

PROBLEMS OF SAND MANIFESTATION IN THE FIELDS OF KAZAKHSTAN: METHODS AND SOLUTIONS**D.S. Saduakassov**[✉], **A.G. Gusmanova**^{ip}, **A.T. Zholbasarova**^{ip}, **R.U. Bayamirova**^{ip}, **A.R. Togasheva**^{ip},
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Sand manifestation in oil and gas wells of Kazakhstan remains a pressing issue that significantly hinders their reliable and efficient operation. This article analyzes equipment failures occurring during well operation under conditions of high mechanical impurity content and proposes possible solutions. As the object of study, the causes of rod screw pump (RSP) failures at the Karazhanbas, North Buzachi, and Kumkol fields were examined. The results showed that the main cause of failures is sand manifestation, accounting for up to 51% of all cases. The article proposes a method to prevent the formation of sand plugs by creating a bottomhole sand collector at an optimal depth. Economic analysis demonstrated that this technology significantly reduces repair costs and extends the inter-repair period of well operation. The effectiveness of the proposed solution is confirmed by field data and detailed calculations.

Keywords: Sand manifestation, Oil and gas wells, Rod screw pumps, Downhole, Sand storage, Perforation holes.

ҚАЗАҚСТАН КЕН ОРЫНДАРЫНДАҒЫ ҚҰМНЫҢ БІЛІНУІ МӘСЕЛЕЛЕРІ: ӘДІСТЕРІ МЕН ШЕШІМДЕРІ**Д.С. Садуакасов**[✉], **А.Г. Гусманова**, **А.Т. Жолбасарова**, **Р.У. Баямирова**, **А.Р.Тогашева**,
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Қазақстандағы мұнай-газ ұңғымаларында құмның білінуі олардың сенімді әрі тиімді жұмыс істеуіне айтарлықтай кедергі келтіретін өзекті мәселе болып отыр. Бұл мақалада механикалық қоспалардың жоғары мөлшерінде, ұңғымаларды пайдалану барысында туындайтын ақауларды талдау және оларды шешу жолдары қарастырылады. Зерттеу нысаны ретінде Қаражанбас, Солтүстік Бозащы және Құмкөл кен орындарындағы штангалы бұрандалы сорғылардың (ШБС) істен шығу себептері талданды. Нәтижелер бойынша, істен шығулардың негізгі себебі құмның білінуі екені анықталды, оның үлесі барлық жағдайлардың 51%-ына дейін жетеді. Мақалада құм тығыздарының түзілуін болдырмау үшін ұңғы түбінде оңтайлы тереңдікте құм жинақтағыш қойма жасау әдісі ұсынылады. Экономикалық талдау көрсеткендей, бұл технология жөндеу жұмыстарының шығынын айтарлықтай азайтып, ұңғыманың жөндеу аралық кезеңін ұзартады. Ұсынылған шешімнің тиімділігі өндірістік деректермен және егжей-тегжейлі есептермен дәлелденген.

Түйін сөздер: Құмның білінуі, мұнай-газ ұңғымалары, штангалы бұрандалы сорғылар, ұңғы түбі, құм жинау қоймасы, перфорациялық тесіктер.

ПРОБЛЕМЫ ПЕСКОПРОЯВЛЕНИЯ НА МЕСТОРОЖДЕНИЯХ КАЗАХСТАНА: МЕТОДЫ И РЕШЕНИЯ**Д.С. Садуакасов**[✉], **А.Г. Гусманова**, **А.Т. Жолбасарова**, **Р.У. Баямирова**, **А.Р.Тогашева**,
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В нефтегазовых скважинах Казахстана пескопроявление остаётся актуальной проблемой, существенно препятствующей их надёжной и эффективной работе. В данной статье рассматриваются

анализ неисправностей, возникающих при эксплуатации скважин в условиях высокого содержания механических примесей, и пути их решения. В качестве объекта исследования проанализированы причины отказов штанговых винтовых насосов (ШВН) на месторождениях Каражанбас, Северные Бузачи и Кумколь. По результатам установлено, что основной причиной отказов является пескопроявление, доля которого достигает до 51% всех случаев. В статье предложен метод предотвращения образования песчаных пробок - создание забойного песконакопителя на оптимальной глубине. Экономический анализ показал, что данная технология существенно снижает затраты на ремонтные работы и увеличивает межремонтный период эксплуатации скважин. Эффективность предложенного решения подтверждена производственными данными и детальными расчётами.

Ключевые слова: Пескопроявление, нефтегазовые скважины, штанговые винтовые насосы, забой, накопитель песка, перфорационные отверстия.

Introduction. Ensuring stable oil and gas production remains a key priority, but the operation of downhole pumping equipment in mature fields is complicated by the high content of mechanical impurities in the produced fluid [1-3]. According to statistics, about 15-35% of the total section of the Karachaganak deposits are poorly cemented to sand [4].

According to the data obtained when analysing well products at Uzen, Karazhanbas, North Buzachi and other deposits, up to 65% of mechanical

impurities are of reservoir origin, while only 8-12% of impurities are of surface origin. The urgency of the problem is confirmed by reports of major oil producing companies in Kazakhstan, which analyse failures of rod screw pumps (RSP) due to sand manifestation. Table 1 presents average data on the frequency of RSP failures due to sand manifestation in three deposits in Kazakhstan from 2019 to 2023. The data shows that deposits such as Kumkol, North Buzachi and Karazhanbas are particularly prone to this problem [5].

Table 1 - Failure statistics of rod screw pumps due to sand manifestation [5]

Deposit	Operator	Number of wells equipped with rod screw pumps, pcs	Share of refusals of rod screw pumps due to sand, %
Karazhanbas	Karazhanbasmunai JSC	1600	26
Northern Buzachi	Branch of Buzachi Operating Ltd.	900	51
Kumkol	PetroKazakhstan JSC	180	up to 40

During the study period for the North Buzachi field, the total number of production wells was 929, of which 871 used screw rod pumps (SRP) units, accounting for 94% of all wells. Over 200 problem wells have been identified in this field in the period from 2019 through 2023. The main causes of failures include the following factors (Figure 1): rod breakage, rod breakaway, pump and compressor pipes (tubing) leaks, failure of screw rod pumps (SRP), sand production, including rotor

jamming, SRP connection pipe failure, violation of perforation interval sustainability, and other causes.

