IEE/09/758/SI2.558286 - MixBioPells

WP 3 / D 3.2.

"Best practice examples" for the production of alternative and mixed biomass pellets

Author: Markku Kallio (VTT - Technical Research Centre of Finland)

With support of the project partners:

Bioenergy 2020+
DBFZ – Deutsches Biomasseforschungszentrum)
SP – Technical Research Institut of Sweden
DTI - Danish Technological Institute
Protecma – Energia Y Media Ambiente S.L.
CTI - Italian Thermotechnical Committee

Supported by the European Commission under the EIE programme

INTELLIGENT ENERGY EUROPE

Table of contents

1 Introduction

Since the pelletizing properties of alternative raw material differ a lot from wood and the pelletizing process is of great relevance for the physical properties of pellets a special focus has to be on the technical details of the pelletizing process itself. So compared to wood, other dies are usually needed to reach optimum results. Another difficulty is that the bulk density of several alternative materials is much lower than of wood dust. Since the feeding systems of present presses have not been planned for low density materials, problems can occur and the production capacity of the press might be rather low.

To give an overview about the actual state of the art for pelletizing processes with alternative and mixed raw materials, best practice examples highlight successful strategies as well as common problems and motivations of the involved key actors in Austria (AT), Denmark (DK), Finland (FI), Germany (DE), Italy (IT), Spain (ES) and Sweden (SE). They are highly valuable to increase the market relevance of alternative mixed biomass pellets in Europe since they can be used as guideline for future projects.

2 Method

The best practice examples were developed based on existing projects and were at least partly realised. Based on the experience and technical facts the “Best Practice” examples of production were chosen. “Best practice” examples of the production can be enhanced to other raw materials and also the presented technology can be applied to the other tasks of bioenergy.

2.1 Preparation of the template for the best practice examples

In the steering group and project meetings, structure and content of the best practice examples were discussed. The suggestion for the content was divided to four main parts:

1. Introduction
   - A short description of the company and public facts.
   - A short description of the background and why it is necessary to use the raw materials as fuel
2. Raw materials
   - A description of typical characteristics and properties of the used raw materials,

- A description of the utilization and problems

3. Pelletising process
   - A description of the process and the used technology
   - The properties and costs of the produced pellets
   - Possible problems and solutions.
   - lessons learned,
4. Producers view
   - View of the producer on further developments in the market and technology

A MS WORD template including labels and instructions was prepared by the WP leader and provided to the project partners, Figure 1. The template was accompanied by a complete and finalised best practice example from Finland as guideline. Each partner prepared a best practice example in close cooperation with the local industry partner in English which was translated in the national languages of the MixBioPells partner countries and uploaded on the project website. The selection criteria of the best practice examples are described in the following chapter.

Pelletizing straw and grass at Biobotnia Oy

Background

Biobotnia Oy is a company in Jalasjavi, founded in 2009. The company has specialised to production of renewable energy. Company has a mobile pelletising unit, by witch it is possible to grind and pelletise fibrous grasses and straw, e.g. straws of local grains and reed canary grass. The unit can be reserved for pelletising of larger storages of bales, in the minimum 100 bales. The mobile machine can crush a complete bale without any preliminary preparations, i.e. complete bales can be fed into the crusher as such.

Advances of straw pelleting are that raw material can be densified to 6 – 8 times smaller space. The heating value of the straw pellets is same as that of wood pellets, and it is real renewable energy! Straw pellets can be combusted with stoker burners or in fireplaces with so called "pelletbasket".

Raw material

There are several possible raw materials for fuels in the area; wood, peat, straw, reed canary grass and even mixtures of them.

Yield of straw is about 4 – 7 t/ha. In the area there is plenty of fields. Density of round bales is about 110 kg/m^3 and they weight 150 – 300 kg depending mostly on the moisture. Moisture content should be under 20%. There are also bigger bales, the density of which is little higher.

The pellets are made of reed canary grass, easily obtainable at the area. The potassium (K) and chlorine (Cl) contents of the plants diminish because these chemicals are water soluble and the reed canary grass will be harvested in spring. In spring the moisture content is about 10 – 15%. After one year's poor storage conditions the moisture content of bales can be up to 40%. Reed canary grass is usually baled with baling machines of the farm and stored in well covered stockpiles. A stockpile is situated on terrain and a truck transports the bales to the market. RCG is a plant which can grow in same, modest place for several years. Price of the reed canary crass, excluding the transport costs, is about 35 €/t.

Characteristics of the used raw material.

Raw-material	Grass (RGC)	Straw (ave.)
Moisture content, %	10 - 35	10 - 25
Heating value, MJ/kg	17.6	17
Bulk density, m^3/kg	90 - 140	80 - 150
Ash content, %	5 - 6	4.5 – 6.9
Ash melting temperature, C	1125	1175 - 1400
Cost of rawmaterial, €/t	30 - 50	0 - 30
Quantity in the area, t/a	14 000	8 000

Pelletising process

The pelletising process of Biobotnia Oy is mobile. Complete straw or reed canary grass bales are fed into the hammer mill of the machine. Hammer mill grinds the straws and the grinded material goes through a screen of Ø18 mm. Screen is rather coarse, but it works fine, if the moisture of bales is under 20%. Belt conveyer feeds a mixing bin and after that the raw material goes to the press.

Experimental pellets from straw and peat mixture.

The model of the press is CPM and type of the die is a ring die. At the moment the producer has ring dies of 60/6 and 60/8 mm. It is easy to pelletise reed canary grass with the die of 60/6 mm. Die 60/8 is little "loose" for straw pellets.

INTELLIGENT ENERGY EUROPE

Pelletizing straw and grass at Biobotnia Oy

Strawpellets include small amount of caoline for better heating results. Machine produces 1.2 – 2 t/h with different raw materials and dies. Pellets are cooled on belt conveyers. In the system there is a bin of 9 m^3, where pellets will gather. The bin has to be emptied every time it becomes full.

