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Determination of the Density Limit of the Grid Density of Wells in the Late Stage of Development of Oil Deposits

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ABSTRACT: The empirical dependencies used to determine the well grid coefficient are given. The results of sealing well drilling at various stages of the development of the Shurtepy oil field are estimated. The side-by-side compaction of the mesh is shown after which the specific recoverable oil reserves of the wells are reduced.

KEY WORDS: field, reservoir, well, extraction, grid, displacement, recoverable reserves, coverage, dynamics, assessment, effect.

I.INTRODUCTION

One of the main indicators of the effectiveness of the development system implemented at the field is the achieved value of the final oil recovery coefficient (CIN).

Currently, the main technology for the development of oil deposits is associated with the displacement of oil by water with a continuous process. According to scientists, the development with continuous water displacement of oil provides an oil recovery factor of 0.38-0.41 on average, i.e. more than 60% of the geological reserves of oil remain in the strata [1,2,3,4 and others].

When developing a field using the technology of oil displacement by various agents, the oil recovery factor is calculated using the modified formula of academician A.N. Krylova:

$$КИН = К_{выт.} \cdot К_{охв.} = К_{выт.} \cdot К_{охв.п} \cdot К_{охв.т} \qquad (1)$$

Where $К_{выт.}$ – oil displacement factor by working agent, $К_{охв.п}$ and $К_{охв.т}$ – coverage factors by area displacement and reservoir thickness, respectively.

When developing fields with heterogeneous reservoirs, the Кохв.п value is mainly influenced by the density and location patterns of wells [5]. In a number of papers, this coefficient is called the grid coefficient [6-12]; its value depends on the density of the accepted well placement grid (S-area of oil content per well), from zonal heterogeneity and discontinuity of oil reservoirs.

The dependences proposed by I.A. Poluden [8], V.D. Lysenko [8-12], E.V. Yudin, A.A. Lubnin and A.P. Roshchektayev [7].

To determine the grid coefficient I.A. Poluden suggested a formula of the form:

$$К_с = LG/2F, \qquad (2)$$

where L is the total length of the boundaries of the replacement of reservoirs by impermeable rocks; G - half the distance between the wells; F is the oil area.

V.D. Lysenko to determine the grid coefficient proposed a formula of an exponential function of the form:

$$К_с = e^{-\alpha \cdot Sy} \qquad (3)$$

where S_y – oil area per well.

In the formula (3) $\alpha = W^2/d^2$ и $S_y = S_н/n_o$, $S_н$- oil area under consideration, $п_0$ – total number of wells within this oil area, W – fraction of the area of reservoir zones within the oil area, d – step of chaotic variability of reservoir properties.

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E.V. Yudin, A.A. Lubnin and A.P. Roshchektayev to determine the grid coefficient proposed the dependence of the following form:

$$K_c = e^{-\alpha \cdot S} \quad (4)$$

where $S = h^2/2$, h – well spacing.

In the formulas (2) – (4) α – the coefficient of decrease in drainage coverage with an increase in the specific area per well.

II. METHODOLOGY

In this regard, in the process of developing oil fields, work is underway on a large scale to compact the initial density of the grid of wells.

The experience of field development in many regions shows that drilling of wells that seal the initial grid is one of the effective ways to increase the oil recovery ratio (ORF). For example, in only 13 fields of Bashkortostan, over 4,000 wells were drilled in excess of the main stock, of which about 170 million tons of oil were produced. Moreover, the accumulated oil production averaged 44.5 thousand tons per sealing well, which recouped all the costs of their construction and made a profit [13-17 and others].

When using dependencies (2) - (4) in practice, difficulties arise in determining the limit of compaction of the grid of wells. Naturally, the greatest effect from compaction of the mesh density is achieved when new design wells are located in areas not previously covered by drainage by previously drilled wells. The smallest effect when they get into the drained zones, which leads to a decrease in the performance of working wells.

