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TECHNOLOGY PRODUCTION OF SOLID BIOMASS FUEL

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In the analysis of the energy potential of solid biomass in Ukraine need to focus on the production of fuel pellets, pellets from straw, waste dereobrabatyvayuschih enterprises manure.

Key words: biomass, biofuels, pellets, briquettes, combustion temperature, ash content, calorific value of diesel fuel.

Introduction. According to the EU directive "On supporting the use of energy from renewable sources" (23.04.2009, the share of renewable energy by 2020 should be 20% of gross domestic energy consumption. The most popular of all types of alternative biofuels in the European Union today is solid biofuels (Pressed fuel pellets), which amounts produced in the EU in 2014 reached 12.6 million. tons, while the volume of total consumption (including imports) - 16.7 mln. tons. its advantages include relatively low cost, high efficiency and very low levels of harmful emissions during combustion (it should be borne in mind that the EU natural gas is not used in the utility sector as fuel). These factors cheapness and environmental led today to what consumers solid biofuels are not only public utilities, that produce heat, but also private households. Major consumer preferences and environmental performance of pressed pellets and briquettes of solid biofuels: 1). Good flame. Fuel briquettes briquettes from sawdust and sunflower burn nice and smooth flame, always maintaining a very high temperature combustion. It is an ideal fuel for fireplaces, given their zharkist compared with birch wood exceeding 3 times. Increased duration of burning - about 1 hours of burning and from 4 to 8 in the mode of decay. 2). Versatility. They do not need to convert an existing heating equipment. Fuel briquettes are ideal for any standard central heating boilers, furnaces and fireplaces, all kinds's heating, boilers for wood. 3). Security. When burning briquettes are completely safe because they do not emit carbons and do not sparkle. 4). The high calorific value. Calorific value of briquettes twice higher than normal firewood and almost equal teplotvornosti lignite. 5). Minimum ash content. After combustion ash weight not more than 2.7%. Whereas after combustion of coal is 30-40%, and after the wood - 8- 15%. Ash is an environmentally friendly fertilizer. 6). Environmentally friendly fuel pellets: a) Briquettes do not contain harmful additives and does not emit any substances poisonous to humans and the environment, and implemented in their manufacture environmentally friendly utilization of biomass annually accumulates. b) in the table. 1 shows the main indicators of ecological processes some types of combustion of solid biofuels, natural gas, coal and petroleum diesel [1,3,4]. Total emissions of solids and carbon dioxide from the fuel pellets is 10 times less than emissions from combustion of gas (table. 1), 20 times lower than emissions from burning oil diesel fuel and 50

times less than that of the Stone coal. 7) Increased heat of combustion. The density of fuel pellets - 1200 kg / m³.

Table 1. Comparative evaluation of heat of combustion and harmful residues of this process for natural gas and solid biofuels

Type of fuel	Heat of combustion MJ/m ³	Sulfur, %	Solid ash, %	Carbon in carbon dioxide, kg/GJ
Natural gas	35–38	0,0	0,0	57
Oil diesel	26	0,2	1,0	78
Coal	17,0	1 – 3	10 – 35	60
Pellets from wood (sawdust)	17,5	0,1	0,3–0,5	4,9
Pellets made from straw	14,5	0,2	4,0	3,7
Pellets from husk sunflower	15,5	0,1	1,0–2,0	1,5

This two and a half times the density of conventional wood. The investigation of this is a huge calorific briquettes - about 5372 to / Calle. kg. That is about the same as one of the best fuels - coal (4900 to / Calle.). One ton of pellets (pallets) provides as much power as 5 m. wood, or 480 cubic meters or 500 liters of diesel fuel. 8) Ease of transport and storage. Fuel briquettes are very compact and take up less space than other fuels; have a neat appearance; 10 pound packaging contains 12 pellets measuring 32 cm in length and 5 cm in diameter, covered in polyethylene.

Problem. Such popularity of solid biofuels was the reason that in recent years the demand far exceeded the domestic production of solid biofuel and the EU ran its imports from Ukraine at 150-200 ths. Tons per year in total production of solid biofuels in Europe 10.5 mln. tons / year (2000 ths. tons / year in Germany and 410 ths. tons / year in Poland). However, in Europe most of all produced biofuels consumed in the manufacturing country. In the same Germany and Austria on the domestic market accounts for almost the entire amount produced, specifically on households - about 80% of the total consumption of briquettes and pellets, Italy and Sweden - 60%. Ukrainian biofuels market is contrary to the normal development of the industry: in Ukraine homes have no more than 20% of the total consumption of solid biofuels due to cheap gas for the population and the lack of certified products.