Research has shown that 94% of all failures can be attributed to four main categories: pump rod breakage, PCP leaks, sand production, and perforation interval bridging. Considering that failures include perforation interval bridging and screw pump failures caused by high mechanical impurity content, especially sand, three main causes

of downhole pumping equipment (DPE) failures can be identified (Figure 2).

Our research conducted at the North Buzachi field during 2019–2023, based on the analysis of

operational data and failure reports of pumping equipment, showed that the main cause of failures is sand production, accounting for up to 51% of all cases.

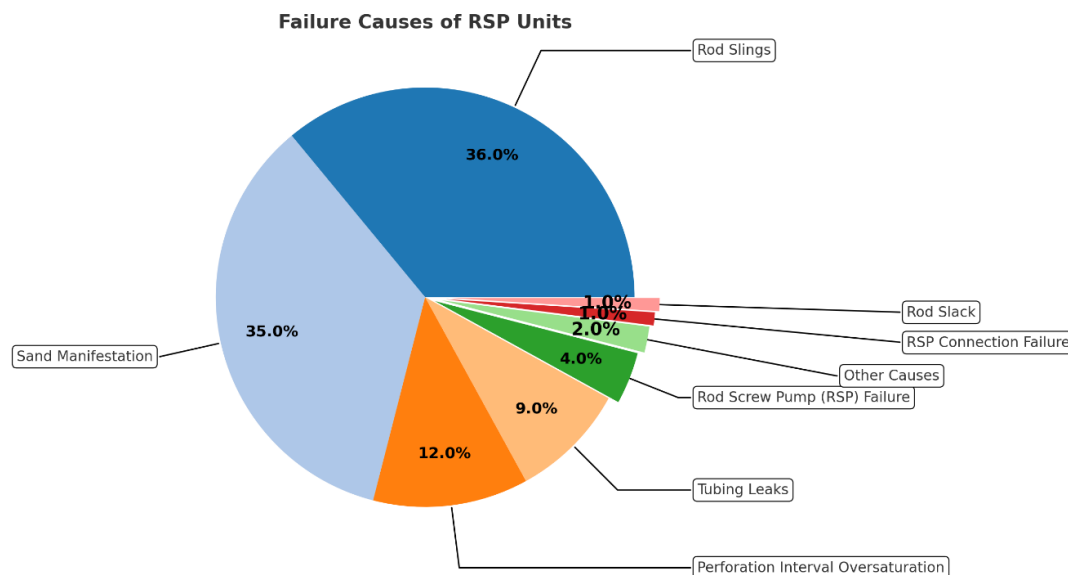


Fig.1 - Main causes of SRP unit failures at the North Buzachi field for the period 2019-2023

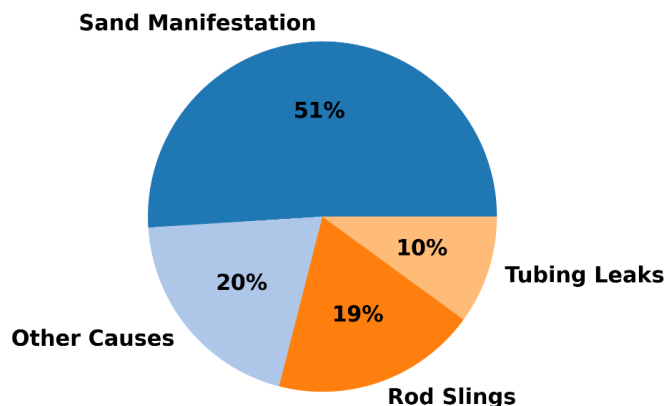


Fig.2 - Distribution of the causes of SRP unit failures related to sand production at the North Buzachi field for the period 2019-2023 [5]

Materials and methods. Our research applied specific methods to assess sand production and to test the proposed bottomhole sand collector technology. Field data from 2019–2023 were collected for three oilfields in Kazakhstan (Karazhanbas, North Buzachi, and Kumkol) comprising more than 2500 production wells equipped with progressive cavity pumps (PCPs). Failure logs, well flow rates, sand content in produced fluids, and inter-repair periods were

systematically analyzed. Statistical methods were used to determine the proportion of failures caused by sand production, with 95% confidence intervals. Critical suspension rates for sand particles were calculated using a simplified Retinger–Ukhanov equation, calibrated to casing diameter, sand particle size, and density parameters. Economic analysis compared the additional costs of deepening wells by 50–150 m with the savings achieved from extended inter-repair periods and stabilized well productivity. Furthermore, pilot field trials were carried out at selected Karazhanbas wells, where a bottomhole sand collector of 60–70 m depth was created during workover operations. Monitoring included well flow rates, inter-repair periods, and sand content before and after technology implementation. All research was conducted in compliance with ethical principles, using only open or operator-approved production data without disclosure of confidential information.

Although numerous studies have addressed sand production in oil wells, many still lack long-term field validation and comprehensive economic

analysis. Research [6] conducted field tests of a hydrocyclone for sand removal in the conditions of South Oman. Their study was limited to specific conditions and lacked long-term analysis. For example, they found that to achieve more than 80% extraction for particles of 200 microns in size, the differential pressure must be at least 200 kPa, demonstrating the specificity of the conditions.

Work [7] describes the problem of sand production and the formation of sand plugs but does not offer specific solutions or conduct a detailed analysis of the causes. It focuses on describing the problem without presenting effective methods for combating sand production. Article [8] considers the application of a multi-directional nozzle for highly inclined wells, but their publication lacks economic analysis and long-term operational results, and it does not address the applicability of the technology in wells with different inclination angles. The authors [9] conduct laboratory studies, showing that sand production in poorly cemented formations increases the permeability of the productive formation. However, they do not provide data on the field application of their methods, which limits the applicability of their conclusions in real-world conditions.

