ENERGY POTENTIAL OF BIOMASS CHARACTERISTIC FOR THE REPUBLIC OF MOLDOVA

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Abstract. The energy potential problem in the Republic of Moldova has been analyzed in this article. A solution of the above problem has been proposed by utilization of solid biofuels as renewable energy sources, ecological clean and cheap biofuel made from various agricultural and communal wastes and forest residues (unused products derived from the harvesting and processing of crops) which include plant stems, roots, straw, leaves, pruning grape vines, etc. The current status of renewable energy sources use in the Republic of Moldova is characterized in the article. For the absence of proper information about the calorific values of various biomass kinds gained from local sources it is impossible to determine the exact energy potential of biomass. Therefore, relevant experiments on specific heat capacity at different materials were conducted and their values included into this paper. Vegetal raw materials characteristic for the climate zones of the Republic of Moldova were used for the above experiments. The experiments aimed at determination of the calorific value of vegetable raw material were made by using the calorimeter MS-10A LAGET in accordance with the European standard EN 14918. As the result, the main factors affecting the calorific value of any type of vegetable raw material were chosen; they particularly are as follows: chemical composition and moisture content. Available potential of biomass needed to produce solid biofuels was also established as defined by the calorific value of the raw material and its energy potential.

Key words: biomass, bio-fuel, calorimeter, vegetal raw material, moisture content, quality.

Introduction

Biomass is a clean fuel without polluting emissions. It can be used in various forms: for burning in free condition of the material or for burning in a compressed form of the material in the form of pellets and briquettes, burning through pyrolysis and combustion of biogas. Currently, there is a practice for the production of solid biofuels, using lignocellulosic materials (wood, straw, vine, etc.).

Nevertheless, these materials have a significant disadvantage – very low density. This disadvantage makes it difficult to obtain the final product, but also the processing, transportation and storage.

However, in the long run, this leads to an increase of the production cost, which affects the cost and quality of biofuels. For this reason, the search for some technological ways to reduce these costs is a sure way to increase the competitiveness of the heat produced from agricultural waste and wood waste. Solid biofuels are used for heat and syn-gas production. Materials of plant origin can serve as solid biofuels, which can be used in unprocessed form (directly collected from the field), ground (chips), seals (straw bales, briquettes, pellets).

Given the above, it is obviously relevance of deep researches in the technology of solid biofuels from agricultural waste in the Republic of Moldova. This argument is motivated by the limited number of studies in the Republic of Moldova and the world in the areas of calorific value research, fuel produced from biomass. As is reasonable by the role that have composition of materials used for the production of solid biofuels from agricultural waste. If we consider the lignocellulosic biomass from the point of view of its use as a raw material to produce solid biofuels, its main sources are the following types of materials listed in Table 1.

It should also be noted, that the data provided by different authors differ and are available in different sources of literature in a wide range. This can be explained by the fact, first of all, that it is not indicated, which calorific value is given – higher or lower, also the data for different types of materials without the percentage, etc. In the available literature, unfortunately, the calorific value of a very small amount of the sources of biomass characteristic for Moldova is specified.

This fact points to the need for research in the domain of the calorific value of most common and promising sources of raw materials for the production of solid fuel in the Republic of Moldova.

Table 1

Heat capacity of some types of raw materials

Type of raw materials	Calorific value, MJ·kg^{-1}			
	[2], p. 21	[5], p. 15	[5], p. 61	[5], p. 63
Grapevine	-	14.2	-	-
Sunflower stalks	-	12.5	-	-
Lucerne	-	-	15.38	-
The branches of fruit trees	-	10.5	-	-
Cereal straw	15.7	10.5	-	15.5
Rye straw	-	-	14.45	-
Corn stalks	-	12.5	-	-
Rape straw	-	-	-	13.9...16.6
Rice husks	-	14.3	-	-
Husk of sunflower	15.4	17.2	-	-
Wood of different species of trees	12.6	14.6...15.6	-	-
Meadow hay	-	-	13.35	-

Materials and methods

Studies were organized in the direction of the theoretical justification and optimization of the promising sources of raw materials for the production of solid biofuel by determining the energy potential of the lignocellulosic materials obtained in agriculture.

The study determined a number of properties of raw materials, and which consisted of several phases: analysis of the quantitative potential of raw materials annually formed in the country, data collection and sampling of promising types of raw materials, preparation of samples for the study in accordance with the standards (shredding, drying), moisture determination, determination of the calorific value. It was done to ensure the reliability of obtaining domestic renewable energy sources. The cycle of the study was conducted in accordance with the method of the study, which prevents errors.