Analysis of recent research and publications. Solid biofuel sector in Ukraine began its development as a fully eksportnooriyentova because more than 90% of the fuel pellets and bricks were removed from the country, but to date the level of exports does not exceed 55% of the production while increasing the volume of domestic consumption in Ukraine. This branch of solid biofuels in Ukraine continues to grow rapidly, as evidenced by the following data: in 2008 in Ukraine was made with pellets and briquettes 77 ths. tons and in 2009 - 350 ths. tons [1-6]. then in 2010 - 650 ths. tons or 1 mln. 850 ths. tons in 2014. That is, the annual production of solid biofuels in Ukraine in 2014 almost reached volume production in Germany and 1.3 times higher than production in Sweden [1-4]. Today on the Ukrainian market employs more than 200 companies that produce solid biofuel in

the form of pellets or briquettes, and their production is exported to Europe, particularly in Poland (18.1%), Germany (45.7%), Czech Republic (14.1%). Competitive suppliers of biofuel pellets in the European Union are Canada, the US, Russia, and the main importers of Ukrainian biofuel serve Germany, Poland, Czech Republic and Belgium.

The purpose of research. In analyzing the energy potential of solid biomass in Ukraine need to focus on getting fuel pellets, Pellets, straw pellets, wood waste and manure. This type of biomass as sunflower husk, often remains out detailed consideration, although Ukraine occupies a leading position in the world market of sunflower seed processing, production and export of oil. The energy crisis, which Ukraine finds itself because of an acute shortage of gas and coal, unconventional forced the company to respond to challenges and producing biofuels closely engaged oliyezhyrovi large and small plants.

Results. According to analytical review, for 9 months 2016 production of solid biofuels in Ukraine compared to the same period in 2015 increased by 40% - to 1610 thousand. Tons. In 2014, growth was 42% and in 2011 - 18%. For 9 months of 2016 the production of solid fuel from the husks of sunflower in Ukraine has increased in comparison with the same period the previous year by 32.3% - to 1188 thousand, tons. In the production of environmentally friendly "sunflower yevrodov" is used specifically screw-pressing equipment, which allows compressed biomass energy without any harmful substances binders. Fuel briquettes Nestro cylindrical produced as a result of pressing the husks of sunflower seeds or waste wood industry in hydraulic or mechanical shock presses under pressure 400 600 bar. Fuel of this type may be a hole or without him, and the humidity does not exceed 10% (for "dry" wood - 20%).

Table 2. Production of solid biofuels from different types of biological raw materials in Ukraine in 2012-2016.

Indicator	2012	2013	2014	2015	9 months 2016
Fuel from waste wood, thous. tons	216	333	455	377	359
Fuel from straw, ths. tons	12	15	28	35	33
Fuel from the husks of sunflower, ths. tons	677	714	1054	1069	1188
Fuel Peat, thous. tons	44	57	55	51	30
However, solid biofuel, ths. tons	949	1120	1591	1532	1610

Today segment using alternative heat carriers is widespread in European countries. The EU directive was adopted to enhance the development of renewable energy, according to which EU countries by 2020 are required to increase the share of renewable energy sources (RES) in the production of heat and electricity to 20%. Most countries in Europe and beyond, which supply fuel pellets to the first quarter of 2010 focused on standard DIN plus, which combines certification for standards DIN 51731 and ONORM M7135 [4,5]. Much attention is given to criteria such as calorific value, humidity, Abrasion, ash and limit content of various chemical elements. The rapid development of production and consumption of fuel pellets, and the related increase in the number of representatives of the market, are a prerequisite for entering the EU in early 2010 new rules on the quality of fuel

