Azeus Machinery Co.ltd

Email: info@biopelletmachine.com

Website: www.biopelletmachine.com

Key words: miscanthus pellets, biomass, fossil fuel, renewables energy, miscanthus fuel pellets

Energy Crops Pellets - a Revolution for Miscanthus

1. An Introduction to Miscanthus

Latitudinal distribution

Miscanthus is a C4 rhizomatous grass of about 15 species of perennial grasses native to subtropical and tropical regions of Africa and southern Asia (with one species (M. sinensis) extending north into temperate eastern Asia), which was introduced to Europe from the Far East in the 1930's as an ornamental and from the 1950's has been developed into a biomass crop through research, breeding and selection programs with considerable potential in a wide range of climatic zones including temperate Europe, and is being increasingly grown as an energy crop in Europe and America now. It reaches an average height of 3 m, and has potential yields of >20 t DM/ha/annul after 3 years under suitable climatic conditions.

Yield:

One acre of Giant Miscanthus, yielding 13 tons of harvest-able dry matter, can produce the same amount of energy as 12 tons of Powder River Basin coal. Miscanthus x giganteus is a perennial grass that grows as tall as 12 feet high and can produce an impressive 15 tons of biomass per acre annually, according to University of Illinois research.

In the Republic of Ireland, the dry matter yields from miscanthus can be expected to be similar to those for the North of England and in the range of 12-15 tonnes dry matter per hectare per year.

Properties

Property	Description
Moisture content at harvest	20-50%
Bulk Density(baled)	130-150kg/m^3
Bulk density at harvest(chopped)	70-100kg/m^3
Calorific value(net)	~17Gj/tonne(dry basis)
Ash content	Typically2-3%
Ash fusion(melting)temperature	1090℃
Temperature which some sintering observed	600℃

Uses:

Firstly, Miscanthus can be used as animal bedding - production of horse bedding
Then, Miscanthus is considered to be a raw material for the paper industry, a source of fiber to be used in building materials.
And, Miscanthus is also widely used as a fiber material in geo-textiles. Its use as canes to support ornamental pot plants and the use of miscanthus ash arising from combustion processes as a fertilizer is also being done.
The most important one is miscanthus has 80-90% of the energy value of the initial biomass material and can be manufactured into pellets or briquettes used as a raw material for energy production and co-firing. Energy production alternatives that have been examined are co-combustion with coal and combustion in heating plants.
In Ireland, there is an increasing awareness of the need to reduce greenhouse gas emissions in line with Kyoto commitments and to develop alternative energy sources to reduce dependence on finite fossil fuel resources. The Irish government has adopted the European Union's Renewable Energy Directive target of 20% of overall gross energy consumption by renewables by 2020, Irelands mandatory target being 16% , further driving the need to develop indigenous bio-energy resources.

2. Miscanthus pellets making process

Miscanthus is a kind of perennial energy crop that grows over three meters tall, resembles bamboo and produces the crop every year without replanting. The rapid growth, low mineral content and high yield have made miscanthus emerging as biomass fuel. While miscanthus may be less straightforward to utilize as a fuel in biomass boilers without some pre-processing such as cubing or pelleting. **The most flexible fuel format is pellets,** and miscanthus fuel pellets can be produced for prices similar to other Biomass pellets. The whole pelletizing processing includes: harvesting(including baling)-chopping-drying-pelletizing-cooling-package-storage.

2.1 Harvesting

Miscanthus is harvested annually during spring, typically with conventional farm machinery.

Timing:

In Ireland, after growing vigorously during the summer, Miscanthus stops growing during Autumn.The leaves drop off the crop and the stems dry as the winter proceeds reaching a moisture content of approximately 30% the following spring. Harvested biomass with lower moisture content is easier to store and the calorific value of biomass increases with decreasing moisture content. Early harvesting of Miscanthus (January, February) can produce a product with high moisture and leaf content which will be unsuitable for many applications. In contrast, delayed harvesting (late April) can damage the new growth of the emerging crop, research at Oak Park has shown that harvest traffic can cause permanent damage to emerging shoots. Consequently, the optimum time of harvest is between these two extremes, generally in March or early April. The soil must be suitable for heavy machinery.

