ANNOTATION

dissertation work

" Development of early degassing methods for mines developing outburst-prone seams",

submitted for the degree of Doctor of Philosophy (PhD)

in specialty 6D070700 - " Mining "

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Relevance of the work. The development strategy of Kazakhstan until 2030 provides for the development of the coal industry as the basis for energy security and stability of production of metallurgical raw materials.

At development depths of over 500 m the gas content of mining areas, even when using various degassing methods, exceeds 20 m^3/t, which has a significant impact on the magnitude of the load on the longwall face. Research on the methods of conducting degassing operations has established that with an increase in the depth of development, the effectiveness of preliminary degassing of the developed seam decreases, which entails an increase in the methane content of the near-face space and, ultimately, the magnitude of the load on the longwall face in terms of the gas factor is further limited, which indicates the need to find ways to intensify the degassing of unloaded coal seams.

All these measures should be interconnected and implemented in a complex to ensure maximum efficiency and safety of mining operations. Increasing the load on the longwall face can be carried out with a decrease in the gas content of the seam due to early degassing, taking into account its stress-strain state. Early extraction of methane from coal seams is the basis for the integrated development of coal deposits, contributing to the reduction of natural gas content to the required values and, as a consequence, a decrease in the absolute gas content of the longwall faces and an increase in the productivity of seam degassing boreholes by 3 or more times.

Thus, the new methods of influencing the coal seam being developed should be aimed at reducing the gas content of coal seams in areas of planned mining operations by increasing their gas output into boreholes and mining roadways. The studies performed are relevant both from the point of view of ecology and ensuring industrial safety of coal mining.

The main objective of intensifying gas emission during formation degassing is to artificially increase the filtration capacity of coal in order to increase the gas flow rate from drilled boreholes, which increases the efficiency of degassing, leads to a reduction in the period of preliminary gas capture, and makes it possible to reduce the gas content of those formations that are characterized by low gas recovery through boreholes drilled in the formation.

These circumstances indicate the need to find ways to intensify gas emission through degassing boreholes drilled through coal seams that are not relieved from rock pressure.

The decrease in the efficiency of preliminary degassing of seams with the depth of work is associated with a change in the geomechanical state of the coal

massif. An increase in geostatic pressure causes a significant deterioration in filtration properties, a decrease in permeability and, as a consequence, a decrease in gas recovery from preliminary degassing boreholes.

The development of this scientific direction for underground works in the coal industry of the Republic of Kazakhstan currently depends on the use of the results of scientific and applied research and the conduct of pilot industrial testing in areas promising for the construction of coal mines in the Karaganda basin. Therefore, pilot industrial testing and commercialization of domestic technology for degassing from advanced boreholes during underground workings based on numerical modeling of the stress-strain state of the rock mass and boreholes for early degassing from the surface is an urgent task in the development of coal seams.

The aim of the work is to establish the patterns of the process early extraction of methane from coal seams of the Karaganda coal basin.

Idea of work consists of extracting coal seam methane using new technologies to intensify gas inflow based on an analysis of mining and geological conditions, physical, mechanical and filtration-capacitive properties of coal seams with an assessment of the effectiveness of the degassing methods used.

Object of study: coal seams of the Manzhinsky section of the Karaganda basin.

Research objectives:

1. Conduct an analysis of existing methods of degassing in the mines of the Karaganda basin and early extraction of methane from unloaded coal seams.
2. To study the geological and technological parameters and filtration and capacity properties of unloaded coal seams of the Manzhinsky site, to assess their prospects for the application of new methods of early extraction of methane using various technologies for intensifying gas inflow and to make a preliminary assessment of the recoverable methane reserves in the site.
3. Conducting theoretical and experimental research on the study of the physical and mechanical properties of rocks, processes of gas emission from the longwall faces, establishing patterns of influence of various factors on degassing processes in front of the longwall faces of development roadways.
4. To develop new methods of influencing a coal seam to increase gas recovery under stress-strain conditions and to evaluate the degree of methane extraction from the coal-bearing strata under various types of active impact on the coal seam aimed at breaking the bonds between methane and coal.

Research methodology: The purpose of the work and the main objectives of the research are formulated on the basis of the analysis of domestic and foreign experience, literary and archive materials, the results of natural and experimental observations, and modern methods of computer modeling.

