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# DEPENDENCE OF ITS PHYSICAL AND CHEMICAL PROPERTIES ON THE STRUCTURE OF BRIQUETTES

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**ANNOTATION**

The article discusses the main properties of organic and inorganic ingredients for the production of coal briquettes from local raw materials and production waste. The structure and properties of these ingredients have been studied. It is shown that all ingredients play a major role in the development of coal briquettes.

Gossypol resin, which is a binder for coal briquettes, has a more complex composition, which includes compounds with different functional groups: aldehydes, ketones, carboxylic acids, alcohols, etc. Therefore, it meets the requirements: it has high adhesive properties, relative environmental safety, quickly hardens, has a high calorific value, and is not in short supply.

**Keywords**

Brown coals, gossypol resin, cotton stalks, composition, bentonite, structure, properties.

**Introduction.** As is known, freshly mined young brown coals have a high moisture content (50-58%), but do not form a solid piece, are not stable during storage and, quickly losing moisture, disintegrate into fines and dust. Due to the high moisture content, such coals have a low calorific value (8.4-9.2 MJ / kg), their transportation over long distances is unprofitable. In the process of briquetting, brown coal is dried to a moisture content of 18 - 19%, as a result of which the heat of combustion of coal increases by 2 - 2.3 times and the transportation of such fuel becomes profitable. Briquetting is greatly influenced by the hardness of the coal. Young brown coals with a moisture content of 50 - 58% are soft. Older coals with a moisture content of 40–45% are classified as semi-solid and coals with a moisture content of 30–35% are classified as solid [1].

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**Objects and methods of research**. The objects of research are organic (gossypol resin) and inorganic ingredients from local raw materials (bentonite) and production wastes, brown coals of the Angren coal basin.

To obtain coal briquettes, we studied the structures, physico-chemical properties of selected organic and inorganic ingredients based on local and secondary raw materials, in relation to the development of coal briquettes.

**The results obtained and their discussion.** In the IR spectrum of the original Angren brown coal, peaks were found that belong to functional groups in the region of 500 to 1000 cm-1, where compounds of benzene carbon with metals sorbed in its composition are concentrated (Fig. 1) [2].

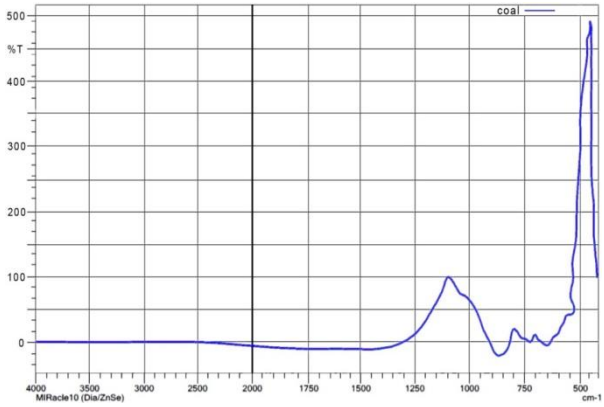


**Fig.1. IR spectrum of the original Angren brown coal**

Peaks related to phenolic groups - OH at a bandwidth of 3400-3500 $cm^{-1}$, 2400 $cm^{-1}$ - $CH_2$ groups. At absorption bands of 1550 $cm^{-1}$, ketone, halogen groups of aromatic compounds and ammonium groups - $NH_4^{-2}$. In the intervals of 1050 $cm^{-1}$, bands of $CO_3^2$ and phenolic groups of unsaturated hydrocarbons are noted. Absorptions of organic compounds with metals vary from 400 to 800 $cm^{-1}$, –C=O 1626 $cm^{-1}$ of the carbonyl group of aromatic, aliphatic acids, esters and lactones. Their bandwidth intensity is negligible. The transmission band in the region of 3430,7 $cm^{-1}$ corresponds to the stretching vibrations of the OH group [3].

We used gossypol resin as a binder. The requirements for the properties of gossypol resin are given in Table 1. In the IR absorption spectrum of gossypol resin (Fig. 2) – 1,1; 6,6; 7,7 - hexaoxy 3,3 - dimethyl – 5,5 - di-iso- propyl – 2,2 – dinaphthyl – 8,8 1 – dialdehyde (CHO) [3] found frequencies at 3751, 3725, 3711, 3670, 3648, 3628, 3608, 3357, 2923, 2853, 1712, 1645, 1557, 1464 , 1456, 1377, 1280, 1110, 967, 8 42 and 723 $cm^{-1}$.

**Table 1**

**Requirements OST 18-114-73 for gossypol resin**

**Properties Indicators**

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| Properties | Indicators |
|---|---|
| Appearance | Viscous mass |
| Color | Dark brown to black |
| Acid number, mg KOH | 50-100 |
| Ash content, % | 1,0-1,2 |
| The content of moisture and volatile substances, in% | 4,0 |
| Solubility in acetone, in% | 70-80 |
| Specific gravity, g/cm$^3$ | 0,98-0,99 |
| Saponification number, mg KOH | 80-130 |

The characteristics of the gossypol resin are shown in Table 2.