Data of pelletising.

Pelletising	
Technology type	Mobile unit, ring die
Production capacity, t/a	3000
Price of pellets, €/MWh (incl. VAT)	35

Producers view

Biobotnia Oy has participated to MixBioPells – project as a test pelletiser. It was made two kinds mixes straw/peat and wood/reed canary grass. A little difficulty was that the batches have to weight and mixed on the ground. In pelletising of the straw/peat (50/50%) –mix there were no difficulties with the former 8/60 mm die. The tests of wood/RCG were done with the die of 6/60 mm.

In everyday life Biobotnia Oy pelletises batches of 100 bales of straw and reed canary grass to local farmers. A farmer calls to Biobotnia Oy for pelletising of bales, which adds the order to the next working period of the pelletiser. The costs of the pelletizer vary. The contractor gets his salary per cubic meter of straw material pelletised.

In some cases, especially with reed canary grass, pellets are sold the price of day. A 100% read crass pellets are used as litter for horses so this is also one part of the business.

There is also a contract between local heat producer Jalasjärven Lämpö Oy and Biobotnia Oy to produce agripellets for district heating.

For pelleting it is needed more suitable dies for different raw materials. For a small entrepreneur the purchase of dies is expensive. Also there might be a bigger cooler in the future.

Mobile pelletising process. Complete bale can be put to hammer mill. Press is a ring die CPM.

Entrepeneur;
Harri Honkavaara
Biobotnia Oy
tel: +358 40 541 0802
fax: +358 6 457 2160
http://louhetar.fi/biobotnia

MixBioPells is a project supported by the European Commission under the EIE programme

The sole responsibility for the content of this report lies with the authors. It does not necessarily reflect the opinion of the European Communities. The European Commission is not responsible for any use that may be made of the information contained therein.

2

mixBioPells Market Implementation of extraordinary biomass pellets

Supported by: Partner:

Figure 1 Template

2.2 Selection of the best practice examples

Since the market implementation of alternative and mixed biomass pellets is at early stage, it was rather difficult to find appropriate best practice examples in some partner countries. At first a literature research and web survey was carried out by all partners to find possible and suitable best practice examples for pelletizing of alternative and mixed biomass pellets and briquettes. Possible best practice examples were discussed in close cooperation with the stakeholders in the initial and the regional network meetings. The selection criteria for each partner country are listed in the following Tables.

Table 1: Selection criteria for the best practice examples in Germany

	Production of grape marc / Miscanthus pellets	Production of rape press cake pellets	Production of straw pellets	Production of Miscanthus pellets	Production of apple pomace pellets	Production of hay pellets
High potential of the used raw materials	Medium	Medium	High	Medium	Low	Medium
Utilisation of new and innovative alternative raw materials as fuel	Yes	Yes	No	No	Yes	No
Production of mixed biomass pellets	Yes	No	No	No	No	No
Relevance and transferability for other European countries	Medium	Medium	High	Medium	Medium	High
Experiences of the producers for the production of fuels (in years)	5	3	20	20	3	5
Use of new and promising pre-treatment and pelletising technologies	Yes	Yes	No	No	No	No
Market availability of the products	No (Demonstration)	No (produced for own use)	Yes	Yes	No (produced for own use)	Yes
Previously unused raw material for fuel production and use in the region and thus create regional added value	Yes	Yes	No	No	Yes	No

Table 2: Selection criteria for the best practice examples in Austria [1)]

	Pelletizing straw at FEX	Briquetting hay from landscape gardening	Pelletizing hay and corn cobs
High potential of the used raw materials	High	Medium	High
Utilisation of new and innovative alternative raw materials as fuel	No	Yes	Yes
Production of mixed biomass pellets	No	No	Yes
Relevance and transferability for other European countries	High	Medium	High
Experiences of the producers for the production of fuels (in years)	10	5	2
Use of new and promising pre-treatment and pelletising technologies	No	No	No
Market availability of the products	Yes	No (produced for own use)	No (produced for own use)
Previously unused raw material for fuel production and use in the region and thus create regional added value	No	Yes	Yes

In Austria there are only few producers of alternative biomass pellets. Therefore, not many choices were available. So in Lower Austria there is even only one company which produces this kind of pellets verifiably in a commercially successful way (FEX Straw Manufacturing Inc). Thus this value chain was chosen for the best practice example “production”. FEX is an industry production of alternative straw pellets for material use (horse liter). However, the company made also first attempts to produce straw and hay pellets for the energetic use, which have been successful. Admittedly the demand for these pellets was lacking. The example”briquetting hay from landscape gardening” is located in Upper Austria. Since they also use the briquettes for combustion purpose, this value chain was chosen for the best practice example “combustion”. The project “pelletizing hay and corn cobs” is located in Styria and was still in initial stage as the selection of best practice examples was ongoing. Thus it was not considered as a best practice example, but the stakeholders were involved in further networking meetings within the MixBioPells project.

