Ways to Improve the Efficiency of Horizontal Wells for the Development of Oil and Gas Field

R.Kh. Muslimov
Kazan Federal University, Kazan, Russia

Abstract. The effectiveness of horizontal wells is tested mainly for increase of oil withdrawal in comparison with usual vertical wells and more rarely for increase of oil recovery factor. In spite of long time application of horizontal wells in Tatarstan Republic, Russia, its efficiency is comparatively low: flow rates of horizontal wells are in 1,5-2,2 times hither than flow rates of vertical wells. The article deals with geological conditions for the effective application of horizontal wells and their limitation for the development of oil and gas fields. Particular attention is paid to the state analysis and the efficiency improvement of horizontal wells operation during field development with introduction of various water flooding systems. The highest technical and economic indicators of field development with horizontal wells are obtained by their systematic use taking into account the experience of developing oil fields with vertical wells, compliance with principles accumulated for decades of the rational field development by means of flooding.

Keywords: horizontal, multi-branched, vertical wells, geological, commercial, initial recoverable reserves, production rates, cumulative production, oil recovery factor

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In the last quarter of the last century, the drilling of horizontal wells in the world has developed at an unprecedented pace. Later, this boom came in the Russian Federation. There were different kinds and constructions of horizontal, multi-branched, branched-horizontal, and, later, lateral branches in the previously drilled (old) wells. Efficiency of horizontal wells is assessed mainly by increase in the current oil production compared with conventional vertical wells and less increase in oil recovery factor. Spread in values of flow rates of horizontal wells compared to flow rates of vertical wells in the whole world is very high, from 5.2 up to 10 and even (in some cases) to 20 times.

This spread (especially in the high values more than 3-5 times) is mainly due to the variety of geological conditions in the application of horizontal drilling. The more challenging the conditions of application of horizontal drilling, the relative increase in oil production by horizontal well will be higher than by vertical well, until the lack of alternatives for the application of horizontal wells. The latter include deposits with the oil rim of small thickness between the gas cap at the top, underlying by an active aquifer. An example is the Troll field in the North Sea. Also deposits of heavy, high-viscosity, extra-viscous oil are included, as well as deposits in tight reservoirs (not previously considered in the state balance). Oil production in said geological conditions using vertical wells is generally unprofitable. In some cases, without horizontal drilling it is not possible to develop (drilling under the settlements, protected, inaccessible areas, water bodies).

The Republic of Tatarstan in the last quarter of a century has gained a lot of experience. As of 01.01.2011 in the Republic of Tatarstan 531 horizontal and 82 branched horizontal wells (Khakimzyanov et al., 2011).

In PJSC «Tatneft» are in operation 464 horizontal wells, including 79 branched-horizontal wells were drilled. Cumulative oil production is 7119 thousand tons, including by horizontal wells – 6901 thousand tons, by branched-horizontal wells – 1028 thousand tons, including production from carbonate reservoirs – 4580 thousand tons, from clastic reservoirs – 2538 thousand tones. On average, one drilled well produces 13.1 thousand tons of oil, including from the carbonate reservoirs – 11.3 thousand tons, from clastic – 18.7 thousand tons. Average oil production rate is 7.9 tons/day; for carbonate and clastic reservoirs – 6.1 and 10.5 tons/day, respectively.

Despite the long period of horizontal wells use in Tatarstan, their efficiency is relatively low: flow rates of horizontal wells in the 1.5-2.2 times higher than rates of vertical wells. There are a number of objective reasons:

1. The heterogeneity of the object, which determines the efficiency of the development as a whole; for the horizontal drilling it is significantly higher. High heterogeneity leads to low coverage of oil displacement (in percentage to the penetrated length of the reservoir) and acceleration of the watering process in operation of horizontal wells without special equipment that separates intervals with different permeability.

2. The deterioration of the filtration properties of the reservoir due to prolonged exposure to drilling muds, as well as during longer operation of horizontal wells than vertical wells.

3. Changes in the stress state of rocks in the horizontal well have a more significant impact on the change in reservoir properties than in the vertical well.

4. Development of deposit by horizontal well with flooding of directed filtration flows that provide necessary formation energy and higher sweep by flooding require a more serious approach. In this case, the injection wells also have to be horizontal (Zakirov et al., 2009).

5. In the application of horizontal wells it is necessary to solve a number of issues of technical and technological nature (length optimization of the horizontal portion, the definition of necessary entry point into the reservoir, the profile and position of horizontal well in deposit, disconnection for separate

		Valu		Difference
		Horizontal wells	Vertical wells	
1	Revenues, thous.rub	325698	266811	58887
2	Oil and gas production tax, thous.rub	105283	86248	19035
3	Business expenses, thous.rub	16669	13655	3014
4	Variable costs, thous.rub	8159	6684	1475
5	Prime cost of commercial output, thous.rub	236063	163459	72604
6	Sales profit, thous.rub	89635	103352	-13717
7	Profit tax, thous.rub	21512	24804	-3292
8	Profit remained in organization, thous.rub	68123	78548	-10425
9	Net Present Value (NPV)	-27073	58882	-85955
10	Profitability index	0,95	2,04	-1,09
11	Payback period, years	1,05	0,49	0,56

Table 1. Economic indicators for the plot No.7.

operation of sites with different geological characteristics).

