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АНАЛИЗ ЭФФЕКТИВНОСТИ БУРЕНИЯ ГОРИЗОНТАЛЬНЫХ СКВАЖИН НА МЕСТОРОЖДЕНИИ «ЮЖНЫЙ КЕМАЧИ»

Аннотация. Приведены результаты бурения горизонтальных скважин на различных нефтедобывающих регионах мира и основные факторы, определяющие их продуктивность. Путем сопоставления технологических показателей эксплуатации горизонтальных и вертикальных скважин установлена высокая эффективность бурения горизонтальных скважин.

Ключевые слова: нефть, газ, залежь, запас, пласт, бурение горизонтальных скважин, коэффициент продуктивности, толщина пласта, горизонтальный ствол, извлекаемые запасы.

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Oil under the gas pool has a great contribution on oil reserves of Uzbekistan. Because of great complexity in exploitation of borehole during the gas breakthrough from gas cap and bottom water to well bottom, oil field development of these reserves refers tohard-to-extract category. Applying traditional technologies to drilling a vertical borehole during the development of similar objects does not provide acceptable technical and economic indices, anticipated amount of coefficient of oil extraction rarely exceed 0,1—0,15.

Increasing the efficiency of oil-field development of small oil-saturated layers with the connection of these strategical direction is considered application of new technologies. One of the most important achievements in oil and gas production in 20th century is lateral drilling. In the 21th century great achievements in techniques and technology of construction of these type of boreholes with enough depth has been commemorated.

Nowadays huge amount of works exist /1, 2, 3 etc./, that result in positive and negative factors, impact on the work of horizontal borehole. Main advantage of horizontal borehole than vertical is that horizontal shaft can be opened up from 10 metres to 1000 metresin dissimilar beds with the increased productivity or heavy crumbled fields. This explained by the increase of production rate similar to surrounded vertical borehole.

Theoretical study and analyzing the results of horizontal well drilling in oil-producing regions of the world Z.S. Aliyev and V.V. Sheremet stated that productivity factor effected by three parameters: layer thickness (h), length of horizontal shaft (L) and anisotropy factor (β).

At the same time defined geotechnical conditions (combinations h, L and β) efficiency factor of horizontal borehole ($c_г$) can be higher than vertical borehole 15 times (fig. 1).

Attitude $c_г / c_в$ rise according to decrease of h, and increase of β.

Analyses of the results of developing oil measures with horizontal boreholes and comparison this borehole with vertical borehole show that productivity of hor-

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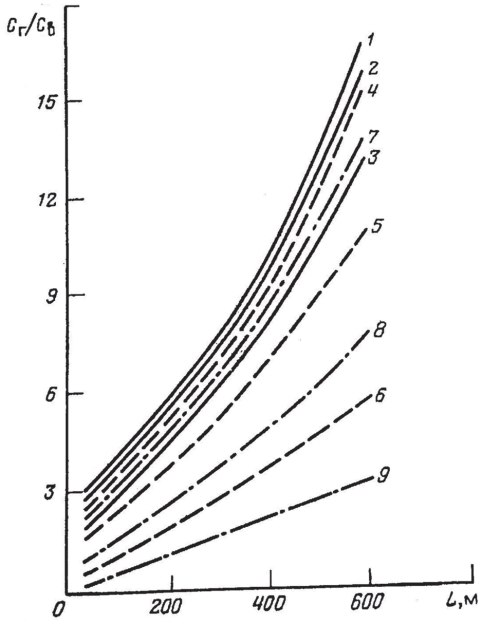

Fig. 1. Productivity factor of horizontal $C_г$ and vertical $C_в$ boreholes depends on the length of horizontal borehole L, layer thickness hand anisotropy parameters β: 1, 2, 3 — h = 6 m; β — accordingly 0,25, 1, 3; 4, 5, 6 — h = 30,5 m; β — accordingly 0,25, 1, 3; 7, 8, 9 — h = 61 m; β — accordingly 0,25, 1, 3

izontal borehole is 2—4 times more than vertical borehole (table 1).

World record on the length of horizontal parts of shaft belongs to the company «Esso» in 1980. In Bass Strait in Australia horizontal bore hole was drilled at 4666 m. In the North sea this record equals to 4023 m. The same borehole was drilled in the Norwegian sector, in Gulf of Mexico the longest horizontal part the shaft is 3379 m (coast of Louisiana).

At present most of firms are able to drill horizontal borehole. One of them, for instance, company «HPS (Horizontal Production Systems)» developed the drilling technology of radial shafts from one borehole. Firstly, one horizontal borehole is drilled, then the radial shafts are which is necessary for layer draining. In 1989, company «HPS» drilled 10 radial shafts with 1275 m in length from existed shaft of horizontal borehole.