pellets. The requirements of the new standard EN 14961-2, enacted Jan. 1, 2010, were not only strengthened but also complemented with new criteria [5,6]. Under the new standards, the pellets are distributed by the quality characteristics into three classes. The most stringent requirements set for wood pellets first grade A1. Maximum ash for these granules is 0.5% (pellets from coniferous trees) and 0.7% (a hardwood). These granules are recommended for use in the private sector. Class II A2 palyvnyh granules can be produced with mixed varieties of ash trees and have 1%. Pellets of the standard commonly used in boiler generalists. The so-called industrial pellets for the new rules referred to in the third grade and are designed for use in high-power industrial type thermal power stations. Ukraine has been producing cake for 6-7 years of age, in 2004 there worked two production plants cake, which used outdated equipment that was imported from Germany by private businesses, and production was about 8 ths. Tons per year. In late 2006 such plants, equipped with new imported and domestic equipment has already numbered about 20, briquette production exceeded 50 thousand. Tons per year, of which over 50% were in Western Ukraine [6,8]. The current dynamics of production of cake positive and, according to optimistic forecasts of Ukrainian experts expect that in 2012 a tenth of European consumption (about 300 thous. tonnes) will provide Ukrainian producer. The major companies that operate in this market are: LLC "VitaPellet", LLC "PelletBioteknologzhi" TEK Ltd. "Atis", LLC "Vista-Dnepr", LLC "Biofuel investments" - domestic companies; Ltd. "Clean lines", LLC "EkoAlternativ», Green Orange Enviromental BV - companies with foreign capital. The process for the production of pellets shown Fig.1. The process begins with the production of pellets separation of waste into two groups: small and lump waste. It should highlight another group - waste bark because they are used for the production of pellets of lower quality. Wood meal served directly to granulation, and optionally at first and then air at the granulation, crushing. Lump shredded waste using crushing plants to sizes smaller than 25x25x2 mm. This allows you to quickly and efficiently dry the raw material and prepare it for further grinding to particle sizes required. Used Hammer shredders with sieve or without them. At the station granulation has come raw and faction desired humidity, so after drying raw size smaller than 25x25x2 mm conducting the second phase - syrovynu pulverized into particles that are smaller than 4 mm. Drying. For high quality pellets need to use raw materials which moisture content 8-12%. Withdrawals of more than 15% humidity pressed bad, especially presses with a circular matrix. For drying plant used two types of drying chambers - drum and belt. For small dry waste (sawdust shavings, etc.). Use the dryer drum, and for chopped lumpy waste - belt. If you use a drum dryer for drying shredded waste lumpy, it will reduce the efficiency of the drying process. Air conditioning. When pressing pellets a mechanical coupling particles due to incorrect shape and jam, and lignin polymerization process. This pellets retain their shape and density [2-8]. Pressing. Pelleting press - the heart of the entire production of pellets, of which depends on all production. There granulators: flat matrix; with a circular matrix.

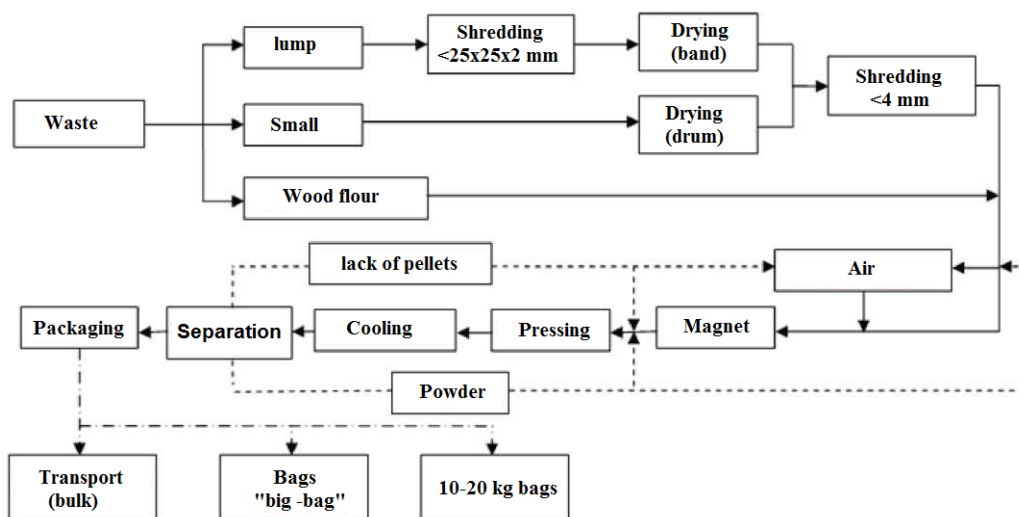


Fig.1. The scheme of production of pellets.

