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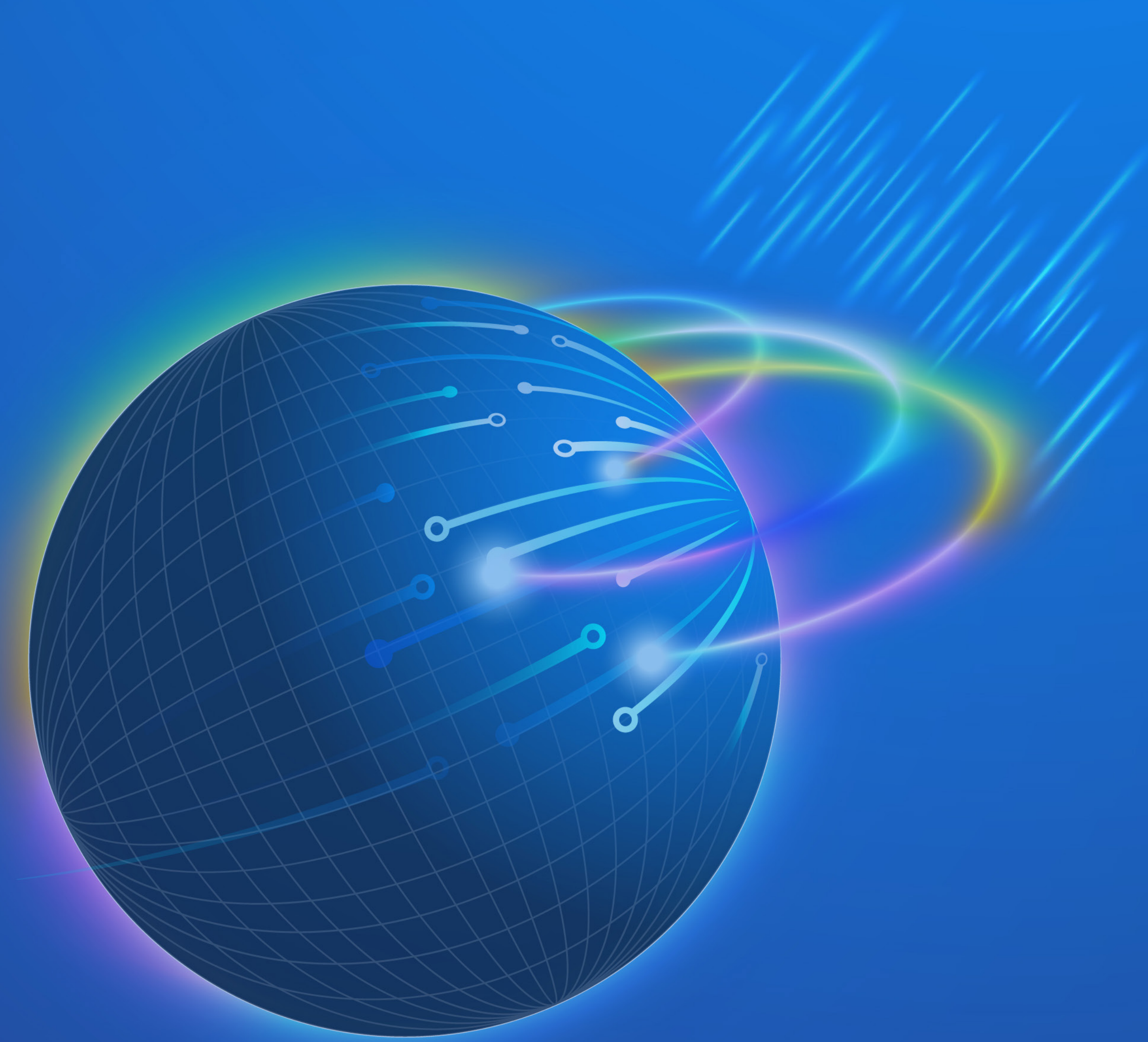

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Investigation of Geological Characteristics and Quality of Shurabak Pul-E-Khumri Coal Mine in Baghlan Province