South Kemachi deposit put boreholes № 2, 3 into experimental-industrial exploitation in 1980. Mining has been directed

Table 1

Comparision of production rate of horizontal and vertical boreholes

Location of boreholes	Company	Length of horizontal part, m	Increase of production rate
Michigan, USA	«Trend-WillOil»	76	Previously nonproducing wellgave 97,5 m^3/day oil and 17,2 m^3/day gas
Utah, USA	«Skyline-Oil»	67 and 145 (two horizontal shafts)	Previously nonproducing wellgave 13,5 thousand tone of oil
Denmark	MAERSK	460—760	Initial production rate with 2—4 times-more than vertical boreholes
British sector of the North sea	«British petroleum»	565	Duringthe examination 955 m^3/day of oilobtained (much more higher than the production rate of vertical boreholes)
Willistone basin, USA	«Meridian»	610—1000	Obtained 41—44 m^3/day ofoiland 9,5 thousand m^3/day of gas (in vertical boreholes 9,5 m^3/day)
Pradxo-Bey, Alaska, USA	«Standard – Alaska-Production»	300—490	Initial productivity with 3,5 more than vertical boreholes
Java Sea, Indonesia	«Arko»	300—760 (thinbed)	Productivity factor of horizontal boreholes with 5,4 times more than vertical boreholes
Purcell, Texas, USA	«Otix Energy»	43—808	Productivity rate of oil to 218 m^3/day, gas 1,8—26,8 thousand m^3/day

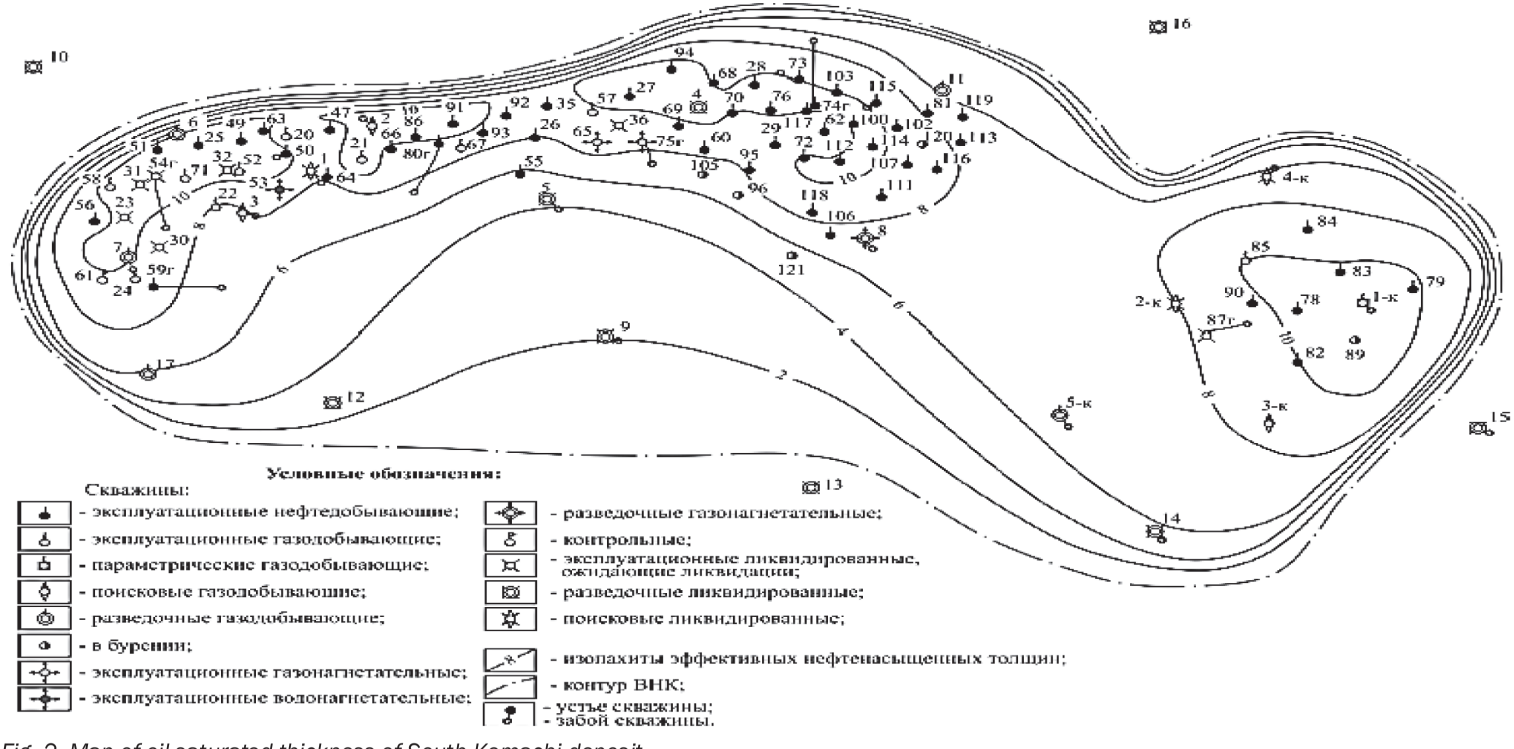

Fig. 2. Map of oil-saturated thickness of South Kemachi deposit

Table 2

Comparison table of exploitation characteristic of horizontal and vertical boreholes by the status 01.01.2013

