When designing the development, it is necessary to consider additional types of WIT: drilling of horizontal wells (HW), horizontal wells with multi-stage hydraulic fracturing (HW with MGF). The design of the HW with MGF allows for a multiple increase in the area of drainage of reserves and, accordingly, productivity in comparison with the IDW. 3D modeling was performed on an adapted model in the specified real conditions of one of the fields. The forecast indicators of well operation were obtained and the economic efficiency in the analytical model was evaluated based on them. Figure 2 shows the distribution of the initial flow rates of HW and HW with MGF.

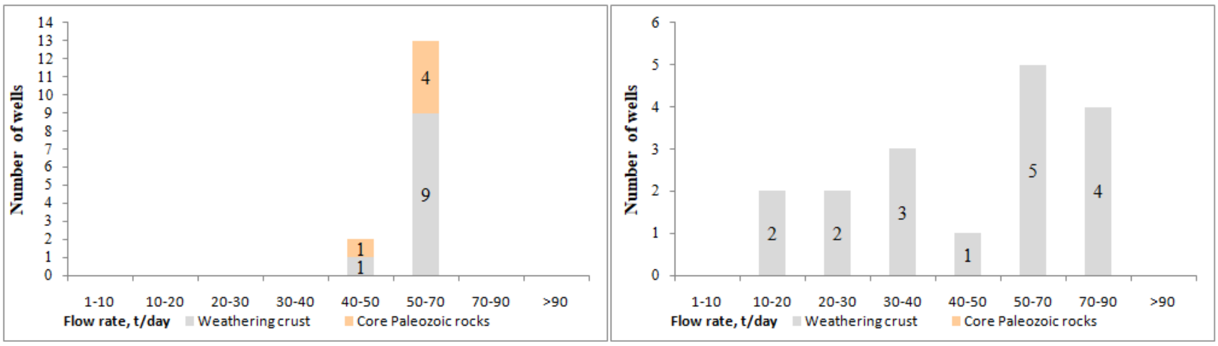

Fig.2 Distribution of the initial flow rates of HW (A) and HW with MGF (B)

Analysis of the calculations showed that all the forecast wells are cost-effective. When using horizontal wells, it is possible to achieve an increase in flow rate by 23% compared to directional wells. The method of drilling horizontal wells with multi-stage hydraulic fracturing allows you to increase the flow rate by almost 2 times relative to the flow rate of directional wells in the productive reservoir M. This technology is the most preferred when developing deposits related to the weathering crust. Thus, the drilling of HW and HW with MGF may become one of the most popular ways to complete the productive horizons of Paleozoic sediments soon.

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CORROSION PREVENTION AND CONTROL OF DOWNHOLE PUMPING EQUIPMENT

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Modern development processes of the oil and gas field are characterized by an increasing complication of geological and technological conditions for the operation of fields and harsh environment of produced fluid. The fluid production leads to premature failures of downhole pumping equipment and oilfield pipeline leaks. One of the main reasons for the failure of oilfield equipment is the corrosion of downhole pumping equipment. Hereafter a statistics graph on oilfield equipment failure due to corrosion is presented [3].

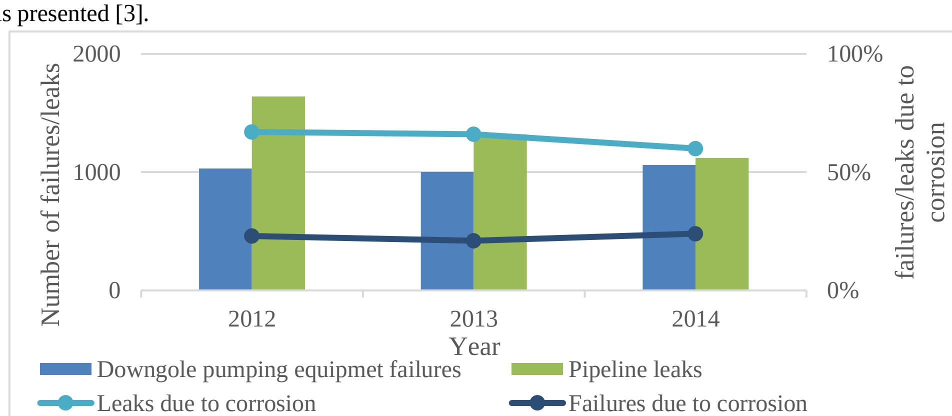

Fig. 1 Downstream pumping failures and pipeline leaks at OAO «Udmurtneft»

Today there are many ways to reduce or prevent corrosion of downhole pumping equipment. The most widely used is the chemical inhibitor method.

