Technical science and innovation

Volume 2022 | Issue 1 Article 6

4-15-2022

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A Karshiev
Tashkent State Technical University, 100095, st.University 2, Tashkent, Uzbekistan, primova.mastura@mail.ru

R Suleimanova
Satpayev University 22a Satpayev str. Almaty city, Republic of Kazakhstan

K Akhmedova
Uzbek Research and Design Institute of Oil and Gas Industry Uzbekistan, 100060 Tashkent city, Republic of Uzbekistan

M Rakhmonkulov
Karshi Engineering and Economic Institute, 180100, Mustaqillik 225, Karshi city, Uzbekistan

Recommended Citation

Karshiev, A; Suleimanova, R; Akhmedova, K; and Rakhmonkulov, M (2022) "CURRENT STATE AND WAYS OF INCREASING THE EFFICIENCY OF TECHNOLOGIES FOR ISOLATING WATER INFLUXES," *Technical science and innovation*: Vol. 2022: Iss. 1, Article 6.
DOI: https://doi.org/10.51346/tstu-01.22.1-77-0161
Available at: https://btstu.researchcommons.org/journal/vol2022/iss1/6

CURRENT STATE AND WAYS OF INCREASING THE EFFICIENCY OF TECHNOLOGIES FOR ISOLATING WATER INFLUXES

A.K. Karshiev[1], R.T. Suleimanova[2], K.A. Akhmedova[3], M.T. Rakhmonkulov[4]
[1]Tashkent State Technical University
University st.,2 100095, Tashkent city, Republic of Uzbekistan
[2]Satpayev University 22a Satpayev str. Almaty city, Republic of Kazakhstan
[3]Uzbek Research and Design Institute of Oil and Gas Industry
Mirabad District, 100060 Tashkent city, Republic of Uzbekistan
[4]Karshi Engineering and Economic Institute Mustaqillik avenu., 225, Karshi city, Uzbekistan

Abstract: *The results of the application of the technology of isolation of water inflows in the wells of the fields of the Mubarek Oil and Gas Production Department are presented. The efficiency is assessed and the problems of the applied technologies for isolation of water inflows are shown. The technical and economic efficiency of the technology for isolating water inflows in wells with collapse of the columns is shown. The flow rates of wells in the fields of the Mubarek oil and gas production department are decreasing due to an increase in the water cut of the produced product. At the same time, for many fields, the value of the current water cut of the produced products is not commensurate with the achieved value of the depletion of recoverable reserves and the oil recovery factor. To prevent premature flooding of well production, perforation intervals are located at a certain distance from the initial oil-water and gas-oil contacts. Wells are operated at maximum allowable drawdowns in order to avoid the formation of water and gas cones. This approach to selecting the perforation interval and justifying the drawdown has fully justified itself in fields with a large oil-saturated thickness (Kokdumalak, Kruk, North Urtabulak). However, it was not possible to avoid premature breakthrough of gas and water to the bottom of the wells in fields with an effective oil-saturated thickness of less than 10 m, which is one of the main reasons for achieving low values of the oil recovery factor and operation of the well stock.*

Keywords: *fields, well, production, water cut, interval, perforation, event, oil-saturated, water-saturated, inflow, isolation, technology, effect.*

INTRODUCTION. The effectiveness of the functioning of the economic system of any state in a significant degree is associated with the state of fixed assets of enterprises, which characterizes not only the production capabilities of industry, but also determines the trends of its development in the future. The efficient use of fixed assets is of particular importance for industrial enterprises, since the efficiency of the implementation of investment projects and directions of enhancing investment activity in the state as a whole. A significant contribution to the development of the theory and practice of analysis of fixed assets of the enterprise was made by well-known domestic and foreign scientists, including Y.A. Babaev, N. D. Banyak, A.B. Borisov, F.F. Efimova, M. Y. Demyanenko, A.V. Shcherbina and others.