Press flat matrix simpler to use and clean. Press driven by an electric motor through worm gear which drives the main shaft. On the shaft installed head of the rolls, the pressure which the matrix is changed using the hydraulic controller. At the head has four rolls. To ensure free roller bearings impaled on roller bearings. Raw material is loaded by conveyor into the chamber, where under its own weight it hits the flat matrix. At poured freely raw roll rolled. Because pressing roll materials pressed into the holes of the matrix. From the back of the matrix due to the constant pressing more and more raw materials come rods of circular cross section. Knife, cutting off these rods, forming long beads. The cut pellets fall to the bottom tilt and fall out of the granulator. Cooling. While pressing raw material is heated to 10SIS, so there is a need for cooling. This process occurs in protypotokovomu coolers and regulated by changing the square holes. It pellets are cooled, dry out and become final density. Slow cooling provides granules with higher density. The final pellet moisture $9 \pm 2\%$. Separation. During the separation remove defective pellets and dust, and turn them directly into the granulator or the air conditioning. Removing dust improves appearance. Packaging. Pellets are transported, in bulk; in bags of 10-20 kg; bagged "big bag." Bulk transport technological granules, at least - pellet quality. Packing in bags of 10-20 kg is quite comfortable and designed for ordinary consumers. bags are transported on pallets. The contents of one pallet - 1 ton. Wood pellets for use: in the boilers and fireplaces for heating private houses, boiler houses housing, systems of combined heat and power (KPTE) for thermal energy, as fillers for cat litter, localization and removal of liquid products in emergency situations [2-8]. Teploutvoryuyuchu opylok ability and increased chip briquetting. After briquetting loose wood is reduced in volume several times, transportable and easy to use. briquetting granular wood is achieved by extrusion. graft required for briquetting presses more powerful than briquetting opylok. Almost bryketuyut only dust. Moisture opylok before briquetting should be not more than 12-15% and 8-9% below. Rozhlyanemo production line production of fuel pellets comprising conveyor, separator, shredder, screw conveyor, Heat, dryer, cyclone screw conveyor extruder E-350-40, briquette divider. Circuit line and its general appearance shown in Fig. 2. Using a

screw conveyor raw material is fed into a separator where the separation of raw material into three fractions: the size of particles up to 2 mm particle size from 2 to 10 mm (which is sent to the dryer drum) and a particle size of 10 mm (which is sent to the Hammer crusher) [2-8]. In the hammer crusher large particles are crushed raw material, and then through a separator are sent to the dryer drum. In drum drying raw material is dried to a moisture content of 8%, from the exhaust fan is fed through a hopper cyclone extruder. From raw material extruder hopper fed into the conical pressing chamber, which is pressed to the density of 0 - 1.2 t / m³ and subjected to heat treatment temperature of 160-350 ° C. After leaving the working body of the extruder cake divided into parts up to 300 mm. For two hours is cooling and solidification of lignin pellets. The surface of the bricks sealed from moisture lignin, which allows to transport it over long distances. In table. 3. presents the main indicators of characterizing the studied line. The resulting figures show that on line productivity of 360 kg for 1 hour. core of briquettes density is 1080 kg / m, which meets the quality briquette and their calorific value is at coal calorific value (4800 kcal / kg to 4900 kcal / kg). During experimental studies evaluated the economic efficiency of production and sale of briquettes from husk sunflower.

