

Hydrodynamic studies of well No 32 the southern section of the Chinarev field of the West Kazakhstan Region

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Abstract. The article analyzes the factors influencing the development of high-quality and cost-effective oil and gas reserves in the region (assessment, design). In order to operate wells, directions for calculating the size of reserves have been found. Scientific and technical trends of its (wells) development are considered. A comprehensive analysis of integrated surveys was carried out at well No.32 of the Chinarevsk oil and gas condensate field, located in the southern section of the district. Hydrodynamic studies were carried out by interpreting the pressure recovery curve (PRC) to determine reservoir pressure, porosity and reservoir properties of the reservoir and the state of the bottom whole zone. These studies confirmed the low porosity properties of the reservoir: permeability - $0.004 \mu\text{m}^2$, conductivity - $0.056 \mu\text{m}^2\cdot\text{m}$, hydraulic conductivity - $0.055 \mu\text{m}^2\cdot\text{m}/\text{mPa}\cdot\text{s}$. The skin factor varied in the range from -0.92 to 18.4, which indicates deterioration in the state of the bottom hole formation zone.

1 Introduction

Reservoir pressure dynamics according to hydrodynamic studies showed that in the reservoir, as withdrawals occur, a decrease in reservoir pressure occurs. As of October 2021, according to PRC data, reservoir pressure in well No.32 is 38 MPa. Well No.32 during the analyzed period (5 months) worked in three modes (from July to September 2021 with a grummet with a diameter of 6 mm, from the end of September with a grummet with a diameter of 8 mm, in October - 10 mm). At the same time, with an increase in the diameter of the grummet to 8 and 10 mm, the bottom hole working pressure sharply decreased from 25 to 11 MPa and the static bottom hole pressure from 37.5 to 29.7 MPa. During the analyzed period, the well worked with a bottom hole pressure below the saturation pressure of oil with gas. Average GOR was $757 \text{ m}^3/\text{m}^3$. Currently, hydrodynamic studies are a source of key information in the planning and control of the development of oil and gas condensate fields. Due to technological and economic restrictions on research, full coverage of the existing well stock is difficult. The purpose of this work is to increase the volume of development of oil and gas fields through high-quality hydrodynamic studies of reservoirs and well No. 32 of the Chinarevskoye field in Western Kazakhstan.

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2 Materials and methods

Kazakhstan's oil and gas production complexes are revising many economic issues in the era of transition to a market economy, which requires the search for alternative ways to efficiently use oil and gas resources.

The relevance of such efforts as unprecedented raw materials in the use of oil and gas in production is significant, that is, the development of oil and gas resources is considered a key force in accelerating the development of all national economic complexes of the country.

The strategy for the development of oil and gas resources can be the scientific and methodological basis of individual regions and the country as a whole.

To obtain complete information about the structure and properties of oil and gas fields, hydrodynamic studies of wells are carried out.

So, for example, the experience of oil and gas exploration at the fields of the Irkutsk region is presented in the work [1-4]. A set of works on the development and testing of wells in a cased hole using the technology of "killing a well at a bottom hole" has been identified. This layout allows to record the bottom hole pressure dynamics and perform a full cycle of hydrodynamic studies of the well in a short time.

The authors of works [5-7] describe the technology of conducting hydrodynamic studies with shutting down the well at the bottom. The problems of studying high-performance, flow-through objects were determined. Technological features, interpretation options, possible complications and optimization measures were analyzed. The possibility of replicating the technology in various geological and technical conditions was considered.

A number of works [8-10] should be noted, which consider the experience of using data from hydrodynamic studies of wells for a geological and hydrodynamic model at the stages of pilot work. It is shown that the production potential of a well can be affected by both geological structure of the reservoir and technological completion. The characteristic features of horizontal wells were highlighted. The calculation of the rate of reservoir pressure decrease during the operation of the aquifer was carried out. A scheme of design injection wells has been developed before they are transferred to the reservoir pressure maintenance system.

The choice of optimal development system for objects with a complex geological structure depends on many factors, the knowledge of which helps to make correct decisions. This is further reflected in the rate of oil production throughout the entire period of development of the object, as well as in the oil recovery factor (ORF).

Thus, the issues of improving the known and creating new methods for monitoring the state of the bottom hole formation zone, allowing to determine the porosity and permeability properties (PRP) of the formation in a short time, taking into account geological and physical features of the reservoirs being developed, the modes of operation of the fields and the operation of wells, are relevant.

The purpose of this work is to increase the volume of development of oil and gas fields through high-quality hydrodynamic studies of reservoirs and well No. 32 of the Chinarevsk field in West Kazakhstan.

At present, the oil reservoirs of this field are being developed, and it is necessary to study gas condensate deposits under them. Well No.32 was drilled in the southern part of the Chinarevsk field and gas condensate was discovered.