Table 3: Selection criteria for the best practice examples in Finland

	Reed canary grass	Straw	Hay	Peat
High potential of the used raw materials	Medium	High	High	High
Utilisation of new and innovative alternative raw materials as fuel	Yes	Yes	No	Yes
Production of mixed biomass pellets	Yes	Yes	No	Yes
Relevance and transferability for other European countries	High	Low	Low	Medium
Experiences of the producers for the production of fuels (in years)	7	3	0	10
Use of new and promising pre-treatment and pelletising technologies	Yes	Yes	no	no
Market availability of the products	Yes, medium	No, produced, low	No	Yes, high
Previously unused raw material for fuel production and use in the region and thus create regional added value	Yes	Yes	No	Yes

Table 4: Selection criteria for the best practice examples in Denmark

	Production of straw & grain screenings pellets	Production of rape and hemp pellets	Production of rape cake pellets	Production and pellets from sun flower shells
High potential of the used raw materials	High	High	High	High
Utilisation of new and innovative alternative raw materials as fuel	Yes	Yes	No	Yes
Production of mixed biomass pellets	Yes	Yes	No	No
Relevance and transferability for other European countries	High	Low. Only pilot scale production	Low. Mainly used for fodder	Low. Only part time production when raw material is available
Experiences of the producers for the production of fuels (in years)	6	0	2	2
Use of new and promising pre-treatment and pelletising technologies	No	No	No	No
Market availability of the products	No sale to the market	No experience	Low, too expensive as fuel	Good when it is available
Previously unused raw material for fuel production and use in the region and thus create regional added value	Yes Grain screenings)	Yes, if commercial	Yes	No. Imported raw material

Table 5: Selection criteria for the best practice examples in Spain

	Production of almond shell briquettes	Production of wine pruning pellets	Use of olive stone residues	Production of straw pellets
High potential of the used raw materials	High	Medium	High	High
Utilisation of new and innovative alternative raw materials as fuel	Yes	Yes	Yes	No
Production of mixed biomass pellets	Yes	Yes	Yes	Yes
Relevance and transferability for other European countries	Medium	High	Medium	High
Experiences of the producers for the production of fuels (in years)	2	1	20	5
Use of new and promising pre-treatment and pelletising technologies	Yes	Yes	No	No
Market availability of the products	Medium	Medium	High	Low
Previously unused raw material for fuel production and use in the region and thus create regional added value	Yes	Yes	Yes	Yes

Table 6: Selection criteria for the best practice examples in Italy

	Grapevine pruning	Hay	Hay/wood	Maize/wood
High potential of the used raw materials	High	High	Medium	Low
Utilisation of new and innovative alternative raw materials as fuel	Yes	Yes	No	Yes
Production of mixed biomass pellets	Yes	Yes	No	Yes
Relevance and transferability for other European countries	Yes	Yes	Yes	No
Experiences of the producers for the production of fuels (in years)	2	>5	1	>5
Use of new and promising pre-treatment and pelletising technologies	No	No	No	No
Market availability of the products	Yes	Yes	Demonstration	Yes
Previously unused raw material for fuel production and use in the region and thus create regional added value	Yes	No	No	Yes/No

Table 7: Selection criteria for the best practice examples in Sweden

	Production of reed canary crass	Production of straw	Rape straw pellets	Mixed pellets	Peat
High potential of the used raw materials	Small	High	No	No	No
Utilisation of new and innovative alternative raw materials as fuel	Yes	Yes	Yes	No	No
Production of mixed biomass pellets	No	No	No	No	No
Relevance and transferability for other European countries	Medium	High	High	High	Low
Experiences of the producers for the production of fuels (in years)	>3	>3	>3	>3	>3
Use of new and promising pre-treatment and pelletising technologies	No	No	No	No	No
Market availability of the products	Yes	Yes	Yes	Yes	Yes
Previously unused raw material for fuel production and use in the region and thus create regional added value	Yes	Yes	Yes	Yes	No

3 Summary

In general, cereal straw and other herbaceous raw materials can be pelletized without major difficulties if proper moisture content and measures of die exist. Feedstock moisture seems to have an important effect on improving the pellet density and durability. Several critical fuel characteristics can be positively influenced by choosing the appropriate harvest time. Within the best practice examples, usually conventional pre-treatment and pelletizing technologies are applied. Thus, hammer mill and ring die pellet presses are most often used. For herbaceous biomass (straw, reed canary grass) in some cases an additional shredder or bale breaker is used before the raw material is grinded with the hammer mill. However, there is also an example where a pellet producer developed a special pellet press particularly suitable for the critical and varying characteristics of alternative raw materials and mixtures based on a hydraulic press concept. According to the best practice examples, manual mixing seems to be most often used for alternative raw materials. However, this is not an adequate solution if standardised pellets with constant quality are to be produced. Though there are some problems with the pelletizing or briquetting characteristics of certain raw materials (e.g. vine pruning, almond shells) none of them appeared to be an insurmountable obstruction to the pellet producers. The varying fuel characteristics of alternative raw materials are a major constraint, Table 8 and 9. Overall, careful adoption of the pelletizing parameters has to be done for each raw material and depending on the available quality of the raw material in order to achieve pellets with good mechanical characteristics. In summary, considerable experience is crucial to successfully perform the pelletizing of alternative raw materials.

Table 8: Raw material properties in Austria, Denmark, Finland and Germany

Raw material	Straw	Straw	Grain screenings	Reed canary grass	Straw	Miscanthus
Country	Austria	Denmark	Denmark	Finland	Finland	Germany
Moisture content, wt.-%	14	13	10	10 - 35	10 - 25	4.0
Heating value, MJ/kg	17.5	14,5	16,5	17.6	17	17.75
Bulk density, kg/m³	n.a.	130	250	90 - 140	80 - 150	645
Ash content, wt.-%	n.a.	5	10	5 - 6	4.5 – 6.9	2.34
Ash melting temp., °C	1,200	870	n.a.	1,125	1,175 – 1,400	n.a.
Chlorine wt.-%	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Sulphur wt.-%	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Nitrogen wt.-%	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Raw material costs, €/ t	70	-	-	30 - 50	0 - 30	130 - 160
Quantity in the area, t/a	155,000	800.000	30.000	14,000	8,000	2,500