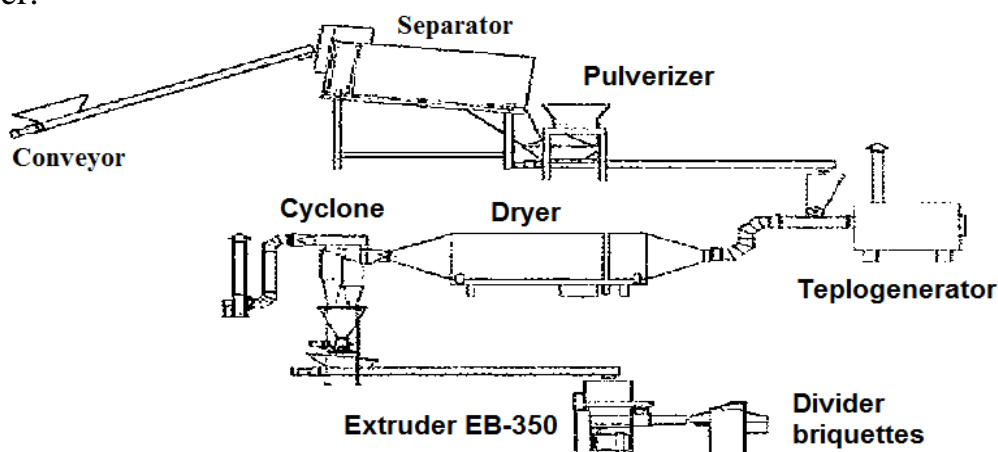


Fig. 2. Scheme lines for the production of fuel pellets.

For performance line of extruder EB-350-40 in one hour time AC 342 tonnes labor costs are 8,77 man-hour / t (three workers). These results indicate the prospects of this technology and the use of products in the installed gas engines [2-8].

Table 3. Yevropeyski standards for production of fuel pellets

Country	Standards
Austria	ONORN M 7135
Germany	DIN 5135
Sweden	SS 18 71 21

The requirements of these standards differ little from each other. They contain high demands on durability during transport. Monitoring is carried out in geometric containers (big bags), verified content for crumbs. Very strong demand obliges European buyers tolerant relate to this. Granules and pellets are made by pressing

(sawdust, wood chips), agricultural wastes (straw and putamen cereals, corn, etc.) and biomass energy crops. They are clean, have a good smell, pleasant to the touch. Granule diameter - about 1 cm in length - from 1 to 3cm. Granules with low humidity (menshe10%) and high calorific value compared with other types of biofuels. After pressing increases the amount of energy per unit volume (energy density) [3-8]. Pellets have a lower thermal conductivity than grains, but they are much cheaper. Production of chips made only one machine - scheporizom. For storage of wood chips do not need special facilities. Wood chips (schepu) are made from all logging residues and woody plants removed as a result of thinning and sanitary felling in forests. There are several types of chips. In shredders, foreign companies offer various construction equipment for cutting trees. These machines can also cut trees for logs. Depending on the production and the available technical means can use a variety of technical and technological schemes of harvesting wood chips (Fig. 3).

