

ABSTRACT

for dissertation work in the specialty

"6D070600 - Geology and exploration of mineral deposits" on the topic "Scientific substantiation of the design parameters of the rock cutting tool for drilling of wells"

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The dissertation is devoted to the study of the structural parameters of a rock cutting tool for drilling geotechnological wells and the development of a new PRI based on an analysis of rock destruction theories.

Relevance of work

About 25% of the world's uranium reserves are concentrated in the bowels of Kazakhstan, and about 70% of them are suitable for mining by underground leaching. The implementation of the industry development program developed by the government of the republic allowed Kazakhstan to take 1st place in the world in uranium mining, which in 2010 reached 15,000 tons. Such an achievement was unthinkable without improving the equipment and technology for constructing geotechnological wells, which have much in common with the technology of drilling hydrogeological wells. Their construction is also extremely necessary for drinking and technical needs, since Kazakhstan is relatively poor in surface waters and rich in groundwater deposits.

In the geological section of uranium deposits and groundwater deposits, as a rule, soft rocks and partially medium hard rocks are involved. One of the promising directions for increasing the efficiency of drilling operations under the aforementioned conditions is to improve the design parameters of rock cutting tools of the cutter type, which are widely used to destroy the bottom of wells.

Drilling operations are the most expensive operation in the general technology of construction of geotechnological wells. The creation and implementation of tools of increased durability, lower energy intensity and greater drilling productivity, taking into account the mass construction of such wells, will provide a very significant economic effect.

Therefore, research on dissertations aimed at solving a similar problem is very relevant.

Objective

The aim of this work is the scientific substantiation of the design parameters of a new cutting rock cutting tool for drilling wells.

To achieve this goal, it is necessary to solve the following tasks:

- explore the main types of existing rock cutting tools and the features of their work on the face;
- give a critical analysis of existing theories of rock destruction during well drilling;
- supplement the generally accepted theoretical provisions and justify the presence of unused reserves to improve the design of rock cutting instruments;
- develop improved designs of crowns and chisels;
- to obtain experimental confirmation of the advanced theoretical provisions by testing the proposed designs of crowns and bits.

Idea of work

The idea of this work is to increase the efficiency of a rock cutting tool by exploring new data on the theory of rock failure.

Working method

The implementation of the above tasks is as follows:

- research and critical analysis of the main structural types of the existing rock cutting tool, their scope;
- a critical analysis of existing theories about the work of a rock cutting tool at the bottom;
- clarification of the basic parameters of the destruction process using computer programs;
- analysis of the physical basis of the process in order to identify reserves for improving the design of rock cutting tools;
- development of the design of crowns, bits;
- testing of the created improved tools and substantiation of their economic efficiency during implementation.

The practical value of the work

The practical value of the work lies in the fact that, on the basis of the developed theory, documentation has been compiled for improved bits and crowns, which are patented by the Patent Office of the Republic of Kazakhstan as inventions. The scientific novelty of the thesis is as follows:

- using the developed computer programs, the main parameters of the first drilling model were clarified, based on the separation of the processes of introduction of the cutter and the spread of fracture throughout the bottom of the well;
- when using the second drilling model, based on the joint vertical and horizontal movement of the cutter along the bottom of the well, the true depth per revolution is directly proportional to the average circumference of the rotation of the cutter, the vertical assigned load minus the friction force along the front edge of the cutter and is inversely proportional to the width of the bottom, the number of cutters covering the face, the elastic modulus of the rock being destroyed, the magnitude of the blunting of the cutter in the directions of rotation and the coefficient taking into account the constrained working conditions of the cutters in the well;
- when using double core shells to reduce the energy consumption of the formation of the annular bottom of the well, a drill bit is proposed that is structurally justified and patented, having only internal and external cutting tools that form an annular protrusion of the rock, which is destroyed at a certain height by a carbide plate installed at an acute angle to the internal crown diameter.

Scientific provisions to be defended:

- the first drilling model, based on the separation of the processes of introducing a cutting tool into the face and spreading the fracture area over the entire surface of the bottom of the well, is recommended to be used to describe the process of shock-rotary drilling, as well as rotary drilling by cutting in solid rocks; the second drilling model, based on the combined vertical and horizontal movements of the cutting tool during destruction at the bottom of the well, is recommended to be used to describe the drilling process by cutting soft and medium hard plastic rocks;
- the reason for the "hang" of the blade bit during drilling is the redistribution of the axial load on the tool blades with a concentration of a significant part of it in the

central part of the bottom of the well, i.e. in the zone of rotation of the bit, the size of which is determined by the iteration method;

- when designing cutting tool rock cutting tools for drilling soft and medium hard plastic rocks, it is recommended to provide in the design a ring type pilot for drilling a small diameter well, the value of which is determined by the need to eliminate excessive load in the area of rotation of the bit, determined by the iteration method, to remove the core formed by washing the wash fluid or with a core breaker, and increase the size of the well to the nominal diameter with stepped expander blades, rigidly connected of the pilot.

Implementation of research results

Comparative experimental and production tests at the Budenovskoye field, which was advanced on the basis of research on pickabur bits, have been comparatively tested. The test results showed a performance of 15% -20% higher than previously used picodrills.

Testing the results of work and publication

The main provisions of the dissertation were reported at 4 international scientific and practical conferences. According to the results of the work, 8 articles were published in scientific journals, 4 of them in publications included in the list of the Committee for Control of Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan, 2 articles in journals included in the Scopus and Web of Sciences database. A patent for inventions from the National Institute of Intellectual Property of the Republic of Kazakhstan was received for a crown and picobur that was developed as part of the dissertation.

Scope and structure of work

The dissertation consists of an introduction, 5 sections, general conclusions and recommendations. It is presented on page 124 of the text, contains 40 figures, 10 tables, 25 formulas, a list of references from 88 sources.