Research [10] analyzes gravel filters, demonstrating their high efficiency in preventing sand production. However, their work lacks data on the impact of the filters on well productivity and potential issues with their installation and operation in various geological conditions. Author [11] proposes a method for removing mechanical impurities from horizontal wells containing heavy oil. Their research is limited to theoretical calculations without sufficient data on the practical application of these methods. The study analyzes the impact of sand on the operation of electric submersible pumps (ESP) in the development of the "Salym Petroleum" field, providing mathematical models and laboratory data. However, their work does not sufficiently focus on field conditions and real operational data [12].

Thus, despite a significant amount of research and proposed methods for combating sand production and sand accumulation, most

publications have several limitations. The lack of field data, limited applicability in various geological conditions, and insufficient economic analysis remain key issues. To achieve more effective solutions, a comprehensive approach is required, including detailed testing, economic analysis, and adaptation of technologies to different operating conditions. In the oil and gas industry, one of the main challenges in the extraction and operation of wells is the control of sand production [13, 14]. The geological formation in oil and gas fields often consists of one or more layers of sandy rocks with poorly cemented and loose structures. During operation, the wellbore can be easily damaged, leading to sand production, reduced development efficiency, and significant complications in extraction. Operation in complex mining and geological conditions leads to the destruction of the near-wellbore zone, reduced reservoir pressure, significant increases in the water cut of the produced fluids, and an increase in the amount of mechanical impurities.

To date, there are numerous methods for combating sand production, allowing their application in various geological conditions. Sand production remains one of the main problems, as it leads to substantial costs both economically and environmentally. In global practice, methods for controlling sand production are classified into two main groups: preventing sand production from the formation (technological method) and operating wells with sand production from the formation (technical method) [15, 16].

Regarding the prevention of sand accumulation and the formation of sand plugs in the perforation zone and inside the production casing, any method or device is very rarely mentioned in scientific, technical, and patent literature [17, 18]. In practice, only at high flow rates, when the velocity head of the upward fluid flow in the well is sufficient to lift sand particles, does sand accumulation and the formation of sand plugs not occur in the well. This generally corresponds to the flowing and gas lift periods of well operation. However, the decline in flow rates and the need to operate wells at low flow rates, up to 20 tons per day, becomes an objective

process that covers a small period of their operation, especially in the middle and late stages of field development.

Sand plugs form both in the perforation zone and in near-wellbore channels. A known method for preventing sand from entering the well involves creating an artificial filter from a permeable plugging material against the productive formation [19, 20]. The main drawback of these methods is the accumulation of sand in the filtration channels of the formation in the near-wellbore zone, which hinders the movement of oil into the well and reduces the well's flow rate. As sand accumulation in the formation's filtration channels gradually increases and they subsequently become silted, sand plugs form not inside the production casing but in the near-wellbore zone of the productive formation. The sand plugs seem to be transferred from the well to the near-wellbore zone. While sand plugs formed inside the well could be cleaned using known accessible methods, cleaning sand plugs formed in the near-wellbore zone of the formation, which have rather large radii, becomes a problem requiring even more effort, resources, and time.

From the perspective of achieving the maximum planned oil production rate and ensuring the longevity of well operation, the free removal of sand from the filtration channels of the formation is effective. Therefore, in practice, simple, low-energy methods are used to clean sand plugs formed inside the well [21-23]. At low flow velocity, sand accumulates in the perforation zone, restricting oil flow. As a result, sand plugs form within the perforation zone, reducing the well's flow rate.

The intensity of sand accumulation in the perforation zone and the formation of sand plugs depends on the looseness of the productive formation rocks, pressure differential, and initial well flow rate. During high oil flow rates in the well's flowing period, when the fluid velocity head is sufficient to lift sand particles in the well, a significant amount of sand is expelled from it. As the well's flow rate gradually decreases, especially during its deep-pump operation period, sand accumulation in the perforation zone and the formation of sand plugs occur more intensively. The

frequency of cleaning the perforation zone of the well from sand plugs increases, the well interrepair period decreases, and, most importantly, the well's flow rate intensively decreases. For example, the well interrepair period for cleaning wells only from sand accumulations at the Karazhanbas field in the first half of 2020 averaged 30-45 days. At the same time, there was a sharp decrease in oil flow rates in wells from 10-7 to 1-0.5 tons per day, and the work of cleaning sand plugs in wells is known to be labor-intensive, requiring significant effort and resources.

To prevent sand accumulation in the perforation zone, increase the well flow rate, and extend the well interrepair period for sand cleaning, we have developed a new technology. The essence of this new technology lies in creating a bottomhole sand collector of optimal depth and volume by deepening the well during major repairs to an optimal depth. This depth is determined based on minimizing the total costs of conducting repair work to clean the perforation zone from sand, increasing the well's flow rate, and additional costs for deepening the well to the optimal depth.

It is known that, to ensure reliable isolation of the productive horizon, the installation of the production casing with overlap of the productive horizon, and the lowering of the perforator to the necessary depth in case of possible solid phase deposition of drilling slurry at the bottom during the well drilling process, the depth of the production well is planned to be 5-10 meters below the base of the productive horizon, forming a sump.

Given the actual depth of descent of the production casing, which is always less than the well's design depth, the length of the shoe, and the height of the stop ring installation, the uncemented interval inside the production casing below the level of the bottom of the productive horizon remains no more than 1-2 meters, and in most cases, this interval is practically non-existent. Thus, in practice and in literary sources, no method is provided for deepening the well to create a bottomhole sand collector during well operation or during major repairs of producing wells. The existing so-called sump, without deepening it to an optimal depth,

cannot and does not perform the functions of a bottomhole sand collector in the operation of sand-manifesting wells.