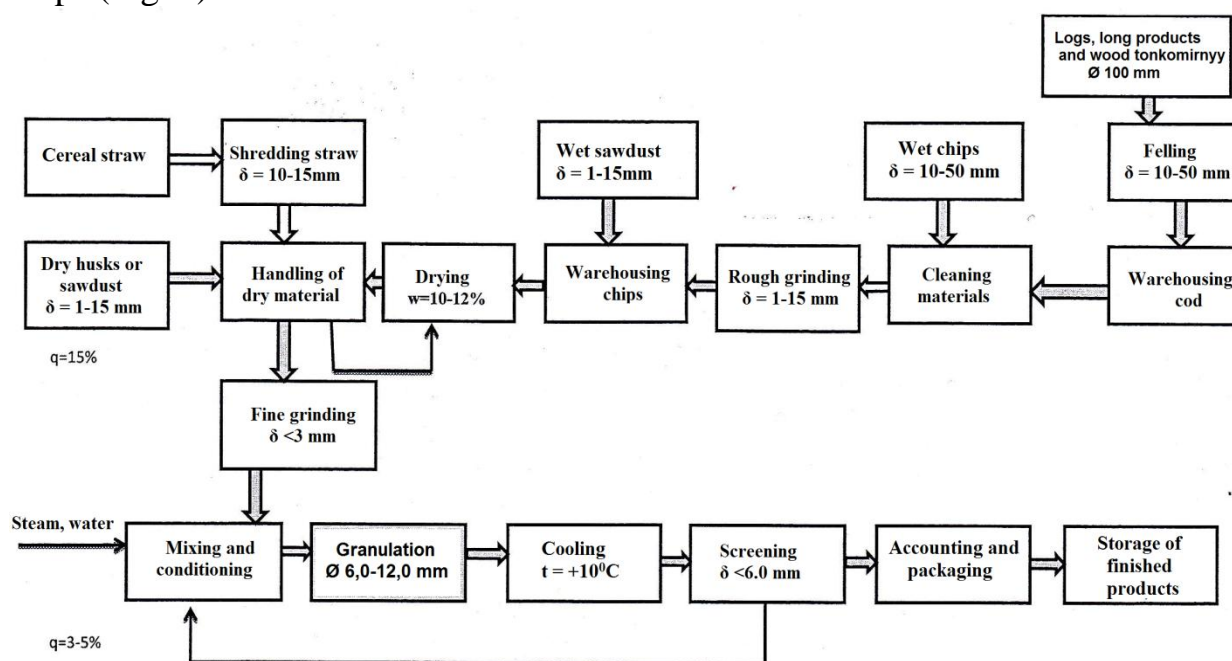


Fig. 3. Scheme of the process of making granules (pellets).

Conclusions. In analyzing the energy potential of solid biomass in Ukraine need to focus on getting fuel pellets, Pellets, straw pellets, wood waste and manure. This type of biomass as sunflower husk, often remains out detailed consideration, although Ukraine occupies a leading position in the world market of sunflower seed processing, production and export of oil. Teploutvoryuyuchu opylok ability and increased chip briquetting. After briquetting loose wood is reduced in volume several times, transportable and easy to use. Briquetting granular wood is achieved by pressing. For chips briquetting presses required more powerful than the briquetting opylok.

REFERENCES

1. Ekonomichne justify switching to heating solid biofuels. The harmonization of Ukrainian and European standards: Handbook / M. Kolomyychenko, S. Analkov,

- Т.Іhnatenko.- "pellet Ukrainian Union" -Electronic edition, 2014-47s.-
ww.bioenergy.gov.ua/sites/default/... /168_0.p
- 2.Rehulyatorni assumptions, resource potential and technical and prospects
ekenomichni energy production in Ukraine and its wood waste. /
Www.ukrbio.com/ua
- 3.Kaletnik G.M. Biofuels. Food, energy and environmental security of Ukraine:
Monohrafiya- K "High TekPres", 2010. - 516 p.
- 4.Pytel S.M. Biofuel Strategy of the European Union. Economy agroindustrial
production abroad: experience, problems / S.M .Pytel // Economy AIC
International Scientific Production Journal. - 2010. - № 4. - P. 152-155.
- 5.Al-Rifai, H., Y. Enakiev, B. Borisov, S. Mitev. Research on Practical
Opprtunities for Utilization of Plant Lefts of the Corn Industry. Energy Efficiency
and Agricultural Engineering. Association of Agrcultural Engineering in
Southeastern Europe. Rouse, Bulgaria, 2004, №1, 658-665.
- 6.Umysky S.M., Chuchuy V.P., Inyutyn S.V. Alternative fuels from biomass.
Publishing and printing "ТПР», ISBN 978-617-7054-33-6, 2014 r.375s
- 7.V. Dumych analysis technology producing various kinds of solid biofuels.
Engineering and technology APC .2013. Number 12 (51) - Ukrainian scientific
journal. S.24-28.
- 8.Chuchuy V.P. Umysky S.N., Inyutin S.V. Alternatyvnyi energy. Textbook for
students of higher educational institutions. Publishing and printing "ТПР», ISBN
978-617-7054-81-7, 2015 r.494s
- 9.Umysky S.M., Chuchuy V.P., Inyutin S.V. Alternative biofuel for power
APC. Publishing and printing "ТПР», ISBN 978-617-7337-44-6, 2016 r.232s.

ТЕХНОЛОГИИ ПРОИЗВОДСТВА ТВЕРДОГО ТОПЛИВА ИЗ БИОМАСЫ

Уминский С. М., Конев С. В

Ключевые слова: биомаса, биотоплива, пеллеты , брикеты, температура
горения, зольность, теплота сгорания, дизельное топливо.

Резюме

*При анализе энергетического потенциала твердой биомасы в Украине
необходимо уделять основное внимание получению топливных брикетов,
пеллетов, гранул из соломы, отходов деревообрабатывающих предприятий,
навоза.*

PRODUCTION TECHNOLOGIES OF SOLID FUEL BIOMAS

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Key words: biomasa, biofuels, pellets, briquettes, burning temperature, ash
content, calorific value, diesel fuel.

Summary

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