

IMPLEMENTATION OF MECHANICAL LOGGING ON THE OLON-SHIBIRSKOYE COALFIELD

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ABSTRACT

The article is dedicated to the results of mechanical logging implementation on the Olon-Shibirskoye coalfield. Previous investigations had shown that non-core drilling could potentially provide information on the geological composition of a coalfield and on the ash content of coal by the means of mechanical logging. Since then, the equation of the correspondence between drilling velocity and ash content has been modified as the result of analyzing a greater amount of data. The next step of the research was examining the implementation of mechanical logging for operational exploitation on the Olon-Shibirskoye coalfield. For this stage, thirty-one boreholes were drilled with the implementation of mechanical logging. Results of this drilling were compared to the geological exploration data that had been obtained earlier in the same area and several drilling process requirements had been developed. The drilling process should be constant, without any intervention of a drill operator, otherwise the results might appear corrupt. The intervention caused by rocks falling into a borehole is aimed at removing drilled solids from the borehole. In order to prevent rocks from getting into boreholes, a number of well parameters, which may lead to the falling of rocks, should be taken into consideration: well depth, the number of coal beds that well crosses, fractures, faulting or other dislocations of rocks, as well as the inclination of a borehole axis.

Keywords: *coal, ash content, mechanical logging, non-core drilling, mining*

INTRODUCTION

As far as geological conditions and quality of coal are the main parameters for coal mining [1], geological exploration has great importance. Also, exploratory drilling as basic method, is an expensive one and takes a lot of time to perform, especially if we talk about core drilling [2]. Despite on these downsides the core drilling provides the most complete information on geological conditions and quality of coal. However, we need to keep costs down and aspire to implement methods that are able to provide all necessary information with lower costs if compared to conventional methods. According to our previous research mechanical logging can be useful in exploratory drilling as an additional or even alternative method to core drilling and other geophysical methods [3].

Mechanical logging is a geophysical method that collects drilling parameters through the process of drilling a well. There is a number of parameters, such as pressure on the bottom of the hole, torque, air irrigation pressure, rotation of drilling

bit, and the most important parameter: drilling velocity. Drilling velocity shows how fast drilling bit is moving through rocks. Due to certain differences between physical properties of bituminous coals and overburdened rocks [4], the drilling process parameters considerably differ.

The geological survey of JSC SUEK has been using the method of mechanical logging since 2010 for the estimation of depths of coal bed's roofs and thicknesses of coal beds. The practice of using it has revealed that the drilling velocity is the most useful parameter in the mechanical well logging method.

In our previous research we have found that it is potentially possible to estimate the ash content of coal beds. In this study we had a task to examine the method and to find its limitations.

GEOLOGICAL SETTING

The Olon-Shibirskoye coalfield is located on the border between Republic of Buryatia and Zabaykalsky Krai and is one of two currently developing coalfields in Tugnuiskaya basin. Tugnuiskaya basin stretches out for more than 100 km from the river Kharauz in the east to the river Khilok in the west, the width of basin is 20-22 km. From the north and the south, the basin is bounded by deep tectonic faults. The basin is divided into seven synclinal structures by tectonic faults that stretch out to the north-east and north-west. One of these synclinal structures is the Olon-Shibirskoye coalfield. The coalfield is bounded by Tsagan-Dabanskiy and Zaganskiy ridge branches in the north and in the east, whereas the Kapsal anticline high bounds the coalfield in the south.

The coalfield consists of early and middle Jurassic deposits overlay the residual soil of Paleozoic granitoids. The Quaternary deposits overlay the Jurassic coal-bearing strata. Jurassic coal-bearing strata is divided into Ichetuiszkaya igneous sedimentary formation (J_{1-2ic}) and Tugnuiskaya terrigenous coal-bearing formation (J_{2tg}).

All coal beds consist of bituminous flame coal. Coals are high-quality fuel for steam-electric power generation.

MATERIALS AND METHODOLOGY

For this study we took mechanical well logging data on thirty-one boreholes. These boreholes have different parameters such as: depth, number of coal beds that were crossed, inclination and quantity of loose material near the wellhead. Using this data, we have estimated ash content and compared it with data that was obtained as the result of previous geological exploration with core samples and geophysical well logs.

Since previous research we have added more data for the correlation between ash content and drilling velocity. Thereby the linear dependency is turned to be more precise than the exponential (Figure 1).

