

ABSTRACT

of dissertation for the degree of Doctor of Philosophy (PhD) in the specialty
6D070700 – “Mining”

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“Study of ways to improve the quality characteristics of Shubarkol deposit’s coal”

Relevance of the work. To implement the program of industrial and innovative development of the Republic of Kazakhstan, it is necessary to stimulate the industry, aimed at increasing the efficiency of the industry and increasing the export of products.

Kazakhstan is one of the ten countries in the world with proven coal reserves of 34.2 billion tons, ranking 8th in terms of proven reserves, and is among the world leaders in production (113.4 million tons in 2020). At the same time, coal accounts for 50% of the volume of consumption of primary energy resources, that is, the bulk of coal is consumed as energy, and exports account for about 25% of the total coal mined and is limited by a relatively high ash content of 42-44% and, as a result, a low price of exported raw materials. on the world market (\$ 15 versus \$ 43.8 world price).

The global coal market is operating in the face of increasing social and environmental requirements for producers. So, for example, starting in 2014, the People's Republic of China refused to import Australian thermal coal with an ash content of 40% in favor of US coals.

Coal mining enterprises are taking measures to increase the competitiveness of national coal mining in the world market, attracting investments in the development of technologies for improving the quality of coal, its processing and expanding the scope of application. One of the reasons for the decline in the quality of coal is the use of mechanical mining methods, as well as the deterioration of technical equipment. The issues of the quality of coal and its deep processing were discussed at the first Kazakhstan Forum of the coal industry "New opportunities of the coal industry in the context of technological modernization." Thus, the priority area of the coal industry is to improve the quality of extracted raw materials, to optimize coal production, aimed at profitability, environmental friendliness and labor safety.

Thus, the modernization of the coal-fired power industry through the development of modern technologies and the production of high-quality coal fuel is among the main areas of mining.

The coals of the Shubarkol deposit are the closest to the requirements of world consumers in terms of quality characteristics, which are distinguished by a relatively low ash content (12-15%) and a calorific value of 5818 kcal / kg. Coal export averages up to 5 million tons annually. Shubarkol coal is in demand by metallurgical enterprises as a raw material for obtaining a reducing agent in the production of ferroalloys, etc.

To meet the needs of the coke-chemical shop in 2014, the planned volume of coal production was reduced from 20 million tons / year to 12.3 million tons / year due to the introduction of selective mining of 0.3-0.5 m layers. In metallurgical enterprises the demand for special coke is about 1 million tons due to the lack of production capacity and volumes of coal suitable for coking.

So, in 2021, the Eurasian Resources Group (ERG) announced the construction of another plant for the production of special coke with a capacity of 400 thousand tons per year, which requires feedstock with an ash content of no more than 5% mining, primary processing and sorting of coal.

The quality management system of mined coal occupies a key link in the process of coal mining activities of a mining enterprise, it is introduced into each production stage from opening the field to the shipment of processed minerals to the end consumer. The development of methods for managing the quality of minerals is inextricably linked with the progress of mining science and inevitably transforms the coal industry in a complex of issues.

Analysis of statistical material, generalization of the results of previously performed studies show that, against the background of a decrease in the quality characteristics of coal in natural bedding, the requirements of consumers for the quality of commercial coal have now significantly increased, and the issues of improving its quality, methods of quality management during production require the introduction of new technological solutions.

The purpose of the dissertation work is to establish the regularity of the change in the ash content of the coals of the Shubarkol deposit under mechanical, thermal and acid effects in order to develop a rational way to improve their quality.

To achieve this goal, the following tasks are set in the dissertation work:

- to evaluate the general practice of applying the technology for managing the quality of extracted raw materials and methods for reducing the ash content of coals to assess applicability in the conditions of the Shubarkol deposit;
- to study the mining and technological factors of deterioration in the quality of coal products;
- to investigate the quality characteristics of coal in order to identify acceptable indicators of ash content for deep processing;
- to test coals for mechanical strength with the determination of fractional indicators to assess ways to reduce ash content during mining and primary processing;
- to conduct pilot tests on the effective separation of coal from the Shubarkol deposit;
- to conduct pilot tests of methods of using fine coal of 0-6 mm fractions and high-ash tailings from the Shubarkol deposit.

