

RENEWABLE ENERGY SOURCE – BIOMASS PELLETS

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OBNOVITEĽNÝ ZDROJ ENERGIE – BIOMASA VO FORME PELIET

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Abstrakt

Zásoby fosílnych palív akými sú uhlie a ropa nie sú večné. Palivo, ktoré predstavujú drevené pelety, je obnoviteľné palivo, ktoré neprispieva k skleníkovému efektu. Spálením 5 m³ oleja sa do atmosféry uvoľňuje 13,8 t oxidu uhličitého. Jednou z ciest ako sa vyhnúť budúcim problémom je pripraviť sa na život bez prírodných zdrojov. Zvýšená úroveň globálneho otepľovania podmieňuje potrebu zámeny fosílnych palív za biopalivá. V mnohých krajinách sa biomasa stáva efektívnym spôsobom ako splniť požiadavky Kjótskych dohôd, ktoré sa týkajú povoleného vypúšťania oxidu uhličitého pri spaľovaní fosílnych palív. Biomasa je energia budúcnosti. Existujú tri základné formy palív na základe biomasy : tuhá, tekutá a bioplyn. Drevené pelety predstavujú upravenú biomasu: tuhé palivo s nízkym obsahom vlhkosti a vysokým energetickým obsahom. Pelety sa zvyčajne vyrábajú z odpadu na pilách a z iných odvetví spracovania dreva. Pelety neprispievajú k skleníkovému efektu. Požiadavky na kvalitu peliet sa menia podľa charakteristík trhu dreva v rôznych krajinách Európy. Výroba peliet sa uskutočňuje v rôznej škále produkcií, od účelovo postavených veľko-kapacitných zariadení na výrobu peliet po nízko výkonové stroje na pelety, alebo na úpravy krmiva pre dobytok alebo drviče trávy. Veľký podiel na trhu predstavuje používanie peliet v domácnostiach. Pre takýchto zákazníkov je vysoká kvalita peliet dôležitá. Noví hráči na trhu často ponúkajú lacné pelety, ale pritom sa však tiež jedná o produkt nízkej kvality.

Abstract

Fossil fuels like petroleum and coal won't last forever. Wood pellet fuel is a renewable fuel that does not provide any net contribution to the greenhouse effect. The burning of 5 m³ of oil releases 13.8 tonnes of carbon dioxide into the atmosphere. One way to prevent future problems is to prepare for life without these natural resources. The increased global warming necessitates exchanging fossil fuels for biofuels. In many countries, biomass is an effective way to meet compliance with the environmentally-friendly Kyoto Accords governing permitted carbon dioxide emissions from consumption of fossil fuels. Biomass is the energy of the future. There are three basic forms of biomass fuels: solid, liquid, biogas. Wood pellets are refined biomass, a solid fuel with low moisture, high energy content. Pellets are mostly manufactured from waste products from sawmills and other wood processing industries. Pellets don't contribute the greenhouse effect. The requirements for pellet quality vary according to the

characteristics of the wood pellet markets in different European countries. Pellet production is carried out on many scales, from the purpose built large scale wood pellet production facility to small scale pellet machines or converted animal feed or grass mills. Private household use of pellets has a large market share. To these customers a high quality pellet is very important. New players in the market often produce a low price pellets, but it is also low quality product.

Key words: pellets, testing pellets, combustion, pellet's ash

1. Introduction

Fossil fuels like petroleum and coal won't last forever, and they can't be regenerated. We don't know when our fossil fuel supply will run out. However, we do know that it will eventually happen. One way to prevent future problems is to prepare for life without these natural resources. The increased global warming necessitates exchanging fossil fuels for biofuels. In many countries, biomass is an effective way to meet compliance with the environmentally-friendly Kyoto Accords governing permitted carbon dioxide emissions from consumption of fossil fuels. Biomass is the energy of the future. It is energy that we can get from organic matter such as wood, agricultural waste, and other vegetation that can be burned and used as a source of electricity, heat and fuel. The term "biomass" refers to materials derived from plant matter such as trees grasses, and agricultural crops. These materials are growing using energy from sunlight. When plants grow they use carbon dioxide from the air to make their wood. If you burn the wood the carbon is released back to the atmosphere. As long as you grow another plant/tree then a stable carbon cycle is set up. So the use of sustainably produced wood as a fuel does not increase the carbon dioxide levels in the atmosphere. Biomass can be renewable energy source for fueling many of today's energy needs. Several factors make it an attractive option for power generation: it does not add carbon dioxide to the atmosphere, low sulfur content means biomass combustion is much less acidifying than with coal, the ashes from biomass are very low in heavy metals, can be recycled. Today, biomass is the fourth largest energy resource behind coal, oil and natural gas. Because biomass energy systems can be based on a wide range of feedstock and use many different conversion technologies, the spectrum of their future applications is large. The EU already obtains a significant fraction of its energy as heat and electricity from biomass. There are three basic forms of biomass fuels:

- solid biomass fuels – wood, wood chips, pellets, briquets,
- liquid biomass fuels – biofuels (ethanol, biodiesel),
- biogas.