n.a. – not analysed

Table 9: Raw material properties in Italy, Spain and Sweden

Raw material	Corn stalks	Pruning tree	Vine pruning	Reed canary grass
Country	Italy	Italy	Spain	Sweden
Moisture content, wt.-%	35-45	35-40	30	n.a.
Heating value, MJ/kg	16.5-17.0	17.0-18.0	17.86	17.5
Bulk density, kg/m³	n.a.	n.a.	110	5.9
Ash content, wt.-%	6-7	3-6	3 - 5	13
Ash melting temp., °C	1,200	1,300	< 900	1,420
Chlorine wt.-%	0.05-0.06	0.03-0.04	n.a.	0.48
Sulphur wt.-%	0.08	0.01	n.a.	0.06
Nitrogen wt.-%	0.8	0.5	n.a.	0.04
Raw material costs, €/ t	25-35	40-50	45	-
Quantity in the area, t/a	-	-	500,000	-

n.a. – not analysed

Among the Best Practice Examples two concepts deserve special attention. Several pellet producers use mobile pelletizing machines, e.g. in Finland (Figure 2). With this strategy they react to the scattered availability of alternative raw materials. In this way, less logistic effort is required. Furthermore, it supports a “grown in the region produced for the region” philosophy that seems to be an important motivation for the pellet producers. The other strategy that is followed by at least two pellet producers is the combination of production of

alternative and mixed biomass pellets based on local raw materials with the testing of the pellets in combustion appliances at their own premise, e.g. in Germany (Figure 3). Doing so, they can overcome another major constraint for the utilisation of alternative and mixed biomass pellets: the lack or limited experience. In having their own combustion test bed they can provide customers with combustion know-how for these more critical fuels and they are aware of possible problems. Thus, they have the opportunity to either adapt the fuel or the combustion appliances and they can give first hand advice and support to the customers. Furthermore, customers can be adequately informed and transparency is guaranteed. In this way disappointment and dissatisfaction can be avoided. In one case, a pellet producer gives as well support to licensed pellet producers not only on production of the licensed pellets but as well on sales and logistics.

Figure 2 Mobile pelleting machine of Biobotnia Oy.

Figure 3 PUSCH PM 6-28 pelleting plant.

4 Best Practice Examples

Austrian best practice example for the production of alternative and mixed biomass pellets Background

Background

FEX Straw Manufacturing Inc. provides a wide range of straw-based products. The primary product is a horse bedding called STREUfex. All pellets are made of 100 % straw and are produced for material utilisation.

The company made also first attempts to produce straw and hay pellets for the energetic use, which have been successful. Admittedly the demand for these pellets was lacking.

Raw material

Characteristics of the used raw material.

	Straw (average)
Moisture content, wt.-%	14
Heating value, MJ/kg	17.5
Ash melting temperature, °C	1,200
Cost of the raw material, €/t	70
Quantity in the area, t/a	155,000

Straw is a residue from the grain harvest. The area-specific straw harvest is subject to strong weather-related variations. The Lower Austrian average area-specific straw harvest is about 3 t / ha.

The harvest and logistic technologies are well established. Usually the harvested straw will be compressed to bales. For the energetic use of straw, it would be useful to avoid raising the soil during the harvesting operations to reduce the quantity of ash, already quite high in the clean product. During the harvest, the moisture of the product is about 40%; during the storage phase, it reaches 14%. As a result of the low water content the harvested straw is well storable.

In Lower Austria the price for straw was about 67.7 € / t in 2009 and about 76 € / t in 2010. The producer's price for harvested straw was about 70 €/ t in 2010. The straw price depends on the amount of the harvest.

Besides the weather the decisions on agricultural policy will basically affect the available quantity of straw. For example an intensified support of energy crops like rape for esterification can cause a decrease of grain cultivation.

Figure 1: Straw bales

Pelletizing process

Data of pelletizing.

Technology type	Ring die
Production capacity in t/a	5,000

Only straw with a water content under 15 % will be taken over. Due to the low water content a drying of the raw material is not necessary. The straw suppliers are mostly farmers of the region (radius<50 km). 20 % of the straw is obtained from two straw dealers.

The bale breaker has a capacity of 5 t/h. The hammer mill has also a capacity of 5 t/h and reduces the straw to 5-20 mm. The company FEX uses a ring die with a production capacity of 2-3 t/h.

Figure 2: Bale braker

The cooling system is a counter flow tower cooler with a capacity of 5 t/h. Fines with a diameter under 4mm are filtered.

The annually production output amounts to 5.000 t and the production costs vary between 80 €/t and 100 €/t. 80 % of the straw pellets are stored in big silos, the other 20 % are stored in bags.

Figure 3: Straw Pellets

Producers view

The company FEX has its own pelletizing unit and a lot of experiences with pelletizing straw. It is located in Lower Austria and in Lumberton/USA.

Figure 4: FEX Straw Manufacturing Inc. in Neusiedl/Zaya

FEX Straw Manufacturing Inc. has participated to MixBioPells project as subcontractor. The objective is to increase the request of straw pellets for the energetic use.

Contact

FEX
ÖKO-Faserverarbeitungs-GmbH
Dobermannsdorferstraße 1
Neusiedl/Zaya
Austria
Tel: +43(0)2533-810 210
Fax: +43(0)2533-810 214
e-Mail: johann.payerl@streufex.com
Homepage: www.fex.at

Danish best practice example for the production of alternative and mixed biomass pellets

Background

Køge Biopellet Factory is a pellet producing plant built in 2004 by the utility company Energi E2. It was built as 2 plants, one producing wood pellets with a capacity of 180,000 tons/year, the other producing straw pellets with a capacity of 110,000 tons/year. The pellets was planned to be used in 2 power plants in Copenhagen: Wood pellets at Avedøre power plant and straw pellets at Amager power plant. It was not allowed by Copenhagen municipality to take this large amount of trucks daily into central Copenhagen. Therefore Energi E2 built the pellet plant 45 kilometers outside Copenhagen by Køge Harbour, and the pellets are then shipped into Copenhagen by boat. In 2006 Vattenfall A/S took over the straw pelletplant. The wood pelletplant, now owned by DONG Energy was stopped in 2007. The argument from DONG Energy was that the raw material supply with round timber and wood logs mainly from the Baltic area was too unstable.