Let us consider the solution to this problem by the example of the Shurtepa field located in the Bukhara-Khiva oil and gas region of Uzbekistan.

In the geological structure of the Shurtepa field, two structurally-forming floors that are sharply different from each other take part; a folded foundation, composed of strongly dislocated Paleozoic rocks (lower structural floor) and a Meso-Kainazoic sedimentary cover overlapping it, forming the upper structural floor.

The geological section of the Shurtepa field was studied based on the materials of field geophysical studies in exploration, re-exploration, and later in production wells, as well as according to core research.

The total thickness of the deposited sedimentary cover was discovered in the first 4 exploratory wells and is 1726-1880 m.

Paleozoic formations at the Shurtepa field, opening in the first 4 exploratory wells, are represented by sedimentary-metamorphic and igneous rocks.

The maximum uncovered thickness of the Paleozoic formations is 52 m (in well No. 1).

The Shurtepa fold is a dome-shaped latitudinal strike brachiantinal with angles of incidence of the wings 2,5°-3,5° and roll 1° – 1,5°. The structure is 10 km long, 7.5 km wide and 200-250 m high. The fold arch is complicated by a discontinuity that cuts the structure from the northwest to the southeast. The amplitude of the violation is 100-180 m; its plane falls to the south and the southwestern part of the structure is elevated (Fig. 1).

Exploration wells drilled in the field established industrial gas and oil content of the XII and XIII horizons of the Lower Cretaceous deposits (Fig. 2).

The sub-gas oil field of the XIII horizon was put into development in 1964. In the first year of development, exploration wells No. 2, 5, 6, 10, 12 were in operation. During the period from 1965 to 1984, 53 production (including pre-exploration) wells were drilled to operate the oil reservoir.

From 1992-1994 9 more wells were drilled to the XIII horizon deposit (No. 80-88).

As of 01.01.2018, the total well stock is 78 units, including:

- along the XII horizon - 17; 12 of them liquidated, control - 5;
- there are 66 units across the XIII horizon, of which 45 liquidated ones, 9 in anticipation of liquidation, and 6 in the current operational fund.

The dynamics of the main development indicators are shown in Fig. 3. From which it can be seen that at various stages of field development (1960-1971, 1984-1990, 1992-2000, and 2005-2017), an increase in the fund was achieved due to the drilling of wells sealing the grid. However, as can be seen from the dynamics of annual oil production, drilling of new wells compacting the grid leads to different results. In this regard, the effectiveness of this event.

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To quantify the efficiency of densification of the density of the grid of wells in accordance with the recommendations of the methodological manual for determining the technological efficiency of hydrodynamic methods for increasing oil recovery, a characteristic of oil displacement by water (CI) was constructed, which is an empirical relationship between $Q_ж \cdot Q_н$ и $Q_ж$ (где $Q_ж$ и $Q_н$ - cumulative production of fluid and oil in reservoir conditions) [18]. The main feature determining the possibility of using CV for this purpose is the straightforward nature of this dependence in the final section. As can be seen from fig. 4. in the HV there are several straight sections.

The only factor explaining the difference between these two straight sections is that, during the period characteristic of each of them, density densification of the grid of wells was carried out.

III. EXPERIMENTAL RESULTS

As you know, one of the main parameters that make it possible to evaluate the effectiveness of hydrodynamic methods is the value of recoverable reserves and the ultimate recovery factor. To determine these parameters, all straight-line sections of the displacement characteristic were processed using the least squares method and were obtained the dependences $Q_ж \cdot Q_н$ от $Q_ж$ with sufficiently high correlation coefficients (Fig. 4).

