

PROSPECTS FOR THE DEVELOPMENT OF BIOFUEL MARKET IN UKRAINE

Klevtsov K.M., Doctor of Technical Sciences, Docent

HERSON NATIONAL TECHNICAL UNIVERSITY

The paper presents the results of a detailed systematic study of the development of biofuel market in Ukraine, as well as leading technologies for the production of granulated fuel. The results of these studies were the theoretical basis for the development of technology for production of pellets and briquettes based on the fires of flax and hemp

Problem essence. The energy use of wood waste generated during the primary processing of bast crops, unsuitable for technological applications, contributes to solving the optimization problem with the utilization of secondary plant resources. Bringing waste wood from the stems of flax and hemp for fuel will increase the efficiency of the processing enterprises, to create a waste-free production cycle and solve the problems related to energy independence and increase the effectiveness of environmental protection measures [1].

Analysis of last studies. Today there are several uses of fiber crops production waste. The most actual in recent years in our opinion is the direction of energy. Briquetting market is growing by enormous pace. Prices are rising steadily, especially after the signing of the Kyoto protocol. The advantages of this fuel are obvious, and the demand for it in Europe only grows with each passing year.

The process of pressing of crushed wood waste (sawdust, scutch, sunflower husks, straw, etc.) is in the base of technology of wood production briquettes under high pressure and temperature, the connecting element is the natural lignin contained in the plant cells. The briquettes are obtained by direct compression in a hydraulic or mechanical press. Furthermore it is possible to use screw compression method when raw feed and the finished output products are happened continuously.

The market demand is for pellets and briquettes of different quality: dark - with a high content of bark and bright - the content of bark which does not exceed 5%. Consumers pay pellets not only cost a lot of products, but also on the number of allocated heat [2].

Wood pellets are a standardized kind of fuel, therefore there are standards for them. Many countries have now been accepted quality standards of fuel briquettes and pellets in Germany these regulations are called DIN (German Industrial Standard). In Europe until recently used German standard DIN 51731 and the Austrian standard OENORM M 7135. In connection with the arrival on the market of low-grade wood pellets made mainly abroad in the spring of 2002 pellets in Germany receive new certificate DIN plus. This certificate has united

German and Austrian standards. Swedish Standard SS 187121 for today is the most demanding in terms of environmental protection.

The current state of the problem. According to our literary-theoretical studies it was found that in 2013, on the pellet market in Ukraine it was recorded 116 active companies (76 producers and 40 suppliers).

In 2014 only the first eight months the market has recorded 228 companies (173 producers and 55 suppliers). In particular, in the first quarter of 2014 in Ukraine it is operated 107 producers and 59 suppliers of pellets, at the end of the second quarter - already 142 products to 65 suppliers of wood pellets.

Thus, in 2014 as of the month of August the number of companies producing pellets increased by 20% compared with the previous year. At the same time, the majority of enterprises for the production of wood pellets in the current year are situated in Kiev, Zaporozhye and Sumy regions - 54, 26 and 14 respectively. Kiev and Cherkassy regions are also occupied leading positions which recorded 11 pellet plants in August month (Fig. 1).

