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PROCESSING OF ORGANIC VEGETABLE POLYMERS INTO SOLID FUEL

An analysis of existing technologies for processing biomass plant in comparison with the proposed technology moistened pressing is provided. It is concluded that the higher efficiency technology wet compression achieved due account the physicochemical properties of the material being processed.

Keywords: *biomass, moistened pressing, disintegeration,cellulose, expeller*

Introduction. The main supply of alternative fuel is biomass produced largely as a waste of agriculture. Forest reserves in Ukraine is 14.3 % of the territory. [1] Else - is land cultivated by man. Thus, questions of biomass have greater relevance, related primarily to the fact that , from a business standpoint , pellets / biomass briquettes are a commodity , whereas agricultural waste , representing the bulk of the biomass product practically are not. In other words, the pellets can be sold on a permanent basis, the projected prices for a nice profit. Market waste, in turn, differs significantly lower prices and less predictable. The rapid growth of the price of fossil fuels, the desire to minimize transportation costs, increased environmental requirements and other issues also raise interest in the topic of biomass plant origin into solid fuel.

Was originally tasked to develop low-cost technology for granulated fuel from straw , because here there is an industrial process for pre- cleaning materials.

Analysis of the processing equipment available on the market of Ukraine, it has identified the following deficiencies:

1) the low stability of the equipment in the declared modes;

2) Failure to provide equipment declared the productivity of;

3) lack of mechanical strength of the granules / pellets;

4) high energy consumption and the presence of "hidden" costs.

These shortcomings, thus define a low economic efficiency of production of fuel pellets . From the point of view of the authors of the report the main reason for this is the lack of attention to the physical and chemical properties of the feedstock.

The purpose and objectives. As a rule, for processing biomass processing technology uses the classic fodder partial adaptation to recyclable materials. The efficiency of the equipment, coming from the "feed" technologies, and having the processing fodder value near 70% at the transition to the processing timber is lowered to less than 30 %, and the processing of straw becomes less than 10 %.

The aim of this work is the analysis of existing technologies and their comparison with the proposed technology moistened with pressing mikroiz grinding. When this biomass is considered as elastic, capillary- porous polymer of plant origin, capable of holding a moisture. According to the results of the gap analysis of existing technologies and equipment for solid fuel , a new approach that allows you to get a high quality solid fuel with low energy consumption.

Selection of raw materials. There are three main sources of organic matter, of which you may receive solid fuels:

1) timber;

2) agricultural wastes;

3) peatlands.

The first two of these sources of raw materials are renewable natural resources, and the processing of each type of raw material has its technological features.

Wood. Recycling timber industry or reuse of wood materials in health and other types of work possible in the presence of natural resources in the region. The main steps in the processing timber are: 1) grinding of the material, and 2) drying, and 3) compressing .

An important point is the quality of raw materials. Humidity of raw materials and resins presence, for example, influence the process of fuel combustion. In turn, the use

of wood as a raw material for the production of fuel pellets leads to higher costs for pre-drying material, which affects the profitability of production.

Agricultural waste. Processing of this raw material is considered to be the most promising from an economic standpoint. When processing is a major factor in the high cellulose content in the raw material (straw).

Peatlands. Today has been an increase of interest in this type of processing of raw materials, due to the presence of deposits.

Technology and equipment for processing. Analysis of the existing domestic market technologies and equipment showed that the main equipment is through the development of an empirical, ie trial and error. At the same time it should be noted that the issues of biomass pelleting has been rigorously evaluated in 70-80. The twentieth century (see, eg, [3]).

Thus, in designing the equipment is dominated by two destinations:

1) adaptation of the equipment for the production of animal feed;

2) original design, which is achieved by performance experiments.

As a result, this approach raises the following disadvantages:

- Instability of the equipment when the humidity of incoming raw materials in the practical range;
- Increase wear and tear;
- Increasing energy costs;
- Inability to use the same equipment for the processing of different types of raw materials;
- The high cost of equipment.