IV. CONCLUSION AND FUTURE WORK

According to the results of calculations of recoverable oil reserves, which is numerically equal to the coefficient “c”, the dependence of the specific recoverable oil reserves per one production well on the total number of oil producing wells is constructed (Fig. 5). It shows that the drilling of sealing wells in the period 1984-1990. led to an increase in specific stocks, and subsequent compaction of the grid in 1992-2000. and 2005-2017 to reduce it. Based on the results obtained, the following conclusions can be drawn:

- drilling new wells in areas not covered by the drainage process with the initial grid leads to an increase in the specific recoverable oil and oil recovery reserves;
- drilling of new wells in areas covered by the drainage process of previously drilled wells leads to a decrease in specific recoverable reserves and a relatively smaller increase in oil recovery factor;
- the effectiveness of drilling sealing wells largely depends on a reasonable determination of the areas not involved in the drainage process with the existing well stock.

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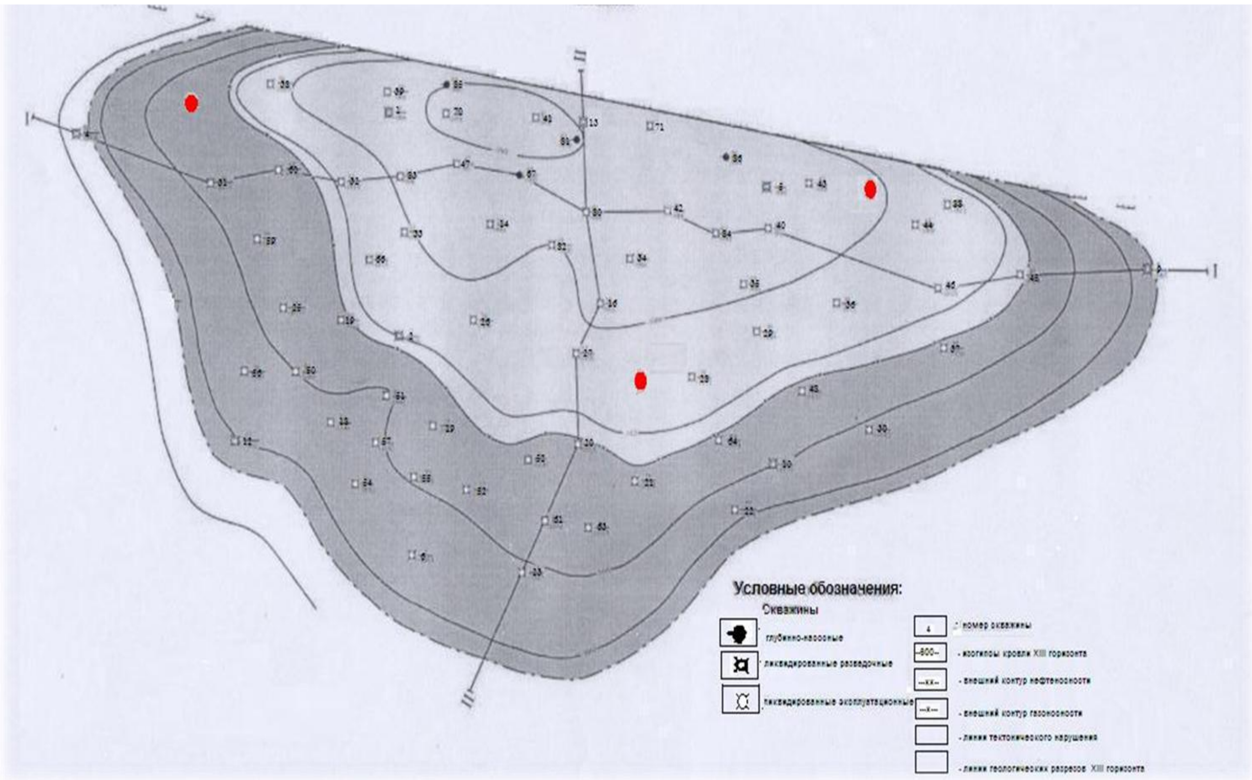

