BFNUF researchers use the characterization laboratory's advanced capabilities for sample preparation, characterization and storage analysis to provide industry with high-quality data on biomass feedstock performance.

Changing the World's Energy Future

Bioenergy Feedstock Characterization Laboratory

Advanced biomass characterization to evaluate feedstock quality for processing and 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 biomass characterization laboratory at the Department of Energy's Biomass Feedstock National User Facility (BFNUF) provides a solution. The laboratory allows researchers to evaluate how biomass characteristics affect processing, conversion and yield.

BFNUF Is Different

Like some commercial laboratories, 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 capital outlays.

Characterization Capabilities

Chemical Compositional Analysis: Analytical procedures established by the National Renewable Energy Laboratory

Idaho National Laboratory

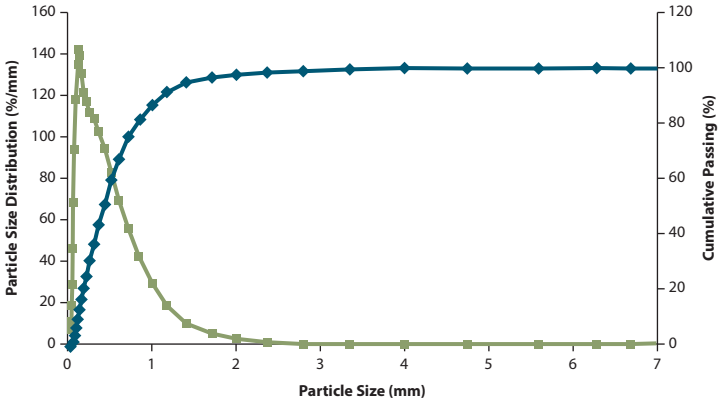
and others help researchers determine the composition and summative mass closure of biomass feedstock materials by fractionating samples to characterize all constituents in the feedstock sample (e.g., ash, carbohydrates and lignin).

Thermochemical Feedstock Properties:
Researchers use proximate and ultimate analysis techniques to evaluate the thermal efficiency 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.

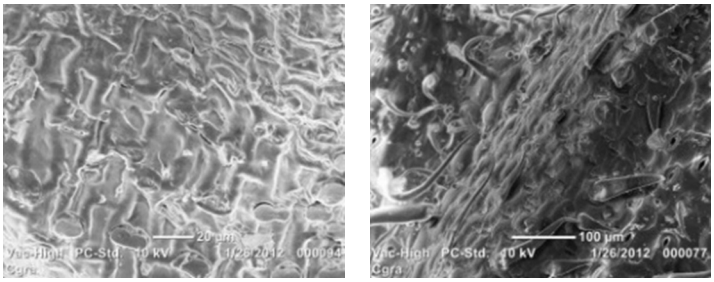
Rapid-Screening Techniques:
Rapid-screening techniques — predictive near-infrared spectroscopy and laser-induced breakdown spectroscopy — allow researchers to determine proximate and ultimate analysis and elemental ash values in minutes instead of days or weeks. Capabilities also include automated dilute-acid pretreatment with enzymatic hydrolysis, a faster, less costly method to analyze 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 Camsizer that can determine geometric mean diameter length and width, sphericity and aspect ratio.

Microscopy and Imaging:
Digital, confocal laser, 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-size distribution of sorghum, as determined by a Camsizer dynamic image analyzer



NeoScope scanning electron microscopy characterization of unprocessed (left) and densified corn stover (right)

Particle Characteristics:
Researchers use pycnometry to determine true 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. Mercury porosimetry is also available.

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.

Lignin Chemistry:
At any point during a biomass conversion process, researchers can use nuclear magnetic resonance 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 CO_2 over time.

For more information

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