All this calls for a more accurate study of geological features of the object, especially in inter-well space.

Analysis of technical and economic efficiency of drilling horizontal wells in 7 plots in the second block of Kizelian deposit, Bavlinsky field, conducted by G.F. Yulmetova, showed:

1. Lack of technological effect from horizontal drilling in the development in natural mode (2 plots).

2. In areas with flooding technological indicators of horizontal wells (oil flow rates, productivity) are better than for vertical wells, but not much (1.1 to 1.5 times).

Economic indicators in comparison with vertical drilling with distance 400 m between wells (drilling of two vertical wells instead of one horizontal with horizontal branch of 400 m long, recognized the optimal in Tatarstan) are significantly worse (Table 1).

Based on the above, for the correct determination of the economic efficiency of development using horizontal wells, it is necessary to compare it with the system of vertical wells, given that horizontal drilling reduce the vertical drilling by 1-2 wells and so on.

Accumulated horizontal drilling experience suggests that in most cases, to improve efficiency of horizontal drilling, it is necessary to create a development system using horizontal wells, and not be limited by drilling the single horizontal well or multi-branched wells. In this case, we obtain a synergistic effect from horizontal drilling. However, in most cases, in the design and implementation of horizontal drilling, a non-systemic approach is marked.

The fact is that the horizontal wells and branched-horizontal wells in platform deposits with their low energy do not solve the issues of improving the efficiency of development of reserves. They are the only elements of the development system, organically fit into this system. As in the development systems using vertical wells it is necessary to comply with the balance of injection and sampling, to optimize density of well grid and the selection and discharge pressures, to provide control and regulation of the development process, and adjust the direction and shape of fluid flow in the reservoir.

The horizontal drilling has developed at the Fedorovsk oil and gas field, the largest in Western Siberia, in order to engage oil and gas difficult to recover from the formations AS4-8, the feature of which is the presence of bottom water and gas cap, and a small thickness (8-12 m) of oil rim (Fig. 1) (Muslimov, 2005).

Given the encouraging results of the first horizontal wells and the low efficiency of the vertical wells (low flow rates and high

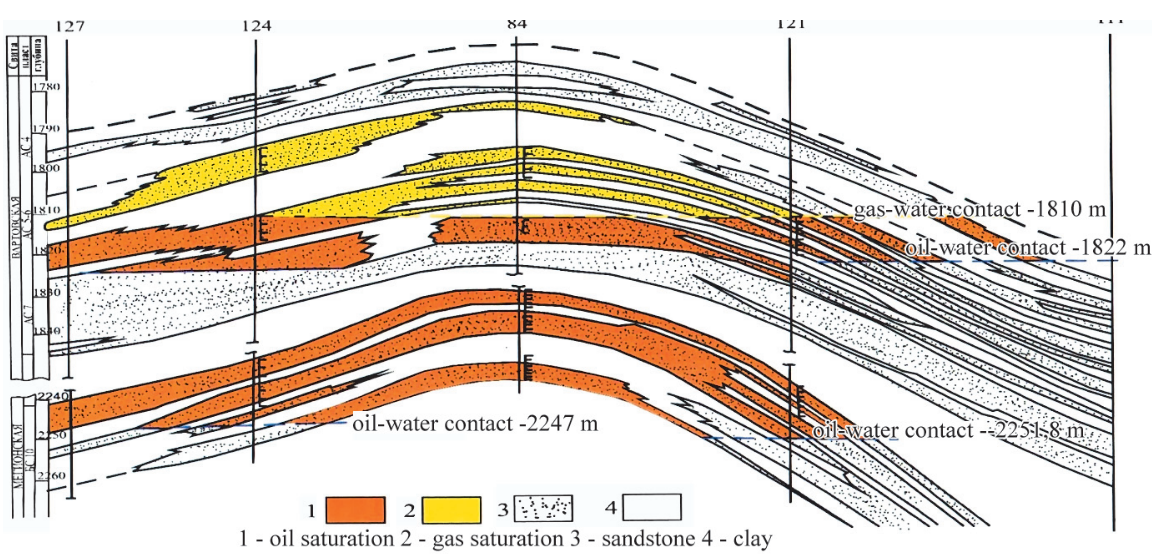

Fig. 1. Geological profile of productive deposits for the formation AS4-8 of the Fedorovsk oil and gas field.

water cut), in 1994 the Tyumen branch of SurgutNIPIneft compiled the development plan of oil and gas formation AS4-8 of the Fedorovsk field using horizontal wells.

Technological scheme provided drilling of 1931 wells, including 1175 producing wells, of which 1003 horizontal wells and 756 injection wells. Drilling of this amount of horizontal wells has no analogues in the world (Fig. 2).

Then, in the process of designing the project fund has been increased to 2511 wells, of which 1003 horizontal wells.

