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Increasing calories based on the processing of Angren brown coal

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ABSTRACT: The article presents the analysis of Angren lignite composition, changes in moisture and ash content, coal beneficiation methods and classification of a new fluidized bed drying beneficiation device. In addition, using the device, reducing the amount of moisture and ash, and increasing the heat of lower combustion, it was determined by research. Based on the research, a drying curve and an fluidized bed curve were constructed and its empirical equation was developed.

KEY WORDS: Coal enrichment, fluidized bed device, bottom combustion heat, empirical equation.

I.INTRODUCTION

The grade of coal used at Angren TPP is 2 BOMSSH B2 coal, its main characteristics are listed in table 1 below.

Table 1

Brand of the technological group	Class, (by piece size in mm)	Quality indicator		Lower heat of combustion, Q kcal/kg
		Mass fraction, %		
		Humidity, W, % average	Ash content, A, % average	
2 BOMSSH	0-50	33,0	23,8	2700
2 BOMSSH B-1	0-50	30,0	32,5	2500
2 BOMSSH B-2	0-50	35,0	46,7	2200

The values presented in the table are variable, so the values of ash content and moisture content of coal delivered to Angren TPP during 1 month were analyzed (Fig. 2).

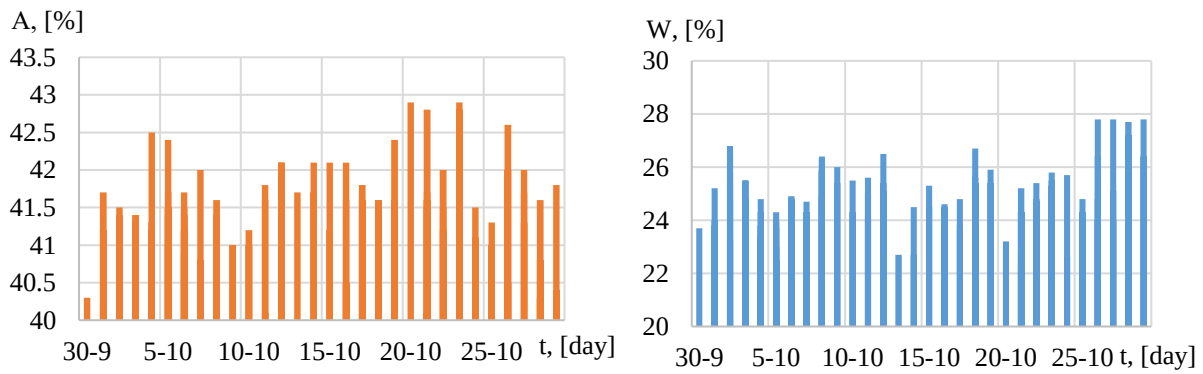

Figure 2. Analysis of coal moisture and ash content.

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As it can be seen from the analysis, the amount of moisture in the coal has changed to 23-28%, and the amount of ash has changed to 40-43%. Because of this, coal has low calories.

II. SIGNIFICANCE OF THE SYSTEM

Combustion of such coal at the station causes a number of problems. That is, a decrease in the heat of combustion, an increase in the ash content of particles that can harm the environment and human health, the formation of corrosion on boiler surfaces and other equipment, a decrease in thermal conductivity, technical maintenance It has several negative consequences, such as increased downtime, increased problems in fuel transportation and delivery, and a drastic reduction in basic efficiency. Further, the first and second critical velocities were obtained by determining the value of the hydraulic resistance. This indicates the beginning of the fluidized bed process and the values of the transfer of coal to the next chamber.

III. LITERATURE SURVEY

To solve such problems, it is advisable to use coal enrichment and drying facilities.
Enrichment of coals is a set of mechanical processing processes to increase the amount of combustible mass in them. All beneficiation processes are separation processes based on the use of physical and physico-chemical properties of coal particles and rocks. The beneficiation of minerals in various industries, including coal, depends on their physical or physico-chemical composition.
There are wet and dry methods of coal enrichment.