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ABSTRACT

The main purpose of this study is to study and evaluate the quality of coal in this region and determine its exploitation potential as an energy source. In this study, bomb calorimeter, dustiness test, and moisture content test experiment were used. So, in this article, the researchers used three articles and four books. Five coal samples were collected from Shurabak region and each of them was analyzed using laboratory analysis methods to determine the quality. The results of the analysis showed that these coals are placed in the category of high quality coals due to their physical and chemical characteristics. The studies show that the region's coals have a heating value between 4150 and 4545 kcal, an ash percentage of 38 to 44%, a gas percentage of 22 to 28%, and humidity between 0.32 and 0.40%. These values indicate the appropriate quality of coal in the region, which can be used in various industries. Since the brine coal is located in layers of sedimentary rocks including sandstones, conglomerates, argillites, siltstones and carbonate-dolomite, the need for deeper studies to better understand these resources and facilitate their optimal exploitation increases. This research provides a foundation for future studies and practical use of this valuable source of energy.

INTRODUCTION

Underground mines, as one of the most basic natural resources, are considered a national wealth and an important part of the economic infrastructure of countries. The importance of these mines is undeniable, especially in countries that depend on the development of their natural resources. These mines play a key role in the production of raw materials and the supply of energy needed by industries. For this reason, the correct and scientific exploitation of these resources can directly affect the growth and development of the national economy and cause the prosperity of various industries. In fact, underground mines not only play a role in creating job opportunities and increasing industrial production, but they can also help develop new technologies and improve industrial infrastructure.

Coal is one of the most important minerals extracted from underground mines and plays a vital role in the global energy supply. This valuable material is a type of sedimentary rock that is formed by the decomposition of plant remains in the depths of the earth under high pressure and heat. The process of coal formation is a long and complex process that takes place over millions of years. This material consists of complex compounds, the largest percentage of which is carbon (Rezazadeh, 2012).

Also, water and components of copper materials also play a role in the composition of coal. The presence of a large amount of vegetable matter is absolutely necessary in the process of coal formation. These plant materials usually accumulate in swampy and humid environments such as peat lakes. In different geological periods, especially since the beginning of the Dionine period, organic or plant materials have been accumulated in these environments without access to sufficient oxygen. These conditions lead to the incomplete decomposition of plant material and finally the formation of peat, which is the initial stage of coal formation. In the absence of oxygen and with the passage of time and under high pressure and heat, this peat turns into coal (Rezazadeh, 2012).

Coal is formed when decaying plant remains accumulate faster than bacterial decomposition. Suitable conditions for this process are usually provided in swamps and humid environments that have little oxygen. In these environments, stagnant water and lack of oxygen prevent the complete decomposition of plant materials by microorganisms. The activity of bacteria in these conditions is such that plant remains to undergo incomplete decomposition and gradually turn into a mass of organic matter called "peat." Peat, as the raw material for coal formation, compacts over time under the pressure of subsequent sediments.

When peat is buried under heavier sedimentary layers, due to high pressure and heat, it undergoes compression and contraction, and the water and gases in it are released. This process, which takes place over millions of years, gradually turns peat into coal. At this stage, coal with different qualities is formed depending on the amount of pressure and heat applied to it (Mikhailov, 1967).

When a 20-meter-thick layer of peat is placed under the one-kilometer-thick sediments and is under severe pressure from these sediments, the peat turns into brown coal (lignite) with an approximate thickness of 4 meters. If plant remains are buried at a greater depth, say 3 km,

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then the 2 m thick peat will be converted into higher quality coal. At great depths, about 6 km, and in high heat, the 20-meter peat turns into anthracite, with a thickness of 1.5 meters.
The amount of carbon in coal varies between 75 and 95 percent, depending on its type (type and quality). This amount of carbon is one of the determining factors in the quality of coal. Also, the moisture in coal can reach up to 12%, which depends on the type and conditions of coal formation (Sahak, 2012).
Coal is one of the most important sources of non-renewable energy, which has been used for more than two thousand years. This mineral has been used since ancient times due to its high energy production capacity, especially in industries such as cement and electricity production. Afghanistan is one of the countries that is rich in natural resources, especially coal. However, until now comprehensive and comprehensive geological and mineral studies have not been conducted on these deposits, and many of Afghanistan's mineral resources have not yet been fully explored.
Based on preliminary geological studies conducted with the cooperation of domestic and foreign experts, two large coal fields have been identified in Afghanistan: The East-Southeast mining field and the Northeast-Southwest mining field. The east-southeast area has not been studied in detail and widely yet. Preliminary research shows that the exploitation of the coal reserves of this area is not economical at the moment due to the quantitative and qualitative limitations and the current conditions.
On the other hand, the northeast-southwest mining area, which starts as a continuous mining belt from Badakhshan province in the northeast of Afghanistan and passes through the provinces of Takhar, Kunduz, Baghlan, Bamyan, Ghor, Samangan, Balkh, Saripul, Jawzjan, Faryab and Badghis ends at Sabzak coal mine in Herat province, it is considered one of the most important coal-rich areas of the country. This mineral strip has significant capacities for industrial exploitation and further studies in this area can help the economic and industrial development of the country (Rezazadeh, 2015, p 1).