This method both advantages and disadvantages. The disadvantages include a high cost of effective inhibitors, insufficient thermal stability, inoperability at flow rates of more than 50 m3 per day, the lack of reliable devices that allow to inject microdoses of inhibitor into produced fluid. An efficiency of a corrosion inhibitor Napor-1012 in terms of OAO «Udmurtneft» oilfield is presented on the figure 2 [1].

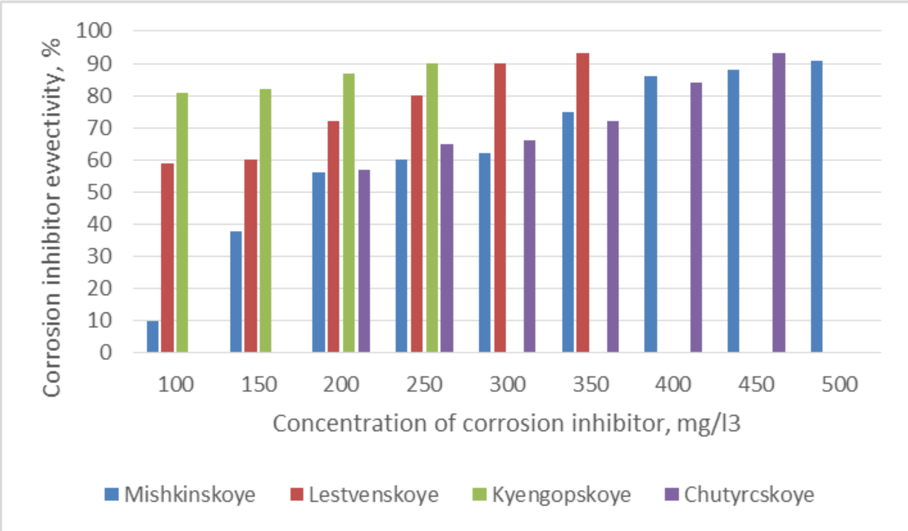

Fig. 2 Efficiency of Napor-1012 in model environments of oil fields of OAO Udmurtneft containing iron sulfide

Electrochemical or cathodic protection is the most promising method of corrosion protection in harsh environment.

Currently, these methods are quite successfully used to protect pipelines and cables, drilling platforms, offshore pipelines and chemical plant equipment. The method of cathodic protection involves the use of galvanic coupling of the corrosive metal to the auxiliary anode.

Over the period of 2011-2013 field trials were carried out at 10 wells with abnormal corrosive conditions at OAO «Tomskneft». According to the test results, a positive trend was noted in the increase in well operating time during the implementation of the cathodic protection device for the operating wells. The operating time increase factor was 1.82 [2].