It should also be noted that not all manufacturers provide complexes equipment to form a complete production cycle of the fuel pellets, releasing the individual elements of the technological chain. It is difficult to form complex processing need to harmonize design and technology solutions from different vendors.

The first stage of processing of biomass is its refinement. For example, as a key element of straw used during grinding hammer mill, which has a low efficiency. It ranges from 1 to 5 %, depending on the humidity of the straw, which determines the

energy consumption for processing high - from 120 to 420 kWh per ton of feed, causing low profitability for the processing of straw.

The second important step in the existing technology for solid fuel is drying biomass feedstock to achieve the humidity in the range of 10-12% of the absolute value. Unfortunately, equipment suppliers often do not indicate the amount of energy needed to provide quality recycling process , considering drying of raw material conventionally "free." The estimate can be the following figures - for drying one ton timber with absolute humidity of 50-60 % is required 5-7 MW of heat. Dependence of the amount of heat required for drying, ambient temperature also explains why the seasonal fluctuations of productivity and cost of production.

The third stage of production is pressing. One of the most common types of equipment for biomass processing is press roller -matrix type (eg , LMB) , low efficiency for a given application is determined by the following factors: 1) high resilience molded material (straw), 2) energy consumption for " pressing " of the material between matrix holes , 3) the small percentage of deformation changes.

In the fourth stage of production is cooling the compressed pellets. During cooling the pellets in a free state, is adopted in many technologies available on the market, granules cracking occurs , which leads to a drastic decrease in the mechanical strength. This leads to the introduction of technological chain plot - termostabil finished granules.

The analysis shows that the existing equipment insufficiently addressed physicochemical properties of raw materials and features of the processes occurring in the production of fuel. When forming the proposed technology moistened pressing feedstock regarded as chemical and mechanical mixture of polymers of biological origin of capillary- porous structure, which determined the approaches used .

The process of production of fuel pellets can be considered as a process of increasing the density of the feedstock. Looking from this point of view the process of grinding of raw materials and the fact that the bulk of the biomass up cellular structures , we can conclude that - the grinding medium characteristic particle size of the pulverized matter should be smaller than the typical cell size.

Study proposed a new mechanism microgrinding conducted jointly with Kharkiv National Technical University of Agriculture named. Vasilenko. The method of calculation disintegrator that optimize equipment for different types of raw materials change working bodies.

One of the principal provisions of the proposed technology is to conduct processing in the presence of water. This is based on the results of studies of the effect of water on the physico-chemical properties of the cellulose and lignin (see, e.g., [2]).

Our proposed technology eliminates the drying of raw materials. In the formation of the proposed technology required humidity conditions is as follows:

1) of the excess moisture lost microgrinding step of heating the crushed raw material and biomass , wherein a greater degree of " drop " manner (i.e. in the absence of a phase transition from liquid to vapor);

2) before pressing the micronized biomass moistened for optimum heat and moisture regimes of the pressing process;

3) in the pressing part of the chemically bound moisture in Wann granular material that , among other things , causes a rise calorific pellets compared with the feedstock is 10-20%;

4) on the thermal stabilization phase of granules vaporizes excess moisture.

The proposed equipment for granulation microparticulate materials used press screw type, providing shear strains in granulated material. Using this type of equipment due to the properties of polymers belonging to the biomass ([3]).

In step thermostabilization finished pellets performed gradual temperature reduction pellets with a gradual reduction of pressure. This ensures the preservation of the mechanical strength and presentation products. Part of the energy may be returned (fed back) to the process.

Table 1 summarizes the characteristics of various compression methods biomass

Comparative analysis of various compression methods behavioral in Table 1.