Biogas is a gas produced when bacteria break down biological material without oxygen (anaerobic process). Biogas can be produced from landfills, sewage treatment plants and manure (manure gas). In this process, the waste is pumped into a gas generator where bacteria break it down into methane which can be used for heat and electricity. There are many pollution problems associated special with the manure such as air pollution, groundwater contamination and the release of methane contributing to global warming.

Biofuels are liquid fuels produced from biomass that can be used for transportation. Ethanol and biodiesel are the two most common types of biofuels. Ethanol is produced by fermenting high-carbohydrate biomass such as corn, wheat and barley into an alcohol. Ethanol is a non-toxic renewable fuel that is used to oxygenate gasoline, making it more environmentally friendly by reducing exhaust pollutants. Biodiesel is a fuel that can be used in diesel engines. It

can be produced by using vegetable oils, animal fats and oils, and recycled grease and refining them into oil.

Wood pellets are refined biomass, a solid fuel with low moisture, high energy content. This fuel can both be used in residences and as an inexpensive and convenient alternative to fossil fuels in large-scale heat and power plants. Pellets are mostly manufactured from waste products from sawmills and other wood processing industries. The materials used, include ground woodchips, sawdust and bark. No chemical additives are needed, the natural lignin of the wood itself serving as a binder, although sometimes small quantities of maize starch are added as well. Part of Europe have been using wood pellets for heating since the mid 1980's.

2. Pellets technology

Pellets take part in the natural rotation in our environment. At the combustion the stored solar energy is released. The carbon dioxide that are consumed during the growth are brought back to nature when the vegetation takes up the carbon dioxide to use it again to "make" new raw material. So pellets don't contribute the greenhouse effect. Wood pellets are a clean, mostly produced from sawdust and wood shavings, compressed under high pressure using no glue or other additives. They are cylindrical shape and usually 6–10 mm in diameter and 10–30 mm in length, bulk density $\sim 650 \text{ kg/m}^3$. As a highly standardized and compressed fuel, pellets allow cost-efficient transportation of fuel and automatic operation of plants for heat and electricity production, from one-family home to large scale power plant. The requirements for pellet quality vary according to the characteristics of the wood pellet markets in different European countries. The European technical specification CEN/TS 14961 recommended for high quality wood pellets for household use:

| Property | CEN Recommendation | Austria Recommendation |
|-----------------------|------------------------|------------------------|
| Moisture content | Max. 10% | Max. 10% |
| Net calorific value | Min. 16.9 MJ/kg | Min. 18.9 MJ/kg |
| Sulfur content | Max. 0.05% db | Max. 0.04% |
| Ash content | Max. 0.7% bd (550°C) | Max. 0.5% |
| Fines (wt% < 3.15 mm) | Max. 2% (factory gate) | 2.3% |
| Nitrogen | | Max. 0.3% |
| Chlorine | | Max. 0.02% |

Generally, the production process of pellets has three basic stages:

- storing and pre-treatment raw materials,
- drying the raw materials (at approximately 18 – 19% moisture content)
- the pellet processing
 - loose raw materials, after grinding to convenient size, are fed into pelleting cavity,
 - rotation of die and roller pressure forces materials through die (pellets),
 - adjustable knives cut pellets to desired length,
- pellet cooling and storing.

With traditional pelleting system, after one century of development and most widely used today, the raw materials are fed into the inside of the die and pellets are extruded to the exterior of the die, with the end product of pellets at an average temperature (effect of high

pressure) between 100 – 120°C. Another step of cooling the pellets has be carried out before the pellets can be packaged. Energy consumption needed for processing 120– 200 Wh/kg. New innovative technology is easy-to-operate pelleting system. Moist raw materials, humidity content of 35% in the starting material does not represent problem, can be processed at low temperature carrying out simultaneous drying and compactation. The last step of cooling is unnecessary. The temperature of pellets only increases to 10 – 15°C and the maximum operating temperature of the dies is in the range of 55 – 60°C. At such a relatively low operating temperature for the dies, there is no emission of fumes and no cooling device is required. Energy consumption needed for processing is only 70 – 100 Wh/kg. This technology represents drastic production costs savings when compared to the conventional process.