The idea of the dissertation work. Improving the quality of mined coal is ensured at the stages of mining by introducing pneumatic separation into the adaptive technological scheme of mining operations.

Research methods at work. In the dissertation work, standard methods, laboratory and pilot-industrial tests, statistical processing of results, technological

planning and economic efficiency assessment, as well as an analytical review of research papers and technical documentation are used;

The main scientific provisions for the defense:

-in order to ensure the quality of coal, namely to minimize impurities and losses, it is recommended to selectively mine with a sub-bench height of 6 and 7.5 m, a seam dip of 15 and 25 degrees using hydraulic excavators with a forward and backward shovel;

- technological combination of dry separation with cyclical-flow technology when extracting coal with a fraction of 0 to 50 mm provides an output of low-ash coal up to 85% with a decrease in the initial ash content of coal by 35%;

- a technological scheme for sorting and transportation of fine fraction 0-10mm, shipped in the near-hole zone with further pressing into fuel briquettes, has been developed.

Main scientific results:

- technological parameters were calculated and established (the height of the undercut, the angle of incidence, averaging coefficients, losses and clogging, the duration of one work cycle) and the economic efficiency of the application of a selective mining scheme with a combination of separation and transportation at the central heating center;

- the degree of separation of Shubarkol coals by density in the liquid phase and in the air for low-ash and high-ash coals was estimated;

- investigated the physical and mechanical (mechanical strength, density, porosity), technical (the yield of volatile substances, moisture, ash content, calorific value) characteristics of coal; tests on the thermal effect on coal were carried out to determine the optimal technological parameters of the feedstock;

- tests of pneumatic separation of coals were carried out, effective yields of each fraction of coal were calculated, studies of pneumatic separation products were carried out;

- in order to improve the quality of the extracted and sold raw materials, experimental work was carried out to reduce the ash content of coal while maintaining the structure and increasing the calorific value of coal by acid extraction of the mineral component of coal fines;

- pilot tests of briquetting of Shubarkol coal were carried out with an assessment of their strength and calorific characteristics.

The scientific novelty of the work consists in:

- development of a cyclic-flow scheme of coal seam mining with the inclusion of pneumatic separation in the face to control the quality of the coal produced;

- in the established regularities of the distribution of particle size classes by density of Shubarkol coals and the dependence of the change in the ash content of coals on the fractional composition in the process of pneumatic separation;

-in the formation of coal streams with a given quality of concentrate and fines of tailings for briquetting at the bottom.

The practical significance of the work.

Development of methods for reducing the ash content of raw coal and fine coal by means of gravitational and chemical methods of action with an increase in their

calorific value. Scientific and pilot testing under the project will create opportunities to provide high quality low ash coal. The research results can be used to work with small coal and apply them for household needs.

The expected economic effect of technological solutions is to reduce the loss of extracted raw materials, increase the value and value of the export volume of coal, stabilize the cost price and efficient planning of production operations.

Objects and subjects of research. In this work, we study the factors affecting the quality of coal. Laboratory and pilot-industrial tests were carried out to reduce ash content, pneumatic separation and briquetting of coal fines. For the tests listed, grade D coals of the Shubarkol deposit and some coals of the Karaganda coal basin were selected. The work was carried out in the Methane Energy Testing Laboratory in the mining and metallurgical complex of the Karaganda Technical University and at the sites of coal storage facilities of the Shubarkol Komir JSC, also on the basis of Shubarkol Premium JSC and Gormasheexport JSC.

Implementation of work. The results of field, laboratory tests and the main conclusions were published in 7 scientific articles, in 3 abstracts of scientific conferences, 2 patents for utility models and 3 acts.

Approbation of work. The main provisions of the work were reported and approved: at scientific seminars of the Department of RMPI of KTU and scientific and technical councils of KTU, international scientific and practical conferences "Saginovskie readings-11", "Saginovskie readings-13" and 1 online conference in Poland. The results of scientific research obtained in the course of the dissertation work were accepted by the ERG corporation and Shubarkol Komir JSC for consideration and inclusion of scientific results in the production process and the newly developed technical regulations.

Work structure. The dissertation work consists of an introduction, 5 sections, a conclusion and contains 115 pages of text, 50 figures, 42 tables, a list of used sources of 114 titles.

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