**Table 2**

**Characteristics of gossypol resin**

| Gossypol resin (fat-oil-combine) | Solubility in acetone,% | Ash content ,% | Acid number, mg KOH/gr | Molecular weight calculated from acid number Product of gossypol oxidation and conversion | The product of oxidation and transformation of gossypol, % | Fatty acid in the form of lactones, polymerized resins,% |
|---|---|---|---|---|---|---|
| Katta kurgan | 77,0 | 1,53 | 78,6 | 658,4 | 33,7 | 54,0 |

Gossypol resin has a more complex composition, which includes compounds with different functional groups: aldehydes, ketones, carboxylic acids, alcohols, etc. Cotton stalk was used as a filler. Bentonite and kaolin were used for comparison.

According to experts, with the level of production of raw cotton in Uzbekistan in the amount of 3,0 million tons, the so-called «waste» of cotton is at least 4,0-4,5 million tons. Over 70% of the waste falls on cotton stalks, which is more than 2,5-3,0 million tons [4], which is a very important raw material resource.

The degree of humidity has a significant impact on the process of grinding the stems. It affects the size and shape of particles, energy consumption, service life of the cutting tool, etc. Based on the study of these factors, it was found that the optimal moisture content of cotton stalks is 30-35%. However, it should be taken into account that each grinding method is determined by the choice of the optimal moisture content and it should be determined depending on the grinding technology used [5-10].

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Under the fractional composition of the chipping mass is meant the percentage of the constituent parts of the stem-bast fibers of the bark, separated during grinding of the bark, not separated from the woody part, wood chips, as well as the quantitative content of particles of various sizes [11].

Sieve analysis allows you to isolate free bast fibers, wood chips and smaller particles from the crushed mass. It has been established that the content of free bast fiber formed from crushed bark is 15-20%. Wood shavings are about 60 - 65%, and a small part - 10 - 20% [11]. The particle size of the crushed chips is mainly determined by the length of the chips obtained during the primary crushing of the stems. The stems were cut into pieces 10 to 100 mm long and a certain amount of each size was collected in a container. Then each heap was crushed on a chipper and the chips were measured. In this case, the criterion «average chip size» was used [11].

To further solve the problem, we conducted research in the field of studying the structure and properties of fillers for coal briquettes.

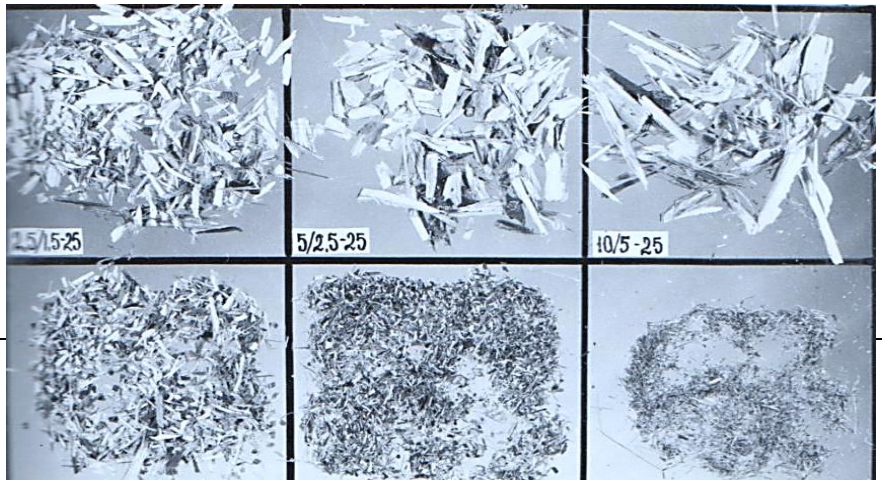
The structure and properties of wood filler were studied by methods developed by researchers from the CIS countries.

As a result of the study, it was found that the volumetric weight of cotton stalks in a dry state is 0,38-0,4 g/cm$^3$, the flexural strength is 0,60-0,68 MPa. The indicated characteristics for wood obtained from aspen are, respectively, 0,39-0,47 g/cm$^3$ and 0,580-0,766 MPa.

Such distinctive indicators of crushed stems as the presence of a fibrous part and core and heterogeneity of the size and shape of particles were studied (Fig. 2) [11].

In figure 2, the numbers in the corner of the photograph mean the following: the first number is the size of the sieve cell in millimeters through which the given fraction passed; the second digit is the size of the sieve cell in millimeters, on which this fraction is isolated; the third digit is the length of the chips in millimeters from which this chip was obtained.

Figure 2 shows that when cotton stalks are crushed, a mass is formed, consisting of needle-shaped particles, fibrous inclusions formed from the bark, fine fraction , crushed wood and the core of the stem.



**Rice. 2. Fractional composition of the crushed mass of cotton stalks**

Each of these components has its own strength properties, physical characteristics, particle size and shape, and chemical composition. This circumstance is the main distinguishing feature of the filler from cotton stalks.

To modify the gossypol resin, bentonite was used as target additives.

Bentonite $Al_2[Si_4O_10](OH)_2 \bullet nH_2O$ – belongs to the group of montmorillonite clays, confined to upper glossy deposits [12], aqueous suspension pH 7–9, the chemical composition of bentonite has several characteristic features. So far, bentonites of Uzbekistan have not been used as a raw material in the production of coatings. Bentonites were added to shape the elasticity of the briquettes.

**Conclusion.** Thus, each selected component is a local raw material and can be used as the main ingredients in the production of coal briquettes. As a result of experimental studies, it was found that gossypol resin meets the requirements: it has high adhesive properties, relative environmental safety, quickly hardens, has a high calorific value, and is not in short supply.

## LITERATURE

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