LITRATURE REVIEW

The identification and mitigation of adverse geologic conditions are critical to the safety and productivity of underground coal mining operations. To anticipate and mitigate adverse geologic conditions, a formal method to evaluate geotechnical factors must be established. Each mine is unique and has its own separate approach for defining what an adverse geological condition consists of. The collection of geologic data is a first critical step to creating a geological database to map these hazards efficiently and effectively. Many considerations must be taken into account, such as lithology of immediate roof and floor strata, seam height, gas and oil wells, faults, depressions in the mine floor (water) and increases in floor elevation (gas), overburden, streams and horizontal stress directions, amongst many other factors (Mikhailov, 1967).
The first work done by the research group in northern Afghanistan, especially in Pul-e-Khumri district, was at the beginning of the 19th century by Gersbach. By Lord in 1886 and by Barry Coate in 1880, only brief information about the stratigraphy of the Hindu Kush region was identified. The stratigraphy of the Hindu Kush region of the north, which is the coal of Permian and Triassic sediments, was conducted in 1935 and research on tectonic stratigraphy was also predicted. In 1937, Girg studied Pul-e-Khumri and Khulm areas in his research essay and considered Sedimentary Stone in 1941, photographing coal mines, and later studied by Ghulam Ali Khan, a member of the Board of Characteristics of Shurabak, Karkar and Ashpeshteh Coal Mines. In 1962-1965, geological mapping was carried out in the coal-rich areas of Afghanistan for the order of 1: 200,000 maps by Mikhailov, while Mikhailov of the Charcoal Area of Pul-e-Khumri (Shurabak, KarKar, Doodkash and Ahndara) considered the geological maps of the area on a scale of 1:5000 and divided Miso-Cenozoic into upper Jurassic and Triassic (Sahak, 2012).

MATERIALS AND METHODS

Three primary categories of methologies were employed in the writing of the article: laboratory, field, and library methods. The laboratory conducted a number of experiment in addition to fieldwork and library research. Several tools were employed in this sector to assess the quality of the coal: Using a bomb calorimeter, one may measure the energy generated combustion and ascertain the calorific value of coal.

Dust Test

To determine the quantity of dust generated throughout the coal mining and utilization process.
The moisture content of coal sample is measured using a moisture test, which has a significant impact of coal's performance and quality.
By using these techniques, we were able to get a thorough and precise grasp of the coal quality and geological features.
In the field research of Shurabak coal region, there are many tools such as GPS to determine the exact geographical location, measuring tape or measuring tape to accurately measure distances, hammer and pen to extract samples, journal to record observations, camera for visual documentation, loupe to see the details of minerals and a mountain compass has been used to measure the directions and slopes of the layers. This set of tools helped to collect accurate information and field sampling.
In the laboratory department, the samples were carefully numbered and recorded, and each sample was carefully examined and analyzed under advanced devices. At this stage, five main samples of minerals have been extracted, analyzed and checked with specialized devices. The results obtained from these five samples were compared, which shows the agreement of the results and confirms

the accuracy and correctness of the tests performed. This matching of the results shows the accurate performance of the devices and the correctness of the methods used in the research process.

Finally, the findings from these three stages are comprehensively analyzed and the final results not only show the clarity and accuracy of this research, but also provide solid scientific foundations for future studies.

Field Research

Shurabak coal mining area is located in the eastern part of Pul-e-Khumri city, Baghlan province and at a distance of 12 km from it. In fact, this area is the continuation of the coal layers of Karker and Chimney mining areas, and it is located in the south of Chimney mining area. Shurabak is located in the eastern arm of the Pul-e-Khumri anticline and geomorphologically, it appears to be a monocline structure. The adjacent and host rocks of the coal beds in this area include sandstones, conglomerates, ergolites, siltstones, and carbonate-dolomite rocks.

