LANL moisture sensors work with partner's smart chutes to make biofuel production more efficient

Los Alamos National Laboratory

Moisture-sensing technology from Los Alamos National Laboratory (LANL) is designed to make conveyor-based biomass refineries more efficient, by identifying too-wet materials before they create clogged machinery.

Biomass, which is plant or animal material that can be used as fuel, is converted in a biorefinery. If a conveyor or chute becomes clogged, the refinery needs to be stopped, and the moisture-laden biomass needs to be removed by hand. This is among the factors currently keeping biofuel from being cost-competitive with diesel and gasoline fuels.

The patented LANL technology, which uses sound waves to quantify the moisture content of the material being processed, will soon be integrated with a "smart chute" system developed by Jenike & Johanson, a bulk-solids handling company. When the LANL acoustic sensor deems the biomass too wet to process—a possible clog risk—the Jenike & Johanson technology uses a computer to make a track change on the conveyor belt, redirecting the material to be further dried.

Under a cooperative research and development agreement (CRADA), LANL and Jenike & Johansen are integrating their technologies with an initial focus on corn stover (composed of the non-edible stalks, leaves, cobs, and husks left over from harvesting), one example of a type of biomass that is particularly prone to excessive moisture content. Sound waves are directed through the corn stover; the extent to which the sound waves change as they pass through the material indicates the moisture content.

Currently, the target location of these acoustic moisture sensors is at the bottom of the feed hopper supplying corn stover to the "smart" transfer chute. When the acoustic moisture sensor detects moisture contents greater than 35%, the smart chute diverts the high-moisture material. When the moisture content returns to acceptable levels (<30%), the smart chute reactivates and directs incoming feedstock back into the integrated biorefinery process. The too-wet feedstock that was diverted is further processed to an acceptable moisture level before being reintroduced to the handling train.

Above: A prototype conveyor at Los Alamos National Laboratory moving bulk material and measuring moisture content.

Many acoustic sensors can be applied throughout the handling train to monitor moisture content at each stage of the biorefinery process. The actual location will depend on an integrated biorefinery's plant design.

The cost of plugged transfer chutes and processing stoppages is significant in industries beyond biomass. This integrated novel technology could also be applied to bulk solids handling and transportation in the pharmaceutical manufacturing, wood-composite, mining, food-processing, and biochemical industries. Similar to biorefineries, their operations are based on processing significant amounts of bulk material, and processing efficiency and work stoppage are sensitive to moisture content.

While excessive moisture is certainly a challenge, insufficient moisture also presents safety and handling problems that can be avoided using the integrated smart-chute system. Materials that are too dry can project unsafe volumes of dust into the air, causing breathing problems, clean-up delays, excessive wear and tear on machinery, and possible dust explosions.