The horizontal drilling out provides the involvement in the development of 522.4 million tons of oil, or 86.8% of the approved reserves, additional 100.8 million tons of oil (16.8% of proved reserves). According to hydrodynamic calculations the oil recovery factor doubles. This came from the fact that the depression using the horizontal drilling is much lower compared to the vertical drilling. The quantities of impermeable layers at the gas-oil contact and water-oil contact hindering gas flow and bottom water at the well bottom are reduced, respectively, to 2 m and 1 m.

For project horizontal wells the average length of the horizontal portion of 550 m was adopted. This value is substantiated by detailed technical and economic calculations, but the authors highlight that the actual length of the horizontal part should be justified for each horizontal well under the terms of its construction. The main provisions, which guided the authors of the project document, are that the drilling of each individual horizontal well should be conducted on individual technological scheme, in which it is necessary to determine the specific geological structure of the formation along the path of horizontal well.

The technological scheme provides construction of 60-65 wells per year. Project profiles of horizontal wells are the most widely used, consisting of portions: vertical, drift angle with large and medium curvature radius and horizontal. The average displacement to the entry point into the formation is 550 m, with a spatial azimuthal curvature 65-70°.

On Fedorovsk field OJSC Surgutneftegas solved the main technical and technological issues of deposits development by horizontal wells system: construction, drilling of horizontal wells (direction of trunk and entry into formation, the profile and provision of the specified interval of horizontal portion), wellhead and downhole equipment, optimal length, horizontal section, horizontal portion, distance of the horizontal portion from the gas-oil contact and water-oil contact and others. All of these issues ultimately found their satisfactory solution.

	Horizontal well	Vertical well
Number of wells	215	93
Time in operation on 1 well, well – year	1,5	4,2
Cumulative oil production on 1 well, th. t	14,9	16,0
Average oil flow rate, t/day	29,8	10,8
Average liquid flow rate, t/day	103,0	94,0
Cumulative water-oil ratio, t/t	2,45	6,97
Productivity factor, 10 t/day, mPa	11,0	5,5
Measured depth, m	2800	2150
Horizontal length, m	521	–––

Table 2. The so-called benefits of the new scheme on reserves approval.

At the peak of annual output reached by half of the project fund, 28.7% of initially recoverable reserves were extracted (the extraction pace of 3.7% from the initially recoverable reserves) with a very high water content, about 85%.

Effectiveness analysis of the oil rim development in the formation AS4-8 held recently by Yu.N. Avramenko.

On the East-Mokhovaya area, where the experiment began for the development of deposit of horizontal well on an annual maximum (the extraction pace of 6.05 from the initially recoverable reserves), in the extraction of 32.5% of initially recoverable reserves water content was 80.7%.

Analyzing the results it can be concluded that in almost all geological conditions displacement characteristics for horizontal wells are better than for vertical wells, the oil production rate is higher, water and breakthrough gas is produced less. An exception is the oil contacted with gas, where in horizontal wells in the initial stage of operation, the gas factor was higher than in vertical wells.

When comparing the development characteristics with horizontal and vertical wells in the East-Mokhovaya area, it can be seen that at the initial stage of development, characteristics of the displacement in the area with horizontal wells are more favorable. The stabilization of water cut started earlier. If for the plot with vertical wells water cut stabilized at 85%, then for plot with horizontal well it was at the level of 70%, that is, the share of oil in the produced fluid at the same oil recovery factor was 2 times more.

At the same degree of injection (the ratio of accumulated liquid production in situ to balance oil reserves) the current oil recovery factor is higher, the accumulated oil-water factor and gas-oil factor are lower.

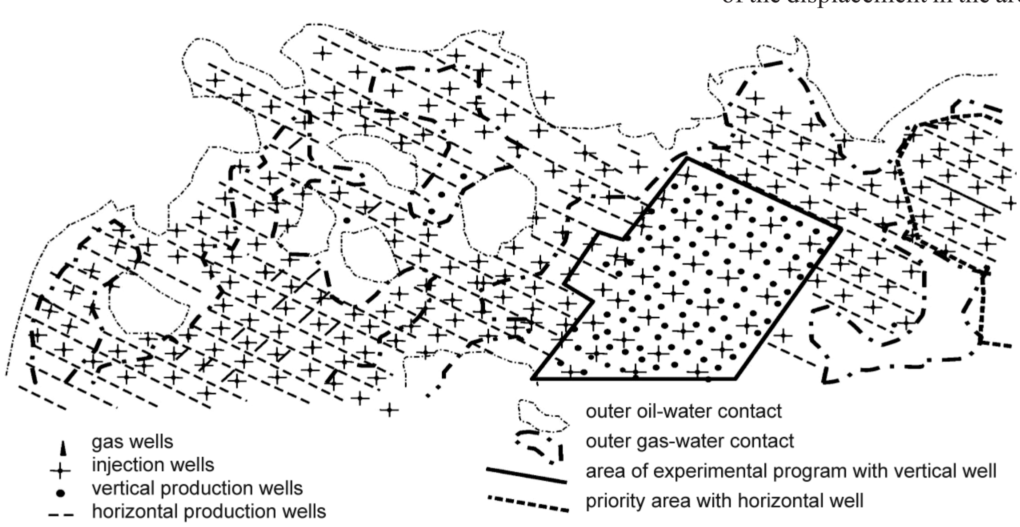

Fig. 2. Fedorovsk field. Placement of horizontal wells for the formation AS4-8 (fragment).

