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Influence of the choice of perforation intervals on the oil recovery factor (ORF)

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ABSTRACT: Today, the productivity of oil and gas wells directly depends on the quality of the primary (while drilling) and secondary opening of the productive formation. In most cases, the secondary opening of the productive formation has not been completed and studied correctly. In this regard, the choice of the interval of perforation of the productive formation both during the period of development and commissioning of the well, and during its operation, is of decisive importance in terms of increasing the productivity of the producing stock. The article discusses the choice of the perforation interval for a given waterproofing layer of well logging and field operation, as well as a calculation was made to determine the perforation interval in the hollow at the Shakarbulak field

KEYWORDS: fields, oil, perforation, interval, hydrodynamic study, viscosity, goless, anhydrous, well.

I. INTRODUCTION

The Shakarbulak field is located within the Bukhara-Khiva oil and gas region. It was discovered in 1987 when, when testing well №1, an industrial flow of oil was obtained from horizons XV-a and XV of the Upper Jurassic carbonate deposits.
The field has been developed by the joint venture since 1991. In 1991, the first project document for the development of the deposit in question was drawn up-"Project for the trial operation of the Shakarbulak deposit ".
On the basis of an operational estimate of reserves in 1998, a project for a trial operation of the Shakarbulak field was again drawn up .
In 2005. Compiled "Feasibility study for exploration for oil and gas within the North-Tagam Tandirchin zone of the Gissar region and the commissioning of the North Nishan, Kamashi, Beshkent , North Guzar and Shakarbulak fields ".
The current project document on the basis of which the development of the Shakarbulak field is carried out is the "Project for the development of the Shakarbulak oil and gas condensate field ", drawn up by Uzbekistan Scientific and Engineering Society of Oil and Gas Industry in 2014.
Shakarbulak deposit from 1991 to 1999 Developed by PPU " Karshioil ", from January 1999 to 2007. JSC Shurtanoilgas , and since 2007 JV LLC Gissaroilgas .

II. MAIN PART

Reservoir pressure in sampling zones. Reservoir temperature

The hydrodynamic characteristics and distribution of the initial reservoir pressure along the depth of the reservoir are detailed in [1] , [2] . At the beginning of field development, reservoir pressure was determined based on the results of measurements in exploration wells (Table 1.).

Table 1 - Results of determining the initial reservoir pressure during testing of exploration wells

Well number	Perforation interval, m	Depth of the middle of the perforation interval, m	Absolute mark of the middle of the perforation interval, m	Reservoir pressure, kg s / cm ^{2}
1	3785-3772	3778.5	-3345.5	400.8
	3769-3746	3757.5	-3324.5	399.1
	3739-3727	3733	-3300	397.8

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	3697-3690	3693.5	-3260.5	395.4
	3696-3686	3691	-3258	395.1
	3680-3670	3675	-3242	394.3
3	3655-3650	3652.5	-3225.5	393.6
4	3780-3770	3775	-3336	401.37
	3765-3760	3762.5	-3323.5	399.77
five	3894-3884	3889	-3450	408.72
	3860-3854	3857	-3418	406.44
	3848-3842	3845	-3406	405.34
	3837-3819	3828	-3389	403.59
	3805-3797	3801	-3362	402.37
Eastern bloc				
OWC (-3365)				402.59
GOC (-3308)				398.7
Western block				
OWC (-3365)				402.59
Western block (area of well No. 3)				
GOC (-3231)				393.5
OWC (-3246)				394.5

Table 2 . - Parameters of productive reservoirs of the Eastern section

Well number	Horizon XV-NR			Horizon XV-P		
	Effective thickness, m	Odds		Effective thickness, m	Odds	
		porosity	saturated - Nosta		porosity	saturated - Nosta
Gas-saturated part of the deposit						
23	4.6	0.138	0.86	85.8	0.128	0.73
25	5.2	0.097	0.82	44.4	0.153	0.81
28	2.2	0.057	0.84			
30	5.0	0.099	0.89	76.6	0.145	0.77
Oil-saturated part of the deposit						
4				25.8	0.106	0.80
5	2.4	0.089	0.79			
23				8.4 *		
25				10.6 *		
28	8.2	0.111	0.78	13.4 *		

Note: * - opened part. Water density 1,06-1,09 g / cm ^{3} density of oil g / cm ^{3} $_=$ 0.902

Information on oil viscosity in reservoir conditions is available only for well No. 4. However, the given data (0.25 mPa · s and 0.31 mPa · s)are underestimated, because in the recombined oil samples there is a high proportion of condensate, as indicated by the low density of degassed oil under standard conditions (0.797 g / cm ^{3}; 0.801 g / cm ^{3}). The values of degassed oil viscosity obtained from wellhead samples in the laboratory of Karshi and ranging from 0.8 mPa · s to 2 mPa · s, and on average 1.12 mPa · s, are also underestimated, since viscosity value gas-saturated oil determined using an empirical relationship of viscosity of the gas-saturated oil the viscosity of the degassed oil installed W yu and Connelly , it was also low (0.25 mPa · s). In this regard, the viscosity in (1) of degassed oil was determined from its empirical dependence on the density of degassed oil under standard conditions and amounted to 3

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mPa · s. Based on the values obtained by the formula H yu and Connelly was calculated the reservoir oil viscosity, which amounted to 0.42 mPa · s.

Therefore, in (1), the use of reservoir oil parameters for well No. 4 was considered incorrect. At the same time, it was recommended to use the following basic parameters obtained as a result of surveys of well № 1:

- saturation pressure, MPa - 24.7;
- gas content , m^3 / m^3 - 275;
- volumetric coefficient - 1.8;
- density of reservoir oil - 624 kg / m^3;
- density of the separated oil - 902.4 kg / m^3;
- density of oil-dissolved gas (by air) - 0.675.

