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MODIFICATION OF WOOD BY GLUTINOUS COMPOUNDS IN PRODUCTIONS FUEL PELLETS

These present researches are aimed at establishing the expediency of using modification of wood in the production of fuel pellets. The results of tests of pellets samples of the modified wood showed that in general use as a modifying agent protein adhesive is more effective than the use of starch pastes. The best values of the physico-mechanical properties were obtained for pellets samples of wood modified by gelatin and albumin at a rate of 0.5%.

Introduction. At present time the production technology of fuel pellets intensively developed and widely adopted in various countries around the world. Developments contribute to a significant increase in the cost of traditional energy sources and increasing environmental requirements for emissions into the environment from incineration. Today the problem of an increase in prices for fuel and energy resources is extremely relevant to the Republic of Belarus.

Wood waste of coniferous species (pine, spruce) usually used to produce fuel pellets. It contains high amounts of lignin and resinous substances that can produce pellets with high mechanical strength [1]. Practical application of wood as a waste wood and sawmill difficult. Hardwood does not provide the required mechanical strength and density of the pellets due to the nature of their chemical composition.

The most real way to reduce the cost of production of fuel pellets is the replacement of expensive and widely used in the woodworking industry softwood cheaper and low-value hardwood which is currently still does not find a satisfactory practical application in various industrial branches [2].

Hardwood contains a large number of highly reactive hemicellulose [3], which act by heating as a binder, as well as lignin, however, the amount is not enough to provide the required strength and transport density of pellets. To improve the adhesion interaction wood particles and denser packing of the granules in the structure of the wood is necessary modification.

As the modifying agent may be used such organic additives acting for binding, as protein adhesives and starch paste [4]. These types of additives are nontoxic, environmentally friendly, capable of forming a minimum quantity of harmful gases during burning and to maintain the low ash content fuel.

Main part. The aim of this study was to determine the effect of modification of wood on the strength characteristics of the pellets.

As a raw material waste wood were chosen as hardwood sawdust. It was used a fraction of 1.0 / 3.0 with 10% humidity.

In the laboratory conditions department of chemical processing of wood BSTU samples were obtained pellets from wood, that have been modified protein adhesives and starch paste and check samples of wood pellets without modification. For additives it was used adhesive based on blood proteins (albumin), on milk protein (casein), on protein hydrolyzed collagen (gelatin), corn starch, oxidized starch, starch syrup. Modifiers were administered in amounts of 0.1, 0.3 and 0.5% of the absolutely dry glue towards absolutely dry wood.

To obtained samples of pellets values of quality indicators such as density, moisture content, ash content varied within limits and meet the requirements of STB 2027-2010 [5].

In industrial conditions after manufacturing pellets packaged in large bags weighing 500-650 kg [6]. The lower layers of pellets under considerable pressure during storage are compressed. The pellets are subjected to vibration during transporting. These two factors lead to the fact that part of the pellet crumbles formed fine pulverulent fraction, which does not possess the required heating value. In this regard, the focus of the experiment was placed pellet strength parameters, namely the influence of the modification of wood by glutinous compounds based on protein and starch paste for flexural strength and compressive strength of the pellets, it degree of resistance to vibration.

Determination results on the influence of wood modification flexural strength and compressive strength of the pellets are shown in Fig. 1 and 2.

Analysis of the results (Figs. 1 and 2) showed that the processing of wood pellets of filler with all kinds modifying additives presented at a rate of 0.3 and 0.5% of the absolutely dry adhesive towards to absolutely dry wood flexural strength and tensile strength, compressed pellet increases. As can be seen from the plot shown in fig. 1 and 2 is generally used as a conductive agent, modify a protein adhesive is more effective than the use of starch pastes. In processing wood gelatin and albumin achieved the best results of mechanical strength and resistance to compression of pellets.