3. Pellet quality tests

Pellet production is carried out on many scales, from the purpose built large scale wood pellet production facility to small scale pellet machines or converted animal feed or grass mills. Private household use of pellets has a large market share. To these customers a high quality pellet is very important. New players in the market often produce a low price pellets, but it is also low quality product. The European specification CEN gives a list of standards of technical specifications for the determination of chemical and physical pellet properties. To compare different wood pellets offered on the market, it is important that specified values of fuel are comparable. New pellet stove with automated feed system and automatic ignition system was installed in home by a certified professional installer who provided a resource for where to purchase pellets. Routine tasks were performed regularly to ensure proper function. Customer bought a lower price pellets from the new player in the pellet market. Heavy damage was done to stove after four months pellets firing due to slagging problems in the boiler. It was done fuel laboratory tests of wood pellets and ash to determine the properties of the fuel.

Results are showed in table 1.

Table 1 Fuel and ash analyse

| Fuel | | Ash | |
|----------|------------|--------------------------------|-------|
| Coal | 46.6% | SiO ₂ | 36.9% |
| Hydrogen | 4.9% | CaO | 21.3% |
| Sulfur | 0.2% | Al ₂ O ₃ | 6.9% |
| Oxygen | 37.4% | Fe ₂ O ₃ | 3.9% |
| Ash | 2.1% | Na ₂ O | 5.8% |
| Moisture | 8.8% | MgO | 2.9% |
| LHV | 16.9 MJ/kg | K ₂ O | 3.8% |
| Volatile | 74.3% | P ₂ O ₅ | 4.0% |

Fine structure of the samples prepared from pellets and ash has been studied using the scanning electron microscope.

4. Conclusions

Some conclusions can be drawn after the data analysis:

Manufacture pellets requires investment in machinery and specialist equipment. Wood pellets are a form of biomass material, dried and processed into combustible pellet form. Pellets can be made from various biomass materials. High quality material is compressed under high pressure

in pelletising machine using no glue or other additives. During this process the lignin, contained in the biomass melts and sticking together the biomass fibres. The pellets are extruded, the lignin cools and the pellets harden – no other additives are used. Poor quality raw material, contamination of the raw material, used to the production pellets cause slagging problems in the boiler. For private customers, users small-scale pellet stoves, a high quality pellet is very important. New manufactures in the market often produce a low price pellets, but it is also low quality product.

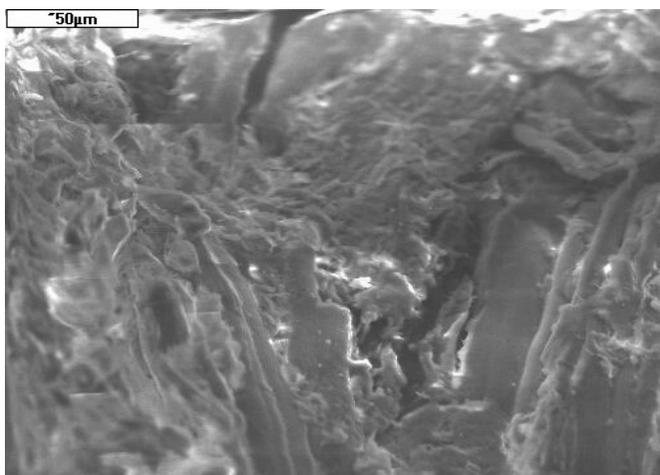


Fig.1 Fine structure of pellet

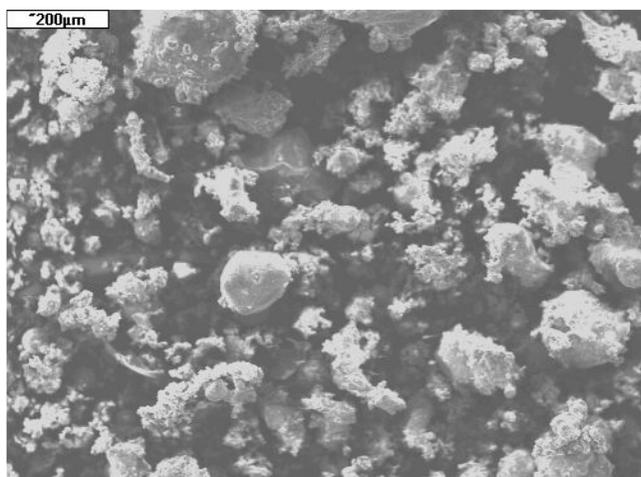


Fig.2 Fine structure of ash

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