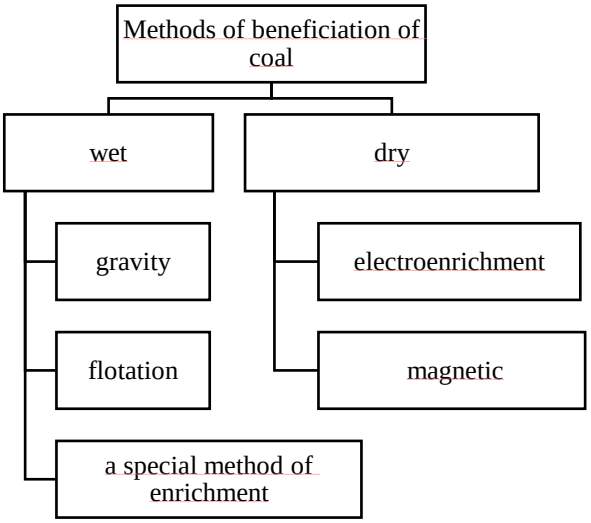

Fig. 1. The main methods of coal enrichment.

The drying and beneficiation device is selected based on the quality of the coal, the physical properties of the substances contained in it, and the location and conditions of the region.
The dry method is mainly used in the enrichment of Angren lignite, because the limited water resources of our region do not allow aqueous methods. The effectiveness of dry methods is also somewhat lower. For example, magnetic enrichment, this method is used in thermal power plants, only in this case it is possible to separate metal bodies from coal. Other similar methods also have several disadvantages. Therefore, a new device for coal beneficiation, i.e. a multi-section fluidized bed drying and beneficiation device, was developed in the research work.

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IV. METHODOLOGY

The appearance of the device is presented in Figure 3.

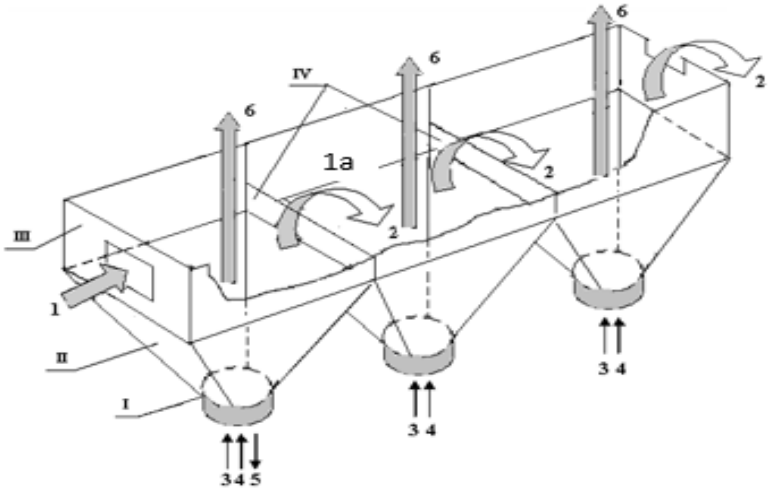

Fig.3. Fluidized bed drying and enrichment device.

1- fuel supply pipe, 2- dry and enriched coal to the next chamber, 3, 4- air supply (flue gas), 5- way to remove wet and solid mineral residues. the direction of movement of the 6th air

The main advantage of this device is the ability to perform two processes in one device: drying and enrichment. In this case, the enrichment agent is a mixture of air and flue gas and does not require any water, besides, it creates the possibility of cleaning from the main ballasts (sand, stone, gravel, rocks, etc.) in the coal.

Knowing the value of hydraulic resistance is the main issue in separating rocks containing coal, because by knowing the amount of hydraulic resistance corresponding to the density of each particle, it is possible to determine the second critical speed of coal particles. Through this, it will be possible to transfer the coal to the next chamber and separate it from the ballast.

With the help of theoretical calculations, the amount of hydraulic resistance, which is an obstacle to coal and non-combustible particles contained in it, was determined (Fig. 4).