The optimal height of the created bottomhole sand collector is determined by solving the equation:

$$\begin{cases} \Pi_p(h) + \Pi_A(h) + \Pi_{к.р.}(h) = \min \left\{ \frac{d}{dh} \right\}, \\ \Pi_p(h) + \Pi_A(h) + \Pi_{к.р.}(h) = 0 \end{cases} \quad (1)$$

where: h - the depth of the well during major repairs, equal to the height of the bottomhole sand collector, m; $\Pi_p(h) = \Pi_p C_p$ costs of repair work to clean the perforation zone from sand, tenge; C_p - the cost of one repair to clean the perforation zone from sand, tenge; Π_p - the number of repairs per year to clean the perforation zone from sand equal to $\Pi_p = 360/t_2$; $t_2 = t_1 * h/l_n$ - the well interrepair period with a bottomhole sand collector, days; l_n - actual perforation interval of the productive formation, meters, m; t_1 - the well interrepair period without a bottomhole sand collector, days; $\Pi_g(h) = \Delta Q E_H$ - costs associated with the reduction in well flow rate due to sand accumulation in the perforation zone; E_H - cost of 1 ton of oil, tenge/m³, ΔQ - annual reduction in well flow rate, equal ; q_H , q_K - daily well flow rates at the beginning and end of the well interrepair period, m³/day; $P_{к.р} = h C_{ye}$ - additional costs for deepening the well to a depth equal to the height of the bottomhole sand collector, h; C_{ye} - the cost of deepening the well by 1 meter during major repairs of a production well, tenge/m.

By substituting the values of Π_p , $P_g(h)$, and ΔQ into formula (1) and solving it, we obtain a formula for determining the optimal height of the bottomhole sand collector and the corresponding well deepening during major well repairs:

$$h_{оп} = 19 \sqrt{\frac{l_n}{C_{ye}} \left(\frac{q_H - q_K}{2} \varepsilon_H + \frac{C_p}{t_1} \right)} \quad (2)$$

Calculations show that the costs of deepening the well by 50-150 meters during major repairs

of production wells are offset by savings from extending the interrepair period and increasing the well's oil flow rate. Figure 1 shows the locations of sand accumulation entering the well during the operation of production wells by existing methods without a bottomhole sand collector, and in figure 2 by the proposed method with a bottomhole sand collector.

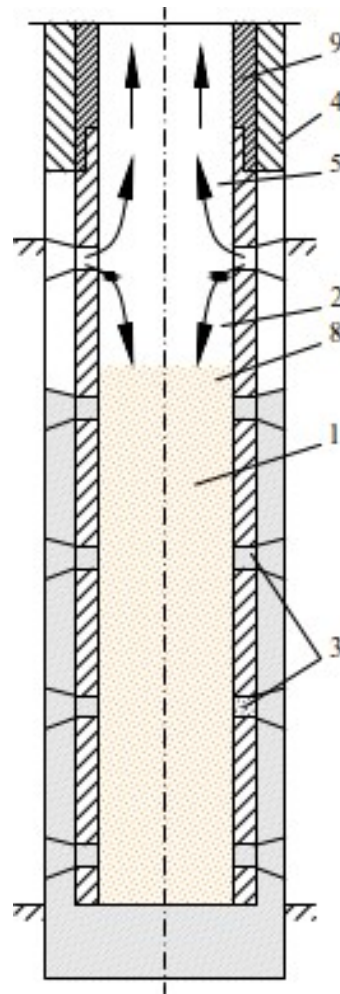


Fig.3 - Operation of production wells by existing methods without a bottomhole sand collector:
1. Sand entering from the formation; 2. Perforation zone; 3. Perforation holes; 4. Productive formation; 5. Well; 6. Bottomhole sand collector; 7. Oil inflow; 8. Production casing; 9. Pump and compressor pipes (PCP)

During the operation of a sand-manifesting well by the existing method without a bottomhole sand collector (Figure 3), the sand 1 entering the well from the formation accumulates in the perforation

zone 2 and clogs the perforation holes 3, thereby resisting the entry of oil from the productive formation 4 into the well 5. Initially, sand clogs the lower perforation holes, and then, with an increase in its amount, gradually clogs the upper perforation holes, leading to a sharp decrease in the well's flow rate.

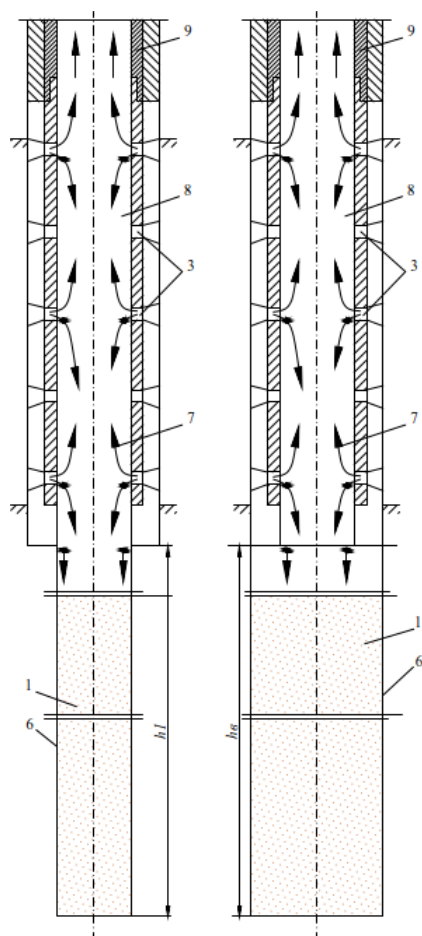


Fig.4 - Bottomhole sand collector:

1. Sand entering from the formation; 2. Perforation zone; 3. Perforation holes; 4. Productive formation; 5. Well; 6. Bottomhole sand collector; 7. Oil inflow; 8. Production casing; 9. Pump and compressor pipes (PCP)

During intensive sand-manifestation, sand accumulation can reach the intake zone of the deep pump, significantly resisting the oil lift in the well and causing wear on the deep pump parts. When operating the well by the proposed method (Figure 4), the sand 1 entering the well from the formation settles in the bottomhole sand collector 6 and does

not obstruct the oil inflow 7 into the well, allowing the well's flow rate to remain constant until the bottomhole sand collector is filled with sand.