Despite a fairly wide degree of study of the topic being analyzed and the presence of practical achievements in the use of fixed assets, today there is still no single rational way to solve the problem of increasing the efficiency of fixed assets for industrial enterprises. Also, questions of a theoretical and methodological nature related to the timely updating of fixed assets, with the optimization of the structure of fixed assets in accordance with the requirements of the production process, remain insufficiently studied, with the organization of their effective and rational use for the innovative and dynamic development of domestic enterprises.

In this regard, the issues of increasing the efficiency of using fixed assets are relevant at the present stage of development of economic science, and their rational practical solution will serve as an incentive to increase the volume of production, which ultimately will contribute to the growth of profitability and profitability of industrial enterprises. The purpose of the article is to study the current state of fixed assets of industrial enterprises, identifying problems in the analyzed area and developing recommendations for increasing the effectiveness of their use.

MATERIAL AND METHODS. The following research methods were used in the work: generalization and systematization, systemic and complex analysis; comparative methods; method of analysis and synthesis; graphic methods visual representation of the material, visualization of theoretical and practical provisions. The main results of the study. In a market economy, one of the conditions for the effective functioning of industrial enterprises is their provision with basic means. Since it is the fixed assets that are the driving force with the help of which the enterprise begins to operate, and in the future - to expand its activities. Based on the analysis of scientific literature, it can be concluded that most of the authors under the definition of "fixed assets" means tangible assets. Some of the authors point out that "fixed assets" are means of labor that can be used in the production process for a long time. A very important addition is that that fixed assets are fully and repeatedly involved in the production process and can transfer their value in parts, as they wear out, to manufactured products.

That is, "fixed assets" are tangible assets suitable for use in the production process of an industrial enterprise, which partially lose their own value by transferring it to manufactured products, while their expected life use is more than one year. Efficiency in the use of fixed assets is one of the most important tasks in modern industrial plants. Reproduction of fixed assets is viewed as a process of their continuous renewal. This is confirmed by the volume of geological and technical activities carried out at the wells of the Mubarek oil and gas production department. While in the total volume of geological and technical activities in 2016 and 2017, the share of works to isolate water inflows is 20.0 and 24.5%, respectively, at fields with an effective oil-saturated thickness of less than 10 m this figure reaches 85% (Fig.-1).

Isolation of water inflows is carried out according to the following technologies worked out in practice [1] technology of reservoir isolation from water inflows, based on the injection of a buffer fluid, an isolating material and a structuring. In each pair, the flushing liquid-converter structures use aqueous solutions of alkali salts of potassium, magnesium, and aqueous solutions of organic or inorganic gel-forming elements are used as an insulating material. The disadvantage of this technology is that the insulating material is seized both in the oil-bearing and auriferous parts of the reservoir, as a result, oil-and-gas-saturated formations are plugged and wells operate at a flow rate below the potential; -technology of reservoir isolation from water inflows, based on the use of grouting compounds based on synthetic resins, hardening in reservoir conditions.

According to this technology, an insulating material containing synthetic resin, a hardener and water is pumped into an injection or production well, and it is forced into the formation with other ingredients. The disadvantages of this technology are the complete isolation of oil and gas saturated and water-saturated formations, as well as the precipitation of various particles in the pores of the formation, which lead to a deterioration in reservoir properties and well flow rates; technology of reservoir isolation from water inflows, based on the injection of sulfuric acid and polyamide.

According to this technology, 48-96% sulfuric acid is injected into the well and polyamide is pre-added in an amount of 5-11%, which is simultaneously and separately injected together with oil into the treated interval of the well. The disadvantage of this technology is that the acid can corrode the metal, which leads to the disruption of the columns. In addition, sulfuric acid of this concentration is hazardous to life and the environment; technology for isolating water inflows, based on the injection of a gel-forming solution of polyacrylamide and an acid into the well.

