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Increasing the Efficiency of Development of Middle Carbonate Carbonate Sediments of the Bureykinskoye Field Due to Completion of the Well Network

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Abstract

The work examines the geological structure of the field: stratigraphy, tectonics, oil content and oil reserves of the Bureikinskoye field, provides technological development indicators, and analyzes the effectiveness of the geological and technical methods used. As a result of the work, the results of calculating the main indicators of well development, a comparison of the main development indicators for three development options are presented, and the field development option is selected.

Keywords: Well Grid, Flood Coverage Coefficient, Increased Oil Recovery.

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زيادة كفاءة تطوير رواسب كربونات الكربونات الوسطى في حقل بوريكينسكوي بسبب الانتهاء من شبكة الآبار

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الخلاصة

الهدف من الدراسة هو تشكيلات حقل بوريكينسكوي. يفحص العمل التركيب الجيولوجي للحقل: طبقات الأرض، والتكتونية ، ومحتوى النفط واحتياطيات النفط في حقل بوريكينسكوي ، ويوفر مؤشرات التطور التكنولوجي ، ويحلل فعالية الأساليب الجيولوجية والتقنية المستخدمة. ونتيجة للعمل تم عرض نتائج حساب المؤشرات الرئيسية لتطوير الآبار، ومقارنة مؤشرات التطوير الرئيسية لثلاثة خيارات تطوير، واختيار خيار تطوير الحقل.

الكلمات المفتاحية: شبكة الآبار، معامل تغطية الفيضانات، زيادة استخراج النفط.

Introduction:

The relevance of this topic is due to the fact that most oil fields in the Russian Federation can be classified as complex due to the fact that they have geological heterogeneity, and the reservoir characteristics of the productive formations of these fields are variable, in addition, they have extensive water-oil areas. As fields are developed, the structure of oil reserves changes, therefore, at a later stage of development, the share of reserves that are difficult to recover and initially limited by unproductive objects and areas begins to increase. Under such conditions, the efficiency of oil production decreases, which requires

adjustment of the well operating modes.

Compaction of well patterns during development was quite widely used in the fields of almost all oil-producing regions of Russia. In most cases, infill drilling has proven to be effective, although there have also been unsuccessful examples of attempts to increase reservoir coverage with infill wells. The effectiveness of this method of influencing oil deposits depends on many factors, including the geological structure, heterogeneity and discontinuity of deposit strata, the implemented development system, the type and density of the well pattern, the degree of formation depletion before the start of infill drilling. [1]

This type of modification can be carried out by planning and subsequent implementation of a complex of geological and technical measures for injection and production wells. In view of the above, it is the correct choice of enhanced oil recovery methods, depending on the conditions of a particular field, that significantly influences the effectiveness of these methods. Therefore, the development of innovative geotechnical, organizational and technological solutions aimed at increasing the efficiency of the development process of complex fields in the current financial and economic situation in the Russian Federation is advocated

An urgent task at the present stage is the development of the fuel and energy complex of the Russian Federation. [2]

The purpose of the work is to increase the efficiency of development of carbonate deposits of the middle Carboniferous of the Bureikinskoye field by compacting the well pattern.

method of influencing oil deposits depends on many factors, including the geological structure, heterogeneity and discontinuity of deposit strata, the implemented

development system, the type and density of the well pattern, the degree of formation depletion before the start of infill drilling. [3]

This type of modification can be carried out by planning and subsequent implementation of a complex of geological and technical measures for injection and production wells. In view of the above, it is the correct choice of enhanced oil recovery methods, depending on the conditions of a particular field, that significantly influences the effectiveness of these methods. Therefore, the development of innovative geotechnical, organizational and technological solutions aimed at increasing the efficiency of the development process of complex fields in the current financial and economic situation in the Russian Federation is advocated

An urgent task at the present stage is the development of the fuel and energy complex of the Russian Federation. [4]

The purpose of the work is to increase the efficiency of development of carbonate deposits of the middle Carboniferous of the Bureikinskoye field by compacting the well pattern.

Main objectives of the study.