Pelletizing straw	Køge Biopillefabrik
Technology type	Ring die
Production capacity, t/a	110,000
Price of pellets, €/MWh	See below
Investment, €	See below

The investment in 2004 for both the wood pelletplant and the straw pelletplant was 50 million Euro (Source: Forskning i Bioenergi, nr. 3, 2004). The straw pellets are not sold in a commercial market, because all pellets are used inhouse at Vattenfall A/S. This means that there is no market price for straw pellets in Denmark. There is no information about the production costs.

Raw material

The raw material is straw in big bales of approx. 530 kg each. They are delivered by farmers at Zealand and nearby Islands with a maximum distance of about 140 km. The toll bridges to Sweden and to Funen are barrierers as the toll is at least 160 Euro for a truck making the business unprofitable for the farmers. The truck takes 24 bales, 12 on the truck and 12 on the trailer in 2 layers.

Truck with 24 bales waiting for unloading.

The unloading of straw bales from the truck.

The 24 straw bales are unloaded by a crane taking 12 bales in one lift. During the lift off the water content is measured by micro-waves and the weight is measured. Grain screenings are also used as raw material mixed with straw. The quality of grain screenings differs from year to year depending on a wet or dry harvest and depending on the growth conditions during the summer time.

Characteristics of the raw material

Raw material	Straw	Grain screenings
Moisture content, wt.-%	13	10
Heatingvalue, MJ/kg	14,5	16,5
Bulk density, kg/m³	130	250
Ash content, wt.-%	5	10
Ash melting tem, C	870	N/A
Raw material costs, €/ t	N/A	N/A
Quantity, t/a [1)]	800.000	30.000

[1)] Straw available for combustion on Zealand is around 800,000 tons

Pelletizing process

The pellet production runs 24 hours a day reaching around 300 tons/24 hours. There are 4 pellet lines. The production consists of:

- Unloading area with crane for straw
- Short term storage
- Conveyor belts and straw chopper
- Hammer mill and possibility for mixing
- Pelletiser with ring die
- Cooling unit
- Conveyor belt to harbour
- Bulk storage at the harbour
- Large scale bulk loader for ships

There is no drying unit for the raw material in the process line. The percentage of grain screenings mixed with straw depends on what is available. Maximum ration of grain screenings is 20 %.

The pelletizing lines at Køge Biopillefabrik

Bulk storage for straw pellets at the harbour

Producers view

Vattenfall A/S has more than 40 CHP plants in operation, which partly or totally are fired with biomass. Every year the biomass consumption exceeds 3 million tons, and the amount is increasing. Vattenfall A/S is one of the worlds leading companies in the energy sector.

Contact:

Vattenfall A/S
Støberigade 14
DK 2450 København SV
Phone+45 8827 5000

Finnish best practice example for the production of alternative and mixed biomass pellets

Background

Biobotnia Oy is a company in Jalasjävi, founded in 2009. The company has specialised to production of renewable energy. Company has a mobile pelletizing unit, by witch it is possible to grind and pelletise fibrous grasses and straw, e.g. straws of local grains and reed canary grass. The unit can be reserved for pelletizing of larger storages of bales, in the minimum 100 bales. The mobile machine can crush a complete bale without any preliminary preparations, i.e. complete bales can be fed into the crusher as such.Advances of straw pelleting are that raw material can be densified to 6 – 8 times smaller space. The heating value of the straw pellets is same as that of wood pellets, and it is real renewable energy! Straw pellets can be combusted with stoker burners or in fireplaces with so called “pelletbasket”.

Raw material

There are several possible raw materials for fuels in the area; wood, peat, straw, reed canary grass and even mixtures of them. Yield of straw is about 4 – 7 t/ha. In the area there is plenty of fields. Density of round bales is about 110 kg/m^3 and they weight 150 – 300 kg depending mostly on the moisture. Moisture content should be under 20%. There are also bigger bales, the density of which is little higher. The pellets are made of reed canary grass, easily obtainable at the area. The potassium (K) and chlorine (Cl) contents of the plants diminish because these chemicals are water soluble and the reed canary grass will be harvested in spring. In spring the moisture content is about 10 – 15%. After one year’s poor storage conditions the moisture content of bales can be up to 40%. Reed canary grass is usually baled with baling machines of the farm and stored in well covered stockpiles. A stockpile is situated on terrain and a truck transports the bales to the market. RCG is a plant which can grow in same, modest place for several years. Price of the reed canary crass, excluding the transport costs, is about 35 €/t.

Characteristics of the used raw material.

Raw-material	Grass (RCG)	Straw (ave.)
Moisture content, %	10 - 35	10 - 25
Heating value, MJ/kg	17.6	17
Bulk density, m^3/kg	90 - 140	80 - 150
Ash content, %	5 - 6	4.5 – 6.9
Ash melting temperature, C	1,125	1,175 - 1400
Raw material costs, €/ t	30 - 50	0 - 30
Quantity in the area, t/a	14,000	8,000

Pelletizing process

The pelletizing process of Biobotnia Oy is mobile. Complete straw or read canary grass bales are fed into the hammer mill of the machine. Hammer mill grinds the straws and the grinded material goes through a screen of Ø18 mm. Screen is rather coarse, but it works fine, if the moisture of bales is under 20%. Belt conveyer feeds a mixing bin and after that the raw material goes to the press. The model of the press is CPM and type of the die is a ring die. At the moment the producer has ring dies of 60/6 and 60/8 mm. The model of the press is CPM and type of the die is a ring die. At the moment the producer has ring dies of 60/6 and

60/8 mm. It is easy to pelletise reed canary grass with the die of 60/6 mm. Die 60/8 is little “loose” for straw pellets. Straw pellets include small amount of caoline for better heating results.