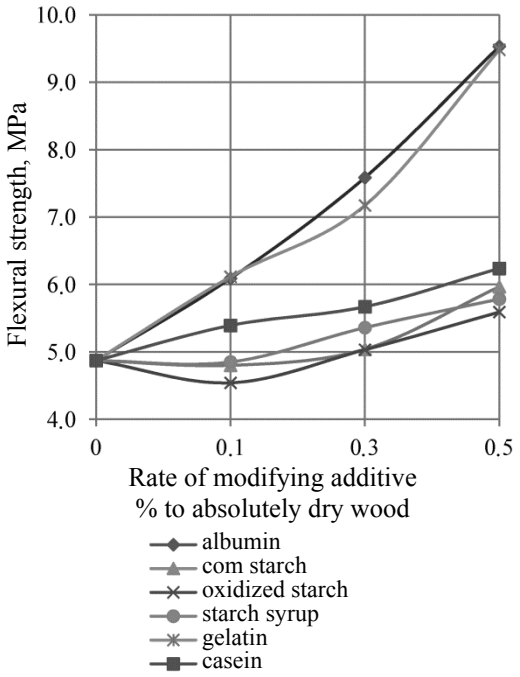

Fig. 1. Influence of modification of wood on the flexural strength of pellets

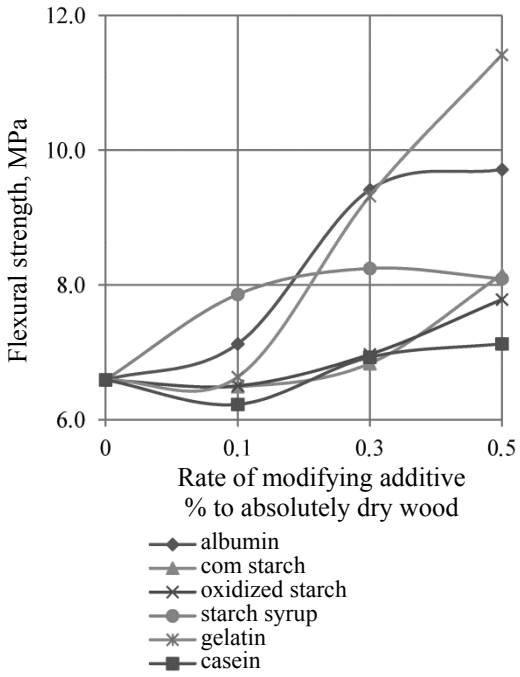

Fig. 2. Influence of modification of wood on the compressive strength of pellets

When used as a builder albumin or gelatin at a rate of 0.5% of the absolutely dry adhesive towards to absolutely dry wood flexural strength of pellets in both cases increases almost 2-fold (from 4.85 to 9.53 and 9.48 MPa, respectively). In this case the compression strength of pellets increases to varying degrees from 6.59 to 9.71 and 11.41 MPa, i. e. at 47 and 73%, respectively.

Studying the effects of vibration on the degree of destruction of pellets, which characterizes the strength of their transport, i.e. dimensional stability, carried out on laboratory sorting machine Haver EML 200 digital plus (Germany) with a three-dimensional dispersion. To determine the stability of the pellets was used to set the vibration sieve with a mesh size of 5.0, 2.0, 1.0 and 0.5 mm. Samples of pellets were placed on the top sieve with a mesh size of 5.0 mm. Then, they were subjected to vibration with an amplitude of 3 mm for 7 min. The mass of dust fractions for each of the sieves was weighed after the test was measured and the fraction of particles on each sieve.

Fig. 3 shows the results of determining the effect of vibration on the degree of destruction of the modified wood pellets. Rate of modifying additive was 0.5%.

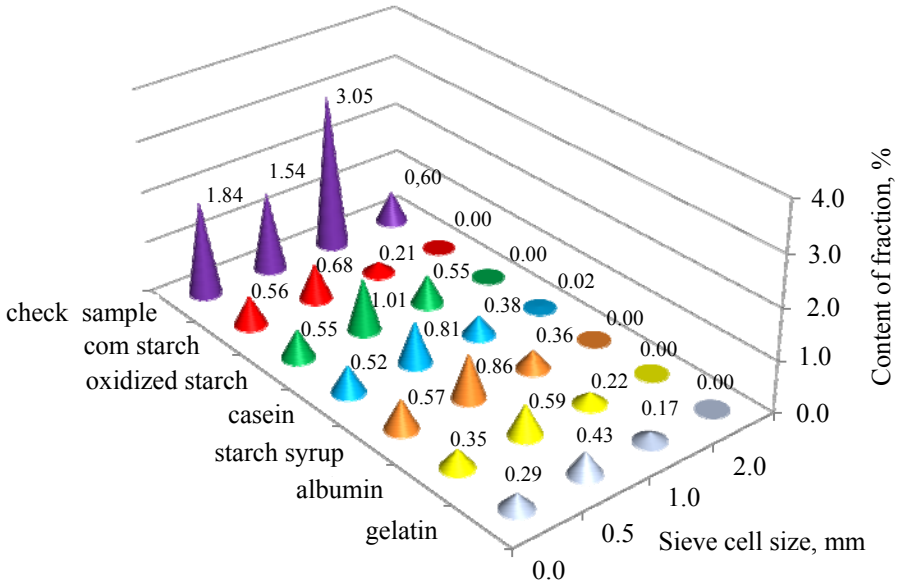

Fig. 3. Influence of vibration on the degree of destruction of the modified wood pellets

Modified wood pellets are more resistant to vibration at the above settings According to STB 2027-2010 regulated by the amount of dust abrasion of granules and pellets of the best quality (group 1), it shall be not more than 0.8%. As can be seen from fig. 3, all the samples of modified wood pellets on the indicator comply with the requirements of the standard. The smallest amount of dusty fraction formed when was tested wood pellets that were modified gelatin – 0.29% Albumin is slightly inferior on this value. The share dusty fraction decreased from 1.84 to 0.35%.

Conclusion. The results of this research indicate the feasibility of using wood modification in the production of fuel pellets. To improve strength characteristics of the use of protein adhesive pellets is more effective than the use of starch pastes. The best values of mechanical strength and resistance to compression achieved with pellet wood modification gelatin or albumin at a rate of 0.5%. While the share of dusty fraction formed by the impact of vibration on the pellets, is significantly reduced, which allows us to characterize them as a granular material with high dimensional stability.

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