1. Assessment of technological efficiency and justification for the use of EOR at the Bureikinskoye field;

2. Analysis of modern approaches to the rational use of well patterns in oil fields; 3. Selection and justification of development options to increase the efficiency of development of the Bureikinskoye field by compacting the well pattern. Research methods

The results of calculating the main indicators of well development, a comparison of the main development indicators for three development options are presented, and the field development option is selected. [5]

Scientific novelty:

1. Justification of development options to increase the efficiency of development of the Bureikinskoye field by compacting the well pattern;

2. Comparison of the main technical and economic indicators of development according to development options and selection of the most effective option for field development. [6]

Characteristics of the object under consideration - General information about the field

The field area has been widely developed by oil industry enterprises and is located near established fields at the Vishnevo-Polyanskoye, Nurlatskoye, and Pionerskoye oil fields. Oil pipeline systems have been operating here since the 60s. Electricity is supplied by power lines from the Kuibyshevskaya HPP and Zainskaya GRES. The area does not experience a shortage of electricity. [7] ‹ For drinking purposes, underground waters of the Permian (Kazan) sediments are used, for technical water supply - waters of the Kondurcha and Shlama rivers (Figure 1).

Fig (1): Overview of the area

In orohydrographic terms, the territory of the field occupies part of the watershed area of the Bol rivers. Cheremshan and Kondurcha, presenting is a low plateau, weakly dissected by a network of ravines. [8]

The climate of the region, like the entire territory of the Republic of Tatarstan, is continental, with sharp seasonal temperature fluctuations. Winters are moderately cold; in severe frosts the temperature drops to minus 420C. Summer is moderately hot with a temperature of plus 20–250C. The average annual air temperature is plus 2.8 °C. [9]

Precipitation falls unevenly throughout the year, with an average annual amount of 410–450 mm. Spring is characterized by a rapid increase in heat, especially intense after the snow cover melts. [10]

Autumn is usually long and rainy. Winds have a predominant southwestern direction, their average annual speed is about 3.6 m/s. Within the region under consideration, small deposits of mineral and construction raw materials are known, having only local significance and for the most part already developed. 1.2 Geological and physical characteristics of the deposit Subsequently, with the development of targeted oil exploration work in Tatarstan, geophysical work was carried out in the field area, including electrical, gravity, magnetic and seismic surveys, deep prospecting and exploration drilling on uplifts prepared by structural drilling. But it should be noted that the main method at the stage of preparing areas for oil exploration work was structural drilling, carried out in 1962–1966 and 1973–1976, as a result of which the Lower Permian structural plan was studied and brachyanticlinal uplifts of the third order were prepared. The density of structural drilling in the field area averaged 1.1 km2 per well. As a result, the Bureikinskoye and Vostochno-Bureykinskoye uplifts were prepared for deep drilling. It should also be noted the effectiveness of the studies carried out on the considered territories of areal seismic surveys. [11]

As a result of the MOM work performed in 1964 and 1967, a number of uplifts were identified along the reflecting horizons “B”, “U” and “D”. In 1974, the thematic party of the Tatneftegeofizika trust carried out a reinterpretation of seismic exploration work from 1964 to 1967, based on the results of which the Bureikinskoye uplift, known from structural drilling data, was identified and several elevated

areas were identified for carrying out seismic drilling in the CDP modification, subsequently completed in 1979, 1980 , 1994 – 1997 . [12].

Deep oil exploration drilling in the area of the Bureykinskoye field began in 1962 with the construction of exploratory well No. 30 on the northeastern flank of the Bureykinskoye Lower Permian uplift. The well did not penetrate oil-bearing strata and was abandoned for geological reasons. Later, deep exploratory wells were laid in the arches of the identified Lower Permian uplifts. So, in 1969, exploratory well No. 607 was drilled in the arch of the Bureikinsky uplift, which during testing produced oil inflows from the Bobrikovsky, Bashkir and Vereisky deposits. Thus, well no. 607 was the discoverer of the Bureikinskoye deposit . [13]

During the period 1974 - 1976, eight exploratory wells were drilled in order to study the geological structure of Lower and Middle Carboniferous deposits on the Bureikinsky uplift.