The main scientific provisions submitted for defense :

1. The use of hydraulic division of the seam at the stage of early degassing has a negative impact on the environment, leads to the formation of emission-hazardous areas and to an increased likelihood of coal and gas emissions .
2. The efficiency of early degassing of coal seams of complex structure, characterized by the presence of low-strength The removal of hazardous formations

with a high rate of methane desorption is ensured only by directional drilling of boreholes, without hydraulic division of the formation.

3. An increase in the filtration area and the release of methane gas from low-permeability coal seams is achieved by creating radial channels length along the formation.

The scientific novelty of the work is as follows:

1. The mechanism of influence of vertical boreholes used for hydraulic fracturing of coal seams to increase gas recovery, depending on the patterns of change in the stress-strain state with increasing depth of occurrence of seams, has been identified.

2. The problem has been solved that determines the relationship between nanometer thicknesses of the surface layer of coals of different grades with diffusion and desorption of methane, heat capacity and humidity, gas permeability under uniaxial loading .

3. A method for radial well drilling has been developed that makes it possible to create long radial channels to increase the filtration area and the release of methane gas from low-permeability coal seams.

Application area: Early degassing of coal seams.

Personal contribution of the author. The work was carried out by the author personally, including setting goals and objectives, carrying out theoretical, experimental and field studies, developing technologies for the early reduction of natural gas content.

The validity and reliability of scientific provisions, conclusions and recommendations are confirmed by the application of methods for modeling coal seam gas recovery processes under the stimulating effect of mechanical, thermal and chemical energy, mathematical statistics to a large volume of experimental data, sufficient convergence of results, developed methods of influencing the coal seam to increase gas recovery, and the use of developed methods for reducing natural gas content.

The practical significance of the work is as follows:

– The use of degassing technology using radial drilling of boreholes from the surface into the contour of the future development roadways, along highly gas-bearing coal seams, will make it possible to create radial channels of great length with an increase in the degassing area, which will reduce the gas content of the seam during development roadways and cleaning operations, due to the radius of influence of the well and radial branches.

– The use of advance degassing technology will prevent accidents among miners as a result of methane gas emissions and explosions by reducing the natural gas content of coal seams before the start of mining operations.

– A new method of influencing a coal seam has been developed to increase gas recovery taking into account the stress-strain state.

Approbation of the work . The main provisions of the work and the results of the completed studies were reported and received a positive assessment at scientific and technical seminars of the Department of Development of Mineral Deposits of the Karaganda Technical University named after Abylkas Saginova , at

the International scientific and practical conferences “Integration of science, education and production – the basis for implementing the Nation’s Plan” (Karaganda, 201 7), "Rational use of mineral and man-made raw materials in the context of Industry 4.0" (Almaty, 2019), "Integration of science, education and production - the basis for the implementation of the Nation's Plan" (Karaganda, 20 19), "Modern trends and innovations in science and production" (Mezhdurechensk, 2020).

Based on the results of the study, acts on the implementation of the results of research work in the educational process under the educational program 6B07202 "Mining" (Appendix A) were received; an act on the implementation of the results of scientific research on the dissertation in the practical activities of Industrial LLC Energy Alliance " (Appendix B) and 2 patents for utility models were received (Appendix B);

– The research internship took place from 01.02.2018 to 01.05.2018 at the enterprise TOO “Scientific and Engineering Center “ GeoMark ”, scientific internship at the Technical University “ Freiberg Mining Academy” (Freiberg, Germany) from October 29, 2017 to November 8, 2017.

Publications. The main provisions of the dissertation are reflected in (fourteen) scientific papers, including one article in peer-reviewed scientific publications on the scientific direction of the dissertation topic, indexed in the Scopus (Elsevier) database, 5 (five) articles in publications recommended by the Committee on the Study of Scientific and Practical Education of the Ministry of Education and Science of the Republic of Kazakhstan, 8 (eight) articles in collections of International and Republican scientific and practical conferences.

Structure and volume of the dissertation . The dissertation consists of an introduction, four sections, a conclusion, a list of references and appendices . The work is presented on 105 pages, contains 28 figures, 23 tables and 68 references.