- Fig1. Structural map on the roof of the XIII horizon

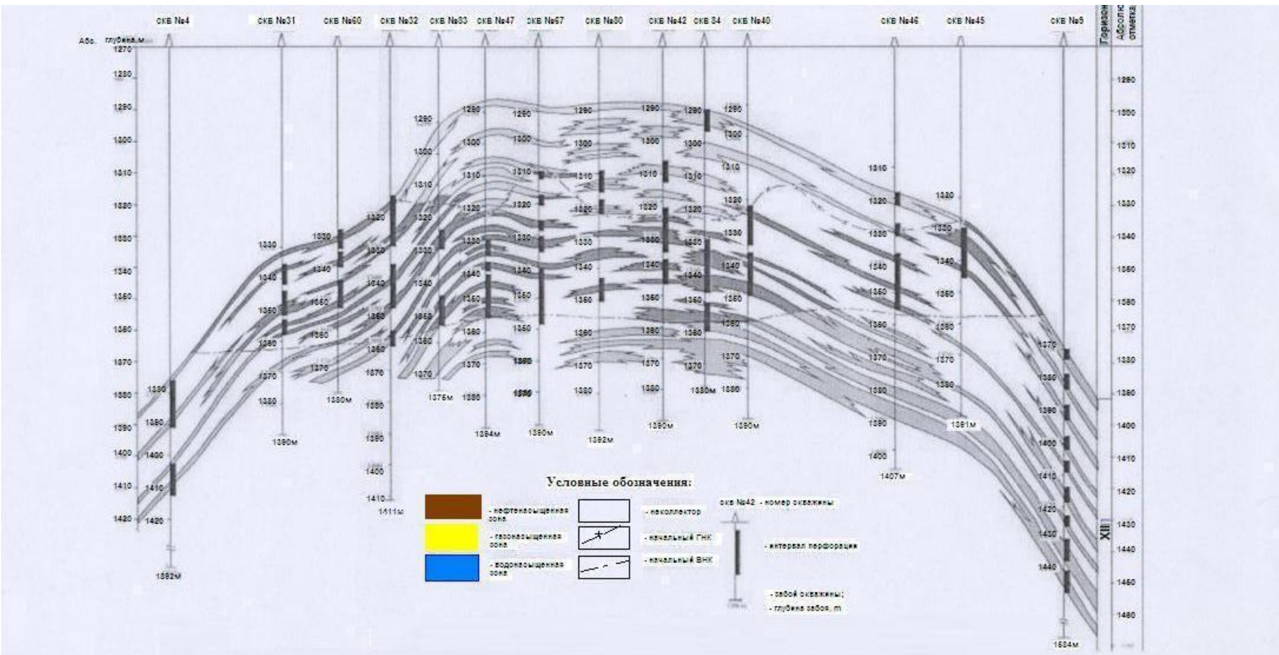

Fig. 2. Geological profile of the Shurtepa field

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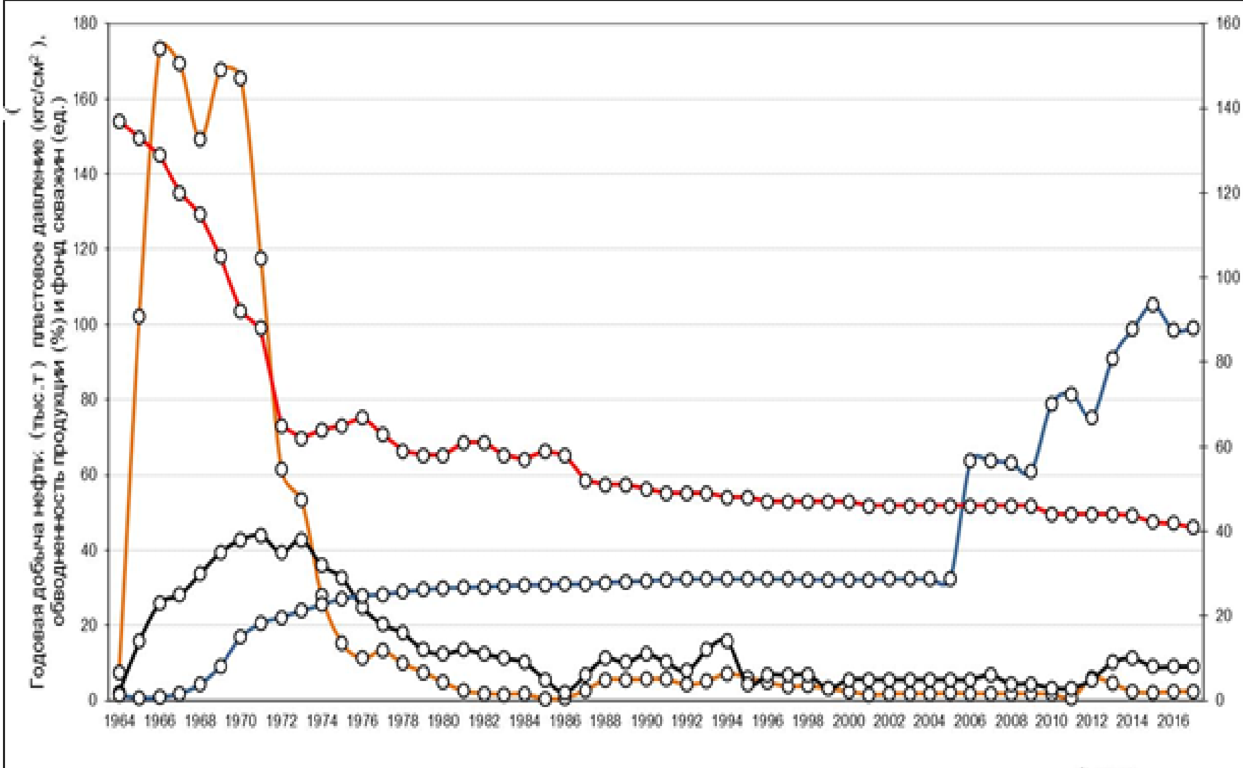

Рис. 3. Динамика основных показателей разработки месторождения Шуртепе: $Q_н$ - годовая добыча нефти; В- обводненность продукции скважин; $P_{пл}$- пластовое давление; N - фонд скважин.