Pellets from straw and peat mixture.

Machine produces 1.2 – 2 t/h with different raw materials and dies. Pellets are cooled on belt conveyers. In the system there is a bin of 9 m^3, where pellets will gather. The bin has to be emptied every time it becomes full.

Data of pelletizing

Technology type	Mobile unit, ring die
Production capacity, t/a	3,000
Price of pellets, €/MWh (incl. VAT)	35

Producers view

Biobotnia Oy has participated to MixBioPells –project as a test pelletiser. It was made two kinds mixes straw/peat and wood/reed canary grass. A little difficulty was that the batches have to weight and mixed on the ground. In palletising of the straw/peat (50/50%) –mix there were no difficulties with the former 8/60 mm die. The tests of wood/RCG were done with the die of 6/60 mm. In everyday life Biobotnia Oy pelletises batches of 100 bales of straw and reed canary grass to local farmers. A farmer calls to Biobotnia Oy for pelletizing of bales, which adds the order to the next working period of the pelletiser.

The costs of the pelletizer vary. The contractor gets his salary per cubic meter of straw material pelletized. In some cases, especially with reed canary grass, pellets are sold the price of day. A 100% read crass pellets are used as litter for horses so this is also one part of the business. There is also a contract between local heat producer Jalasjärven Lämpö Oy and Biobotnia Oy to produce agripellets for district heating. For pelleting it is needed more suitable dies for different raw materials. For a small entrepreneur the purchase of dies is expensive. Also there might be a bigger cooler in the future

Contact

Biobotnia Oy, Harri Honkavaara
tel: +358 40 541 0802
fax: +358 6 457 2160
http://louhetar.fi/biobotnia

The mobile pelletizing process: The complete bale can be put to hammer mill. The press is a ring die of CPM.

German best practice example for the production of alternative and mixed biomass pellets

Background

The PUSCH AG provides a comprehensive concept for the decentralized production of mixed biomass pellets from agricultural and woody raw materials. Based on the license concept "agrarSTICK®" different license holders are producing and marketing alternative pellets based on specific recipes. Therefore these partners are provided with complete production, sales and logistics support based on a virtual trading platform for all internal and external business activities. Based on the „produced in and for the region" -philosophy, the agrarSTICK® will be distributed in the respective region.

Raw material

In general mixtures from herbaceous, fruity and woody biomass have been pelletised so far. Since kind and potential of the available raw materials differ significantly between the regions, a suitable combination of different raw materials and additives has to be developed. Due to the fact that the pelletizing plant PM 6-28 has low requirements on mechanical properties and water content usually no pre-treatment of the raw material is necessary. To ensure a transparent communication with the customers a fuel data sheet will be provided from the production partner.

Pelletizing process

In contrast to pelletizing processes with roller dies a hydraulic press offers less work and cost intensive pretreatment of the raw materials. Therefore, the production of different mixed biomass pellets can be done without changing the press die. Due to these advantages the Pusch AG has developed and manufactured the pelletizing plant PM 6-28 with a production capacity of 1,000 kg/h. The modular design provides an increase of the production capacity to a maximum of 4,000 kg/h.

Pelletizing plant PM 6-28

The benefits of the technology are:

- User-defined pellets from a mixture of raw materials can be produced.
- Raw materials with residual moisture up to 30 w. -% can be used.
- No additional grinding (e. g. hammer mill) or pre-treatment processes are necessary for raw materials with a length up to 5 cm.
- The production energy is reduced by an efficient plant technology.
- Rotating parts are not installed in dirty parts of the pelletizing plant.

Two different products are offered by PUSCH AG - the agrarSTICK® black for the utilisation in public and small industrial combustion plants above 100 kW and the agrarSTICK® yellow for small combustion plants. In the region of Rhineland-Palatinate pellets produced from Miscanthus and grape marc have a high potential.

Miscanthus pellets (left) and pellets made from 2/3 Miscanthus, 1/3 Grape marc (right).

The mean values of these pellets are listed in the following table:

Raw material	2/3 Miscanthus and 1/3 grape marc	Miscanthus
Moisture content, wt.-%	6.0	4.0
Heating value, MJ/kg (dry basis)	18.557	17.754
Bulk density, m^3/kg	676	645
Ash content, wt.-% (dry basis)	3.77	2.34
Cost of raw material, €/t	50.00	80.00
Range for price of pellets, €/t (incl. VAT)	100 - 130	130 - 160
Raw material potential in the area, t/a	4,500	2,500

Producers view

To establish the production of alternative (mixed) biomass pellets in several regions in Germany and Europe the marketing of the pellet presses is of great relevance. Important aspects for enhancing regional pellet markets are:

- The requirements of the target groups regarding the optimal (regional) mixture are often unknown.
- The technical know-how of the key actors for production of alternative (mixed) biomass pellets is too less.
- Regional market structures do mostly not exist.

Due to these aspects the agrarSTICK® concept will provide the partners with know-how of the production of alternative (mixed) biomass pellets and support for the marketing of their products.

By 2020 a production of 1,000,000 t / a alternative (mixed) biomass pellets with about 60 to 90 partners is planned by building up a decentralized production network which will be coordinated by Pusch AG.

Contact

PUSCH AG
ENERGY COMPANY

Auf der Weid 1–15
56242 Marienrachdorf
Phone: +49 (0) 2626/92569-0
Fax: +49 (0) 2626/92569-27
www.pusch.ag · www.agrarstick.de
info@pusch.ag ·info@agrarstick.de

Italian best practice example for the production of alternative and mixed biomass pellets

Background

Bagioni Group is a consortium of companies involved in agriculture, livestock and energy sectors. Companies have been engaged for many years in the cultivation and trade of products for animal feed. Afterwards, the group has developed a strong interest in agri-energy, building a biogas plant for electricity production (850 kW_{el}). Part of the heat energy produced by the power plant is used for drying the materials used for pellet productions. This makes possible saving energy and reducing the production costs of pellets and makes the process more sustainable.

