AN INTEGRATED APPROACH TO THE TREATMENT OF THE BOTTOMHOLE FORMATION ZONE AS A WAY TO INTENSIFY PRODUCTION

Bychkov D.A.
Scientific advisor associate professor Bolsunovskaya L.M.
National Research Tomsk Polytechnic University, Tomsk, Russia

Rational development of oil fields includes the use of various methods of impact on the formation and the bottom-hole zone of the formation, aimed at the most efficient and cost-effective extraction of oil and uninterrupted operation of underground equipment. The bottom-hole zone of the well (CCD) is exposed to the most intense effects of various physical, mechanical, hydrodynamic, chemical, and physico-chemical processes caused by the extraction of liquids and gases from the reservoir or their injection into the deposit during its development. Therefore, in the process of opening the reservoir, during drilling and subsequent work on fixing the well, equipment for its face, etc., it is very important not to worsen, but to preserve the natural permeability of the CCD rocks. One of the reasons for the decrease in the productivity of the well is the decrease in permeability in the bottom-hole part of the formation - the most strongly affected by the processes during drilling and development of the well. The reason for the decrease may be:

1) Drilling: incorrectly calculated operating pressures can cause the penetration of drilling mud or filtrate into the formation. The interaction of the filtrate with reservoir water may cause the formation of salts and their precipitation.

2) Removal of mechanical particles or salt deposits from the depth of the formation into the bottom-hole zone.

3) Contamination of the well may occur during repair work and jamming procedures.

4) The bottom-hole zone of injection wells may be contaminated in case of insufficient purification of the injected water.

All this leads to a decrease in the productivity of the well, and, therefore, it is necessary to carry out measures to restore it. [3]

Figure 1 shows the dynamics of basic oil production and additional oil production after the GTM at the Nizhne-Tabagan field for the period 2008-2018. The figure shows that significant shares of production from GTM in annual selections fall on 2015 (29%), 2017 (30%), 2018 (52%). In 2015, this is the implementation of the COE at well No. 28 and the transitive effect of the performed IDN in 2014 at well No. 29.

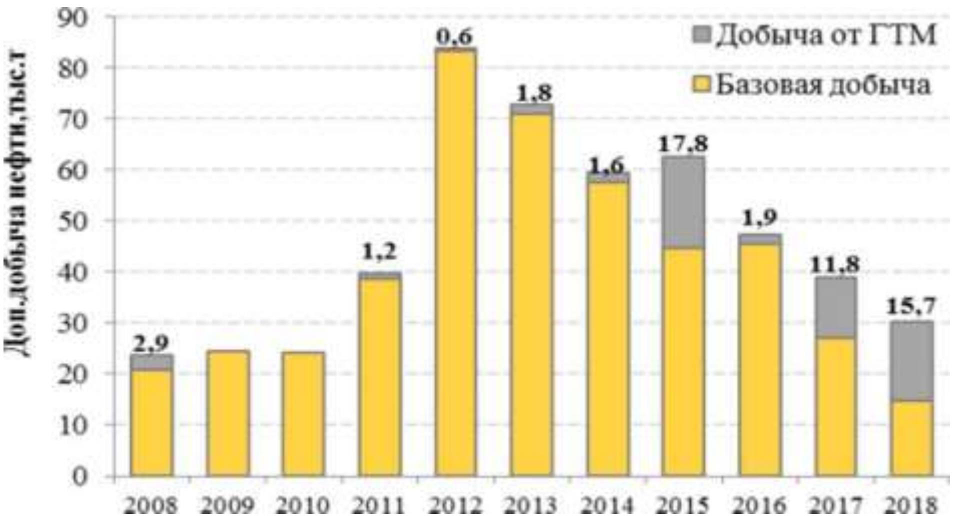

Fig. Dynamics of oil production for the period 2008-2018

Table 1 shows the geological conditions of the analyzed Nizhnetabagan field in comparison with similar deposits Lomov and Chkalovsky, which are characterized by partial similarity in basic geological and physical parameters such as the initial reservoir saturation pressure, gas factor, etc.

