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THE PROBLEMATIC ISSUES CONCERNING MODERN WELL DRILLING TECHNOLOGIES

Well drilling is the leading technological cycle that makes it possible to carry out prospecting and mining operations within different mineral deposits.

Numerous operations as for construction of different industrial and civil purposes are impossible without well drilling technologies.

It should be noted that wells are constructed in the rocks differing with their mechanical properties; in addition, those wells vary greatly in their depths. These are the reasons why the construction periods for the majority of wells are rather long-term with the resulting significant deceleration in completing the current operations [1].

Consequently, there arises a topical problem concerning the acceleration of rock-breaking processes on the well bottomhole. The latter can be achieved by the application of necessary dynamic forces to a rock-breaking tool. Such a method can be implemented by using special bottomhole impact machines – hydraulic and pneumatic hammers. Their application favours considerable growth of a mechanical drilling velocity, being proved demonstratively by practical cases. That is connected with the fact that intensive fissility is formed in the bottomhole rock mass that favours its cardinal disintegration. Moreover, there are certain methods of additional intensification of the breaking effect at the expense of special compositions of cleaning agents [2].

Use of impact machines allows applying a hard-alloy drilling tool, being rather cheap and relatively simple in its design. Its operation is possible even in such a hard rock where a costly diamond (or similar) tool is required for the most popular rotary drilling technique.

Fig. 1 – Well drilling technologies

As a result of thorough analytical and laboratory studies, the authors of the report have developed a set of radically new hydraulic hammers [3] as well as the innovative procedure of their use (Fig. 1).

The feature of the proposed machines is that their design is rather simplified with the exclusion of high-wearing components in terms of complete preservation of all functional characteristics. The hydraulic hammers provide distinctness and consistency of each separate phase of the impact pulse formation as well as their stability and controllability irrespective of the cleaning agent properties. They favour both positive use of pressure difference in the pumping system of a well and great reduction of hydraulic power consumption to generate impact pulses. Contrary to the available designs, the hydraulic hammers propose simple continuous surface regulation.

There is also an additional factor of using the hydraulic impact in terms of necessary elimination of complications and accidents in a well requiring the available source for the formation of oscillations and impact loads. The aforementioned makes it possible to expand considerably a range of possible application of the facilities while forming the technical and technological schemes of bottomhole drill strings of core (hard-alloy and diamond) and noncore drilling. In this context, the performance of the drilling operations experiences certain intensification; besides, a mechanical and drilling speed per run increases along with the reduced amortization of the facilities and drill pipes (Fig. 2).

Fig. 2 – The hydraulic hammers

The main part of the hydraulic hammer, which delivers the blows used to break the rock, is called the striker or hammer, and the part of the hydraulic hammer that experiences the hammer blow is called the anvil. The hydraulic hammer valve is designed to block the flow of flushing fluid in order to obtain a hydraulic shock. The pressure drop that occurs when the valve closes (water hammer occurs) is taken up by the piston of the hydraulic hammer [4].

As a result of the research, it was found that the magnitude of the hammer stroke has a significant impact on the frequency of the hydraulic hammer. The speed of the hammer depends on the magnitude of its stroke only up to a certain limit. With an increase in fluid flow, an increase in the frequency of the hydraulic hammer occurs mainly due to a reduction in the duration of idling.

References

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