Raw material

The company has developed experience in the production of alfalfa pellet material. However, other biomasses are involved (and will be involved) in the production of pellets for energy use. Among them: straw, corn stalks, residues of maize, pruning of trees, plants extirpated and also various types of wood (mixed with other biomasses). The production of these crops is highly variable. In the case of straw, the production can range from 3 to 5 t/ha dry matter, depending on the kind of crop (maize, sorghum,…). The biomass moisture content at harvest time can vary from 30% to 40%. Pruning trees production can range in average from 1.5 to 3 t/ha dry matter depending on the type of training system and the residual crop. The moisture content during harvest time can vary from 40% to 50%. Corn stalks production is over 3.5 t/ha of dry matter. Bulk density of the raw material varies between 120 and 180 kg/m^3. The pellet production process increases the bulk density of about 3.5/4.5 times and improves the stability of the final product with less moisture content. The crops are harvested using different machinery systems. Straw material is available during the summer time (June and July preferably) after the threshing. The material, left in the fields for a short period of time, loses part of the moisture content; then it is stored in covered barns. The product is handled with the traditional transport machinery used for forage. Corn stalks are stored in bales (300 – 500 kg). Good storage conditions could reduce significantly the moisture content of the materials up to 20-25 %. Prices of the material varies between 25 and 35 €/ton (transport excluded). The quality of the material depends on the kind of biomass and the conditions of its working. It's important to avoid picking up the soil from the ground during the harvesting: in this way, the level of ash can be kept low and the consumption of the die for the production of pellets can be reduced. In the following table the characteristics of the materials are shown.

Raw material characteristics.

	Corn stalks	Pruning tree
Moisture content wt.-%	35-45	35-40
Heating value MJ/kg	16.5-17.0	17.0-18.0
Ash content wt.-%	6-7	3-6
Ash melting temperature °C	1,200	1,300
Chlorine wt.-%	0.05-0.06	0.03-0.04
Sulphur wt.-%	0.08	0.01
Nitrogen wt.-%	0.8	0.5
Raw material costs €/t	25-35	40-50

Pelletizing process

The pellet plant of Bagioni Group has a production capacity of 15,000 t/year working on three production lines. Great part of the production is currently used for animal feed. For the production of mixture pellet, made of agricultural residues and wood, the product is loaded onto conveyor belts and then mixed.

Corn stalks & sorghum stalks bales close to the conveyor belt

A hammer mill grinds is used and the material goes through a sieve of Ø20 mm before the drying. This process takes place in a drum rotating cylinder dryer until the material reaches a moisture content of 12-14 %. A belt conveyer transports the raw material to the pelletizing machineries (flat and ring die). At the moment, the producer has ring dies of 6 and 8 mm (28 mm for hard material – 50 mm for soft material) and no additives are used. Model of pelletizing machinery is Matador 30.

Drum rotary drier

The moisture content before the pellet process is between 10-14 % depending on the raw materials. Just produced pellets reach a temperature of 90 °C, then they are cooled by air and the dust is removed from the product. Production costs, without considering the raw material cost, range from 50 to 80 €/t.

Internal view of the pelletizing machine

Producers view

Bagioni group considers the production of pellets for energy an important alternative to the livestock sector. It's interesting to consider that this company can utilize the low-cost heat produced by the biogas plant. This opportunity reduces the cost of the raw material drying and especially for the wood, used with alternative biomasses to obtain a better quality pellet.

Contact

EUROFORAGGI Società Agricola S.r.l.,
V. Serachieda, 1/C; 47122 Forlì (FC)

Tel: 0543 729628; Fax:0543 729833

Spanish best practice example for the production of alternative and mixed biomass pellets

Background

Since 2010, Orientación Sur Consultoría S.L. owns and operates a pellet production plant. The plant has an initial production capacity of 20,000 tons/year. It has been designed to allow for any necessary modifications of the raw material used for pellets production in a short time span. The company aims to achieve a pellets production which is consumed within the national market, as well as its use for heat generation. The production site is based in the village of Valdepeñas, which is located at the Spanish region of Castilla la Mancha, the largest wine production area in the world. Due to the broad variety of biomass goods that can be treated, it is equipped with a pellets combustion laboratory that carries out the pellet design, which varies depending on the combustion technology to be used. Orientación Sur Consultoría S.L. is privately owned company and its R&D&I work is aimed to be the Company´s main value for the future. Orientación Sur Consultoría S.L.´s vision can be summed up as a "THINK GLOBALLY, ACT LOCALLY" philosophy and its main work line is based on making the most of the local resources and use organic waste in a proper way.

Technology used	Ring die press
Production capacity, tons/year	20,000

The market of vine pruning and organic waste is fairly reduced, so even though the possibility of their use is real, the information about its advantages is not reaching the client at the time he/she buys his/her pellets boiler. No information is provided on the various types of pellets that can be used. So far, all produced pellets have been generally called "wood pellets", which has caused confusion among consumers, as not every one of them presented the same behaviour during combustion.

Raw material

The main raw material is the vine pruning that has been collected at a maximum distance of 15 km from the place. Logistics is quite complex due to two main factors: first, the low density of the raw material and secondly, the average size of the agricultural development plots.

Pruned vine.

Another important factor is the seasonal nature of vine pruning collection, from November to February, for its subsequent manufacturing, as we have to allow for the necessary storage space.

Vine pruning storage.

mixBioPells
Market Implementation of extraordinary biomass pellets
Supported by:
Partner:

Raw material characteristics

	Vine pruning
Moisture content, wt.-%	30
Lower Heating value, MJ/kg	17.86
Bulk density, kg/m³	110
Ash content, wt.-%	3 - 5
Ash melting temperature, °C	< 900
Raw material costs, €/t	45
Biomass potential, t/year [1)]	500,000

[1)] Total amount of the annual vine pruning produced within the region is 500,000 t/year.