Table

Geological conditions of the Nizhnetabagan field and the analog field

Parameter	Nizhne-tabaganskoe				Sovetskoye	Chkalovskoe
Formation	$Ю_5$	$Ю_1^1$	$Ю_3$	M_{1-10}	$Ю_1^{1+2}$	M_1
Average depth of occurrence, m	2861	2606	2715	2982	2733	2710,0
Permeability, 10-3, mm2	1,6	2,9	3,2	2,4	11,3	5,0
Initial reservoir pressure, MPa	29,5	26,3	27,1	31,0	27,4	27,7
Initial reservoir temperature, °C	84	80,0	83,0	85,0	104,0	97,4
Oil viscosity in reservoir conditions, MPa*s	-	0,51	1,62	0,30	0,38	0,51

Based on the geological and technological characteristics of the objects of development of the Nizhne-Tabagan field and the criteria for the application of PNP methods, the use of large-scale PNP technologies aimed at increasing the displacement coefficients and the coverage of the displacement process in the oil deposits of the field is impractical, therefore, recommendations are given for them on the use of technologies of local impact on formations (treatment of bottom-hole zones of formations), contributing to the intensification of production oil, as well as increase as current, and the final oil recovery due to the implementation of a mechanism to increase the coverage of the reservoir by the impact from the sampling and injection zone. One of the most commonly used methods is acid treatment - a method of increasing the permeability of the bottom-hole zone of the formation by dissolving rock particles and polluting particles.SKO is designed to treat the bottom-hole zone in order to clean them from contamination and restore natural productivity, as well as reduce the time of their development.

The main purpose of the QO is to create a network of highly permeable channels in the PZP by dissolving the rock. To achieve the most efficient and optimal shape and size of wormholes, many factors must be taken into account. An important aspect that needs to be taken into account is the flow direction of the acid composition in the PP. This is especially important for wells that open several productive horizons with various very different FES, where there is a risk of CS leaving the absorption zones, leaving the low-permeable and most polluted zones untreated. Another important nuance is the regulation of the reaction rate of acid with rock. There are two characteristics that limit the use of hydrochloric acid: 1) reaction rate, 2) corrosion activity. One of the recommended approaches is the use of emulsified CS. The mechanism of action and the features of acid treatment have their own characteristics , depending on which type of collector acid treatment is carried out view For the treatment of carbonate reservoirs, hydrochloric acid is used in the absolute majority. The resulting calcium chloride $CaCl_2$, magnesium chloride $MgCl_2$, iron chloride $FeCl_2$ are well soluble in water and washed out of the PP. The main purpose of hydrochloric acid is the formation of channels for the dissolution of carbonate rocks. It is also used to dissolve polluting particles.

The main purpose of the treatment of terrigenous reservoirs is the dissolution of siliceous particles, which limit the inflow and reduce the permeability of the PZP. Hydrofluoric acid HF is mainly used for this purpose . Terrigenous reservoirs mainly consist of sandstones cemented with clay. In the composition of terrigenous reservoirs, a carbonate component may be present in varying degrees of severity, which dissolves during the reaction with hydrochloric acid HCl, therefore, when processing terrigenous reservoirs, along with hydrofluoric acid, clay acid (a mixture of HF and HCl) is used

The greatest experience in the development of carbonate reservoirs has been accumulated at the Chkalovsky deposit. In general, the treatment of the bottom-hole zone with acid compositions has experience of successful application at the Chkalovsky field , since additional oil production amounted to 59 thousand tons, and the number of effective operations is 8 out of 14 carried out.

At the Sovetskoye field, the best results during experimental work on acid treatments were achieved using a complex (cyclic) OPZ. The principle of which is based on the cyclic action of various compositions of chemical reagents to remove a whole group of various pollutants from the well's manhole. Since 1990, more than 570 measures have been carried out at the field to treat the bottom-hole zone in order to restore productivity. The dynamics of the performance and efficiency of the OPZ of producing wells shows that additional production for the entire period amounted to 1,707.6 thousand. t, the maximum indicators for the number of treatments were achieved in 2013-2014, the effect continues to the present. In many cases, OPP was carried out in combination with other methods, for example, Additional perforation, so it is difficult to assess the effectiveness of each type separately. The most common method is salt and clay acid treatment, the additional production for which amounted to 967.7 thousand tons

In the course of the work, the optimal acid solution was calculated on the experience of similar fields. From the calculations obtained, it can be seen that if the bottom-hole zone is polluted by less than 20%, it is unprofitable to perform the operation. At the same time, contamination of the bottom-hole zone by 60% or more requires the implementation of the COEX. It is impractical to perform the operation on areas with less than 40% contamination. For areas with contamination from 40 to 60%, an economic calculation is required depending on the well potential

References

1. Victorin V.D., Lychkov N.P. "Development of oil fields confined to terrigenous reservoirs" M. Nedra, 2014.
2. Kudinov V.I., Suchkov B.M., "Intensification of current oil production" "Oil industry 2019, No. 7.
3. Muslimov R.H., Abdulmazitov R.G. "Improving the technology of development of inefficient oil fields of Samara" Samaraneftegaz 2018