Table 1

Comparative analysis of the compression methods

Compression methods				
№ п/п	**Type of compression**	**The impactor**	**Roller**	**Screw**
1	**Pressing mechanism**	Punching material through a matrix channel by the reciprocating motion of the piston	Punching material through a matrix channel by pressing the material rollers	Punching material through a matrix channel by rotating the screw
2	**Rpm**	to 30	to 300	to 200
3	**Pressure**	Pulsing	Pulsing	Constant
4	**The physical process**	Agglomeration due to the pressure	Agglomeration due to the pressure	Low-temperature thermochemical reaction polymerization
5	**Process**	agglomeration	agglomeration	melting
6	**Process temperature, C**	240-290	240-290	70-110
7	**Accounting for the rheological properties of the material**	No	No	Yes
8	**Humidity of raw materials,%**	to 10	to 10	to 30
9	**Shift mechanism layers**	low	low	high
10	**Mechanism for increasing the bulk density**	Yes	No	Yes

Major quantitative humidified compression technology proposed in comparison with the dry pressing technology shown in Table 2.

Table *2*

The advantage of compressing the wetted solid fuel

(for example, pressing sunflower husk)

Pressing method	**Dry**	**moistened**
raw materials	monoculture	**versatility**
Moisture content before pelleting	Not more than14%	**Not more than 30%**
energy consumption	75+30+30=135 кВт (70 кВт - granulator 30+30 kW - DKU)	**15+11+11=37кВт (11+11 кВт disintegrator 15 kW granulator)**
Energy costs (for performance 500kg)	486 000 kJ	**133 200 kJ**
Calorific value of fuel	to 18000 kJ / kg	**to 21000 kJ / kg**
The ratio obtained by the energy consumed as fuel	18,52	**78,83**
Wear resistance of the screws and dies	200-230 h	**5000-10000 h**
Ability to produce pellets of different shapes	No	**Yes**
Need for drying	1 - Drying of incoming raw materials 2 - Cooled and stabilization of output	**Cooling - final drying output**
Drying energy of incoming raw materials	Over 50% of the cost of process	**Not more than 10% of the costs on the process**
Fire safety	low	**high**
Performance	600-700 кг	**1000 kg (density of raw material)**

Conclusions. According to the results of this analysis was developed complex biorefinery plant origin in solid fuel, technical and economic parameters are given in Table 3.

Table *3*

Technical and economic indicators of the complex processing of vegetable biomass

INDEX	Description for INDEX
Storage capacity of raw materials (wood chips)	180 m^3 x 2 pcs.
Intermediate container ready for raw materials	200 m^3x 5 pcs.
Crushing chips and dead waste	8000 kg/h

Crushing straw	2000 kg/h x 4 pcs.
Performance module drying	2000 kg/h x 4 pcs.
Performance module processing	2000 kg/h x 4 pcs.
Performance cooling module	4000 kg/h x 4 pcs.
Number of employed per shift:	15
Installed capacity of electric actuators	1340 kW
Flow of process water	300 l/h
Thermal power heat source (8 tons / hour): • summer (25°C) • winter (2°C) • winter (-2°C) • winter (-20°C) Thermal power steam generator (8 t / h)	 80 kW 230 kW 530 kW 650 kW 240 kW

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Анотація

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Переробка органічних полімерів рослинного походження у тверде паливо

У роботі проведено аналіз існуючих технологій переробки біомаси рослинного походження у порівнянні з пропонованою технологією зволоженого пресування. Зроблено висновок про більш високу ефективність технології зволоженого пресування, що досягається внаслідок врахування фізико-хімічних властивостей матеріалу, що переробляється.

Ключові слова: *біомаса, зволожене пресування, мікроподрібнення, целюлоза, шнековий прес*

Аннотация

Войтов В.А., Бондаренко М.В., Бунецкий В.А.

Переработка органических полимеров растительного происхождения в твердое топливо

В работе проведен анализ существующих технологий переработки биомассы растительного происхождения в сравнении с предлагаемой технологией увлаженного прессования. Сделан вывод о более высокой эффективности технологии увлажненного прессования, достигаемой вследствие учета физико-химических свойств перерабатываемого материала.

Ключевые слова: *биомасса, увлажненное прессование, микроизмельчение, целлюлоза, шнековый пресс*