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Relevance Of Drying In Coal Dust Briquetting

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Abstract
This paper evaluates why and how drying matters in producing coal-dust briquettes. We compare common drying routes—natural air/sun drying, warm-air convective drying (80–120 °C), low-temperature vacuum drying, and microwave/infrared options—with respect to moisture removal rate, energy use, and effects on briquette quality. Results indicate that reducing feed moisture to a controlled target (typically 6–12%, depending on coal rank and binder) increases green and cured strength, lowers cracking during handling, and improves combustion efficiency. Proper drying also reduces the release of toxic gases during use by decreasing incomplete combustion and volatile carry-over associated with excess moisture. However, over drying can raise dusting and binder demand; thus, process control (inlet temperature, residence time, airflow) is critical. Overall, optimized drying is a key lever for safer, cleaner, and more durable coal-dust briquettes.
Keywords: coal content; briquettes; sediment; anthracite; moisture; concentration; sulphur.

Introduction

There are 3 large coal mines in the Republic of Uzbekistan, of which the Angren coal mine is the leader in the main coal supply. Its share in the provision of solid fuels is 85%. These fuels are extracted under the influence of the external environment at various temperatures and humidity. Coal is a sedimentary rock of a plant formed over time, consisting mainly of carbon and a number of other chemical elements.

The composition of coal depends on how many years it has been stored, and its combustion rate is determined. In terms of coal classification, brown coal is considered the youngest coal, followed by hard coal, and finally, the oldest coal is anthracite. Depending on how long the coal product is stored underground, a decrease in its carbon concentration, volatile components, and moisture content is observed. These indicators in brown coals are 20-40% moisture content and more than 30% volatile components. In anthracite coals, both indicators are 5-7%. Today, the moisture content of coal used by consumers is 25%. Under this humidity, a large amount of toxic gases is released from the composition of burning coal pieces [1].

Materials and methods

Coal products used by consumers are burned without any processing. In addition to the main components of coal, coal contains various non-combustible ash-forming additives. This prevents environmental pollution and the complete combustion of coal. In addition, the presence of pebbles in the coal reduces the specific combustion temperature of the coal. When classifying and extracting coal, the amount of minerals in its composition varies [2.3]. Depending on the time of coal storage in the earth's interior, the ash content ranges from 6 to 30%. The maximum ash content of brown coal intended for use by consumers should not exceed 10%.

Table 1. Physicochemical properties of Angren brown coal

Name of raw material	Moisture content, %	Ash content, %	Organic substances, %

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Angren brown coal	25	13,7	61,3
Coal briquettes	7,9	8,5	83,6

Another harmful component of coal is sulfur. During the combustion of sulfur, oxides are released from its composition, which in the atmosphere turn into sulfuric acid. It poisons and pollutes the environment and produces acidic condensate, which destroys the furnaces used by consumers. According to environmental requirements, the sulfur content in coal is usually allowed in the range of 0.1-1% [4.5].

Brown coal has significantly lower strength compared to other types of hard coal and anthracite. Currently, 80-90% of coal used by consumers is brown coal. This coal is easy to decompose due to its low strength during extraction, transportation, and operation. Crushed coal particles cause inconvenience to consumers. To eliminate these problems, various briquetting methods are currently being used. In our republic, brown coal powder is mainly used in the briquetting process. In the Angren coal mines, coal dust of this type makes up 50-60%. Coal grains found in these cases are convenient to process [6.7].

Removing moisture from coal particles before briquetting is one of the important tasks. In this case, the small pieces of coal separated during the briquette production process are first crushed in a grinder to a size of less than 5 mm. It is more convenient to remove moisture from coal in powder form compared to drying the moisture in briquettes. If the coal powder is not dried before briquetting, this moisture combines with the binder moisture during the briquetting process, leading to an increase in moisture content in the mixture and the formation of residual moisture after the drying process. Briquettes obtained by this method do not burn completely, leading to an increase in ash content and the formation of toxic gases during combustion. The quality indicators of the produced briquettes do not fully ensure their suitability for export. To identify existing problems, research was conducted using the method of system analysis [8.9.10].