It is evident that there is a critical well flow rate at which the sand entering the well with specified particle diameters remains in suspension in the upward flow. For example, with an internal diameter of the production casing of 148 mm and sand particle diameter of 2.0 mm, the critical well flow rate is 8-10 m³/day. If the well flow rate is less than the critical rate, the sand particles entering the well from the perforation holes with a diameter larger than the specified one will settle in the collector. If the well flow rate is greater than the critical rate, then the sand particles entering the well from the lower perforation holes will settle in the collector, while the sand particles entering the well from the upper perforation holes, due to the increased velocity head of the upward fluid flow, will rise up through the production casing 8 and the PCP 9. The sand entering the PCP, due to the increasing fluid flow velocity, will exit the well without forming sand plugs inside the PCP. When sand enters the deep pump operating zone, a zone of variable fluid velocities is created due to its intermittent operation, where sand accumulates, causing resistance to the upward fluid flow and wear on the pump parts.

By creating a bottomhole sand collector with a height of 64 meters, the number of repair works for cleaning the sand collector in the perforation zone is reduced by: $h / l_{on} = 64 / 8 = 8$ times. This increases the well interrepair period by 8 times. Importantly, during this period, the well will operate stably without a reduction in flow rate, as the sand entering the well will settle in the bottomhole collector, not obstructing the movement of oil in the perforation zone. When sand accumulates in the perforation zone, filling the bottomhole collector, it is cleaned using existing sand plug cleaning methods. With a sufficiently high bottomhole collector, the frequency of its cleaning from accumulated sand is no more than once every 2-3 years. Table 2 shows the optimal heights of the bottomhole sand collector for combinations of $\Delta q = q_{\pi} - q_k$; 1 perf, t

Table 2 - Optimal Heights of the Bottomhole Sand Collector

t1 , days.	1перп . М	hоп , m Δq= qп – qк		
		3	6	9
30	5	38	47	55
	8	48	60	70
	16	67	84	99
60	5	33	44	52
	8	42	56	66
	16	60	78	93
120	5	31	42	51
	8	39	53	64
	16	56	75	91

To improve the efficiency of cleaning the bottomhole sand collector, a container can be used. This container is lowered into the sand collector, equipped with a grab head, and is extracted from the well after it is filled with sand.

To increase the volume and operational period of the bottomhole sand collector, in the absence of lower water-producing formations with pressures not exceeding hydrostatic pressure, the bottomhole sand collector is created with an expanded diameter compared to the diameter of the production casing. This can be achieved using existing wellbore enlargement methods, such as hydromonitor expanders.

The bottomhole sand collector for the operation of a sand-manifesting well can be created during the well drilling process. In this case, it is necessary to reliably establish the possibility of sand manifestation in the well during its operation, based on the example of neighboring production wells with similar sand-manifesting formations. Operating an oil and gas well using the proposed method with a bottomhole sand collector not only extends the well's interrepair period but also improves the performance of the deep pump. A well with a bottomhole collector will maintain a constant flow rate until the collector is filled with sand. The greater the height and volume of the collector, the

longer the interrepair period for cleaning sand plugs will be.

Below, Table 3 presents the critical values of the well flow rate determined using the simplified Retinger-Ukhanov formula:

$$q_{кр} = 6.3 \cdot 10^3 d_B^2 \sqrt{g d_n \left(\frac{\rho_n}{\rho_{ж}} - 1 \right)} \quad (3)$$

where: d_B - internal diameter of the production casing, m; ρ_n and $\rho_{ж}$ densities of sand particles and fluid, g/cm³; $g=10$ - acceleration of gravity, m/sec²; d_n - diameter of sand particles, m;

The analysis of the table shows that the critical flow rate ($q_{кр}$) increases with the growth of the well diameter and the density of rocks. At a well diameter of 120 mm, the critical flow rate varies from 4 to 21 m³/day; at a diameter of 126 mm, it varies from 4 to 22 m³/day; and at a diameter of 148 mm, it varies from 6 to 31 m³/day. Increasing the diameter of sand particles also contributes to the growth of the critical flow rate. These data are important for preventing sand-manifestation problems during well operation. Table 4 presents the pressure drop across the purifier attachments at different attachment diameters, the flow rate of the washing fluid (water), and the velocity of the hydromonitor jet outflow from the attachments.

Table 3 - Critical values of well flow rate $q_{кр}$

$Dв \cdot 10^{-3} \text{ m}^3$	$\rho п \text{ g/cm}^3$	$q_{кр} \text{ , m}^3/\text{day}$				
		$d_n \text{ , mm}$				
		0,1	0,5	1	1,5	2
120	2,0	4	9	12	15	18
	2,4	5	10	14	18	21
126	2,0	4	10	13	17	19
	2,4	5	11	16	19	22
148	2,0	6	13	19	23	27
	2,4	7	15	22	27	31

Table 4 - Pressure drop across the purifier attachments at different attachment diameters, the flow rate of the washing fluid (water), and the velocity of the hydromonitor jet outflow from the attachments

Diameter of the hydromonitor attachment, mm.	Total area attachment mm ²	Flushing fluid flow rate l/s	Fluid flow rate from attachment m/s	Differential pressures on attachment Mpa
10x10	157	18	115	7,3
		19	121	8
		20	127	8,8
11x11	191	22	115	7,3
		23	121	8
		25	131	9,4
12x12	226	25	111	6,8
		28	124	8,3
		30	133	9,7
13x13	265,5	30	113	7
		33	124	8,3
		35	132	9,6
14x14	308	35	114	7,2

Analysis of Table 4 shows that as nozzle diameter and flushing fluid flow rate increase, the fluid flow rate and pressure drop across the nozzles increase. These data are important for optimization of cleaning processes and effective control of

pressure drop in flushing systems.

Results and discussion. At Karazhanbas field, productive formations lie at a depth of 300-350 m, production columns have diameters of 168, 146, 139 mm with thicknesses of 6-8 mm.