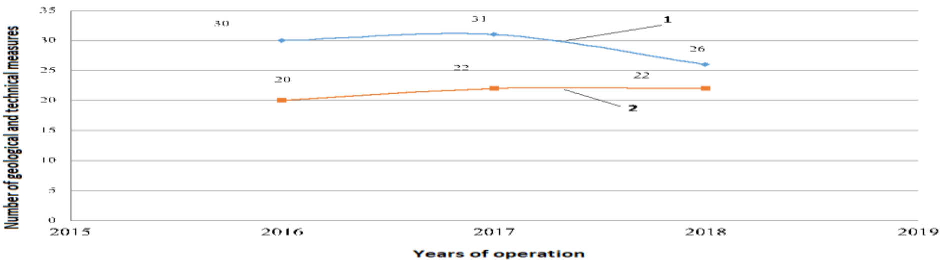

Fig. 1. Dynamics of geological and technical measures carried out in the wells of the South Kemachi oil and gas condensate field

1 – total number of geological and technical measures; 2 – geological and technical measures for isolation of water inflows.

According to this technology, a gel-forming solution of polyacrylamide and an acid solution are forced into the formation with water of increased density. The operation starts at the far end of the water flow interval and is repeated as it moves along the water flow interval. Technological exposure is carried out until the formation of a gel, before isolation of the water inflow, this productive interval is filled with acid, technological exposure is carried out in the bath mode and pushed into the formation. The disadvantage of this technology is also the deterioration of reservoir properties due to the isolation of oil and gas reservoirs. As can be seen from the above, all currently used technologies for isolating water inflows have certain disadvantages. Common to all these technologies is that they cannot be carried out in collapsed wells.

According to the results of the study by I.Kh. Khalismatov and I.I. Divev, wells with the highest oil production and a decrease in reservoir pressure are prone to collapse of the columns [2]. Considering that most of the fields of the Mubarek oil and gas production department are developed in depletion modes, and with a drop in reservoir pressure, an inevitable process can predict an increase in the number of wells with collapsed strings. In this regard, there is a need to improve existing technologies for carrying out work to isolate water inflows in wells with collapse of the columns. In wells with collapsed strings and equipped with non-removable packers, it is impossible to carry out any tripping and installation of cement bridges, as a result of which the well fails when the formation is flooded.

For the re-commissioning of the well, it is proposed to inject the cement slurry without any round-trip operations. Initially, the liquid level in the wellbore is determined and a column of liquid located in the wellbore is pushed into the formation. Due to the proximity of the phase permeabilities of the reservoir of water and water in the well, the injected water will flow into the watered interval. Then, a portion of low-density cement slurry is pumped into the well, of the order of 1.2 g/ cm^3, and then, gradually increasing the cement slurry density, bringing it to -1.6 g / cm^3.

Then the density of the cement slurry decreases and at the end of the injection the cement density is brought to the lowest. The gradual transition of the cement slurry density from lower to higher and then to lower allows the injected solution to be directed into the watered formation without contaminating the oil-bearing or gas-bearing formation. Then air (gas) is pushed into the well according to the calculation.

In terms of its phase permeability, air or gas is the closest in phase permeability to productive formations, and it mainly enters the pay zone, destroying the clogging of the formation and, to a lesser extent, enters the watered interval. Air trapped in the aquifer creates a barrier to the movement of water and, as it were, slows down the exits from the watered formation, creating an air baffle.

In an oil and gas bearing formation, air forced into the formation increases the saturation of the formation with gas or air, as a result of which the permeability for the oil and gas bearing formation is improved. After the back pressure is removed, the well is restored and begins to work, and the watered formation is isolated by the injected cement slurry. An analysis of the series of experiments carried out to determine the insulating capacity of insulating materials obtained by mixing water and cement with different concentrations shows that [3].