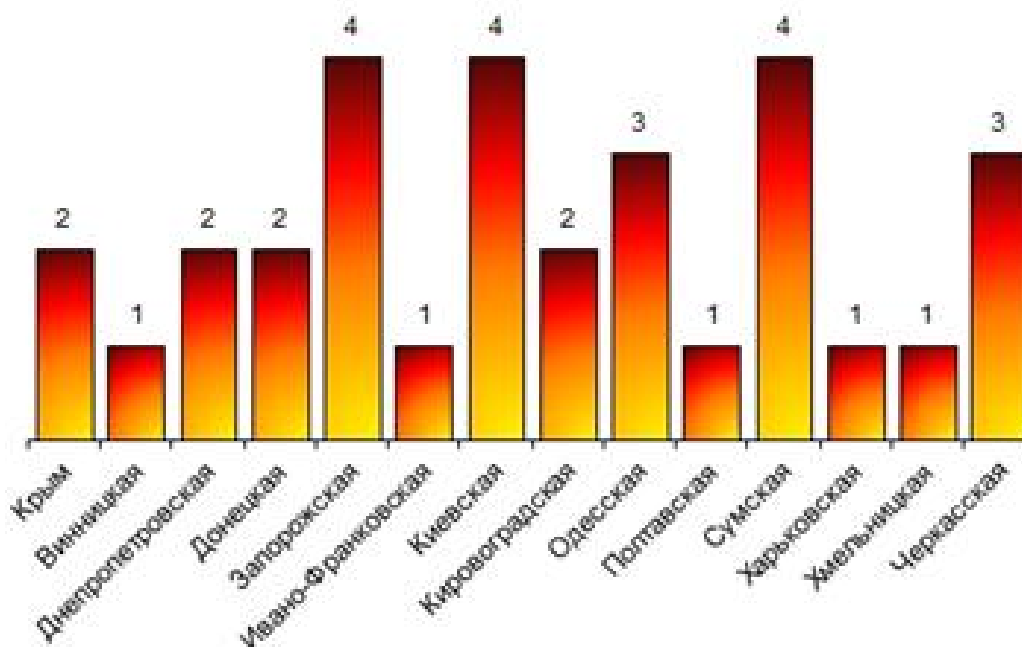


Fig 1 – Regional location of the straw pellets producers in Ukraine in 2014 (in units)

After reviewing statistics of exports of the solid biofuel from Ukraine company-buyers of Ukrainian wood pellets and compiled their top were established (Fig. 2). The basis of rating list served as the volume of imported products (wood briquettes).