The heating value (calorific value) of the plant material in the study was determined in accordance with the standard ISO 1928:2009 Solid mineral fuels – Determination of gross calorific value by the bomb calorimetric method and calculation of net calorific value by complete combustion of the material in the calorimeter LAGET MS-10A in the Laboratory of Biofuels, State Agrarian University of Moldova (Fig. 1).

Fig. 1. **Calorimeter LAGET MS – 10A**

The thermal process is the transition from one condition to another thermal condition. The value which measures the thermal process is called heat and it is denoted by Q.

$$\langle Q \rangle\ SI = J \quad (1)$$

The coefficients of the calorific value are the factors that affect the heat:

- specific heat capacity;
- calorific value.

The calorific value Q_{AS} is determined according to the relationship:

$$Q_{AS} = [(DTK \times TK / \text{weight of sample}] - Q_W - Qp \quad (2)$$

where DTK – corrected temperature jump;
TK – heat capacity, JUMP;
Qw – heat of combustion of wire, 50 $J \cdot g^{-1}$;
Qp – heat of combustion of paper 1462.86 $J \cdot g^{-1}$.

During the research the following samples were analyzed: branches of fruit trees, straw, corn stalks, sorghum, sunflower husks, bush, poplar, grapevine in 100 % dried condition.

Results and Discussion

For Moldova, the use of energy from biomass, which in itself is clean and cheap energy is the solution of the current problem of the lack of heat energy. Using your own waste and various agricultural wastes it will also be able to effectively influence the environmental problem which consists in the accumulation of large amounts of agricultural waste.

During the research the calorific value of the most common types of raw materials was established (Fig. 2).

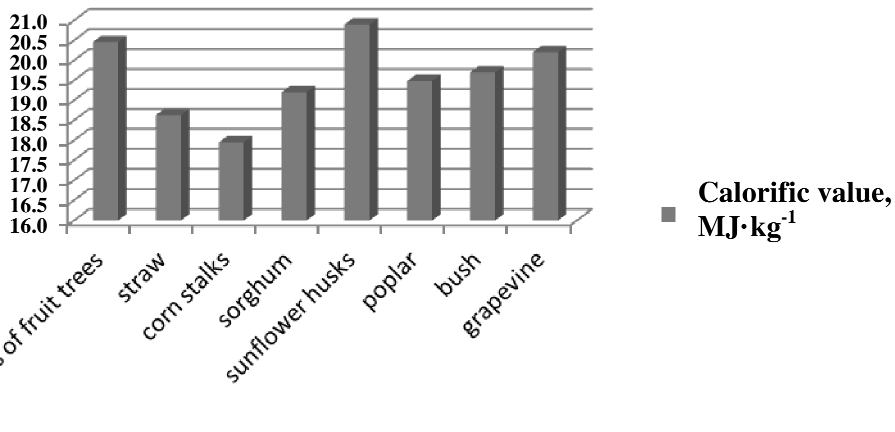

Fig. 2. **Calorific value of the most common types of raw materials**

It was established that the sunflower husks have the highest calorific value (average 20.89 $MJ \cdot kg^{-1}$), and then the branches of fruit trees (20.45 $MJ \cdot kg^{-1}$) and the grapevine (20.20 $MJ \cdot kg^{-1}$), the lowest result was registered in straw (18.62 $MJ \cdot kg^{-1}$) and corn stalks (17.94 $MJ \cdot kg^{-1}$).

Based on the results, we can conclude that the materials of lignocellulosic origin have a high calorific value and can be applied for high-quality solid biofuel. But this requires more study of this material.

Conclusion

The use of biomass as a raw material for energy production is particularly interesting for the conditions of the Republic of Moldova, as most of the land is used for agricultural production; there is a large amount of agricultural waste that can be successfully used for the production of solid biofuel. The use of solid biofuels for energy will contribute to significant social and economic benefits to a country that does not have a significant amount of traditional energy sources, an example is the

Republic of Moldova which imports a large amount of energy, but has large reserves of biomass that can be converted to bioenergy and biofuels.

It was also found that the published data on the calorific value of biomass are quite controversial and need to be clarified for the different regions of Moldova. To get a clearer idea about the availability of biomass energy potential in Moldova it is necessary to hold a number of studies aimed at quantification of available biomass.

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