A hydrodynamic study of this well will determine its productivity, consider what it will produce in the future, and consider ways to further increase its production. In order to increase the development of oil and gas fields, a special place is given to improving the quality of hydrodynamic studies in the reservoir and in the well. Figure 1 shows a general map of the region's work.



Fig. 1. Overview map of the work area.

Hydrodynamic studies at well No.32 were carried out using the pressure recovery curve (PRC) interpretation method. Studies were carried out to determine reservoir pressure, porosity properties of the reservoir and the state of the bottom hole zone.

- The study design in general included:
- flow rate measurement in the mode before shutting down the well;
- measurement of pressure at the mouth, in the annulus;
- shutting down the well and recording PRC and downhole temperature with downhole tools;
- PRC interpretation.

3 Results

Information about the parameters of the operation mode of well No.32 before shutdown, the results of PRC interpretation with comparison with studies before trial production are shown in Table 1.

Table 1. Results of PRC studies.

Research date	Company	Perforation interval	Well operation parameters before shutdown at PRC					PRC interpretation results								
			Nozzle diameter, mm	Bottom hole pressure, MPa	Oil production rate, m ³ /day	Gas fixer, m ³ /m ³	Water cut, %	Productivity index, m ³ /day/MPa	PRC recording duration, hours	Measurement depth, m	Reservoir pressure at the measurement depth, MPa	Reservoir temperature, C ⁰	Permeability coefficient (k), μm ² *10 ⁻³	Conductivity coefficient (kh), μm ² *m*10 ⁻³	Hydraulic conductivity coefficient (kh/μ), 10 ⁻³	Skin factor
25.09-03.10.2022	GeoTech Service LLP	4896-4926	4	44,0				84	4820	50,0	105,7					
16-18.10.2022	Erdan Oil Service LLP		8	28,9	124,3	586	0	7,3	42,2	4898	45,9	107	25,2	126	784,6	9,14
17-26.10.2022	Erdan Oil Service LLP		12	11,2	50,0	2100	0	2,0	186	4890	36,0	107	2,58	30,9	192,4	1,9
06.07.2022	Erdan Oil Service LLP		6	28,4	57,59	1125	0	4,3	6	4900	41,6	105,7	4,59	55,1	292,6	-0,92
03-07.10.2022	Erdan Oil Service LLP		8	15,1	48	1089	0	2,1	78	4823	37,5	103,6	2,85	34,2	55,1	0,985
26.11-03.12.2022	Erdan Oil Service LLP		10	10,3	38,1	814	0	1,9	80	4831	30,6	102,5	4,72	56,6	55,1	18,4

The research data confirmed the low porosity properties of the reservoir, adopted in the project: permeability - 0.004 μm², conductivity - 0.056 μm²*m, hydraulic conductivity - 0.055 μm²*m/MPa*s. The skin factor varied in a wide range - from minus 0.92 to 18.4, which indicates deterioration in the state of the bottom hole formation zone. The productivity index was obtained in the operation mode with bottom hole pressure below saturation pressure and has a low value - at the level of 2-4 m³/day*MPa, which is significantly less than the design value of 9 m³/day*MPa.

The initial reservoir pressure determined in the study of well No.32 during approbation was 55.6 MPa (reduced to abs. OWC level minus 4830.5 m).

Reservoir pressure dynamics (reduced to OWC) according to hydrodynamic studies is shown in Figure 2.

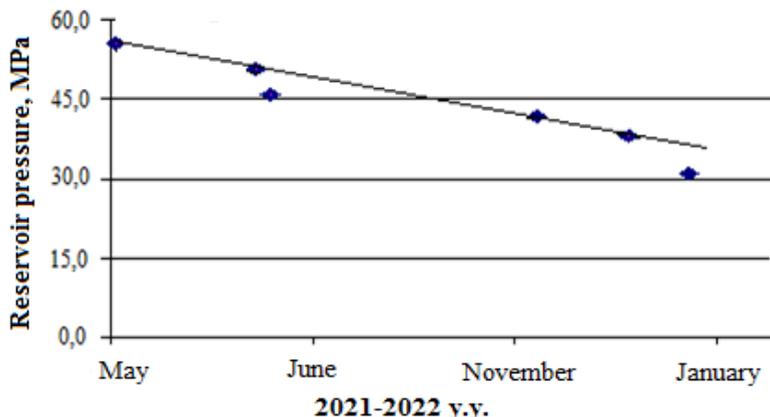


Fig. 2. Reservoir pressure dynamics.

As can be seen from Figure 2, a significant decrease in reservoir pressure occurs in the reservoir as the extraction proceeds, which may indicate a limited drainage zone. The reservoir operation mode is characterized as resiliently closed.