In 1976, exploratory well No. 938 was drilled in the near-crest part of the East Bureikinsky Lower Permian uplift, which produced an influx of oil from the Verei sediments.

In 1979 – 1980, the results of seismic exploration confirmed the previously identified Bureikinskoe and Vostochno-Bureykinskoe uplifts based on structural drilling data, and also identified the Dorozhnoe and Tatarstan seismic uplifts. In 1981, exploratory well No. 3955 was drilled in the arched part of the Tatarstan uplift, which produced oil inflows from the deposits of the Vereiskian horizon and the Bashkirian stage. [14]

. In the arched part of the Road elevation there are laid wells Nos. 1023, 1024, during testing of which industrial inflows of oil were obtained from the Verei deposits.

Carrying out seismic exploration work in 1994 - 1997 using the

common depth point method (CDP) made it possible to detail the structure of known uplifts along the reflecting horizons of the Middle and Lower Carboniferous, as well as to identify new uplifts. [15]

Within the field, the surface of the crystalline basement and the roof of Devonian terrigenous deposits have the form of a monoclinal slope, plunging from northeast to southwest.

On the structural plans of the Tournaisian, Bobrikovian, Bashkirian, Vereiskian and Kashira ages, the formation of local high-amplitude uplifts controlling oil deposits is observed. [16]

According to the main marker horizons of the Lower Carboniferous, Middle Carboniferous and Permian deposits, these plans coincide with each other; only the flattening of the structures up the section can be traced. Only the surface of the Tournaisian stage differs from the overlying objects due to complications caused by incisions. [17]

The zone of erosion of the roof of the Tournaisian stage is recorded mainly on the Bureikinsky uplift itself. In areas of incision, the structural plan of the Tournaisian stage is not consistent with the overlying horizons. [18]

In the section of the field, oil-bearing strata are confined to carbonate deposits of the Tournaisian stage of the Lower Carboniferous, Kashirsk, Vereisky horizons and Bashkirian stage of the Middle Carboniferous and terrigenous deposits of the Bobrikovsky horizon of the lower. (Surguchev ، [19]

At a depth of 1393 m, carbonate rocks of Tournaisian age occur, to which seven massive oil deposits are confined. Carbonates are represented by alternating porous permeable layers of limestone and compacted dolomite, from 0.4 m to several meters thick, fractured and clayey. Reservoir layers identified in well

sections are often not correlated and communicate with each other through systems of fractures and merging, forming a single complexly constructed reservoir. [20]

Fig (2): Fragment of the tectonic diagram of the Paleozoic structural stage of the central regions of the Volga Federal District

A characteristic feature of Tournaisian deposits is the fluctuation in the thickness of the sedimentary strata. This is due to the erosion of carbonate rocks in the Early Visean. The total oil-saturated thickness of Tournaisian deposits varies from 3.8 to 37.0 m, averaging 11.9 m. The OWC of the deposits was determined based on sampling data and geophysical surveys of wells in accordance with the structural plan. Direct oil-water contact was installed in 15 wells. The deposits are established within the Bureikinsky, East-Bureykinsky and Filipovsky uplifts. A total of seven deposits have been identified: five in . [21]

Bureykinsky and one each on the East Bureykinsky and Filipovsky uplifts. To the northeast (area of well No. 3906) there is a small oil deposit discovered by seven wells. A graben-like trough up to 40 m deep separates the deposits from each other. The dome part of the structure was significantly eroded in Early Visean times; as a result, in wells Nos. 3905, 4011, 4239, Tournaisian deposits are waterbearing. Oil-saturated thicknesses vary from 1.6 to 6.4 m, the height of the deposit is 10.5 m.

According to GIS data, the OWC was taken at an absolute level of minus 1207.