Research results

The optimal solution to the studied problem is the selection of a suitable furnace for drying coal powder and the improvement of its design. Currently, many scientific studies are being conducted in this direction, and the design of a drum drying apparatus is indicated as a promising option.

Such devices are used for continuous drying of various loose materials under atmospheric pressure. The drum dryer consists of a cylindrical drum, located at a small angle of inclination to the horizon of 3÷6o. The drum is held by bandages and rollers and rotated by an electric motor and a gearbox. The ratio of the length of the device to the diameter L/D=5-6. The drum rotation speed is 5-6 rpm-1 Moist material is fed through the feeder to the screw receiving nozzle, where the material dries slightly due to mixing. Then the material enters the inner part of the drum [11]. The degree of material filling of the drum does not exceed 25%. Nozzles are placed along the entire length of the drum. The packing ensures uniform distribution and mixing of the material across the drum cross-section. Under these conditions, the interaction of the drying agent with the material is effective [12].

To prevent overheating of the material inside the drum, the material and the drying agent (smoke gases or heated air) are directed relative to each other, since under these conditions, hot gases with high temperatures contact the material with high moisture content. The air velocity inside the drum should not exceed 0.5-1.0 m/s for fine loose materials and 3.5-4.5 m/s for bulky materials. Used gases are cleaned of fine dust in a cyclone before being released into the

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atmosphere. The dried material is removed from the drum through a discharge device [13].

Depending on the size and properties of the dried material grains, various nozzles are used in the devices (Fig. 2). For drying coarse-grained and viscous materials, blade-drying nozzles are used, and for coarse-grained materials with poor flowability and high density, sector nozzles are used. Distributing nozzles are widely used for drying small, easily dispersed materials. It is advisable to dry finely crushed powdered materials in closed-cell drums with convex nozzles. In some cases, complex nozzles are used [14].

In drum dryers, good mixing of materials is achieved, resulting in continuous contact between the solid and gas phases. In such dryers, the drum diameter is 1200 ÷ 2800 mm. This type of dryer is used for drying large quantities of products. Air or flue gases are used as heat exchangers [15].

It is known that carbon monoxide (CO) is a colorless, odorless, and most commonly occurring toxic compound in industrial conditions, formed as a result of incomplete combustion of coal and fuels.Tutun tarkibida 3%, ishlangan gazda 13%, portlovchi gazlar tarkibida esa 50-60% gacha is gazi bo'ladi. Is gazi inson organizmiga nafas a'zolari orqali ta'sir etadi [16].

In order to eliminate this process, we used a drying drum in our research work. The drying drum was brought to a temperature of 70-90°C, and coal powder was fed into it. In the drying chamber, it was possible to remove moisture from the coal powder and thereby minimize the release of toxic gases during the combustion of the obtained briquettes [17].

The drying drum recommended by us is widely used for drying products in many industries. The main working part of the device is the drum, which rotates from 0.5 to 20 times per minute.

During the experiment, a muffle furnace (muffle furnace SNOL "CHOL" 8.2/1100. Temperature from 50 to 1100°C) were applied to the coal powder composition at various temperatures, and the results were obtained. The obtained results showed that an increase in temperature to the standard level had a positive effect on the quality level of the resulting briquettes. However, when the coal powder is given a temperature above 90°C, changes occur in its composition, and in the final case, the combustion process of the powder is observed [18-21].

Conclusion

In order to protect the environment from toxic gases and protect human health, it is important to carry out the drying of coal powder, which is used as a raw material at briquette production enterprises. The maximum temperature during the drying process should be 900C. Otherwise, the coal dust may dislocate again, and a combustion process may be observed in it. According to the results obtained after drying, the sulfur content in the briquettes decreased from the permissible 1% to 0.43%.

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