Name of theattributes	Average measures by vertical boreholes № 56, 58, 61, 68, 71, 73, 94	Average measures by horizontal boreholes № 54г, 59г, 74г
Initial average dailyoil production rate, t/day	13	55
Average watering for the whole period, %	54	46
Average gas-oil factor, thousand, m^3/t	23	9
Average borehole downtime, year	6	5
Accumulated oil production, t	10 982	50 969

forward excavation of oil layer until 2004. Because of gas break through from current perforation interval in oil bed, horizon of oil-producing wells were preserved. Under such mining method, exploitation became economically unsuitable. In this connection for increasing the oil production in 2004, suggested solution on turning to compatible development of oil and gas field, one perforation interval, single grid of wells /5/.

Mining method is found insufficient and ineffective according to following reasons /6/:

• transfer of gas-producing reserves for exploitation to gas cap, carrying out irrational spending of reservoir energy and as a consequence essential contribution of oil reserves can be lost;

• whole installation of bottomhole device «СОД» (GMG International, USA) and bottom-hole choke provide positive effect. However, it is a short-term effect. For extension of the term of effect, it is necessary to systematize the action of boreholes, including boreholes which such technology is not applied for guaranteeing optimum technological condition;

• isolation technology of water production. Oil and gas producing interval often turns into gas producing reserves. Lack of modern technologies and means of selective isolation cause loss of oil reserves.

In 2007, for the purpose of increasing the rate of selection and oil extraction coefficient in gas-condensate field South Kemachi horizontal boreholes № 54г, 59г, 74г were drilled.

As can be seen from the fig. 2 horizontal boreholes were drilled in oil-bearing field with the thickness of 8—10 m.

Analysis of exploitation efficiency of horizontal boreholes № 54г, 59г, 74г by comparison their attributes with work attributes of horizontal boreholes, positioned in the table 2 with analogical conditions.

Analysis of results of average horizontal exploitation and vertical boreholes uncovered the greater efficiency (table 2). Initial average dailyoil production rateof horizontal boreholes is 4,4 times more than the average vertical boreholes. Accumulated oil production of horizontal borehole are 4,6 times more than the average vertical boreholes owing to the fact that horizontal borehole downtime is less (5 against 6 years). Moreover, average gas-oil factor and watering (from accumulated level) horizontal boreholes are accordingly 2,6 times and 1,2 times less.

Since horizontal boreholes have less watering rate and gas breakthrough etc. their unit discharge of energy is less, and their oil production is considerably exceed than vertical boreholes, obviously they obtain high efficiency.

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КОРОТКО ОБ АВТОРАХ

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Analyzing efficiency of drilling horizontal borehole in South Kemachi deposit

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Abstract. The results of drilling horizontal wells in various oil producing regions of the world and the main factors that determine their productivity are given. By comparing the technological indicators of operation of horizontal and vertical wells, a high efficiency of drilling horizontal wells is established.

Key words: oil, gas, reservoir, reserve, reservoir, drilling horizontal wells, productivity factor, formation thickness, horizontal trunk, recoverable reserves.

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РУКОПИСИ, ДЕПОНИРОВАННЫЕ В ИЗДАТЕЛЬСТВЕ «ГОРНАЯ КНИГА»

ИНВАРИАНТ ПРОЧНОСТИ В ТЕОРИИ ТРЕЩИНООБРАЗОВАНИЯ ПРИ ВЗАИМОДЕЙСТВИИ РАБОЧИХ ОРГАНОВ ГОРНЫХ МАШИН С ТОРФЯНОЙ ЗАЛЕЖЬЮ

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Тело всегда стремится уменьшить запасенную в нем энергию, трещина длиной больше критической развивается стремительно и безостановочно, разрушая образец материала. Критическая (для заданных напряжений σ) длина трещины будет соответствовать максимуму общей энергии тела разрушения. Трещины с размером, большим критического L_c, неустойчивы и самопроизвольно увеличивают свои размеры, что приводит к образованию макроскопической трещины и разрушению тела.

Ключевые слова: инвариант прочности, торфяная залежь, горные машины.

INVARIANT STRENGTH OF THEORY OF CRACK FORMATION IN THE INTERACTION OF WORKING BODIES OF MINING MACHINES WITH PEAT ACCUMULATION

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The body always seeks to reduce the energy stored in it, a crack longer than the critical develops rapidly and without interruption, destroying the sample of the material. The critical (for given stresses σ) crack length will correspond to the maximum of the total energy of the fracture body. Cracks with a size larger than the critical L_c are unstable and self-increase in size, which leads to the formation of a macroscopic crack and destruction of the body.

Key words: strength invariant, peat deposit, mining machines.