The wells are operated by deep pumping with cemented filters with perforated filtration hole diameters of 8-12 mm, well filtration interval is 8-5 meters. Average initial oil flow rate of the well is 10-7 tons/day. Most of the wells are sand penetrating wells. Intensive sanding occurs in the first 3-4 years, and then the intensity decreases. Reduction of oil flow rate in wells occurs from 10-7 tons/day to 1.5-0.5 tons/day during 45-60 days of time. The main cause of oil flow rate reduction is sand accumulation in the filtration interval inside the filter and production casing, in the intake of the depth pump, filtration holes and channels of the wellbore zone, which impedes the flow of oil into the well from the reservoir and causes wear of pump and equipment parts.

The well is repaired every 1.5-2 months by hydromechanical methods, only the internal cavity of the filter and production string. There are many wells in the field that need to be repaired to clean out sand accumulations.

The proposed technology makes it possible to significantly increase the inter-repair period (IRP) of wells affected by sand accumulations, thereby stabilizing and in many cases increasing the oil flow rate, and reducing overall costs for pilot testing and implementation, including workover

operations. The technology consists of creating a bottomhole sand collector by deepening the well by 60-70 m during workover, followed by hydromonitor cleaning of the perforation interval. The process includes preparatory work, lowering of drilling tools with a bit and UBT-36m assembly to clean the bottomhole and form the sand collector, and subsequent well flushing for at least 0.5 hours. In the presence of weakly cemented rocks, the diameter of the collector is enlarged by hydraulic reamers. A cleaner with hydromonitor nozzles is then run into the well on tubing or drill pipes and moved slowly along the perforation interval with a water flow rate of 18-20 l/s. Sand removal is monitored throughout the process, and cleaning stops only after the sand completely exits the well. The cleaner is lifted, and the well is then returned to production. Comparative analysis of oil flow rates before and after the application of the technology is carried out to evaluate efficiency. The technology will pay off due to profit from increased oil production and reduced number of workovers in the first half of the year of application of the proposed method on only one well.

The preliminary economic effect of the proposed method, coming per well per year, can be determined by the following calculation formula:

$$\mathcal{E}_1 = 360 \left[\frac{q_H - q_K}{2} \left(1 - \frac{K_{об}}{100} \right) E_H + \frac{C_p}{t_1} \left(1 - \frac{l_n}{h_{он}} \right) \right] - h_{он} \cdot C_{yr}; \quad (4)$$

where: $K_{об}$ - water cut factor of the well, %.

In the case of well workovers, in order to create a bottom-hole sand accumulator, the cost of the entire well workover can be taken as an additional cost $h_{он}$ C_{yr} .

The resulting economic effect attributable to one well per year, 5.9 times more than the additional costs of deepening the well, equal to only 682 thousand tenge. With an increase in the number of wells working with downhole sand accumulator with cleaning of filtration holes at least to 100, the total economic effect will be equal to 40.9 million tenge, which shows how profitable the application of the proposed technology in the operation of

producing wells.

Sequence of works according to the proposed technology:

- Preparatory work: provide the crews with necessary materials, tools, including hydromonitor cleaner made according to the working drawings submitted by the Institute; instruct the workover crew on the application of new technology.

- Launching of drilling tools into the well with the assembly: bit, UBT-36m, tubing or drill pipes for cleaning the bottomhole from the junk and drilling of the bottomhole sand accumulator with the depth of 60-70 m, by rotary method. Well flushing at least 0.5 hours, and lifting of drilling tools from the wells.

In the presence of soft weakly cemented rocks of the borehole walls in the interval of well deepening, the diameter of the accumulator is expanded by hydraulic reamers. In this case, the depth of the sand accumulator is selected according to [25, 26]

- Run downhole tool with assembly, cleaner with hydromonitor nozzles, drill pipe or tubing to the filtration interval. Conduct well flushing with very slow rotation and progressive movement of the cleaner from top to bottom along the filtration interval, with water flow rate of 18-20 l/sec.

- Conduct observation of the sand exit from the well while the cleaner is moving along the filtration interval, record changes in the intensity of their sand exit from the well.

- Stop cleaning of filtration holes with hydromonitor water jets only when the sand comes out of the wells. Lift the cleaner out of the well.

- Proceed to well operation with inducing oil flow from the reservoir to the wells.

To record changes in oil flow rate of a well under steady production mode. Perform comparative analysis of changes in oil flow rate in the well before and after the introduction of new technology and calculation of economic efficiency according to actual data.

All operations on application of new technology are performed under direct engineering control of responsible representatives of the contractor and the customer.

Conclusion. Analysis of operational data from the Karazhanbas, North Buzachi, and Kumkol fields (2019-2023) revealed that sand occurrence is the main cause of equipment failures, with

rod screw pump (RSP) failures reaching 26% at Karazhanbas, 40% at Kumkol, and 51% at North Buzachi. In many wells, the inter-repair period (IRP) was reduced to 30–45 days, and oil production rates dropped from 10–7 tons/day to 1.0–0.5 tons/day due to sand plug formation.

Pilot tests of the proposed downhole sand collector technology at Karazhanbas demonstrated that forming a collector of 60–70 m depth increased the IRP by 6–8 times, reducing the frequency of cleanings from once every 1–1.5 months to once every 2–3 years. Well productivity was stabilized at the level of 7–8 tons/day, without sharp declines during the inter-repair cycle.

The downhole sand collector technology proved effective in extending the inter-repair period and stabilizing well productivity, as demonstrated by pilot trials at the Karazhanbas field. Economic evaluation showed that deepening wells by 50–150 m resulted in additional costs of only 682 thousand tenge per well per year, while the economic benefit from increased oil production and reduced workovers reached 5.9 times this amount. Scaling the technology to at least 100 wells would yield a total annual economic effect of about 40.9 million tenge, confirming its profitability.

Thus, the downhole sand collector has proven to be a practical and cost-effective solution for mitigating sand production in Kazakhstani oilfields. It allows for longer well operating cycles, reduced repair costs, and stable oil output. Future research should address adaptation to other geological conditions and assess long-term performance under varying operating regimes.