- with an increase in the density of the injected fluid from 1.1 to 1.5 g / cm^3, the permeability of the aquifer, depending on the initial reservoir properties, decreases tens and hundreds of times;

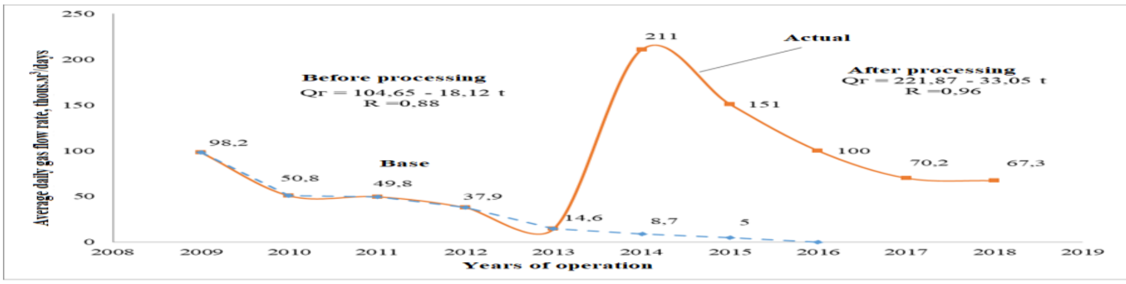

Fig. 2. Dynamics of the average daily gas production rate of well No. 42 of the Urtabulak field.

- with an increase in the density of the liquid to 1.8 g / cm3, the permeability of the aquifer decreases to 2-3 mln;

- with a decrease in the density of the solution from 1.8 to 1.0, the permeability initially increases to 5-7 ppm, and then decreases to 1 ppm. With subsequent air injection, the permeability is 3-5.pm. The increase in the rate of decrease in permeability, depending on the increase in the density of the solution, and then decrease to the initial state, is associated with the formation of a more durable insulating material and coverage of deeper zones of the formation.

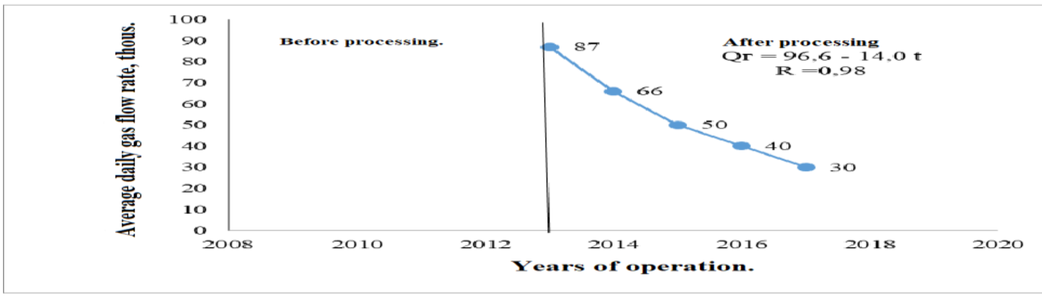

Fig. 3. Dynamics of the average daily gas production rate of well No. 217 of the Urtabulak field.

At the same time, oil-bearing strata retain their reservoir properties in terms of permeability. The inventive method for isolating water inflows in wells with collapse of the production string and equipped with fixed packers is carried out in the following sequence. If there is watering in the well, it is necessary to shoot a new interval.

Before doing this, it is necessary to isolate the watered intervals. Well isolation works are carried out in the following sequence.

According to the logging data, the volume of the pore space is determined by the height and depth of the perforated interval, and then the required amount of materials for the first injected part and the second is calculated. This requires the following:

- determine the fluid level in the wellbore.
- bring the estimated amount of cement slurry and water to the well;
- tie the wellhead with the end. I aggregate (1-worker, another spare) through a tee with a rigid line;
- press the lines to a pressure of 150 kg / cm^2; - to pump into the tubing the calculated volume of cement-water solution with a density of 1.2, 1.4, 1.6, 1.4, 1.2, 1.0 m^3 in equal shares of the calculated one;
- push this entire volume into the near-wellbore part of the well with the calculated volume of air (gas) or displacement fluid;
- seal the wellhead and leave it awaiting the formation of an insulating material until the cement slurry sets (hardens);
- in the process of pumping the displacement fluid, monitor the pressure change on the unit;
- after the waiting time has elapsed, call the inflow after perforation and determine the results of the isolation work.

