OPTIMISATION OF SAMPLING OF COAL FROM THE OBEDINEN OPEN CAST MINE AND THE REPUBLIKA MINE

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ABSTRACT. The article discusses in detail the processes that the coal undergoes after it enters the *Pernik* Preparation Plant. Special attention is paid to one of the main problems in the quality management of the coal from the *Obedinen* open cast mine and the *Republika* mine, namely the sampling of coal. Two modern sampling methods are presented, with instruments that provide the necessary information about the quality of the coal in real time, taking into account the problems of the *Pernik* Preparation Plant.

Keywords: open cast mining, quality management, coal

ОПТИМИЗИРАНЕ НА ПРОБОВЗЕМАНЕТО НА ВЪГЛИЩА ОТ ОТКРИТ РУДНИК ОБЕДИНЕН И РУДНИК РЕПУБЛИКА

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РЕЗЮМЕ. В статията подробно са разгледани процесите през които преминават въглищата след тяхното постъпване в Обогатителна фабрика "Перник" и по-специално внимание е обърнато на един от основните проблеми в управлението на качеството на въглищата от Открит Рудник Обединен и Рудник Република, а именно пробовземането на въглищата. Представени са два съвременни метода на пробовземане, с уреди, които дават необходимата информация за качеството на въглищата в реално време, съобразени с проблематиката на Обогатителна фабрика "Перник".

Ключови думи: открит добив, управление на качеството, въглища

Introduction

General information and technological processes in the *Obedinen* open cast mine and the *Republika* mine

The Pernik Coal Basin is located about 30 km southwest of Sofia, with the following approximate boundaries of the productive horizon: the Viskyar Mountain to the north; the Vitosha Mountain and the Lyulin Mountain to the southwest, to the east, and to the northeast; the village of Golo Bardo to the south; and the Chernogorski heights to the west.

Fig. 1. Location of the *Obedinen* and the *Republika* open pit mines

It includes two open pit mines: the *Republika* and the *Obedinen*. Their object of production is brown coal. They occupy an area of 5608 dka and cover terrains on the territory of the town of Pernik, the village of Divotino, the village of Lyulin, and the village of Golyamo Buchino.

The development system in the two open pit mines is a transport system with the removal of the waste rock by trucks. Segments use the cyclic-flow technology. Coal is loaded with excavators and transported to a reloading point. The maximum height of the benches in the mines is determined depending on the maximum height of rowing of the excavator and the conditions for drilling and blasting operations. The array is pre-crushed according to well-established drilling and blasting projects. The exploded waste rock is loaded onto trucks with excavators and transported to the internal embankments. The height of the benches is less than 15 m in order to improve the compaction of the array.

The annual program of the *Republika* and the *Obedinen* open pit mines is as follows:

- Coal = 1 078 000 t (with a Coal Volume = 1,82 t / m^3)
- Waste rock = 11 040 000 m^3

The mode of operation is continuous: two shifts of 12 hours. Work is suspended only on public (bank) holidays and due to annual repairs and planned repairs. Or:

365 days - the total number of days within a year;
less 7 days - the number of public (bank) holidays within a year;
less 18 days - planned repairs;
less 40 days - yearly repair is done for 40 days on average.

The development system is a transport system with the removal of the waste rock in the bulldozer embankments by trucks.

The coal-mining scheme is implemented as coal is transported with the help of trucks. For this purpose, reloading points have been constructed in the sections. Through bunkers in which coal is poured, they are transported along a conveyor belt that is connected to the main conveyor belt. Coal loading is done with hydraulic excavators.

Methods

Coal sampling and technological processes in the *Pernik* Preparation Plant

After elimination of the main processes at the *Pernik* Preparation Plant, the coal undergoes a process of sampling, charging, crushing, and sieving. The supply of coal for processing from the mines to the filling plant is carried out by railway transport.

After reaching the landfill by means of a folding ramp at the top of the wagons, the sampler enters the wagons and takes a sample, digging a hole at a depth of about 30 centimeters and then taking a sample of a few shovels large. Two samples are taken from each bunch from the wagons coming from the *Obedinen* open pit mine, a total of 6 samples from each wagon. One sample of each bundle is taken from the wagons coming from the *Republika* open pit mine, a total of 3 samples from each wagon, because the material there is relatively homogeneous. The sample results are obtained within 4 hours. Although the results have not been obtained yet, the coal is discharged into the receiving hoppers. Trains arriving from both pits can be unloaded simultaneously on two tracks: the wagons from the *Republika* open pit mine are unloaded on the sixth track, and the wagons from the *Obedinen* open pit mine are unloaded on the seventh track. The unbaked pieces are manually crushed on 400-250 mm grills. Once the material passes through the grate, it goes into a pick-up hopper. Under each track, there are eight receiving hoppers distributed in a column, but over them there can be precisely three wagons. Under each wagon, there are 2.67 bunkers making it impossible to accurately distribute the coal from the wagons to the bunkers. Each bunker has a volume of 90 tons. By means of four finers with a capacity of 300 tonnes/hour, coal is fed to two conveyors belts with a total output of 600 tonnes/hour. The two conveyor belts are then assembled into one that weighs the coal from the *Republika* open pit mine and from the *Obedinen* open pit mine and transports the material for screening. The sieve has a gradient of 15 degrees and 100 mm holes. The 200 mm offshore fraction is transported to another conveyor belt for further crushing in cone crushers where a 100 mm fraction is obtained. The cone crushers are two and below each there are five storage hoppers with a volume of 200 tons each, meaning that 1000 tons of coal can be stored under each tapering crusher. The submerged material of the size of 0-100 mm and the crushed material are combined onto one conveyor belt. This transports the material to a rotor crusher that crushes the material to a size of up to 30 mm, as is the requirement of the *Republika* thermal power plant.

