Grass Pelleting – The Process

Purpose: The purpose of this publication is to describe the steps involved in pelleting biomass.

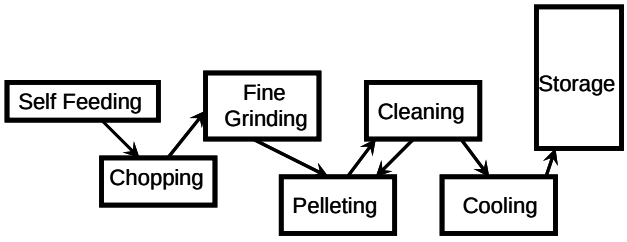
Worldwide Perspective

Grass biomass is a bulky material that can be burned as whole bales, chopped and burned, or powdered and burned without densification. Densification into briquettes, cubes or pellets, however, gives the feedstock more uniform density and physical size, which improves handling, storage, transportation, and control over the combustion process.

World-wide, a commonly used form of biomass densification is the small scale production of briquettes for cooking and heating. Dry biomass residues are ground to a uniform consistency, partially composed, mixed with water, and pressed into fuel briquettes with a manual press. Dried fuel briquettes are use as fuel for cooking or heating.

A fuel briquette press.

Cubing would also work for this purpose, but requires a significant equipment layout and power source. Both cubes and manually-made briquettes are suitable for manual feeding of cooking or heating stoves in developing countries. Cubes and briquettes are normally mass produced for use in large biomass combustion systems. Pellets, on the other hand, are best suited to mechanized small-scale heating appliances.



Schematic of the grass pelleting process.

Chopping

Herbaceous plant material must be reduced in size prior to grinding. This is typically accomplished with a tub grinder. Bales or portions of bales are either manually transferred to the chopper using a loader, or are fed in automatically using a conveyor belt. This chopping process reduces particle size to facilitate feeding and fine grinding. Some method of separating any metal or stones from the feedstock prior to grinding is advisable. Missing from the schematic above is a very significant component of a wood pelleting operation: the drying unit. Sawdust is typically around 30% moisture and must be dried prior to processing. Grass hay does not require any additional drying before pelleting.

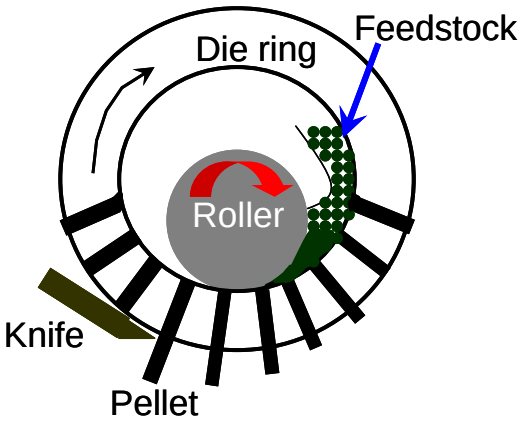
Grinding

The chopped material is transferred by auger or vacuum system to the hammer mill. A cyclone mounted above the hammer mill separates air from the chopped material. The hammer mill grinds grass biomass to a size appropriate for pelleting. A combination of beating and cutting is used to pass the material through a 1/8 inch or smaller mesh screen. Ground material again needs to be separated from air prior to pelleting, this is accomplished in a second cyclone mounted above the pelleting unit. Air pressure or augers move the ground material up into the cyclone.

Pelleting

Virtually all pellet presses in North America use ring-type dyes, some regions of the world use flat dyes. By rotating the dye ring, frictional forces turn the roller assembly, and a thin

layer of ground material between the roller and dye is forced through the dye holes. The extruded pellets are cut to length. Perforation diameter and dye thickness determine pellet size. Different feedstocks may require different dye specifications for optimum pelleting. Some moisture may be added to the material if it is too dry for pelleting. Moisture content should be approximately 10-15% depending on the specific equipment. Steam may be used at startup to heat the dye assembly up to a temperature that optimizes pellet formation. Normally binders have not been used with grass to improve pellet hardness and stability. If process parameters are matched to feedstock properties there should be no need for binders. Often grass pellets are short, and may not be structurally stable. A variety of binders could be used, if required, to improve pellet hardness and stability.



Pellet die and roller assembly.

Pellet Formation

The compaction process begins with mechanical forces bringing individual particles in close contact. The feedstock is physically crushed to eliminate open spaces, from hollow stems to intracellular space. A combination of temperature, pressure and moisture conditions will cause some components of the feedstock to soften and become plastic. In this plastic form materials become elastic and "flow", increasing the physical contact between particles. A variety of physical forces act to give strength to the densified particles, from short-range atomic bonding to mechanical interlocking. Successful pelleting will result in a matrix of plant fiber cemented together in a stable densified unit.

Cleaning, Cooling, and Storage

Pellets are very hot and soft following the extruding process. The individual feedstock, the grinding process, and various adjustments to the pelleting process will influence the percentage of fines in pelleted material. Pellets should be screened to remove these fines. The screenings are returned to the pelleting unit for reuse. Pellets need to be quickly cooled within a few degrees of ambient temperature, or they will attract moisture. Pellets will loose about two percentage units of moisture during the cooling process. Pellets can be stored in ground level silos, or in elevated storage bins to facilitate loading for bulk transportation.

Pellets

Pellet Fuels Institute quality standards for wood pellets require a bulk density of no less than 40 lbs per cubic foot and fines no more than 0.5% by weight. Fines are particles that pass through an 1/8 inch screen. Most pellet mills produce a cylindrical pellet up to 1.5 inches long with a ¼ to 5/16 inch diameter. Premium wood pellets must be less than 1% ash, with a maximum of 300 ppm chloride. High chloride content will cause increased corrosion in the heating appliance. The goal is pellets that are free flowing, essentially dust free, and are relatively compact for storage.

Summary

Grasses can be pelleted with some effort, and drying of the grass feedstock is not necessary. Grasses may require some type of binder to produce pellets with physical quality similar to wood pellets. There is some concern about plant silica causing wear on equipment. Pelleting requires a significant capital investment, and a major time commitment to master the art of pelleting.

For more information

Cornell University
Cooperative Extension

Dept. of Crop & Soil Sciences
http://www.GrassBioenergy.org
J.H. Cherney
E.V. Baker Professor of Agriculture
JHC5@cornell.edu