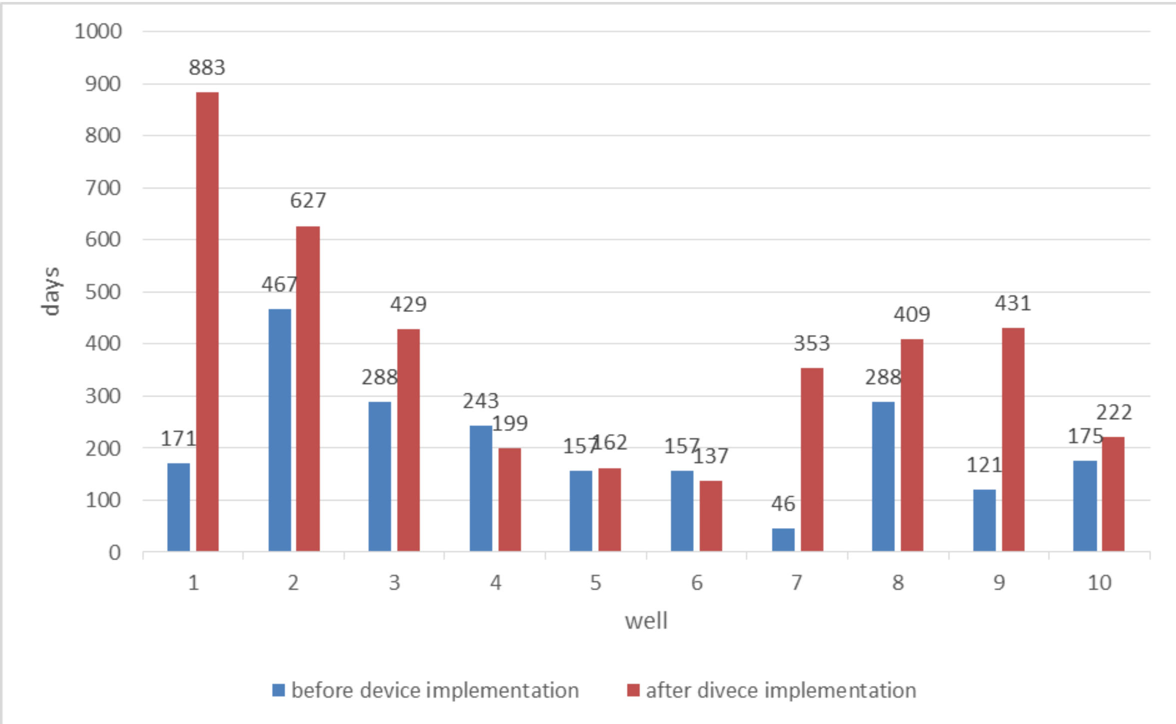

Fig. 3 Results of cathodic protection device implementation at OAO «Tomskneft»

At present time the corrosion is a major cause of serious hazards to the downhole equipment. The traditional protection technologies of borehole equipment, such as injection of the inhibitor through capillary tubes in this case ineffective. In this regard the current task is to develop devices that prevent or retardate corrosion [2].

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USE OF PASSIVE SEISMIC DURING THE OIL AND GAS EXPLORATION WORKS IN THE UDMURT REPUBLIC, RUSSIA

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Currently, the level of oil production in the Udmurt Republic is on a declining trend, due to the depletion of large and medium-sized oil fields, operated for a long time. Therefore the main challenge in this region is to stabilize and increase the amount of oil extraction by exploring more prospective very small fields. The Udmurt Republic holds nearly 6,4 billion barrels of proved hydrocarbon reserves. In case of successfully discovered oil fields, the probable resources of the region are estimated at 9,6 billion barrels. The main problem is the difficulty of turning estimated resources into reserves, due to complex geology of structures and high facies' variability of layers. The most promising geological structures are very small-sized reservoirs, containing less than 2,1 million barrels of original oil in place. However, it is often difficult to detect such structures with a traditional set of exploration works, because of some problems, complicated the process. An example substantiating good prospects of searching for new hydrocarbon deposits in the Udmurt Republic is oil fields discovered in the region in 2017. They included the Vesenny, Pikhtovsky and Aleksandrovsky oil fields. Besides, there are geological exploration works in progress in the Orosovsky and Vyazovsky oil fields. Problems complicated the process of small-sized reservoir exploration and development, include:

●lithological and geological complexity of these structures;

●difficulties in proper detection of a small-sized reservoir with a small number of prospecting and exploration wells;

●some errors during the hydrocarbon reserves' calculation process and difficulties in proper locating of the exploration wells;

●difficulties in discerning of the small-sized reservoir based on 2D and 3D seismic data;

●the high cost of well drilling during the geological prospecting and exploration works as well as during the oilfield development process.

The exploration of the Oparinsky oil field, located in the Udmurt Republic, with using only a traditional set of works, was aimed to detect small oil fields. However, it has become an example of ineffectiveness. Reserves were estimated at 6,3 million barrels, and oil in place was estimated at 312 thousand barrels [1]. Eleven of the wells were drilled in this field, but ten of them turned out to be empty. According to geological prospecting works, reserves have been estimated at 312 thousand barrels and oil in place – at 64 thousand barrels. Well drilling in the Oparinsky oil field alone consumed $22 million.

Table 1

Results of prospecting and exploration well drilling in the Oparinsky oil field

Estimated reserves (before the prospecting drilling), thousand bbls	6319
Original oil in place (OOIP), thousand bbls	312,4
Oil in place (OIP), thousand bbls	63,9
The number of wells	11
The number of empty wells	10
Well drilling cost, million $	22