Литература

1. Шмидт А.А. Повышение эффективности эксплуатации скважин осложненных содержанием мех-примесей в продукции: автореф. дис. канд. техн. Наук/ Уфа. - 2007. -107 с.
2. Круглов С. В. Разработка технологии механизированной насосной эксплуатации обводненных газовых скважин: автореф. дис. канд. техн. Наук / Москва. - 2024. - 133 с.
3. Тимашев Э. О., Уразаков К. Р., Латыпов Б. М. Стенд для исследования эластомера статора винтового насоса //Нефтегазовое дело. - 2019. -Т.17(1). - С.85-90. DOI 10.17122/ngdelo-2019-1-85-90.
4. Боранбаев К. Х., Боранбаев А. К. Нефтегазоносные комплексы доюрских отложений Южного

- Мангистау и их характеристика //Вестник нефтегазовой отрасли Казахстана. - 2022.- Т.4(3).- С.3-9. DOI 10.54859/kjogi108579.
5. Мырзахметов Б. А. и др. Противопесочные клапаны для защиты скважинного насосного оборудования в условиях высокого пескопроявления //Горный информационно-аналитический бюллетень (научно-технический журнал). -2020.- №12. - С.125-136. DOI 10.25018/0236-1493-2020-12-0-125-136.
6. Hagemeyer P. M., Jagernath S. Hydrocyclone field tests for removal of sand from production wells in South Oman //Journal of Canadian Petroleum Technology.- 2003.-Vol.42(06). DOI 10.2118/03-06-03.
7. Namig I. PAHTEI-Proceedings of Azerbaijan High Technical Educational Institutions//Hal. - 2023.- Vol.28(05) - P.2674-5224. DOI 10.36962/PAHTEI28052023.
8. Elwan M., Mousa H., Shahin E., Elshiekh M., Wahib O., Mansour M. Application of Multi-Oriented Nozzle for Clean Out Sand Fill in Highly Deviated Well had Succeed to Unlock Oil Reserve in Hpht Oil Well //SPE Gas & Oil Technology Showcase and Conference. - 2024. DOI 10.2118/219267-MS.
9. Tananykhin D., Tcvetkov P., Kamoza V. Analysis and recommendations of sand consolidation methods to limit sand production in gas wells //Journal of Physics: Conference Series. -2018. - Vol.1072(1). P. 012022. DOI 10.1088/1742-6596/1072/1/012022.
10. Saveleva N. N., Shed S. N., Savelev Y. V. Gravel padding filters for combating sandblasting in wells //E3S Web of Conferences - 2023. -Vol.460: 09017. DOI 10.1051/e3sconf/202346009017
11. Dengaev A., Shishulin V., Drozdov I., Novikova A., Eremenko O., Safiullina E., Vakhin A. V. Mechanical Impurities Carry-Over from Horizontal Heavy Oil Production Well //Processes. - 2023.- Vol.11(10). - P.2932. DOI 10.3390/pr11102932.
12. Shamkov A., Gorlov A. Sand Influence Analysis on ESP Operation in Salym Petroleum Development. Effective Methods and Procedures for Sand Protection //SPE Russian Petroleum Technology Conference. - 2019. - Paper Number: SPE-196821-MS. DOI 10.2118/196821-MS
13. Klimov D. S., Ostapchuk S. S., Zakirov E. S. Review of Studies on Plugging Compositions Creation with Controlled Rheological Properties and the Ability to Restore Fluidity for Completion, Workover and Abandonment of Oil and Gas Wells // SOCAR Proceedings. - 2021.- Vol. 2. -P.028-046. DOI 10.5510/OGP2021SI200546
14. Ихсанов К. А., Каримова А. А., Избасаров О. М., Алиев Н. М Ұңғымадан ілеспе құмды шығару жылда //Endless light in science.-2024.-Т.2(2). - С.379-383.
15. Султанов Б. З., Орекешев С. С. Вопросы выноса песка в процессе эксплуатации нефтяных скважин //Нефтегазовое дело.- 2005. - № 1. - С. 2-13
16. Netzhanova A., Bae W., Arystanbay R. A case study on optimization of PCP operations for production increase in an unconsolidated sandstone reservoir //SPE Annual Caspian Technical Conference.- 2014. - P SPE-172285-MS. DOI 10.2118/172285-MS.
17. Кустышев А. В., Дубровский Н. Д. Способ промывки песчаной пробки в газовой скважине в условиях низких пластовых давлений/Патент РФ 2341644. – 2007.
18. Кольцов Е. В., Муляк В. В., Чертенков М. В., Коноплев Ю. П., Чикишев Г. Ф., Герасимов И. В., Цгоев К. Н. Способ борьбы с пескопроявлением в скважине. Патент РФ 2410528. - 2009.
19. Modeland N. J. Method of well completion. Patent USA 10544663. – 2020.
20. Мамаджанов Э. У. Изучение причин осложнений на различных этапах строительства и эксплуатации скважин и меры по их предупреждению в условиях горно-геологических разрезов Узбекистана //Инновации в нефтегазовой отрасли.- 2021.-Т.2(3).- С.30.- 34 DOI 10.5281/zenodo.5804433.

21. Долгов А. В., Долгов С. В., Комарницкий М. М. Устройство для очистки скважины. Патент РФ 2752963. – 2021.
22. Матвеев А.П. Способ очистки скважины от песчаной пробки и гидромониторная насадка для его осуществления. Патент РФ 2715003. – 2020.
23. Верисокин А. Е., Жулина Л. Г. Новый метод снижения обратного выноса проппанта из трещины в скважину после проведения гидроразрыва пласта //Актуальные проблемы нефти и газа.- 2019. - №.4 (27).- С.1-5. DOI 10.29222/ipng.2078-5712.2019-27.art17.

