unit and Bioenergy Feedstock Library — BFNUF provides the bioenergy industry with experts and data to minimize or eliminate feedstock problems before costly setbacks occur.





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FOR MORE INFORMATION

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CHARACTERIZATION CAPABILITIES

Chemical Compositional Analysis:

Analytical procedures established by the National Renewable Energy Laboratory and others help researchers determine the composition and summative mass closure of biomass feedstock materials by fractionating samples to characterize all constituents in the feedstock sample (e.g., ash, carbohydrates and lignin).

Thermochemical Feedstock Properties:

Researchers use proximate, ultimate and calorific analysis methods based on the American Society for Testing and Materials' standards to evaluate the chemical constituents, combustion characteristics and energy content of a given feedstock. Thermogravimetric analyzer/differential scanning calorimetry and gas chromatography techniques help scientists analyze caloric effects to better understand biofuel properties.

Rapid-Screening Techniques:

Rapid-screening techniques — predictive near-infrared, mid-infrared spectroscopy, solid-state nuclear magnetic resonance spectroscopy and x-ray fluorescence — allow researchers to determine chemical constituents and elemental ash values in minutes instead of days or weeks. Capabilities also include automated dilute-acid pretreatment with enzymatic hydrolysis, a faster, less costly method to analyze biochemical conversion potential of bioenergy

feedstocks and a bench-scale microwave pyrolysis reactor to evaluate thermochemical conversion potential of bioenergy feedstocks.

Particle-Size Distribution and Morphology:

Researchers use various methods and instruments to determine particle size, size distribution, shape and density. Methods include a particle image analyzer to measure particle features such as geometric mean diameter length and width, sphericity, and aspect ratios.

Microscopy and Imaging:

Digital, Raman microscopy, scanning electron and Fourier-Transform infrared microscopy help researchers develop mechanical and chemical preprocessing and densification options that impact the chemical and physical attributes of feedstocks.

Particle Characteristics:

Researchers use pycnometry to determine true, envelope and skeletal densities, and gas sorption analysis to determine surface area, pore volume, average pore size, and pore size distribution of microporous and mesoporous solids.

Rheology:

Researchers test biomass flowability using a rheometer, 2-D and 3-D image analysis of size and shape distribution of bulk solids, an automated Schulze ring shear tester, uniaxial compressibility and springback analysis, air permeability analysis, auger feeding tests, and hopper flow tests. Time-Domain NMR spectroscopy has also

been used to understand water distribution impacting particle rheological behaviors.

Lignin Chemistry:

At any point during a biomass conversion process, researchers can use NMR spectroscopy to analyze lignin chemistry from isolated and purified lignin or from lignin still intact within the cell walls.

Biomass Storage Simulation:

Storage simulation reactors help researchers monitor feedstocks in a variety of storage conditions to understand biomass losses from microbial degradation. These highly instrumented and automated storage reactors determine microbial action by monitoring the evolution of CO₂ and heat generation over time.



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Battelle Energy Alliance manages INL for the U.S. Department of Energy's Office of Nuclear Energy.