Quality:

To ensure the best quality of product, it is important that Miscanthus is harvested at the correct moisture and stored in a suitable manner to keep it dry. The leaf litter layer which gathers on the ground under the crop over the winter should not be harvested. This leaf material that sits on the ground is generally excessively wet as it is in direct contact with the soil. The leaf material will be decaying, mouldy, definitely wet and have a high probability of containing soil or small stones. Inclusion of this leaf material could lead to an increase in both moisture content and ash content within the harvested material. Additionally, nutrients within this leaf layer provide nutrition for succeeding crops. Consequently, mowing height and the height of the baler pick-up should be set to avoid picking up this material. Additionally, it is important that mown windrows are not raked together as this will gather any decaying leaf material that will have fallen from the plants over the year and through the winter whilst drying.

Machinery:

Miscanthus can be harvested either by a self-propelled harvester as used for forage maize, with the dry chipped material handled in bulk, or mown, allowed to further dry

in swaths and subsequently baled, pelleted or chipped and stored for future use as a fuel.

Machinery similar to that used for harvesting maize is suitable for harvesting Miscanthus due to the height and strength of the Miscanthus stems, but bulk handling and storage of the fresh chips may lead to moulding, heating and deterioration if the moisture content is not below 20%. Alternatively, the Miscanthus is mown to reduce the rigidity in the stems and to increase moisture loss, then swathed and chopped or baled. A variety of balers can be used with round bales having a DM density of 130 kg/m3 and square bales having a DM density of 150 kg/m3.

Miscanthus may also be harvested using a compact roller baler giving bales with a density of 300-350 kg/m3 or by specialized equipment such as that used for harvesting reed grass.

It was concluded that the mower conditioner was more suitable for Miscanthus harvesting for the following reasons:-

• More efficient biomass recovery
• Better swath dimensions
• More rapid activity
• Greater stem conditioning, enabling
• Better bale formation

2.2 Chopping

When miscanthus is harvested and baled in the field to increase density and maximize transport efficiency, it is then transported to the processing facility where it is chopped. **Miscanthus is chopped into fibers (25mm-35mm lengths)** using a chopper or bale shredder then dried and pelleted.

2.3 Drying

The chopped miscanthus is further dried using a drier to allow processing to pellets. **The required moisture content for pelleting is 10%-15%.**

2.4 Pelletizing

• a variable speed auger conveys miscanthus to the hammer mill
• binders can be added and mixed in the lifting screw
• mixed ingredients are loaded into receiving hopper
• a vibrating sieve takes out the dust and fines which are recycled
• hot miscanthus pellets exit mill via a collection chute
• hot pellets are cooled down in a pellet collection conveyor fitted with cooling fans,and the belt speed is variable to ensure that pellets have chance to cool before storage

Functional characteristics of miscanthus pellets as follows:

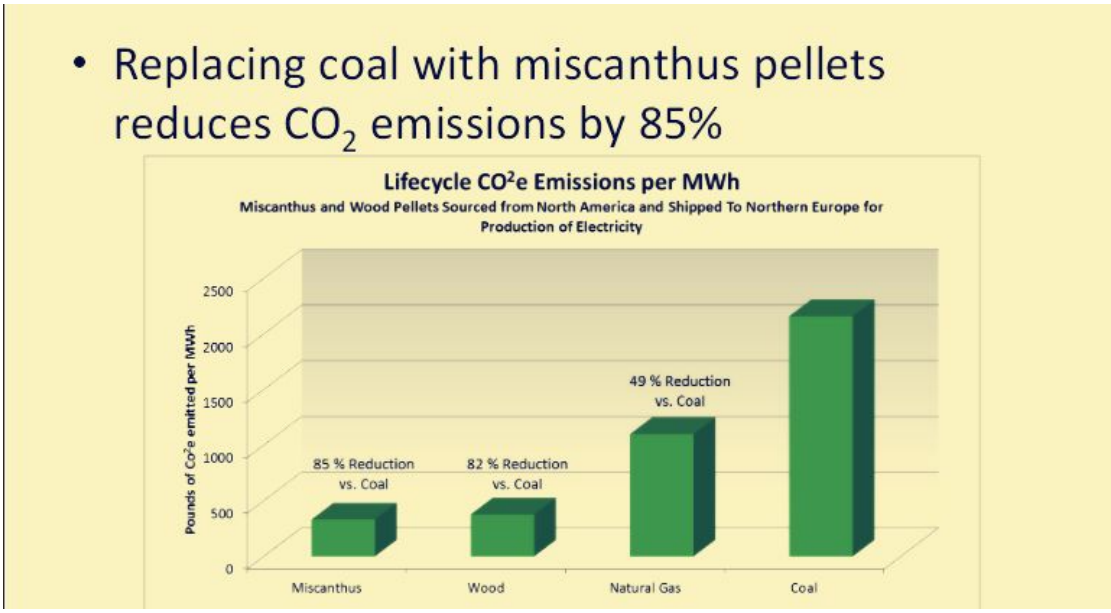
Parameter	Value
Diameter(mm)	6
Moisture content	<8%
Net calorific value(MJ/kg)	18
Energy required(MJ/GJ)	272.1
Density (kg/m^3)	600
GHG(green house gas) emission	15.5-20.23kg CO2 eq/GJ

