NREL
NATIONAL RENEWABLE ENERGY LABORATORY

New NIR Calibration Models Speed Biomass Composition and Reactivity Characterization

Highlights in Research & Development

Using near-infrared (NIR) spectroscopy, NREL researchers have developed powerful tools to rapidly estimate biomass feedstock characteristics.

An NREL scientist analyzes herbaceous feedstocks using a near-infrared spectrometer with an autosampler in NREL's Biomass Analysis Technology Lab.
Photo by Dennis Schroeder, NREL 34510

Obtaining precise chemical composition and reactivity information (measures of carbohydrate release and yield) for biomass feedstocks in a timely manner is necessary for the commercialization of biofuels. Accurate measurement of biomass carbohydrate content and carbohydrate accessibility are of prime importance because they are directly proportional to production yields of biofuels and biochemicals. Recently, researchers from the National Renewable Energy Laboratory (NREL) developed broad-based, multi-species feedstock models to predict these valuable characteristics by using multivariate statistics to correlate laboratory data on biomass composition and reactivity to NIR spectra of a population of mixed feedstocks.

By analyzing feedstock samples such as corn stover, sorghum, switchgrass, perennial cool season grasses, rice straw, and miscanthus, NREL researchers demonstrated the effectiveness of multispecies feedstock models for composition and carbohydrate release and yield. The new methods provide an alternative to single-feedstock models, which although effective, cannot support researchers studying different feedstocks grown in different geographical regions, nor do they support characterization of feedstock blends. The new models are also particularly useful when a well-developed single feedstock population is not available. Additionally, these methods demonstrate the feasibility of using a higher throughput form of scanning that uses an autosampler and disposable glass vials.

The NIR calibration methods were built on decades of NREL compositional analysis research. They not only provide a rapid, cost-efficient means to accurately predict composition and reactivity for a wide variety of biomass feedstocks simultaneously, they also impart the ability to scan large numbers of samples relatively quickly. This high-throughput method is increasingly valuable for screening large numbers of plants for suitability as biofuel feedstock as part of agronomic field trials.

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References: Payne, Courtney E., and Edward J. Wolfrum, "Rapid analysis of composition and reactivity in cellulosic biomass feedstocks with near-infrared spectroscopy," *Biotechnology for Biofuels*, 8, no. 43 (2015). http://dx.doi.org/10.1186/s13068-015-0222-2

National Renewable Energy Laboratory. "Standard Procedures for Biomass Compositional Analysis." http://www.nrel.gov/biomass/analytical_procedures.html

Key Research Results

Achievement

Researchers at NREL recently developed rapid methods to predict the composition and the release and yield of structural carbohydrates for a variety of mixed herbaceous feedstocks. These models correlate robust laboratory data with near-infrared spectra to generate predictive mathematical models.

Key Result

The models provide a rapid, cost-efficient means to predict composition and reactivity for a wide variety of herbaceous feedstocks (including corn stover, sorghum, switchgrass, perennial cool season grasses, rice straw, and miscanthus), allowing researchers to screen large numbers of samples quickly.

Potential Impact

The calibration models allow for the rapid estimate of feedstock characteristics that are critical for determining the value of these materials. These new methods are powerful tools for identifying promising feedstock samples for further research and development.

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