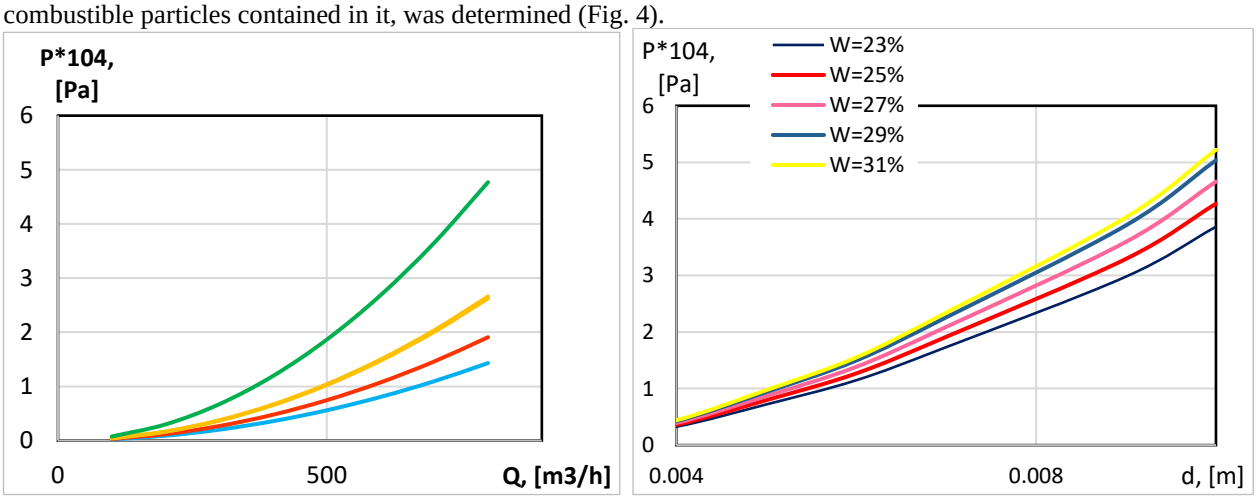

Fig 4. The graph of dependence of the hydraulic resistance of the layer on the air consumption and the equivalent diameter.

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By using the device, it is possible to reduce the amount of moisture and ash by almost 2 times. In this case, how much the lower combustion heat changes is analyzed using the following graphs.

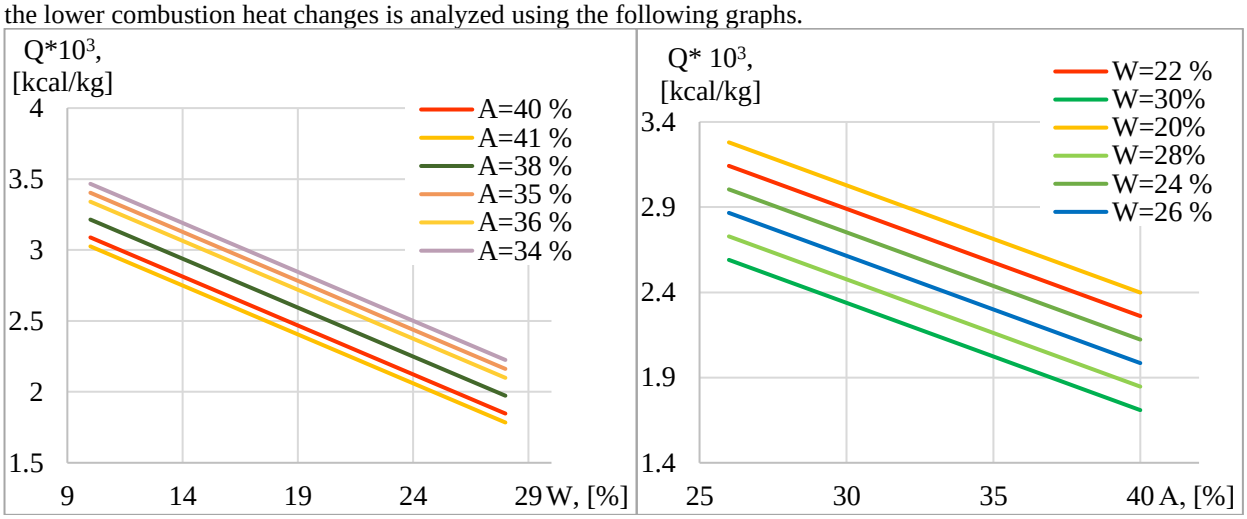


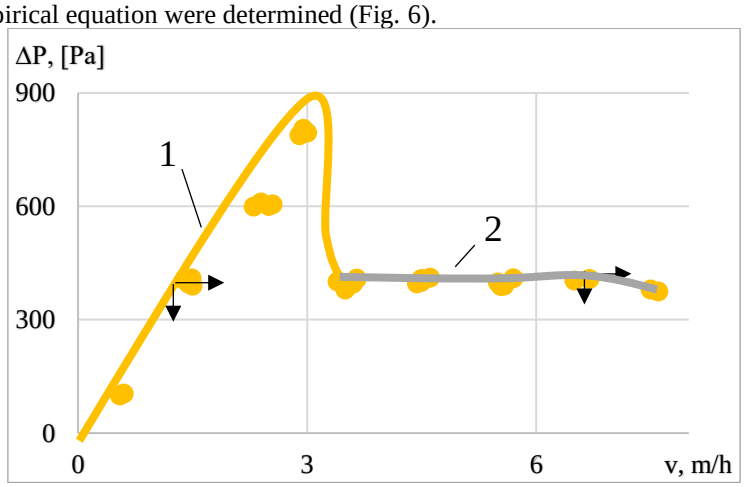
Fig. 5. graph of the dependence of the heat of lower combustion on changes in the moisture content and ash content of coal.