Pelletizing process

The plant produces about 4 tons per hour depending on the material used. There is one pelletizing line:

- Raw material storage
- Hammer grinder
- Ring matrix pelletizer
- Cooler
- Packaging machine
- Bulk storage tank
- Big bag and standard bag storage

Aerial view of the plant.

Drying is not necessary due to the local climate, which simplifies the industrial process and reduces production costs.

Laboratory with Biokompakt AWK boiler. An adjusted combustion technology is important.

Producer´s view

100 % of the biomass material used by Orientación Sur comes from agriculture or forestry. The company is prepared to integrate several types of locally generated biomass material within its productive process and has worked at developing energy crops with low water consumption needs.

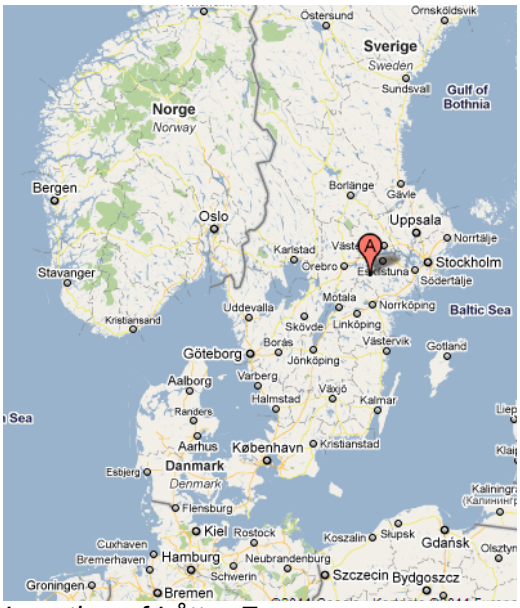
Contact

Orientación Sur Consultoría, SL
Avda Primero de Julio, 70 Local 4
13300 Valdepeñas (Ciudad Real) Spain
Phone +34 926 32 32 43
E-mail: orientacionsur@orientacionsur.es

Swedish best practice example for the production of alternative and mixed biomass pellets

Background

Due to increasing prices for woodchips and growing competition for raw materials Låttra farm, located about 150 km west of Stockholm, started to look into the possibility to produce reed canary-grass briquettes. A spring harvest usually yields between 4 and 6 tonnes dry weight per hectare under normal conditions. If the crop is harvested early in the spring the dry substance is usually between 80 to 90 percent. Låttra Farm grows reed canary grass on 70 hectares and the goal is to increase this to 100 hectares by 2012. There is potential to increase the amount of land used for growing RCG in the area around Vingåker and Katrineholm. Nearby land is used for ley and fallow because many farms in the area have fields with “low productivity” i.e. that do not yield enough profit to warrant growing foodstuffs.



Location of Låttra Farm

Cultivation of reed canary grass (RCG) on Låttra farm

RCG is a perennial grass that can be grown throughout Sweden. The quality and quantity of the harvest depends on the quality of the soil, the species of RCG and what and if fertilizer is used. The first harvest is taken in the spring two years after sowing and is about 20 % lower than following harvests. The harvest rate is around 4-6 tonnes DM per hectare at normal conditions for a spring crop.

Typical fuel properties in spring (db…dry basis).

Net calorific value	MJ/kg db	17.5
Ash content	wt.-% db	5.9
Moisture	wt.-%	13
Softening temperature of ash	°C	1,420
Nitrogen	wt.-% db	0.48
Sulphur	wt.-% db	0.06
Chlorine	wt.-% db	0.04

Harvest

Reed canary is slain during autumn and dries in wedges in the field until spring. In spring the grass is pressed into round or square bales. The goal is to store the bales protected from the weather beside the field to keep storage costs down. The Bales are afterwards transportetd from the field to the the briquetting hall for chipping and briquetting.


Reed canary grass

Briquetting

Låttra farm has the capacity to produce 3500 tonnes of wood briquettes per year. The briquetting presses have a capacity for briquetting of reed canary-grass from about 500 hectares. Today briquettes (wood) are supplied to both households (15 %) and greater heating plants (85 %). The bales of grass are cut up in a slow shredder before being shredded further in an industrial grinder.

mixBioPells
Market Implementation of extraordinary biomass pellets
Supported by:
Partner:

The material is then fed into three Bogma V40 briquette presses which produce briquettes of 40 mm diameter. The finished briquettes are fed into a horizontal silo with capacity for 1000 tonnes of briquettes. The briquettes are taken directly from the silo for delivery to customers.

Briquetting presses

Transport

The briquettes are loaded on Låttra farm on a demountable container and transported heating system at Ökna school. Each shipment contains about 30 tons of reed canary grass briquettes.

Consumers

There are currently a number of heating plants within a 100 km radius of Låttra Farm that use woodchips, wood pellets or briquettes.

One of these plants is the briquette-fired plant at Ökna School in Tystberga, which is run by TCG Teem Combustion Group, heating supplier, based in Ulricehamn.

TCG builds and operates different kinds of district heating plants. The aim is to replace one of the older solid fuel boilers which runs on wood briquettes with a new solid fuel boiler suited for ash-rich reed canary grass briquettes during the summer of 2011. In autumn 2011, TCG will begin work with optimising the plant to be able to use reed canary grass from Låttra Farm.

Problems/ possible obstacles

The main challenge is the establishment of a profitable supply chain and market for reed canary-grass briquettes especially with regard to storage of raw material before pressing.

Contact

SP Technical Reasearch Institute of Sweden
Anna Sager
Tel: 010-516 58 37
E-mail: anna.sager@sp.se