As of October 2021, according to PRC data, reservoir pressure in well No.32 (at OWC level) is 38 MPa.

Analysis of the operation of well No.32

Optimization of flowing modes during operation was carried out, according to the technological mode planned for each month, by setting the required diameter of the nozzle (grummet) passageway. Figure 3 shows a graph of the operating modes of well No.32 for the analyzed period.

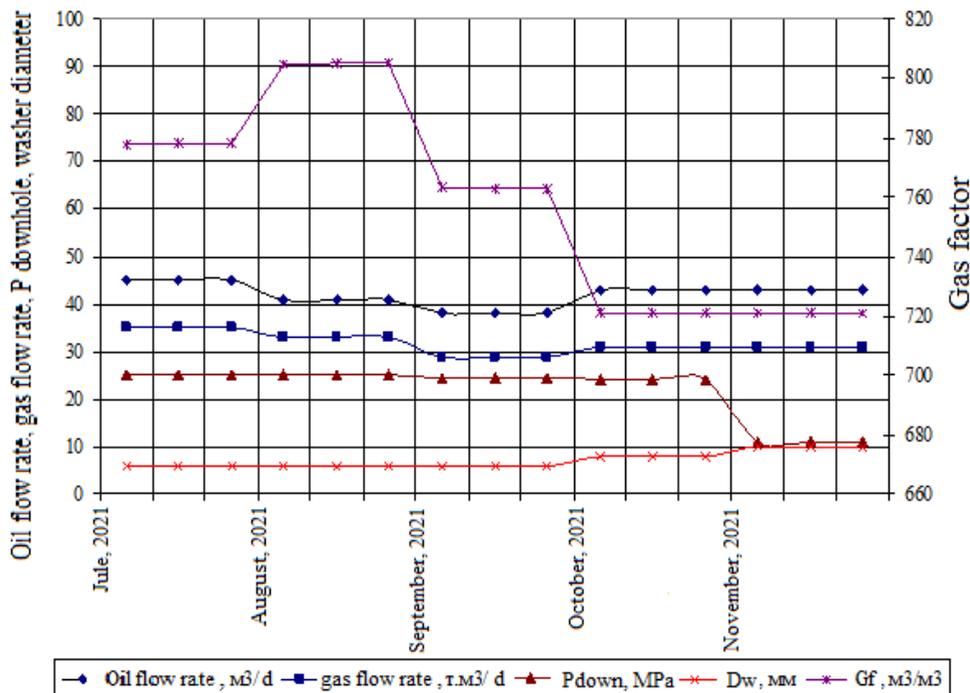


Fig. 3. Well No.32 operation mode.

As can be seen from the graph, well No.32 during the analyzed period (5 months) worked in three modes (from July to September 2021 with a grummet with a diameter of 6 mm, from the end of September with a grummet with a diameter of 8 mm, in October - 10 mm). At the same time, with an increase in the diameter of the grummet to 8 and 10 mm, the bottom hole working pressure sharply decreased from 25 to 11 MPa and the static bottom hole pressure from 37.5 to 29.7 MPa. A large decrease in bottom hole pressure may be due to a decrease in fluid inflow into the well, since the increase in oil production is small (5 m³/day). In September 2021, 2 treatments were carried out in the well to remove asphalt-tar-paraffin deposits, which may have caused a slight increase in production in October-November. The well was shut down in December.

In general, the well was characterized as low-productive, a small flow rate was provided by a high drawdown of 15-18.7 MPa. The entire analyzed period, the well worked with bottom hole pressure below the saturation pressure of oil with gas. The average GOR was 757 m³/m³.

4 Conclusions

Thus, research work at well No.32 during the operation period was carried out in accordance with the recommended schedule. Measurements of oil and gas flow rates, determination of gas factor were carried out daily at the oil treatment unit separator. Wellhead pressure was measured with wellhead manometers. Determination of chemical composition of water was performed once a month in the oil treatment unit laboratory.

Determination of bottom hole pressures and temperatures was carried out during hydrodynamic studies and geophysical instruments by lowering downhole tools into the well with a frequency of once a quarter.

Hydrodynamic studies were carried out by the PRC method with a frequency of once a quarter.

Wellhead fluid sampling and geophysical studies to determine the inflow profile at well No.32 were not carried out after its commissioning.

In the future, it is necessary to continue research work to clarify the geological and physical characteristics of the Mullin deposit. Due to the lack of knowledge of the properties of reservoir fluids at this stage and to confirm the saturation pressure of oil with gas, conduct a full set of PVT studies of deep samples of reservoir oil taken directly from wells perforated into the Mullinsk productive reservoir of the Southern section of the Chinarevsk field.

Further design of the commercial development of the deposit should be carried out taking into account the results of trial operation and sidetrack drilling in well 32.

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