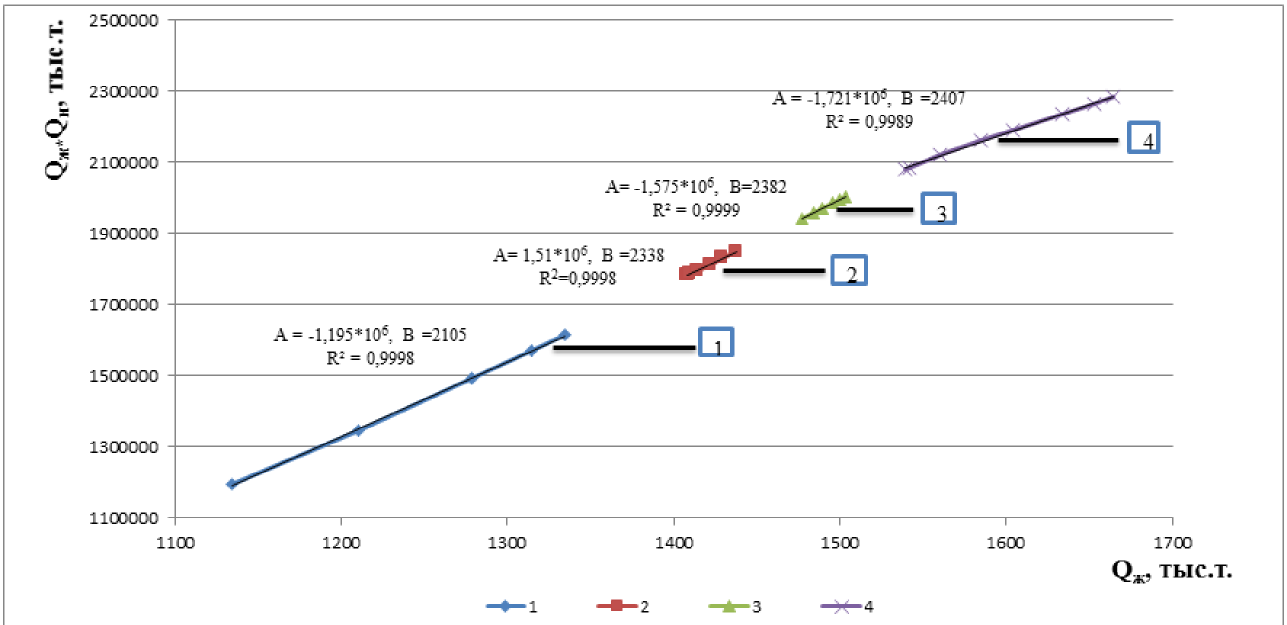

Fig 4. Characteristics of oil displacement by water of the XIII horizon of the Shurtepa field:

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1 for the development period of 1960-1971. with a well stock volume of 64 units;
2 for the development period 1984-1990 with a well stock volume of 66 units;
3 for the development period 1992-2000. with a well stock volume of 75 units;
4 for the development period 2005-2017 with a well stock volume of 77 units;