Comparison of operation parameters for horizontal and vertical wells is shown in Table 2.

Comparison of operation parameters shows that almost the same oil production (13.9 thousand tons for 1 horizontal well and 16.0 thousand tons for 1 vertical well) was received for 1.5 years of work of horizontal well and 4.2 years of vertical well work. In horizontal well the water was extracted 2.8 times less than in the vertical well (horizontal well – 2.4 tons of water per 1 ton of oil, vertical well -7.0 tons of water per 1 ton of oil).

Extraction of breakthrough gas from the gas cap for the horizontal well is grater than for the vertical well (horizontal well- 982 m3 per ton of oil, vertical well – 862 m^3 per ton of oil).

Average production rates for the period of operation are as follows: oil – horizontal well – 27.8 tons/day, vertical well – 10.8 tons/day (for horizontal well 2.5 times more), liquid – horizontal well – 103.0 tons/day, vertical well – 94.0 tons/day (1.1 times greater for horizontal well), productivity index is 2 times greater for horizontal well than for vertical well.

Actual indicators of reserves development in 2012 for horizontal well are the best for horizontal well: 59.7% of the initially recoverable reserves were extracted for horizontal wells, 9.2% – for vertical wells. Peak production for 231 horizontal wells in 4.22 times higher than vertical wells, the average production rate is of 22.7 tons/day. For 119 vertical wells the average production rate is of 10.4 tons/day (Fig. 3).

According to calculations in the deposit operation to limit water cut is of 98%, water content in accordance with the implemented system of CIN may reach 0.27 at the design 0.31. Pilot area indicators developed by vertical wells are much worse. With cumulative production of 56.8% from initially recoverable reserves, the water cut was 92.7%, the current oil recovery factor – 0.142, with production rate of oil – 7.4 tons/day. Obviously a project oil recovery factor 0.25 here will not be achieved.

To achieve the project oil recovery factor, and possibly exceed it at the present stage of development of East-Mokhovy depression it is necessary to perform the following activities: change of the development system, creating a block layout, allowing the best use of cyclic waterflooding, change in the direction of filtration fluid flow, in its classic versions to collect oil in the circuit areas followed by their long working off to the water content of 98-99 %. At the same time within blocks injection wells should be transferred to production wells with drilling of old wells. The same measures should be taken

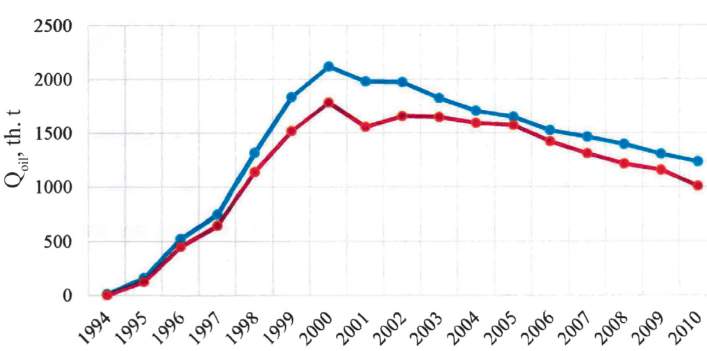

Fig. 3. The dynamics of oil production indicators in the north of East-Mokhovy area of the Fedorovsk field. – Oil production, total, thousand tons. – including horizontal wells, thousand tons.

evidently in Fedorovsk field as a whole. This is the experience of the Republic of Tatarstan for the basic technology of circle waterflooding.

Experience of the Fedorovsk field shows that in the most complicated geological conditions of oil and gas object AS4-8 (small oil rim, which lies between the gas cap and underlying water, unfavorable ratio of oil viscosity to water viscosity – 13.6, high heterogeneity and segmentation of layers), the use of traditional systems of development with vertical wells can not provide sufficient current production levels and more or less acceptable oil recovery. The use of horizontal wells significantly increases the current production and ultimate recovery.

However, in the application of horizontal drilling we should take into account the basic principles of development, proven for years of using conventional vertical drilling. This applies to in-depth study of detailed geological structure, allocation of production facilities, assessing the impact of well spacing on the current production and oil recovery, setting operation mode (optimum and minimum allowable values of formation and bottomhole pressures), control and regulation of development processes. We have to pay much more attention to these issues when using the horizontal drilling than in the operation of vertical wells (especially in the study of geological structure, wells operating modes, control and regulation of development processes).

The need for systematic approach to the development of fields with reserves difficult to recover is demonstrated on the experience in developing Kizelsky deposit of Bavlinsky field.

The main feature of deposits in Upper Tournaisian substage is their exceptional heterogeneity and low productivity. For this reason, held for nearly 30 years trial operation and pilot water injection at sufficiently large distances between production and injection wells have not yielded positive results. Therefore, due to unprofitability the reserves of these deposits were transferred to the category of off-balance.