Two local oil deposits have been identified in the southeastern part of the Bureikinsky uplift. They are separated by a northwest-trending trough with a depth of 30 – 35 m. The reservoir in the area of well No. 4028 has an oval shape with an oilbearing level of 15.8 m. In the west it is partially lithologically limited, since in well No. 4029 there are no oil-bearing and aquifer layers. In general, the average oil-saturated thickness of the deposit is 4.9 m, varying by well from 1.1 to 18.2 m. The dimensions of the deposit are 1.1 x 0.5 km. According to GIS data, the VNK is installed at an absolute elevation of minus 1213m. [22]

Almost the entire wing part of the reservoir in the area of well No. 4051 was subject to erosion, which was the main reason for the significant decrease in oilsaturated thicknesses. With an oil-bearing level of 25.1 m, the average effective oil-saturated thickness is only 3.2 m, varying across wells from 0.9 to 9.4 m. The dimensions of the deposit are 0.7 x 0.6 km. Based on the results of testing and GIS, the OWC was established at an absolute elevation of minus 1223 m. [23]

On the East Bureikinsky uplift, a massive oil deposit with partial lithological limitation was discovered by only one well No. 938, which is located in the marginal zone. According to new data seismic exploration work, the dome part of the deposit is located 200 m southeast of the drilled well. In the same direction, the deposit is partially limited by a zone of absence of reservoir layers. Within the oil-bearing contour, established according to GIS data at an absolute elevation of minus 1212 m, the dimensions of the deposit are 1.1 x 1.1 km. The effective oil-saturated thickness is 6.8 m. The oilbearing level of the deposit is 19.2 m. [24]

Results:

This research discusses 3 development options for increasing the efficiency of the development of

carbonate deposits of the Bureikinskoye field by compacting the well grid: the basic option, which involves drilling along a uniform triangular grid with a distance between wells of 300 m, drilling five wells at the Vereisky site, including two horizontal wells, kick-off of three horizontal lateral trunks from existing wells, transfer of three directional production wells to injection. The Bashkir site was supposed to be developed with three existing wells.

The second option involves drilling directional wells along a compacted grid - triangular with a distance between wells of 200 m. When implementing this option, it will be necessary to drill 28 wells, including 19 production wells and 9 injection wells for oil production.

The third option provides for further compaction of the well grid - drilling directional wells along a triangular grid with a distance between wells of 150 m. When implementing this option, it will be necessary to drill 45 wells, including 30 production wells and 15 injection wells with production for oil. In addition, it is planned to transfer one of the existing production wells to injection.

Conclusions:

The slowing decline in oil flow rates necessitates, the search for more intensive oil production from the Bureikinskoye field. One of the ways to solve this problem is to compact the design well pattern.

To increase the efficiency of the development of carbonate deposits of the Bureikinskoye field by compacting the well pattern, this work considers 3 development options that differ in grid density, waterflooding intensity, and well design.

The first option offers a development system that involves drilling along a uniform triangular grid with a distance between wells 300 m, drilling five wells at the Vereisky site, including two horizontal wells, sidetracking three

horizontal lateral trunks from existing wells, converting three directional production wells to injection. The Bashkir site was supposed to be developed with three existing wells.

The second option proposes drilling directional wells along a compacted grid - triangular with a distance between wells of 200 m. When implementing this option, it will be necessary to drill 28 wells, including 19 production wells and 9 injection wells with oil production. In addition, it is planned to transfer one of the existing production wells to injection.

The third option involves further compaction of the well grid - drilling directional wells along a triangular grid with a distance between wells of 150 m. When implementing this option, it will be necessary to drill 45 wells, including 30 production wells and 15 injection wells with oil products.

References

[1] Garifullina, D. N. Selection and justification of the optimal density of the grid of production wells and field development systems / M. Yu. Nazarko // Academic Journal of Western Siberia. – 2015. – No. 3. – P. 91–95.

[2] Instructions for improved technology for injection of low-concentrated polymer compositions for conditions of low injectivity of injection wells (NKPSM) [Text]: RD-153-39.0-872-14: approved. PJSC "Tatneft" 02/13/17:

[3] commissioning. effective from 03/07/17. - 28 s.

[4] Kozhevnikov, N. M. Compaction of the well grid as one of the ways to increase oil recovery at the Chutyrsko-Kiengop field / N. M. Kozhevnikov. — Text: immediate // Young scientist. — 2019. — No. 40 (278). — pp. 181-183.