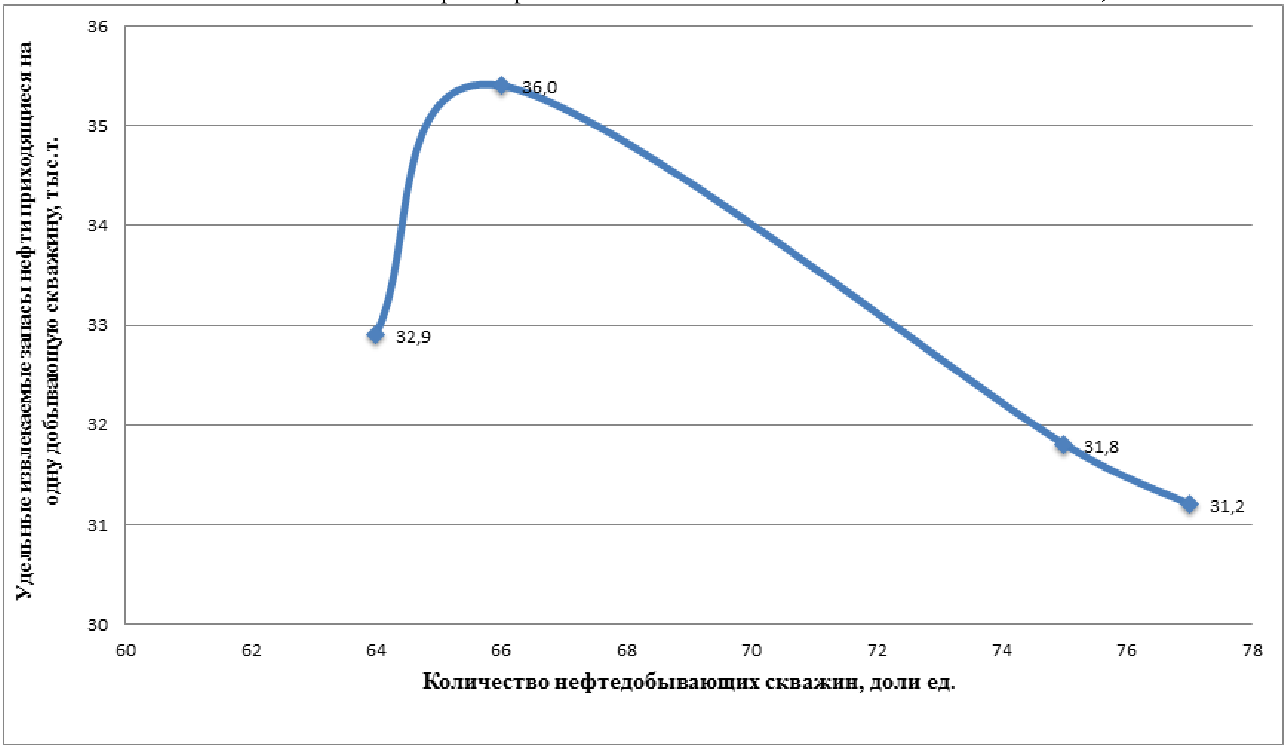

Fig 5: Dependence of specific recoverable oil reservs per one production well, depending on the number of oil producing wells.

REFERENCES

[1] Tokarev M.A. Integrated geological and field monitoring of current oil recovery during oil displacement by water. // M: "Nedra", 1990, 267 p.
[2] Surguchev M.J., Kolganov V.A., Gavura A.V. et al. Oil recovery from carbonate reservoirs. // M. "Nedra", 1987, 230 p.
[3] Van Everdinger A.F./ Propsal to improve recovery efficiency. The Journal of Petroleum Technology.1980. V. 32. №7. pp.1164-1168.
[4] Holm L.W. Infill drilling vs. tertiary oil recovery v.s. more imports. -The Journal of Petroleum Technolgy. 1980.v.32. №7. pp.1168-1174.
[5] Krylov A.P. Cost-effective vacuum grid wells in terms of oil recovery. // “Oil industry”. 1980, No. 6. S.28-30.
[6] Tokarev M.A., Khayritdinov N.Sh. About the choice of density of the grid of wells. // “Oil industry”. 1981 No. 4. S. 31-33.
[7] Yudin E.V., Lubnin A.A., Roshchektayev A.P. Estimation of grid coverage factor using well operation data. // Territory of oil and gas. Moscow, 2011 No. 4. S. 40-45.
[8] Poluden I.A. The effect of errors in the calculation of the grid coefficient on field development indicators. //Oil industry. Moscow, 1980 No.3. S. 34-37.
[9] Lysenko V.D. Comparison of the development of oil reservoirs during gas injection, water flooding and gas flooding. // "Oilfield business." Moscow, 2002 No. 12. S. 8-14.