In 1962 TatNIPIneft made a development technological plan of the Lower Carboniferous deposits as a whole, in accordance with which the joint development was performed of Bobrikovian and Tournaisian deposits. However, the practice of joint development of oil deposits, confined to various reservoirs did not pay off; therefore in the project of 1987 carbonate deposits of Tournasian tier were allocated to independent object.

By decision of the Central Committee for Development on priority development areas of Kizelian horizon, experimental work was conducted on the effect of well spacing on the development effectiveness of complex reservoirs saturated with highly viscous oil, as well as the testing of stimulation systems.

In the course of experimental work on one of the sites it was established that the use of cavern storages, organization of flooding, injection of hydrochloric acid provided increased oil recovery by 15-20 % (absolute). The results of the flooding carbonate reservoirs with porosity of 8-11 % at a different site with the development of injection wells were quite encouraging. The expected recovery factor on a site was 0.30 at the design value of 0.2. Drilling and development of one of the sites showed that the mesh density of 4 hectares/well provided enough high rate of annual extraction even in a natural mode.

According to the latest Project Document of 1994 the following was adopted:

- For Kizelian horizon drilling of the combined horizontal wells (8-9 wells per year) and vertical wells with the organization of three-row flooding system, the creation in vertical wells of artificial cavern oil storage, testing of new development technology of carbonate reservoirs with injecting surface-active agents and polymer dispersed systems in the order of pilot development;
- Carrying out on all objects of development of non-stationary flooding.

Investigation of the geological structure of the carbonate productive horizon and generalization of the results of pilot development has allowed identifying the main ways to improve the development of low permeable heterogeneous reservoirs to ensure their cost-effective development.

The object is Kizelovsky deposit of Bavlinsky field, the development of part of which provides essentially horizontal wells.

The total thickness of the development object in the deposit is 21.4 m, for blocks the average values vary from 20.6 to 23.3 m. The total net pay thickness, respectively, equals to 18.6 m changing average values for blocks ranging from 16.0 m to 20.5 m. The average net pay thickness varies according to areas from 5.3 to 8.5 m and average for the deposit is 7.0 m. The proportion of reservoirs in the context of an object changes in the range of 0.268 to 0.435 unit share and averaged 0.369 unit share. The stratification of the section is low and does not exceed an average of 1.548 unit share, while in some wells according to the logging data up to 8 layers of productive reservoirs are allocated. The thickness of dense carbonate layers between reservoirs ranges from 0.4 m to 15.2 m and an average of 5.5 m (Fig. 4) (Khisamov et al., 2013).

On the deposit substantially vertical-lateral development system is applied (Zakirov et al., 2009).

Block 6 is the most drilled both with vertical and horizontal wells on Kizelian object, which accounts for 53% of horizontal wells drilled on the deposit (Fig. 5).

Oil deposit of Korobkovsky area is of massive type. Kizelian horizon of Tournaisian tier consists of limestone. Development of this area of Bavlinsky field was started in 1976.

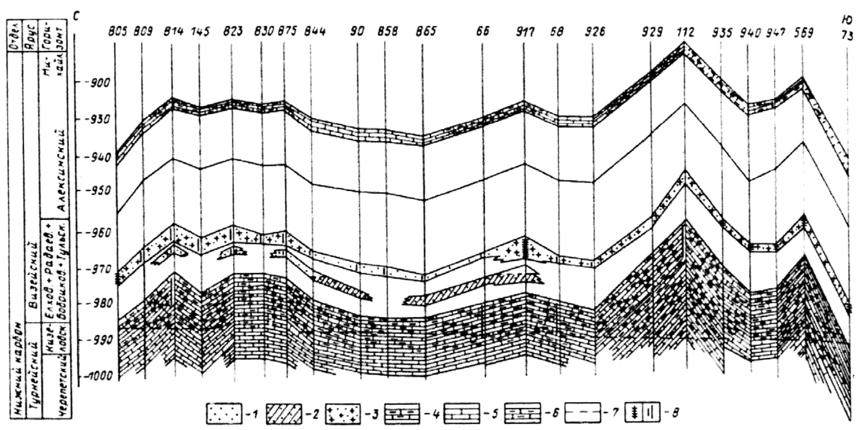

Fig. 4. Geological field profile by line of well 805-73 on the Lower Carboniferous sediments of Bavlinsky field. Clastic rocks, reservoirs: 1 – oil saturated; 2 – water saturated; 3 – water flooded. Carbonate rocks. Reservoirs: 4 – oil saturated; 5 – water saturated; 6 – tight rocks; 7 – oil-water contact; 8 – perforation intervals of injection/production wells.