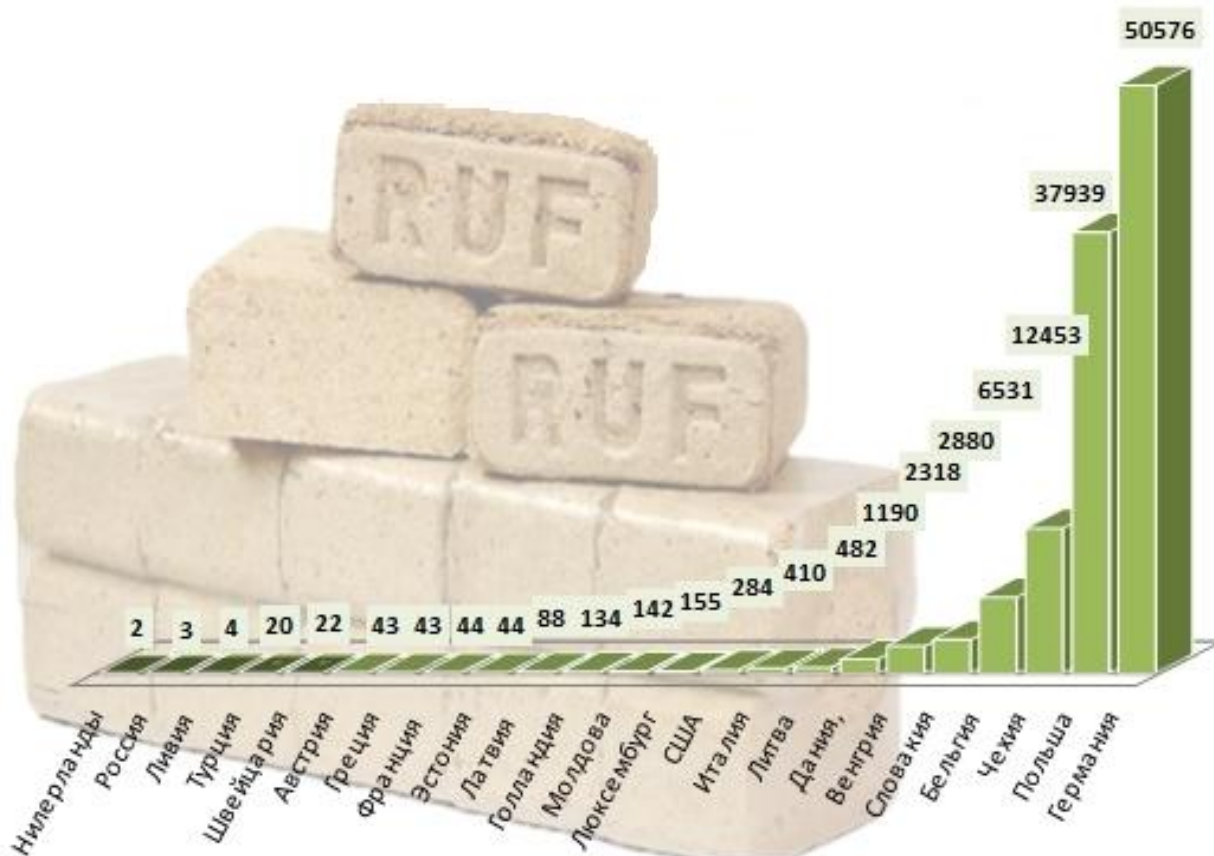


Fig. 2 – European imports of wood briquettes from Ukraine in 2013

The figure shows statistics about the buyers of wood briquettes from 22 countries, including 117 companies from Germany, 55 from Poland, 38 from the Czech Republic, 19 from Denmark, 13 from Slovakia, 12 from Hungary, 8 in Belgium, as well as information about the importers from Austria, Holland, Greece, Italy, Latvia, Libya, Lithuania, Luxembourg, Moldova, Russia, USA, Turkey, France, Switzerland and Estonia. Statistics of imports represented in Fig. 2 shows that in these countries the largest number of wood briquettes importers of Ukrainian origin is concentrated. This is due to the territorial proximity of the importing countries to Ukraine, developed transportation network, as well as the high level of demand for biofuels in these countries.

Prices of wood pellets in 2013 recorded in the range of 800-1400 UAH per ton depending on the season. In 2014 during January-August level of prices is varied within 70-180 euros per tonne. In particular, in the Kiev region prices on EXW are fixed at the level of 1000 UAH to 1400 UAH per ton, Rivne - 1550 UAH, Odessa and Zaporozhye -. 1400 UAH, Ivano-Frankivsk -. 1300 UAH, Zhytomyr and Dnipropetrovsk -. 1000-1300 UAH, Donetsk -. 800-1350 UAH, Cherkasy and Poltava -. 1200 UAH, Volyn - 1100 UAH, Lvov -. 1000-1200 UAH, Chernigov -. 1000-1150 UAH, Ternopil -. 1100 UAH, Chernivtsi and Sumy -.1000 UAH.

Main part. Laboratory equipment (Fig. 3) for briquetting flax and hemp scutch has been developed on the basis of Kherson National Technical University. The developed equipment has simple and easy to modify the design of the drive mechanism. To control the physical and mechanical properties of the products obtained it can be changed the exit cone that will be formed as pellets or briquettes in one and the same equipment [3].



Fig. 3 – Laboratory sample of extruder ECH-100P

In the extrusion process the changes of temperature, pressure, duration and intensity of exposure to raw material is possible. Technological extrusion process is as follows: prescription components are sieved and enter into the mixer where a homogeneous mass of the dry screw conveyor is fed into the storage hopper mounted on the dispenser of dry extruder components..

Further when advancing screw extruder operating in the array direction, the raw material is subjected to intensive thermal and mechanical stress. Consequently processes corresponding long thermal and mechanical treatment is happened with it. Then, the finished product is pressed through a forming die.

Tests laboratory sample showed the fundamental possibility of producing pellets and briquettes from the flax and hemp scutch which can be widely used as a fuel material.

Table 1 shows the necessary physical and mechanical characteristics of the raw material (scutch) compared with sawdust and sunflower husks for fuel briquettes on a laboratory extruder sample ECH-100P.

Table 1 – Physical and mechanical properties of the initial raw material

Options	Type of waste		
	sawdust	sunflower husk	bast crops scutch
Humidity, %	to 10	to 8	to 6
Processing temperature, C	320 – 350	240 – 290	100 – 110
Waste size, mm	до 8	2 – 8	4 – 8
Density, t/m ³	200	120	140

We should pay particular attention to the humidity of the processed waste. In case of exceed of 6%, the briquette is falling apart because of the excess produced under high temperature steam-gas mixture which makes it necessary to carry out preliminary drying of waste.

Thermal processing is created by the frictional forces arising during the passage of material through the die and the screw body. The minimum processing temperature is 80-110 °C.