[10] Lysenko V.D. Oil recovery calculation. // "Oilfield business." Moscow, 2008 No. 6. S. 4-8.
[11] Lysenko V.D. To the calculation of oil recovery. // "Oilfield business." Moscow, 2001 No. 6. S. 13-16.
[12] Lysenko V.D. The dependence of oil recovery from the density of the grid wells. // "Oilfield business." Moscow, 2006 No. 6. S. 15-18.
[13] Syrtlanov A.Sh., Iskhakov I.A., Gaynullin K.Kh. et al. Influence of well grid density on oil recovery by the example of the Arlansky field. // "Oil industry" in 2002 No. 5. S. 77-81.
[14] Results of drilling double wells on the horizon D0 + D1 of Minnibaev Square. // “Oil industry”. 2001, No. 8. S. 52-53.
[15] Chunosov P.I. A quantitative assessment of the influence of the geological and technological parameters of the terrigenous reservoirs of an operational facility on oil recovery during water flooding // "Geology, Geophysics and the Development of Oil and Gas Fields". 2008, No.4. S. 52-54.
[16] Khusnullin M.Kh., Halabuda.E.P., Muslimov R.Kh. Method for optimizing the density of a grid of wells. // "Oil industry" 1983, No.11. S. 31-35.
[17] Dovzhok E.M., Ivanishin V.S., Onaprienko V.P. et al. Experience in compaction of a grid of wells at a low permeable heterogeneous object. // "Oil industry" 1982, No. 9. S. 25-28.
[18] Guidelines for determining the technological effectiveness of hydrodynamic methods to enhance oil recovery. RD 39-0147035-209-87. M. Ministry of the Oil Industry, 1987, p. 52.