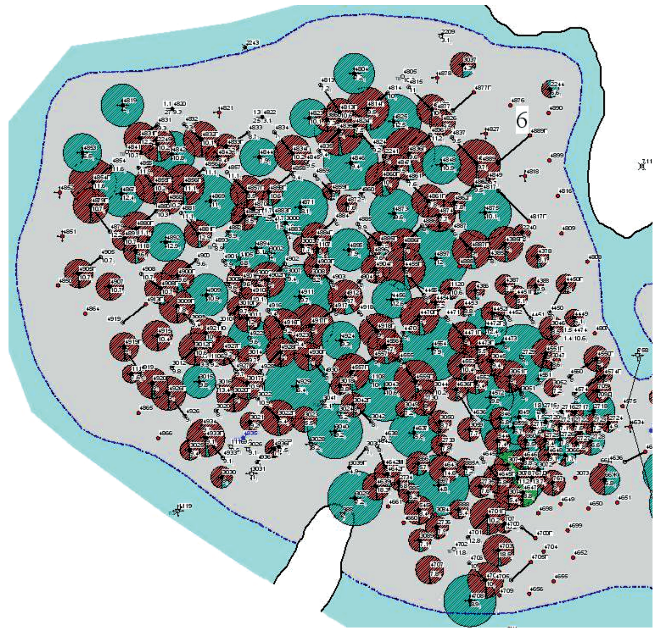

Fig. 5. Development map of block 6 (Korobkovsky portion) (Podavalov et al., 2016).

The total thickness of Kizelian horizon averages of 21.4 m, the effective average net pay thickness of 5.8 m; stratification rate is 1.4 unit share. Oil is characterized by medium viscosity 20.8 mPa*s, density – 872.5 kg/m^3 at reservoir conditions, the saturation pressure – 3.3 MPa. According to the content of sulfur oil is sour.

In 2002 the Institute TatNIPIneft in collaboration with specialists from geological survey of oil and gas production department "Bavly-Neft" proposed a new complex technology of carbonate reservoirs development (Khisamov et al, 2013; Podavalov et al, 2016.).

The technology includes areal nine-point system of wells with horizontal and system vertical trunks and injection wells in the center of the element. The distance from the injection to the horizontal production well is 450 meters; to vertical corner production well is 635 m (Fig. 5).

In the injection wells it is recommended to conduct vertical seismic profiling for fracture studies. Closure pressure of cracks is determined. Estimates are produced of the required volume of water injection from the conservation of initial reservoir pressure after the selection of the reservoir fluid. The injection wells are perforated in the bottom part of the formation. Anticipatory cyclic water injection is produced, thus preparing the formation for oil extraction. Water injection as displacing agent must be alternated.

After specification of the geological structure of drillable object, vertical and horizontal wells are drilled equidistant from injection wells. The horizontal shaft, as well as the perforations in producing wells is carried out in the top part of the productive formation. This ensures a uniform coverage of the reservoir with filtration flow from the bottom up.

Extraction of well production as water injection is carried out in a cyclic mode.

Values	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Oil flow rate (vertical well) t/day	2,3	2,1	2,3	3,2	3,4	3,7	3,9	3,7	3,4	3,8	3,4
Oil flow rate (horizontal well) t/day	6,7	3,8	5,9	6,8	8,3	8,4	8,1	7,7	7,3	7,0	6,8
Water flooding (vertical well), %	14,2	19,1	17,7	14,9	10,2	9,5	10,4	12,5	15,4	16,3	17,1
Water flooding (horizontal well), %	6,0	6,5	7,9	5,3	6,7	4,2	4,6	6,7	7,6	6,3	3,9
Producing well fund (horizontal wells)	1	4	9	15	24	27	36	46	57	65	73
Producing well fund (vertical wells)	46	51	61	73	76	76	77	85	94	102	105
$P_{deposit}$, mPA	7,6	7,4	7,5	7,9	8,1	7,8	8,04	7,1	6,8	7,5	7,4

Table 3. The dynamics of flow rates, water content and the existing fund of vertical and horizontal wells.

Since 2002, the drilling and operation of Korobkovsky area is carried out by adopted technology (Podavalov et al., 2016).

As of 01.01.2016, there are 172 producing (71 – horizontal) and 40 injection (1 – horizontal) wells are in the industrial exploitation, of which 8 are in the permanent work from the group pumping station (KNS-12), the remaining injection wells operate from the wells giving process water in a cyclic mode.

In 2015, oil production on the object in question was 293.6 thousand tons, the rate of extraction from the initial recoverable reserves – 6.9%, 343.6 thousand tons of the liquid was produced with water cut of 14.6%. In order to maintain reservoir pressure 72 thousand m3 of water was pumped.

The dynamics of flow rates, water content and the existing fund of vertical and horizontal wells is shown in Table 3 and Figure 6. The oil flow rate and water cut of the sun and the HS are shown in Figure 7 (Podavalov et al., 2016).

It draws attention to the discrepancy between the oil extraction rate and water cut of production. At the very high depletion of deposits (76.6% of the initially recovered reserves) water content is only 14.6%, which is contrary to the development experience (especially for oils with a higher viscosity (Fig. 8) (Muslimov, 2014). With such low water content the current oil recovery factor is 0.153 at the design 0.2. At the same time the pace of development is very high – 6.9% annually from initially recoverable reserves (compared to conventional deposits in carbonate formations of Tatarstan 0.5-1, at least 2% per year). Moreover, such oil recovery was achieved at an early stage of development when the reservoir did not even reached the maximum annual production.