Figure 1: Shurabak coal mining area of Pul-e-Khumri, Baghlan province

The extension of coal layers is from northeast to southwest and the slope of these layers is (20) degrees. The coal of this area is powdery and has a shiny black color. The type of coal available in this area is (Bituminous, Sub-Bituminous). Geological studies and preliminary surveys of this area have been carried out by the technical team of the company, but the exploration and exploitation of this mining area has not started yet.

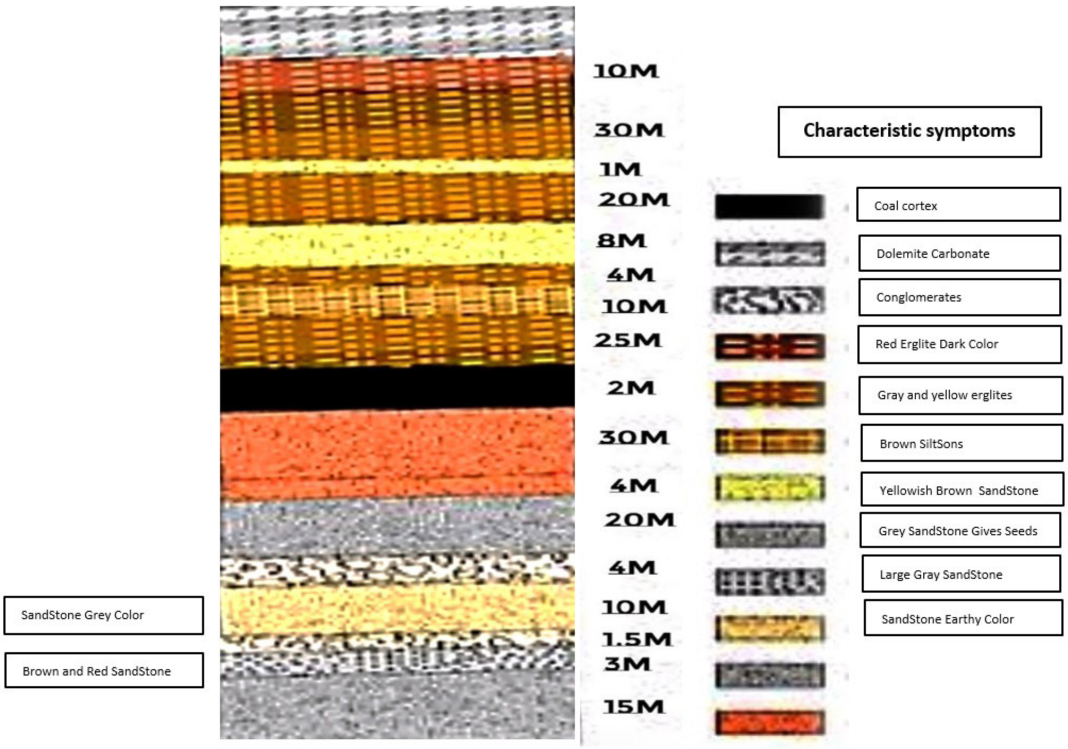

Figure 2: Longitudinal section of Shurabak mining area

Operational-Exploratory Programs

As mentioned before, Shurabak coal mining area has only been subjected to geological studies and prospecting. Hence, it requires conducting exploratory operations. Taking into account the geological conditions, exploration operations will be designed and implemented in Shurabak coal mining area with exploratory excavations. In the coal layers, exploratory excavations are planned parallel to each other at a certain distance, which is shown in the following diagram:

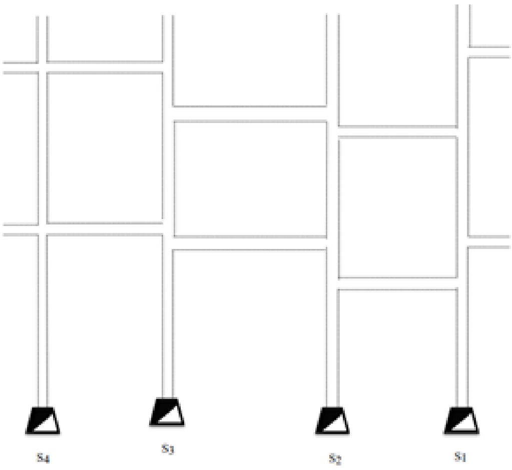

Figure 3: Schematic of planar ledges of Shurabak mining area

Laboratory Research Procedures

For the laboratory study, the samples have been taken according to the specific geological profile, packed and transferred to the laboratories for further studies. To determine the quality of the samples, laboratory methods are usually used and the samples are subjected to the analysis device to determine the percentage of purity and quality of the coal included in the samples.