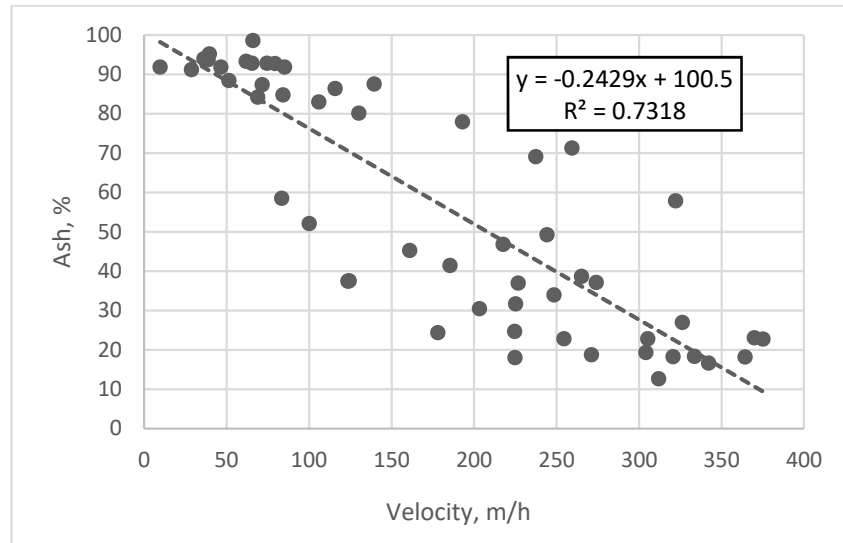


Figure 1 The drilling velocity dependence on the ash content

Also, we have examined if other drilling parameters, except drilling velocity, correlate with ash content. It turned out that pressure on the bottom of the hole, torque, air irrigation pressure, rotation of drilling bit, are not correlate with ash content (Table 1).

Table 1. Correlation coefficients between ash content and drilling parameters

Parameter	A, %
Velocity, m/h	-0.86
Pressure, atm	-0.01
Torque, atm	0.37
Air, atm	0.20
Rotation, rpm	0.11

RESULTS AND DISCUSSION

Analysis of mechanical well logging data has shown that accuracy of ash content estimation depends on different parameters of borehole such as: depth, number of coal beds that were crossed, inclination and quantity of loose material near the wellhead. These parameters control the quantity of rocks and loose materials falling into the well, that causes drill operator to slow down the drilling process in order to remove drill solids from the borehole with air flow. The most adequate accuracy of ash content estimation was found in vertical boreholes, that has a little quantity of loose material near the wellhead. One of exploratory borehole (well 1) was drilled near the borehole that was drilled on the stage of geological exploration (well 2270) so we could compare its data (Figure 2).

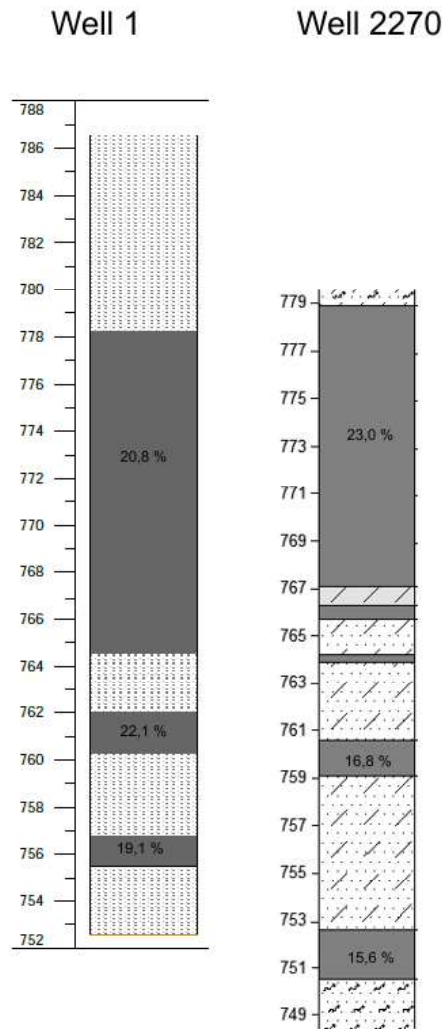


Figure 2. The comparison between two boreholes. Well 1 was drilled with implementation of mechanical logging, well 2270 was drilled with core drilling. Vertical - altitude

As we can see, the difference between ash content estimation is not exceed 5,3 %. However, we believe that this method could provide more accurate estimation. In order to reduce inaccuracy, we developed several requirements for drilling process. These requirements will prevent drill operator from intervention to drilling process.

1. All loose material should be removed from the surface where drilling will take place.
2. Boreholes should be vertical, greater inclination leads to bigger inaccuracy.
3. The deeper the borehole, the less accurate ash content estimation might be.

Obviously, the amount of analyzed data is still insufficient for precise ash content estimation. However, the current data allows to estimate the approximate ash content. The goal for the further research is to examine method with the all above-mentioned recommendations in mind.

CONCLUSION

The method of mechanical logging can be useful in exploratory drilling as an alternative or in addition to core drilling and other geophysical methods on coalfields. It can provide information about boundaries between coal and overburden rocks, in addition we have shown that we are able to estimate ash content in coal. Our priority goal is to improve accuracy of this method.

Also, we have developed several drilling process requirements that will provide more accurate data. For this purpose, the following should be taken into consideration in process of drilling: well depth, the amount of coal beds that well crosses, fractures, faulting or other dislocations of rocks, quantity of loose material near wellhead, as well as the inclination of a borehole axis.

Besides above-mentioned, the further research will also concern the following issues:

1. possible methods of the evaluation of moisture, fracturing and other parameters of coal;
2. dividing the overburdened rocks by their composition;
3. the estimation of the geological setting of the coalfield and the tectonic dislocations.

Thus, this paper shows the experience of implementation of the mechanical logging method on the open-pit coal mine.

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