So, as can be seen from the graph, in theoretical calculations, it was determined that it is possible to increase the heat of lower combustion by using the device. In order to carry out research taking into account theoretical calculations, a laboratory copy of the device was created and research was carried out in it.

V. EXPERIMENTAL RESULTS

Researches were carried out on pieces of coal weighing between 40-200 g and equivalent diameter between 3-10 mm. The air temperature was 100-140 ^{0} C.

First, the amount of hydraulic resistance acting on coal lumps was determined, and based on the results, an abstract boiling curve and an empirical equation were determined (Fig. 6).



$$P_1 = -186.67 \cdot v^5 + 1933.33 \cdot v^4 + -7833.33 \cdot v^3 + 15516.67 \cdot v^2 - 14630 \cdot v + 5300$$
$$P_2 = -0.0066 \cdot v^4 + 0.3909 \cdot v^3 + -8.29 \cdot v^2 + 54.58 \cdot v + 292.05$$

Fig. 6. Fluidized bed curve and empirical equation.

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It can be seen from the graph that the researcher reached the first critical speed of 3.5 m/s, and it was determined that the second critical speed was reached at 6.5 m/s. So, if we give air at a speed higher than 6.5 m/s, coal particles will have the ability to fly through the fluidized bed state.
By using the device, the amount of non-combustible particles in coal can be reduced from 40% to 28%, moisture content from 28% to 8%, and as a result, it can be seen from the following picture that it has decreased (Fig. 7). By reducing the amount of coal moisture and ash in the experimental unit, the lower combustion heat was increased from an average of 2200 kcal/kg to 3500-3900 kcal/kg.

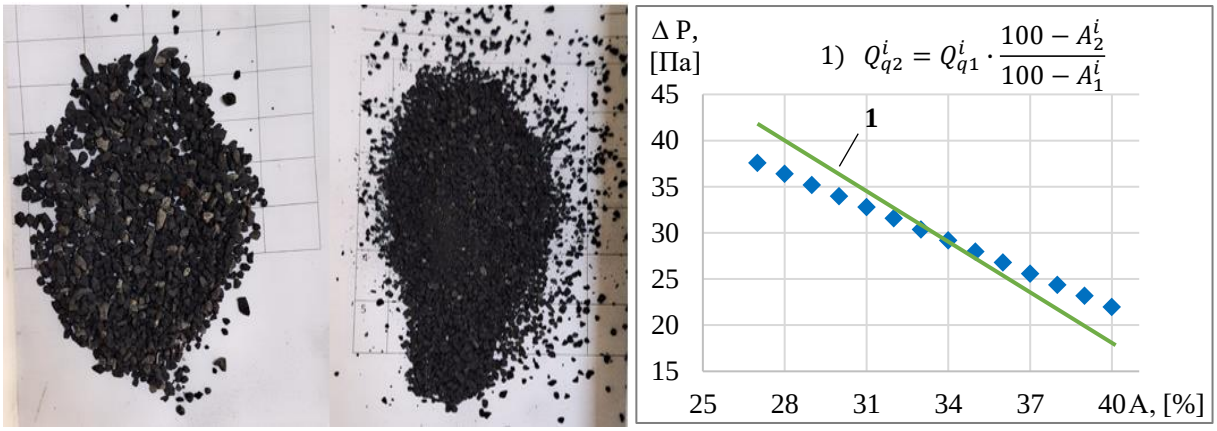

Fig.7. The initial and subsequent state of coal pieces passed through the device and the change in its lower combustion heat.

VI. CONCLUSION AND FUTURE WORK

In conclusion, it can be said that it is possible to increase the heat of lower combustion by separating coal from non-combustible particles and moisture, and this device is more efficient than other enrichment and drying devices due to its simple construction. As a result of the research, not only enrichment, but also the course of the drying process was studied, and thus the drying curve, the drying speed curve was constructed, and the results were based on the increase of the lower combustion heat.
Adequacy of the obtained empirical equations was checked using Fisher's criterion, the fulfillment of the criterion condition 5.38 > 3.17 showed the reliability of the obtained empirical equation.

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