However, in (1), the parameters of the oil saturation pressure and the viscosity of reservoir oil were additionally illuminated, since the results obtained from them are very contradictory and questionable (Table 2.).

III. METHODOLOGY

Determination of the perforation interval in wells № 4 and e at a given initial limit gasless-waterless oil production rate

Well , is n and for the development of the oil rim oil and gas deposits underlain by water, is perforated only in the range, located in averaging of oil-saturated stratum. In this case, the distance from the upper perforations to the initial position of the gas-oil contact is h_0. At the same distance, the lower perforations are spaced from the initial position of the oil-water contact [4]. The scheme of oil inflow to a well of an oil and gas field with the formation of gas and water cones is shown in Fig. 1.

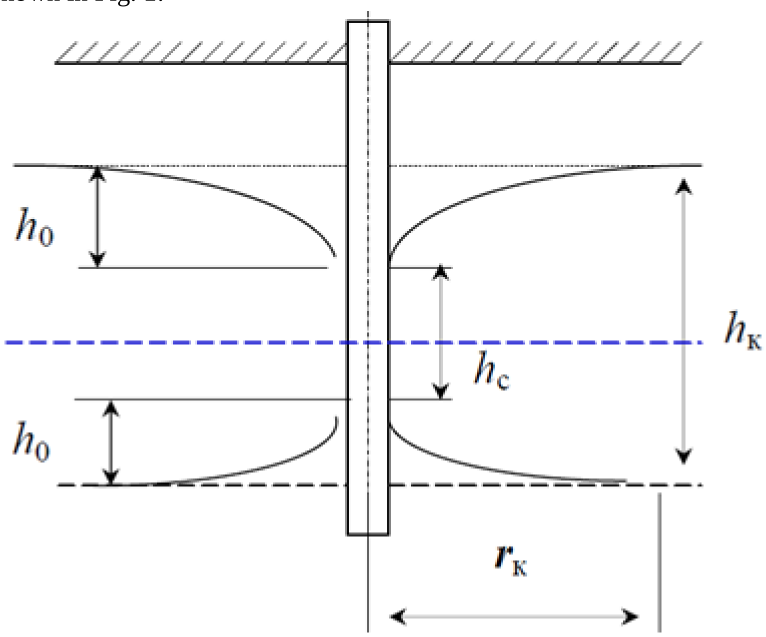

Fig. 1 Scheme of the formation of gas and water cones

It is required to determine the perforation interval in the well h_s. The initial data for the calculation are given in table. 3.

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Table 3.
Initial data table for determining the perforation interval in

№4 well field Shakarbulak

Name of initial parameters	*Value*		
		1	**2**
Radius of conditional power loop	r_{k}, m	500	480
Oil column height on a conventional feed loop with a radius r_{k}	h_{k}, m	25.8	22
Permeability of the plate	k, m^2	0. 1326 x 10^{-12}	0. 12954 × 10^{-12}
Oil viscosity	μ_{n}, mPa s	1.12	0.42
Specific gravity of oil	$\gamma_{n}, n/m^3$	0.797 g / cm^3 8.9 10^3	0.801 g / cm^3 9.2 10^3
Specific gravity of gas in reservoir conditions	$\gamma_{g}, n/m^3$	0.675 0.8 · 10^3	0.7 · 10^3
Writhing s ny weight of water	$\gamma_{in}, n/m^3$	9.81 · 10^3 1.055 g / cm^3	9.81 · 10^3
Well radius	r_{c}, m	0.1 27	0.127
The limiting initial gasless-waterless well flow rate is set	$q_{n}, m^3/day$	23.4	24.6

IV. RESULTS

Let us conditionally single out two zones in the oil filtration area near the well: upper and lower, separated by a horizontal plane passing through the middle of the perforation interval. For the first zone, we will find, respectively, the initial gasless flow rate, and for the second - the initial waterless flow rate . and proceeding from the approximate theory of coning, the following expression is valid for the limiting gasless flow rate:

$$q_{H1} = \frac{\pi \dot{k} \Delta\gamma_1 \left[\left(\frac{h_k}{2}\right)^2 - \left(\frac{h_c}{2}\right)^2\right]}{\mu_H \ln\frac{r_k}{r_c}}$$

where: $\Delta\gamma_1 = (\Delta\gamma_n - \Delta\gamma_g)$ is the difference in the specific *gravity of* oil and gas.
Accordingly, the formula for the limit s Nogo anhydride production rate is given by:

$$q_{H1} = \frac{\pi \dot{k} \Delta\gamma_1 \left[\left(\frac{h_k}{2}\right)^2 - \left(\frac{h_c}{2}\right)^2\right]}{\mu_H \ln\frac{r_k}{r_c}}$$

where: $\Delta\gamma_2 = (\Delta\gamma_{in} - \Delta\gamma_n)$ is the difference in the specific *gravity of* water and oil.

The total limiting non-goose-waterless oil production rate is determined by the sum of the indicated production rates:

$$q_H = q_{H1} + q_{H2}$$

Using the known (from the problem statement) value of the limiting gas-free-waterless oil flow rate q_H, we express and determine the perforation interval in the well h_c.

Payment

$$h_c = 2 * \sqrt{\left(\frac{h_k}{2}\right)^2 - \frac{q_{H1}\,\mu_H \ln\frac{r_k}{r_c}}{\pi \dot{k} \Delta\gamma_1}}$$

after calculation the perforation interval $h_c = 39{,}4$ м

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V. CONCLUSION

Comparing the practical and calculated indicators, it can be seen that the oil-saturated part of the deposit is 25.8 m at the calculation of 39.4 m. If the study of the deposit is incorrect or the calculation used does not correspond to this, different conclusions can be drawn.

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