References

1. Shmidt A.A. Povyshenie jeffektivnosti jekspluatacii skvazhin oslozhnennyh sodержaniem mehprimevej v produkcii: avtoref. dis. kand. tehn. nauk. Ufa.- 2007. -107 s. [in Russian]
2. Kruglov S. V. Razrabotka tehnologii mehanizirovannoj nasosnoj jekspluatacii obvodnennyh gazovyh skvazhin: avtoref. dis. kand. tehn. nauk. Moskva. - 2024.- 133 s.). [in Russian]
3. Timashev Je. O., Urazakov K. R., Latypov B. M. Stend dlja issledovanija jelastomera statora vintovogo nasosa //Neftegazovoe delo.- 2019. -T.17(1). - S.85-90. DOI 10.17122/ngdelo-2019-1-85-90. [in Russian]
4. Boranbaev K. H., Boranbaev A. K. Neftegazonosnye komplekсы dojurskih otlozhenij Juzhnogo Mangistau i ih harakteristika //Vestnik neftegazovoj otrasli Kazahstana. - 2022.- T.4(3).- S.3-9. DOI 10.54859/kjogi108579. [in Russian]
5. Myrzahmetov B. A. i dr. Protivopesochnye klapany dlja zashhity skvazhinного nasosного oborudovanija v uslovijah vysokogo peskoprovajlenija //Gornyj informacionno-analiticheskij bjulleten' (nauchno-tehnicheskij zhurnal).-2020.- №12- S.125-136. DOI 10.25018/0236-1493-2020-12-0-125-136. [in Russian]
6. Hagemeyer P. M., Jagernath S. Hydrocyclone field tests for removal of sand from production wells in South Oman //Journal of Canadian Petroleum Technology.- 2003.-Vol.42(06). DOI 10.2118/03-06-03.
7. Namig I. PAHTEI-Proceedings of Azerbaijan High Technical Educational Institutions//Hal. - 2023.- Vol.28(05) - P.2674-5224. DOI 10.36962/PAHTEI28052023.
8. Elwan M., Mousa H., Shahin E., Elshiekh M., Wahib O., Mansour M. Application of Multi-Oriented Nozzle for Clean Out Sand Fill in Highly Deviated Well had Succeed to Unlock Oil Reserve in Hpht Oil Well //SPE Gas & Oil Technology Showcase and Conference. - 2024. DOI 10.2118/219267-MS.
9. Tananykhin D., Tcvetkov P., Kamoza V. Analysis and recommendations of sand consolidation methods to limit sand production in gas wells //Journal of Physics: Conference Series. -2018. - Vol.1072(1). - P. 012022. DOI 10.1088/1742-6596/1072/1/012022.
10. Saveleva N. N., Shed S. N., Savelev Y. V. Gravel padding filters for combating sandblasting in wells //E3S Web of Conferences - 2023. -Vol.460: 09017. DOI 10.1051/e3sconf/202346009017
11. Dengaev A., Shishulin V., Drozdov I., Novikova A., Eremenko O., Safiullina E., Vakhin A. V. Mechanical Impurities Carry-Over from Horizontal Heavy Oil Production Well //Processes. - 2023.- Vol.11(10).- P.2932. DOI 10.3390/pr11102932.
12. Shamkov A., Gorlov A. Sand Influence Analysis on ESP Operation in Salym Petroleum Development. Effective Methods and Procedures for Sand Protection //SPE Russian Petroleum Technology Conference. - 2019. DOI 10.2118/196821-MS.
13. Klimov D. S., Ostapchuk S. S., Zakirov E. S. Review of Studies on Plugging Compositions Creation with Controlled Rheological Properties and the Ability to Restore Fluidity for Completion, Workover

and Abandonment of Oil and Gas Wells // SOCAR Proceedings. - 2021.- Vol. 2. -P.028-046. DOI 10.5510/OGP2021SI200546.

14. Ihsanov K. A., Karimova A. A., Izbasarov O. M., Aliev N. M. Ўңғымдан ilespe қымды шығару zhylda //Endless light in science.-2024.-T.2(2). - S.379-383. [in Russian]

15. Sultanov B. Z., Orekeshev S. S. Voprosy vynosa peska v processe jekspluatatsii neftjanyh skvazhin //Neftegazovoe delo.- 2005. - № 1. - S. 2-13. [in Russian]

16. Netzhanova A., Bae W., Arystanbay R. A case study on optimization of PCP operations for production increase in an unconsolidated sandstone reservoir //SPE Annual Caspian Technical Conference.- 2014. - P SPE-172285-MS. DOI 10.2118/172285-MS.

17. Kustyshev A. V., Dubrovskij N. D. Sposob promyvki peschanoj probki v gazovoj skvazhine v uslovijah nizkih plastovyh davlenij. Patent RF 2341644. – 2007. [in Russian]

18. Kol' cov E. V., Muljak V. V., Chertenkov M. V., Konoplev Ju. P., Chikishev G. F., Gerasimov I. V., Cgoev K. N. Sposob bor' by s peskoproyavleniem v skvazhine. Patent RF 2410528. – 2009. [in Russian]

19. Modeland N. J. Method of well completion. Patent USA 10544663. - 2020.

20. Mamadzhanov Je. U. Izuchenie prichin oslozhenij na razlichnyh jetapah stroitel' stva i jekspluatatsii skvazhin i mery po ih preduprezhdeniju v uslovijah gorno-geologicheskikh razrezov Uzbekistana //Innovacii v neftegazovoj otrasli.- 2021.-T.2(3).-S.30-34. DOI 10.5281/zenodo.5804433. [in Russian]

21. Dolgov A. V., Dolgov S. V., Komarnickij M. M. (2021). Ustrojstvo dlja ochistki skvazhiny. Patent RF 2752963. [in Russian]

22. Matveev A.P. Sposob ochistki skvazhiny ot peschanoj probki i gidromonitornaja nasadka dlja ego osushhestvlenija. Patent RF 2715003.- 2020. [in Russian]

23. Verisokin A. E., Zhulina L. G. Novyj metod snizhenija obratnogo vynosa proppanta iz treshhiny v skvazhinu posle provedenija gidrorazryva plasta //Aktual' nye problemy nefti i gaza.- 2019. - №.4 (27).- S.1-5. DOI 10.29222/ipng.2078-5712.2019-27.art17. [in Russian]

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