Thus, using the proposed technology of isolation works in wells, it is possible to enter a well after watering the formation. The proposed technology for isolating water inflows was implemented in wells No. 42, 217 of the Urtabulak field. The calculation of the technological effect from the technology for isolating water inflows was carried out by comparing the performance of wells before and after the event (Fig. 2, 3): For well No. 42, the dynamics of the average daily flow rate before and after carrying out is rather reliably extrapolated by a straight-line relationship (Fig. 2):

- before the event $Qg = 104.65-18.12 \cdot t$, (1) (correlation coefficient - 0.88);
- after the event $Qg = 221.87-33.05 \cdot t$, (2) (with a correlation coefficient of 0.96).

RESULTS AND DISCUSSION. By comparing the predicted flow rate for the base case and the actual average daily flow rate, the increase in gas production was calculated (Schedule 1, 2).

Table. 1

№ PP	Years of operation	Base case debit thous, m^3/days	Actual flow rate, thous, m^3/days	Incrase in production rate thous. m^3/days
1	2009 y.	98,2	-	-
2	2010 y.	50,8	-	-
3	2011 y.	49,8	-	-
4	2012 y.	37,9	-	-
5	2013 y.	14,6	211	196,4
6	2014 y.	8,7	151	142,3
7	2015 y.	5,0	100	95,0
8	2016 y.	-	70,2	70,2
9	2017 y.	-	67,3	67,3
10	2018 y.	-	35,3	35,3

Well №217 did not work before the work due to full watering. Therefore, the entire volume of gas produced after the isolation of the water inflow is taken as additionally produced gas (Fig. 3 and Schedule 2). The calculation of the economic effect is carried out according to the formula:

$$E = (Tsopt.g.-Su.\ per) \cdot \Delta Qg + (Tsopt.k.-Su.\ per) \cdot \Delta Qk – Zza \qquad (1)$$

Table.2

Initial data for calculating the economic effect of isolating water inflows in wells No. 42, 217 of the Urtabulak field

№	Indicators	Option	
		Basic-old development system	New way to develop by event
1	Settlement period, duration from	01.01.2015 to 31.12.2015	
2	Field, number of wells	№ 42, 217 of the Urtabulak field	
3	Additional gross production of gas and condensate from the well for the estimated period from the implementation of the measure, (ΔQ)		gas - 12,537.8 thousand .м^3; condensate-7,8 т
4	Wholesale price:		
	Wholesale price of gas $1\cdot10^3$м^3, sum (T_{sopt}.g)		38 002,63
	Wholesale price of 1 ton of condensate, sum ($T_{sopt.k}$)		183 780,64
5	The total cost of $1\cdot10^3$м^3 of commercial gas for the enterprise for the billing period, the sums - from it the conditionally variable part, Su.per. (calculation)		39 044,68 13 291,06
6	The total cost of 1 ton of commercial condensate at the enterprise for the billing period, the sums - from it the conditionally variable part, Su.per. (costing)		163 904,05 55 813,42
7	Coefficient of the ratio of the amount of commercial gas and condensate to the gross produced by the field (enterprise) for the billing period, share of units.		Gas – 0,890 Condensate – 0,894
8	Additional commercial gas obtained as a result of the implementation of the measure, $1\cdot10^3$м^3 (ΔQ_g)		12 537,8 x 0,890 = 11 158,64
9	Additional commercial condensate obtained as a result of the implementation of the measure,т (ΔQ_k)		7,8 x 0,894 = 6,97
10	Costs for workover of wells, amount (Z_{zat})		75 635 026

CONCLUSION. The initial data for calculating the economic effect from the work on isolating water inflows in wells № 42, 217 of the Urtabulak field are given in table. 3. For the period under consideration from 01.01.2015 to 21.12.2015, the economic effect from the work on isolating water inflows in wells No. 42, 217 of the Urtabulak field amounted to 201.0 million soums, and for the period 01.01.2015 to 2.21.2018 - 2,250.5 million soums. At the same time, 98.7 million $м^3$ of gas and 86 tons of condensate were additionally produced

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