The particle size and density of the feedstock greatly affects the productivity and quality of the finished product. Another problem is the disposal of smoke formed during briquetting which must be resolved by the consumer at the place of operation of extruders.

Today there are no standarts into briquettes in the countries of the Commonwealth of Independent States (CIS). Briquette manufacturers are guided by western standards. In Europe there is no uniform standard for European briquettes, and in different countries they differ significantly from each other (Table. 2).

Table 2 – The quality standards of fuel briquettes in Germany, Austria, Sweden

Options	Germany DIN 51731	Germany DIN plus	Germany DENORM M 7135	Sweden SS 187120
Diameter, mm	4-10		4-10	<25
Length mm	<50	<5xd	<5xd	<5xd
Density, kg/dm ³	>1,0-1,4	>1,12	>1,12	нет
Resistance to destruction, %	нет	<2,3	<2,3	<3,8
Humidity, %	<12	<10	<10	<10
Bulk density, kg/m ³	650	650	650	>500

Options	Germany DIN 51731	Germany DIN plus	Germany DENORM M 7135	Sweden SS 187120
Briquetting dust, %	no	<2,3	<2,3	no
Ash content, %	<1,5	<0,5	<0,5	<1,5
Calorific value, MJ/kg	17,5	>18	>18	>16,9
Sulfur content, %	<0,08	<0,04	<0,04	<0,08
Nitrogen content,%	<0,3	<0,3	<0,3	нет
Chlorine content,%	<0,03	<0,02	<0,02	<0,03
Arsenic, mg / kg	<0,8	<0,8	no	no
Lead, mg/kg	<10	<10	no	no
Cadmium, mg/kg	<0,5	<0,5	no	no
Chromium, mg/kg	<8	<8	no	no
Copper, mk/kg	<5	<5	no	no
Mercury, mg/kg	<0,05	<0,05	no	no
Zinc, mg/kg	<100	<100	no	no
Binders	no	<2	<2	no

There is an opinion that pellets have a greater demand than briquettes abroad. However, the demand for briquettes in Europe is persistently high, prices are continuously growing and they are no less than pellets. Briquettes made by screw compression are more economical in manufacturing compared to the simple one, as in simple compression binders are used and as a result that leads to a rise in the cost [4].

It should be noted the fact that the screw productivity is much higher than others, and the labor costs of production are much lower due to a higher degree of automation.

Qualitative characteristics of the granulated biofuel produced from the flax and hemp scutch for the developed technology are presented in Table. 3.

Table 3 – Qualitative characteristics of the granulated biofuel produced from the flax and hemp scutch

Options	Test method	Unit	Scutch	
			flax	hemp
Diameter	Method to measure 10 random samples	mm	5-8	5-8
Length	Method to measure 10 random samples	mm	<20	<20
Calorific value	DSTU ISO 1928:2006	MJ/kg	19,0	18,5
Ash content	GOST 11022-90	%	0,7	0,8
Moisture content	GOST 11014-81	%	<10	<10
Sulfur content	DSTU 3528-97	%	no	<0,01
Chlorine content	DSTU-P CEN/TS 15289:2009	%	<0,02	<0,02

Analysis of the results showed that the content of the main component corresponds to parameters of European standards (Table. 2), and the content of harmful substances such as sulfur and chlorine, respectively, 0.01% and 0.03% lower than the requirements of the German standard DIN plus.

The calorific value may vary by 3-5% depending on the density of the pellets due to the structural features of power and extrusion equipment.

Conclusions

By developing the technology for biofuels from waste fiber crops production in line with European standards it has been established:

1. On the basis of literary and theoretical studies of the structure and characteristics of the physical and mechanical characteristics of fiber crops, it developed the theory of their complex use with the use of modern energy-saving technologies.

2. Scientifically based resource-saving technology of producing biofuels from waste products POLW enterprises which provides new kinds of products.

3. A technology of new materials for non-traditional sources of biofuels – scutch of fiber crops was created.

4. Analysis of existing standards ONORN M 7135 in Austria, DIN plus 5135 in Germany, the SS 187120 in Sweden showed that the biofuels produced on the new resource-saving technologies in line with European standards on briquettes and is suitable for all countries importing Ukrainian briquetted biofuels.

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