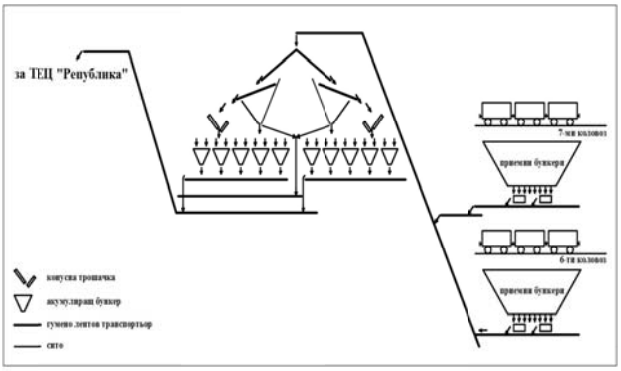


Fig. 2. Diagram of the processes in the *Pernik* Preparation Plant

After studying the ways of coal sampling and the mode of operation of the *Pernik* Preparation Plant, it was found that no more than 60÷62% of the coal supplied is suitable for energy fuel, which shows that the percentage of reduction of the useful component is about 35%.

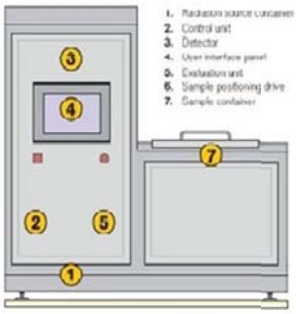
Discusions

In view of what has been discussed in this article, the following could be proposed to improve the coal quality management and to increase the volume of coal used for energy use. This could be achieved after a change in the method of coal sampling.

1. After reaching the coal layers in both the *Obedinen* and the *Republika* open pit mines, samples must be taken with the ENELEX GE3030 device. Then, the results are set in a mathematical model for quality management, and only then can we proceed to loading the coal. After solving the algorithm, the two open pit mines receive accurate information about how many tons of coal they should take and transport to the preparation plant.

The GE 3030 coal fast-analyser enables fast analysis of the non-combustible content and the calorific value of coal samples immediately on site or in the laboratory. Operational evaluation of coal quality can significantly raise processing efficiency and, consequently, keep running costs lower, too. Coal is one of the most important energy sources. The need of saving all kinds of energy is strongly emphasised nowadays and though coal mining and efficient processing, it becomes the first-degree interest. The need of immediate coal quality evaluation or evaluation in reasonably short time results from the requirements of combustion and mining process optimisation. The unit is intended for fast measurement of ash content and calorific value of coal samples. The unit is produced as a desktop unit. The whole measurement is performed with no user manipulation of samples in the radiation beam. After putting the sample into the measurement

container and closing the cover, the sample is moved to the measurement radiation beam. The measurement is performed automatically. After finishing the measurement, the sample is automatically moved out of the radiation beam for user manipulation. The complete information on the measurement process is displayed on the touchscreen user interface panel with possibility of data transfer to the supervisory system. System setup and calibration can also be performed using the user interface panel in a simple and user-friendly way. The measurement method evaluates the coal non-combustible content according to differences of attenuation of two gamma beams of different energy passing through the coal. While the changes in chemical composition in the ash content are low, there's a significant correlation between the ash content and the average proton number. The measurement beam passes through coal sample while the resulting radiation is evaluated by a detector with a control unit. Based on the retrieved attenuation values of radiation beams, the control unit can compute the ash content and the calorific values within no longer than 10 minutes.



2. After the wagons arrive at the landfill, apart from the sampling that has already been performed to make a laboratory analysis of the coal, "The Ash Probe", produced by Bretby Gammatech, could also be employed. Again, the data from it is set in a mathematical model. On the basis of the decision taken, we can dispose of those wagons with which the decision of the algorithm for the average of the quality of the coal will be as accurate as possible.

The Ash Probe is a hand portable instrument for measuring the ash content of piles, wagons or trucks of coal. It provides the user with quick and accurate ash readings within seconds. It contains no radioactive sources. The Ash Probe consists of two parts: the Probe and the Display Unit. The ash measurement is obtained by inserting the probe into the coal and operating the Display Unit. The ash reading is displayed and its precision improves with measurement time. The desired precision is user selectable from four values ranging between 0.25% and 1% ash. The measurement times out once the required precision has been reached. In Pile Mode, the Ash Probe is used at several locations around the pile. Up to 99 readings per pile can be made. Both the individual readings and the pile average ash can be displayed, along with the standard error for the pile. Results from up to 99 piles can be displayed and stored. Calibration is readily achieved by the customer using the supplied sample gathering equipment. The Display Unit can store up to nine separate calibrations for different coal types. Stored data can be transferred to a PC for off-line data archiving and analysis.

Conclusion

The article discusses how coal was sampled at the *Pernik* Filling Plant which is served by the the *Obedinen* and the *Republika* open pit mines. The results of the study suggest that the use of the abovementioned coal sampling technique will improve the quality of coal management and the volume of coal that is suitable to be used for energy.

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