Automatic Oxygen Bomb Calorimeter

This automatic calorimeter device is used to determine the calorific value (Calorific Value) or the thermal quality of coal (by exploding a certain amount of it) in units (Cal/gr).

It is worth mentioning that G.C.V or Gross Calorific Value is the amount of total calories, i.e. the total calorific value of coal, which is automatically measured and measured by this device and the final result appears on the screen.

The explosion of one gram of coal sample (in the form of a tablet) takes place in a special device called a bomb, which is placed in distilled water, the information of which is included in table (1).

The device is equipped with a distilled water tank and it is used to cool and balance the temperature of the blast area, and it is also a UPS bottle stand and a computer stand that reveals information in digital form, as well as an O_2 oxygen balloon. It connects to it.

Figure 4: Automatic calorimeter machine for determining the thermal quality of coal

Description of Sample Number (1)

The sample taken under analysis is coal and it is considered among the coals with good heating that has been subjected to analysis. Considering that the target sample has impurities and idle elements, its ash yield reaches (44) percent, and its heating is 4150 kcal.

The coal of the salt-water mining area is powdery and has a polished black color. The nature of its coal is Bituminous, Sub Bituminous. The thickness of coal layers in the area is (2) meters.

Table 1: Characteristics of the Shurabak coal sample and its heating rate

Sample number	1	Moisture percentage	0.36
Gas percentage	22.00	Ash percentage	44.00
Time analysis	2023/09/25	Height above sea level	1066 m
Heating	4150 kcal	Coordinates	N=35°59′ 42″
			E=68°46′ 40″

Description of Sample Number (2)

The sample taken under analysis is coal and it is considered among the coals with good heating that has been subjected to analysis. Considering that the sample in question has impurities and idle elements, its ash yield reaches (41.5) percent, and its heating is 4320 kcal.

The coal of the salt-water mining area is powdery and has a polished black color. The nature of its coal is Bituminous, Sub Bituminous. The thickness of the coal-bearing layers of the area is (2) meters and the inclination of its layers is (20) degrees.

Table 2: Characteristics of the Shurabak coal sample and its heating rate

Sample number	2	Moisture percentage	0.32
Gas percentage	24.00	Ash percentage	41.50
Time analysis	2023/09/25	Height above sea level	1065 m
Heating	4320 kcal	Coordinates	N=35° 59′ 41″
			E=68° 46′ 40″

Description of Sample Number (3)
The sample taken under analysis is coal and it is considered among the coals with good heating that has been subjected to analysis. Considering that the sample in question has impurities and idle elements, its ash yield reaches (38) percent, and its heating is 4540 kcal.

Table 3: Characteristics of the Shurabak coal sample and its heating rate

Sample number	3	Moisture percentage	0.40
Gas percentage	28.00	Ash percentage	38.00
Time analysis	2023/09/25	Height above sea level	1066 m
Heating	4540 kcal	Coordinates	N=35° 59′ 42″
			E=68° 46′ 40″

Description of Sample Number (4)
The sample taken under analysis is coal and it is considered among the coals with good heating that has been subjected to analysis. Considering that the sample in question has impurities and idle elements, its ash yield reaches (40) percent, and its heating is 4410 kcal.
The coal of the salt-water mining area is powdery and has a polished black color. The nature of its coal is Bituminous, Sub Bituminous. The thickness of coal layers in the area is (2) meters.