What's the matter? Such indicators may be either due to underestimation of balance reserves, or by understating the project oil recovery factor when applied new technology of development, or by both. Obviously on the considered deposits we are dealing with the third case. With regard to the under-balance reserves we are dealing with carbonate array, in which the current practice of determining the so-called balance reserves is not perfect. They are defined only by artificially allocated, so-called permeable interlayers. Calculated on the accepted technique share of reservoirs in this case is about 45%. But in the development the whole carbonate array participates. With this in mind, reserves are understated by half.

Recent studies of the Kazan Federal University (V.P. Morozov et al.) for the Upper Tournasian deposits of the east board of Melekess depression showed the presence of oil in almost all oil-saturated part of the section.

According to many modern concepts about the oil and gas basins (Morariu, Averyanova, 2013; Prischepa, Averyanova, 2013), the following rock types can be distinguished in them:

- Reservoir rocks (conventional);
- Source rocks (unconventional);
- Dense rock or half-reservoirs.

If the conventional reservoirs are usually localized within anticline structures, the unconventional reservoir rocks do not comply with it. Important features of oil and gas deposits in shale reservoirs and tight reservoirs that distinguish

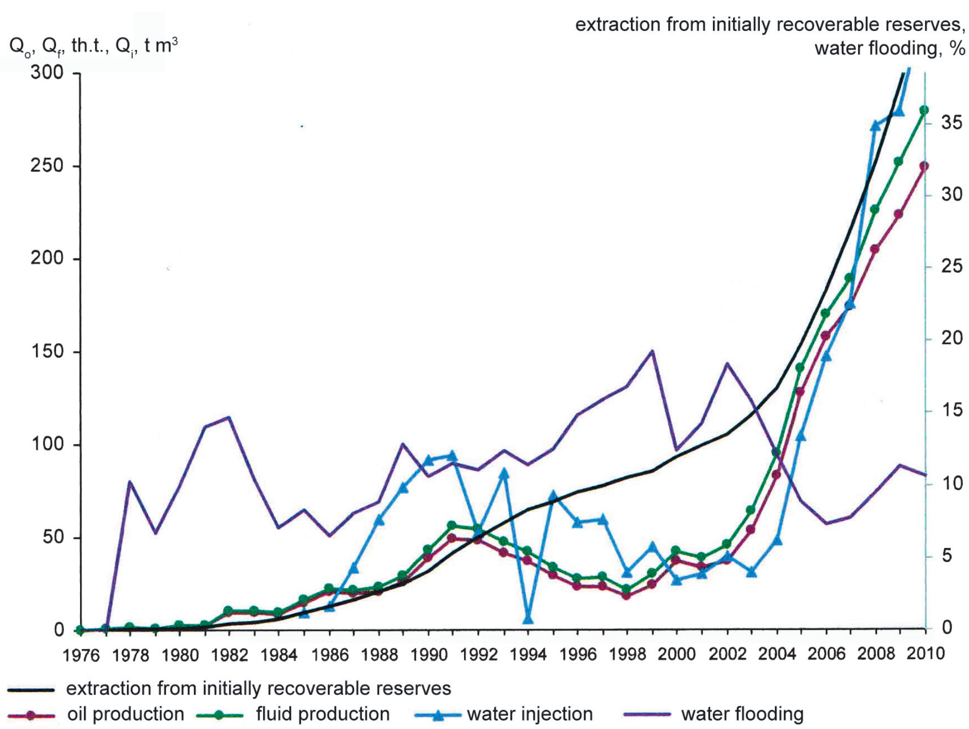

Fig. 6. Development scheme of the Kizelian horizon

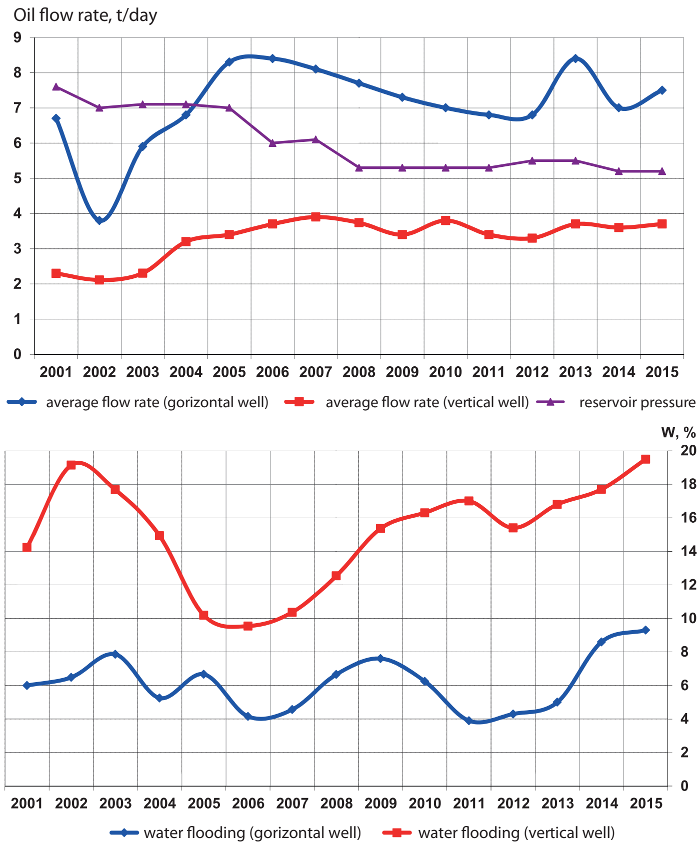

Fig. 7. Distribution of flow rates and water cut of horizontal and vertical wells of block 6 (Podavalov et al., 2016).

