Biomass Densification/ Pelletization

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Abstract:

The operational characteristics of a small scale biomass pelletizer were studied, in an attempt to assess the impact of feedstock and process variables on pellet quality and tendency of plugging. Ground switchgrass (6mm screen) was used as the primary feedstock for tests on a "horizontal rotating plate die" pelletizer with 6mm die openings. Variations in moisture content, particle size, admixture material, and operating procedure were tested. Pellet quality and tendency of plugging were measured using a subjective scale, and power demand measurements are underway.

Why we study biomass densification?

Penn State's Department of Agricultural and Biological Engineering Department is one of the leaders in applied and fundamental research and outreach in the area of biomass densification in the Commonwealth of Pennsylvania.

Biomass represents a significant opportunity for producing a local, renewable and sustainable source of energy that can help meet the nation's energy demands. However, the physical characteristics of most biomass crops are not easily adaptable to energy using equipment such as combustors and gasifiers. In addition biomass feedstock is not cost effective to transport to the end user due to its relatively high volume and low output energy value.

Variations in fresh harvested biomass properties can be quite significant – leading to difficulty in designing systems that can utilize the fuel in an efficient manner.

Densification of the biomass crop material is one way to transform biomass material into a higher density, higher value, consistent quality product that is readily transported and utilized in advanced combustion systems and other energy systems.

Results:

Results indicate that unmodified ground switchgrass does not readily or reliably densify into pellets. Poor pellet quality and/or die plugging were common - which indicates the difficulty of establishing appropriate rheological conditions when the properties of the ground switchgrass are coupled with the operating characteristics of the pelletizer. Addition of moisture alone did not yield repeatedly suitable results, nor did the addition of oil. However, it was found that by incorporating starch and moisture in combination consistently yielded a higher pellet quality.

Preheating the die was crucial in successfully creating the pellets, and an ideal running temperature was approximately 95°C (about 200°F). Running soybeans or other hard biomass material through the die helped to unclog the die without having to stop running the machine. Maintaining tight contact between the roller and the die was found to be an important operational characteristic, because it allowed for the material to be compacted tighter and resulted in a higher density pellet.

Small Scale Pelletization:

There is a growing interest in on-farm pelletization of biomass for fuel manufacturing. While sever models of small scale pelletizers are available of the market there is relatively little that is known about the energy efficiency or performance of these devices. Penn State is conducting an ongoing project in this area to determine the characterizations and fundamental running practices that will yield the most efficient and successful pelletization, in order to develop guidelines for on-farm use. One of the primary goals of this effort is to identify the key performance characteristics that can be related to the operating conditions within the pellet mill, and identify the appropriate combinations of feedstock type, particle size distribution, moisture content and feed rate that result in the highest quality fuel.

Outreach to the community:

Penn State publishes educational material on biomass densification and conducts presentations and workshops aimed at enabling the local community to safely and effectively take advantage of opportunities in biomass pelletization and densification. Visit the Renewable and Alternative Energy Extension website at http://energy.extension.psu.edu to get an overview of programs and materials.

For more Information:

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