Table 4: Characteristics of the Shurabak coal sample and its heating rate

Sample number	4	Moisture percentage	0.34
Gas percentage	26.00	Ash percentage	40.00
Time analysis	2023/09/25	Height above sea level	1067 m
Heating	4410 kcal	Coordinates	N=35° 59′ 42″
			E=68° 46′ 40″

Description of Sample Number (5)
The sample taken under analysis is coal and it is considered among the coals with good heating that has been subjected to analysis. Considering that the target sample has impurities and idle elements, its ash yield reaches (38.5) percent, and its heating is 4545 kcal.
The coal of the salt-water mining area is powdery and has a polished black color. The nature of its coal is Bituminous, Sub Bituminous. The thickness of the coal-bearing layers of the area is (2) meters and the inclination of its layers is (20) degrees.

Table 5: Characteristics of the Shurabak coal sample and its heating rate

Sample number	5	Moisture percentage	0.38
Gas percentage	25.00	Ash percentage	38.50
Time analysis	2023/09/25	Height above sea level	1064 m
Heating	4545 kcal	Coordinates	N=35° 59′ 41″
			E=68° 46′ 41″

The collected samples have been studied under the analysis device, as can be seen, in the evaluated samples, the ash percentage is generally higher.
On the other hand, looking at the results of the coal quality study, it can be seen that all the studies will present the same result. If it can be seen from the studied sample that its heating is good.
Therefore, it is clear from the comparison of the study of the analysis method that Shurabak coal in Pul-e-Khumri area of Baghlan province is one of the coals that have different percentages of gases in its composition.

RESULTS AND DISCUSSIONS
Conducting comprehensive and detailed studies is very important for investigating, analyzing, and evaluating coal and nearby stones. Therefore, samples were taken from the target area and studied carefully.
This article deals with the analysis and review of coal samples, in which the results of laboratory analyzes are presented in detail. The mentioned samples are considered as one of the most important and valuable samples in laboratory studies and were collected from the range of coal expansion.
Using analytical methods, the quality of coal in Shurabak area has been studied. The results show that the average heating of the samples is 4393 kcal, its gray percentage is 40.4, its gas percentage is 25 and its moisture percentage is 0.36.
The total results obtained from these laboratory studies clearly show a strong correlation and adaptation among the different results, which confirms the accuracy and correctness of the analyzes performed.

CONCLUSION

Shurabak coal mine is a key source of high quality coal in Afghanistan, which is associated with various geological formations including sandstones, conglomerates and carbonate-dolomite rocks.

Samples from the Shurabak area show strong heating values: sample 1 provides 4150 kcal with 44% ash and 22% gas, while sample 2 provides 4320 kcal with 41.5% ash and 24% gas. This indicates that the coal of the region has excellent thermal and chemical properties, making it suitable for industrial applications.

Physically, the coal is fine, black and shiny, showing high purity, with a layer thickness of about 2 meters, facilitating easy extraction. It is especially suitable for supplying energy to cement factories, especially Ghori Cement Factory.

Considering the high potential of Shurabak coal, it is required to investigate the area with deep geological studies and more detailed explorations. These researches can help identify new reserves and convert possible reserves into definite reserves. Also, the technical and technical exploitation of Shurabak coal should be evaluated more carefully in order to use the maximum capacities available in this region.

Novelty of Research

From the laboratory study, it is seen that, in addition to coal, the rocks around this area include sandstones, conglomerates, ergolites, siltstones, and carbonate-dolomite rocks, which are rich in geology.

Since the samples taken from Shurabak area have grossities and the results are as follows:

Sample (1): heating 4150 kcal, ash percentage 44%, gas percentage 22% and humidity 0.36%.

Sample (2): heating 4320 kcal, ash percentage 41.5%, gas percentage 24% and humidity 0.32%.

Contribution

The total results obtained from these laboratory studies clearly show a strong correlation and adaptation among the different results, which confirms the accuracy and correctness of the analyzes performed. Shurabak coal mine, is one of the important sources of coal in Afghanistan, which has a significant quality. From the field study, it can be seen that Pul-e-khumri brine coal is one of the materials with suitable heating for supplying energy to cement factories. In addition to coal, there are sandstones, conglomerates, ergolites, silty stones and carbonate-dolomite stones in this area, which can be used as building materials.

Limitation

For writing this article, the researchers faced some challenges such as; in our Higher Education Institute we do not have standard library in Geology and Mine field, as well as we do not have developed laboratory. And it is mentionable that, in our university as a researcher we do not have financial independence. Besides this, in this research the researchers used library method, we utilized books, reports, and magazines available in the libraries of Jawzjan University and Saripul Higher Education Institution.

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