COMPARATIVE ANALYSIS OF CHARACTERISTICS OF COAL UNDER THERMAL ACTIVATION

Mansurkhon Mehmonkhonov [1] ,
Khayot Bakhronov [2]
[1] Namangan Engineering-Technological Institute, Namangan, Uzbekistan
[2] Tashkent University of Information Technologies named after Muhammad al-Khwarizmi, Tashkent, Uzbekistan

Annotation
This article presents the results of the analysis of the characteristics of coals after their thermal activation at 850ºC. Different grades of coal have been found to have unique weight loss, ash content, carbon and moisture properties. Coal WCLWWSG1 (weakly caking large walnut with small group 1) proved to be the largest mass loss, but at the same time it had a high carbon content. Noteworthy is the difference in the ash content of coals, which can affect their porous structure and activation characteristics. These studies are relevant for determining the most suitable conditions and methods for activating various grades of coal.

Key words: angle, carbon, adsorbent, activation, temperature, humidity, analysis, ash.

Hard coals are one of the most common natural resources that are widely used in various industries. One of the key aspects of their use is their potential role as adsorbents – materials capable of attracting and retaining substances from the environment [1–3].
In modern industrial technologies, coal acts not only as a source of fuel, but also as the main component for obtaining a number of valuable products, including activated carbon. Activation of coal makes it possible to significantly expand its application by enriching the porous structure and increasing adsorption activity [4, 5]. An important component in this process is the activation temperature, which can affect many characteristics of the coal. This paper considers the effect of temperature activation at 850ºC on various grades of coal and their main characteristics. Thus, the purpose of the study was to determine the behavior of various grades of coal during thermal activation and to identify possible relationships between the initial characteristics of coal and its properties after activation.
The physical and chemical characteristics of coal were determined in accordance with the requirements of regulatory documents, such as ISS (international state standard) R 56357-2015, ISS 8302-87, ISS 8298-89 and TSh12-18:2001. The content of carbon and ash in coal samples was determined by complete combustion of the material in a tube furnace using an accelerated method in accordance with ISS 2408.1-95.
To obtain activated carbons, the procedure of carbonization and subsequent physical activation in a protective atmosphere was carried out. Different coal fractions were subjected to

carbonization in a laboratory fixed bed reactor under the same experimental conditions. The reactor was heated to 450°C at a heating rate of 8 K/min. After that, thermal activation was carried out at 850°C using a nitrogen flow of 100 ml/min and kept for 2 hours.

Qualitative characteristics of coal are given in table. 1.

Table 1.

Qualitative characteristics of coal

Indicators	Brand (group)		
	WCLWWSG1	WSSG1	SPG1
Type of regulatory document	TSh12-18:1998	TSh12-18:1998	TSh12-20:2003
Piece size, mm	18-90	≤13	20-120
Ash content, % no more	25.0	30.0	32.0
Mass fraction of total moisture, % no more	10.0	10.0	14.0
Lower calorific value, kcal/kg	6200	5400	4600

The following parameters are typical for WCLWWSG1 grade coal: particle diameter from 18 to 90 mm, ash content not more than 25%, total moisture content up to 10%, while its lower calorific value is 6200 kcal/kg.

Hard coal grade WSSG1 (weakly spicy seed of group 1) has a particle diameter not exceeding 13 mm, the ash content is limited to 30%. The total moisture content will not exceed 10%, and its lower calorific value is 5400 kcal/kg.

The SPG1 (skinny private group 1) coal grade is distinguished by particle sizes in the range of 20-120 mm, a maximum ash content of 32% and a total moisture content of not more than 14%. Its lower calorific value is 4600 kcal/kg.

Based on the above information, it can be concluded that different grades of hard coal have unique characteristics in terms of size, ash content, moisture content and thermal performance. These specifications affect the areas and ways of their industrial application.

Coals subjected to heat treatment at a temperature of 450°C for 1 hour, were characterized by the following characteristics, as indicated in table. 2.

Table 2.

Characteristics of coals obtained by thermal activation at a temperature of 850°C

Indicators	Sample		
	WCLWWSG1	WSSG1	SPG1
Mass loss, %	13.18	9.31	10.31
Ash content, %	26.47	30.87	33.44
Coal content, %	68.01	59.32	49.72
Humidity, %	4.10	3.80	4.60

When studying the characteristics of coals after heat treatment at 850ºC, it was found that WCLWWSG1 coal loses the largest amount of mass - 13.18%. While the losses in coals WSSG1 and SPG1 are 9.31% and 10.31%, respectively. These differences may indicate specific processes of coal degradation and evaporation of its elements during activation.

The percentage of ash in coal reflects the level of mineral impurities. Thus, WCLWWSG1 coal contains 26.47% of ash, while for WSSG1 and SPG1 coals these figures are higher, amounting to 30.87% and 33.44%, respectively. A large percentage of ash can affect the porous structure of the coal and its activation properties.

As for the carbon content, WCLWWSG1 coal stands out with the highest indicator - 68.01%. The WSSG1 and 1TP coals contain 59.32% and 49.72% carbon, respectively, which indicates different concentrations of carbon elements in the samples under consideration.

The moisture level of WCLWWSG1 coal is 4.10%, while for WSSG1 and SPG1 coals these values are 3.80% and 4.60%, respectively. The moisture content of the coal can affect the activation process and the formation of the pore structure.

Thus, as a result of the analysis of the characteristics of coals after their thermal activation at 850ºC, it was revealed that different grades of coal have unique properties of weight loss, ash content, carbon and moisture content. Coal WCLWWSG1 showed the greatest weight loss, but at the same time it had a higher carbon content. Noteworthy is the difference in the ash content of coals, which can affect their porous structure and activation characteristics. These studies are relevant for determining the most suitable conditions and methods for activating various grades of coal.

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