2.5 Packaging

After cooling process, the miscanthus pellets will not directly enter into the fuel process, avoiding the miscanthus pellet affected with damp, the packing process is very necessary. The packing process is effectively handled by pellets packing machine. They can be packaged in 20kg eco-friendly paper bags, as well as 15kg plastic bags.

3. Application of miscanthus pellets in Ireland

Market opportunities for those pellets lie in combined-heat-and-power applications and commercial power plants, but primarily in agricultural heating markets create an environment more conducive than other heating fuels.



They can also be used for bedding, such as beds for equine, small pets, reptiles, poultry and cattle. Here we have to discuss the benefits for animal bedding and how to use.

Benefits:

• natural, sustainable and eco-friendly
• superior absorbency and odor control
• create a soft, springy and non slip surface
• virtually dust free (made from 6mm fibers, not sawdust)
• easy to store and use (no watering required to activate)
• easy to dispose of (composts quickly)
• long lasting and cost effective (need 1 bag per week)
• carbon neutral in 1 year (wood requires 20 years +)
• sourced and made in Great Britain

How to use:

Spread the miscanthus pellets around to produce an even layer using a fine tine fork. If required, spray the pellets with a little water (approx. 3 liters per bag) and wait 30 minutes. Remove dropping daily, replacing pellets as required - in most cases, using Pellet Beds, people will not need to add any additional water.

Although the pellets are virtually unpalatable, when using them for the first time and especially if your cattle has a tendency to eat bedding, please lay a test sample. To initially establish the bed and reduce the possibility of bed eating, spray the pellets with a little water and wait 30 minutes.

4. Market conditions of miscanthus pellets in Ireland

Price

In terms of price, Miscanthus is directly competitive with conventional fossil fuel heating sources, such as oil, even at today`s values. With reported prices for miscanthus pellets bound for Europe at $100 per ton, a 10 ton per acre yield of the tall perennial grass would be competitive with even high-priced corn.

Opportunity

The use of miscanthus pellets offers a number of potential benefits which include import substitution and greenhouse gas mitigation in addition to offering an alternative enterprise for farmers. Among non-wood pellets (including willow, miscanthus, rape and cereal straw pellets), pellets manufactured from willow and miscanthus were easiest to make, had the highest quality and had the lowest levels of particulate and gaseous emissions on combustion.

Future prospect

Miscanthus pellets are not currently manufactured on a commercial scale at all in Ireland. However, a number of support mechanisms are currently in place to develop a market for solid bio-fuels in Ireland. The Reheat and Greener Homes schemes have generated huge interest in using biomass pellets heating fuels. New markets have been developed for wood chips and pellets from miscanthus and sawmill residues. Interest is now beginning to emerge in using miscanthus in biomass boilers. The initial target market would be buildings with a large, continuous heat demand such as hotels and hospitals.

The use of miscanthus pellets as a co-fuel in the peat burning electricity plants could potentially open up a significant market outlet for these crops. The three peat stations burn a total of 3 million tonnes of peat per annum. Delivery on the 30% co-firing in the peat stations by 2015 would require biomass pellets to replace 0.9m tonnes of peat. About 0.6m tonnes of biomass pellets would be required to meet this target.

Miscanthus pellets have the potential to make a significant contribution to Irish energy supply concerns, in combination with all other available RES sources.