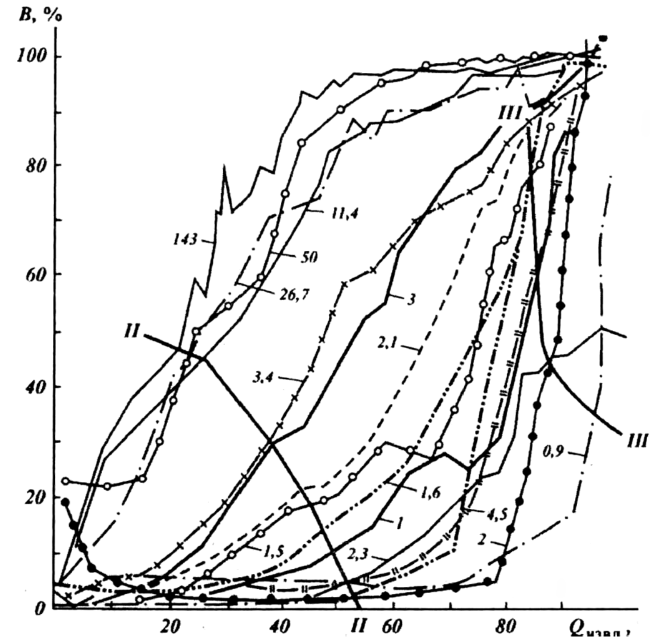

Fig. 8. Dynamics of product water cut in the development of production facilities with varying viscosity of reservoir fluid (M.M. Ivanova et al.).

them from conventional deposits, are:

- Continuous type reservoir;
- Are not controlled by the structure factor;
- Controlled by stratigraphic and lithological factors.

Therefore, the prevalence of non-conventional reservoir rocks, controlled by lithological and stratigraphic factor has a very wide areal distribution.

The result of work held by V.P. Morozov et al was the presence among the studied sections of tight oil-saturated carbonate rocks with potential industrial oil bearing.

Thus, the study of core material sections of the Lower and Middle Carboniferous show that it is possible to distinguish carbonate rocks by the degree of oil saturation:

- Oil-bearing rocks;
- Tight with no signs of oil;
- Tight oil-bearing rocks, intermediate between them (half-reservoirs).

V.P. Morozov on an area of 8.5 thousand km^2 on the eastern board of Melekess depression defined in the tight layers 8.5 billion tons of oil. Thus, the geological reserves in carbonate array are substantially above the so-called balance reserves. According to our research, the so-called tight sections in carbonate and clastic reservoirs take an active part in the processes of filtration and oil displacement (Muslimov, 2014). Therefore, some experts strongly suggest to go on account of the so-called balance reserves to geological reserves (Zakirov et al, 2009; Muslimov, 2005; 2014). Then discrepancy will disappears between the large selections from the recorded reserves on the balance sheet and low water cut on Korobkovsky area. A similar pattern is observed throughout the Republic of Tatarstan.

The second aspect relates to the effectiveness of development technology in the area with the use of horizontal drilling. The calculations of oil production until the end of the development, to the water content of 98% showed the possibility of achieving oil recovery factor 0.369, i.e. initially recoverable reserves will be more on the balance sheet by 1.84 times. Given the necessary adjustment of reserves (switching to geological), this value of initially recoverable reserves should be increased at least twice.

But this does not exhaust the possible effectiveness of this technology. It can be improved and further developed.

The real basis of the adopted technology is the application of horizontal wells and vertical lateral cyclical flooding. As substantiated in the publications of S.N. Zakirov (Zakirov, Zakirov, 1996) it is proved that if horizontal production well is drilled, it must be complemented by a horizontal injection well. In addition, over time, the selection of 80% or more from the actual oil reserves, which are described above, it is necessary to use such a powerful lever as a change in the direction of filtration of liquid flows in the formation, changing the location of production and injection wells, transferring on the block developing system that allows to concentrate residual oil in particular, already emerged areas and ensuring that it is selected with the use of classical schemes of non-stationary flooding. At this we estimated that oil recovery factor would amount to 0.45 to now adopted balance reserves (or 0.361 to adjusted geological reserves). The latter requires a special calculation for the methods recommended by specialists of the Kazan Federal University.

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Information about author

Renat Kh. Muslimov – Doctor of Science (Geol. and Min.), Professor, Department of Oil and Gas Geology, Kazan Federal University

Russia, 420008, Kazan, Kremlevskaya str., 4/5

Phone: +7 (843) 233-73-84, e-mail: davkaeva@mail.ru

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