A process for pelleting raw biomass without a rotary dryer could help make biofuels more sustainable and more profitable for U.S. bioenergy companies.

High-Moisture Pelleting Process

Approach could reduce densification costs by 40 percent

Technological Marketing Summary

At the Biomass Feedstock National User Facility (BFNUF), Idaho National Laboratory researchers help overcome key technical barriers facing the U.S. bioenergy industry, in part by investigating advanced feedstock supply and logistics, including preprocessing and characterization.

Densifying biomass into pellets or briquettes helps overcome raw biomass limitations such as low mass and energy densities. This preprocessing can reduce transportation costs and improve flowability, processing performance and conversion performance for biorefineries. But the cost of such processing has been a persistent concern.

INL researchers have developed a pelleting process for various high-moisture feedstocks such as switchgrass, corn stover, lodgepole pine, municipal solid waste and chemically pretreated biomass. These high-moisture pellets retain the advantages of densified biomass while reducing overall pelleting costs. Secondary benefits include reduced volatile organic chemical emissions because of the low-temperature drying method associated with the process.

Description

Traditional pelleting processes typically involve drying biomass in a 160 C to 180 C rotary dryer to achieve 8 to 12 percent moisture content before the biomass is processed in the pellet mill. The High-Moisture Pelleting Process eliminates the energy-intensive rotary drying stage.

Instead, high-moisture biomass goes through two grinding steps and enters the pellet mill at moisture contents higher than 20 percent. Some high-moisture pelleting techniques require a short preheating step or a binder such as cornstarch. Frictional heat generated in the pellet die due to compression and extrusion of biomass results in about 5 to 10 percent moisture loss in the biomass. The high-moisture pellets are then further dried to about 9 percent moisture content in a grain dryer.

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With the High-Moisture Pelleting Process, INL researchers are able to reduce the overall preprocessing cost of pelletized biomass by 35 to 40 percent using biomass with moisture contents ranging from 20 to 39 percent. Those savings include a roughly 55 percent reduction in operating energy costs and a 35 percent reduction in capital costs compared to traditional methods. The pellets produced from the high-moisture process have bulk density and durability in the range of 400-610 kg/m3 and 90 to 98 percent, respectively.

Benefits

- Overall preprocessing cost of pelletized biomass is reduced by 35 to 40 percent.
- Pellets formed using biomass with moisture contents ranging from 26 to 39 percent.
- Bulk density and durability are in the range of 400-610 kg/m3 and 90 to 98 percent based on the initial moisture content and type of the biomass.
- Process is environmentally friendly due to fewer volatile organic emissions during drying.

Applications and Industries

- Biorefineries
- Timber industry
- Animal feed
- Landscaping
- Ethanol byproducts
- Pyrolysis byproducts

A: Raw municipal solid waste

B: Municipal solid waste pellets

C: High moisture corn stover pellets

D: High moisture alkaline pretreated corn stover pellets

Related publications

Hoover, A. N., Tumuluru, J. S., Teymouri, F., Moore, J., & Gresham, G. (2014). Effect of pelleting process variables on physical properties and sugar yields of ammonia fiber expansion pretreated corn stover. Bioresour Technol, 164(0), 128-135.

Tumuluru, J. S. (2014). Effect of process variables on the density and durability of the pellets made from high moisture corn stover. Biosystems Engineering. 119: 44-57.

Tumuluru, J. S. (2015). High moisture corn stover pelleting in a flat die pellet mill fitted with a 6 mm die: physical properties and specific energy consumption. Energy Science & Engineering. 3: 327–341.

Tumuluru, J. S. (2016). Specific energy consumption and quality of wood pellets produced using high-moisture lodgepole pine grind in a flat die pellet mill. Chemical Engineering Research and Design. 110: 82-97.

For more information

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