[5] Instructions for the technology of intensifying oil

production from lowpermeability reservoirs through complex chemical-depression effects (KKhDVSNPH-9030) [Text]: RD-153-39.0-665-10: approved. OJSC "Tatneft" 05/17/10: commissioning. effective from 05.26.10. - 26 s.

[6] Altunina L.K. Methods and technologies for increasing oil recovery for reservoirs in Western Siberia: a textbook. – Tomsk: TPU Publishing House, 2006. P. 166.

[7] Gazizov A. A. Increasing oil recovery from heterogeneous formations at a late stage of development - M.: Nedra-Business Center LLC, 2002. - 639 p.

[8] Lysenko V. D. Development of oil reservoirs with vertical and horizontal wells // Oilfield business. 2001. No. 2. P.5-14.

[9] Mayer V.P. Improved hydrodynamic model of three-phase filtration in a porous medium // In the book: Oil of Surgut: Tr. TF "SurgutNIPIneft" – M., 1997.

[10] Aliev Z.S., Samuilova L.V. Gas-hydrodynamic studies of gas and gascondensate formations and wells. – “Max Press”, 2011, – 338 p.

[11] Myrzagalina, A. Economic assessment of changes in oil recovery depending on the density of the well pattern // Humanitarian, socio-economic and social sciences.

[12] Nurgaliev, A. A. Analysis of the influence of well pattern density on oil recovery and development of waterflooding systems in carbonate reservoirs of small fields of the Republic of Tatarstan / L. T. Khabibullin // Interexpo Geosiberia. – 2016. – No. 3. – P. 234-238.

[13] Project for the development of the

Bureikinskoye oil field Bugulma, 2017

[14] Gondyreva E. Yu. Application of new methods for increasing oil recovery at the fields of OJSC // Autumn economic readings. Materials of the International Scientific and Practical Conference. - Ekaterinburg: Limited Liability Company "IMPRUV", 2016. - pp. 101–107.

[15] Surguchev M.JI., Kolganov V.A., Gavura A.V. etc. Oil extraction from carbonate reservoirs. // M. "Nedra", 1987, 230 p.

[16] Theory and practice of modeling the development of oil fields in various geological and physical conditions [Text] / R. S. Khisamov [etc.]; OJSC Tatneft, TatNIPIneft, IMM KazSC RAS, AGNI. – Kazan: Publishing House “Fen” of the Academy of Sciences of the Republic of Tatarstan, 2009. – 239 p.

[17] Addition to the technological scheme for the development of the Bureikinskoye oil field, book 1, hand. Petrov V.N., Bugulma, 2018, – 295 s

[18] Zakirov S.N. Analysis of the problem “Well pattern density – oil recovery”. M.: “Grail”, 2012. – 314 p.

[19] Instructions for the technology of using high-strength cross-linked compositions to increase oil recovery from flooded heterogeneous formations (VPSK technology) [Text by OAO Tatneft 01.12.11: input. effective from 12/23/11. - 27 s.

[20] Instructions for the technology of acid stimulation of reservoir layers using acid compositions “KSK” [Text]: RD-153-39.0-682-10: approved. OAO Tatneft 12/16/10: commissioning. effective from 01/01/11. − 24 s.

[21] Instructions for the technology of thermal implosion treatment of wells using a thermal source [Text]: RD-153-39.0-247-02: approved. OAO Tatneft 04/09/02: commissioning. effective from 04/09/02. - 15 s.

[22] Modeling the development of oil and gas fields: textbook / V. S. Sokolov. - Tyumen: TyumGNGU, 2014. - 146 p.

– 2014. – No. 12–3. – pp. 106–108.

[23] Development and operation of oil and gas fields: textbook - method. allowance / I.R. Yushkov, G.P. Khizhnyak, P.Yu. Ilyushin. – Perm: Perm Publishing House. national research Polytechnic Univ., 2013. – 177 p.

[24] Collection of instructions, regulations and guidance documents on technologies for reservoir recovery and well stimulation [Text]: RD 153-16-05-2006: approved. OAO Tatneft 02/06/06: commissioning. effective from 01/01/06. - 227 p.