



## PROBLEMS OF CLEANING HORIZONTAL WELLS FROM DUST AND THEIR INNOVATIVE SOLUTIONS

**Samadov A.Kh.**

Associate Professor,  
Department of Technological Machines and Equipment,  
Karshi State Technical University

**Nurmatov J.T.**

Associate Professor  
Department of Technological Machines and Equipment,  
Karshi State Technical University

<https://doi.org/10.5281/zenodo.20195670>

### ARTICLE INFO

Qabul qilindi: 10-may 2026 yil  
Ma'qullandi: 12-may 2026 yil  
Nashr qilindi: 14-may 2026 yil

### KEY WORDS

*hydraulic program, completion, boycott effect, zenith angle, second borehole, reverse flushing, bending radius, flow regime.*

### ABSTRACT

*Horizontal well drilling is carried out in difficult conditions. During the drilling process, it is not possible to optimize hydraulic parameters, even if they are interconnected, in terms of each parameter. Horizontal wells with any curvature have problems with bringing the sand to the surface at the curvature section. The article discusses the solution to these problems.*

The technological features of horizontal well washing largely determine the technical, economic, and quality construction of wells. To implement a hydraulic program for drilling horizontal wells, it is necessary to implement specific criteria. Such criteria are: wellbore pressure, maximum drilling rate, rheological and structural-mechanical properties of the flushing fluid, minimum wellbore cleaning, etc. Despite the success achieved through a large number of studies, the generalization and distribution of experiments engaged in the extraction of oil in the construction of wells, as well as the treatment of Wells, the problems of the oil industry remain the subject of constant controversy [1,2,5].

It is not possible to optimize hydraulic parameters for each parameter, no matter how interconnected they are. The most important criteria are to ensure maximum digging speed and completion of the wellbore cleaning. The design of a hydraulic program for washing horizontal and vertical wells begins with determining the consumption of drilling mud, ensuring the washing of the well bottom from sediments and their transportation through the annular space. For this, the necessary mechanical speed for a large zenith angle plot is selected, that is, the worst conditions for ejecting the particles. Then, based on the limitations of the wellbore motor and wellbore parameter measurement system in terms of fluid consumption and pressure, the appropriate types of these devices are determined. There are several ranges of fluid consumption and pressure changes in which efficient drilling is possible.

Many experiments conducted during the construction of horizontal wells have shown that the issue of theoretical developments in the field of well cleaning in such wells lags behind, and it does not allow an objective assessment of the adequacy of scientific experiments conducted by oil and gas company centers and an understanding of the nature of such phenomena: the formation of deposits in the well, the sedimentary movement of deposits directed against the

flow of drilling fluid, the Boycott effect (acceleration of sedimentation in the inclined section of the wellbore), etc. [3,4].

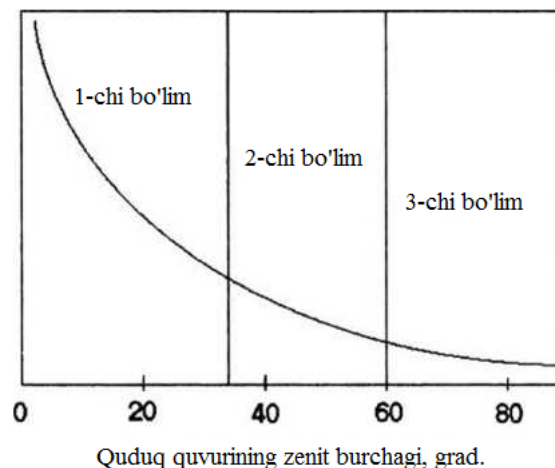
Despite the criticism of experimental devices for transporting natural sediments through a closed cycle, it must be recognized that they laid the foundation for the theoretical cleaning of wells and their successful application in practice.

Classification of sections of a horizontal wellbore depending on the condition of the sediment in the back space of the pipe. The most difficult zone to clear in the annular space zone is the area at a zenith angle of 35-55°. All researchers calculate the slowdown of the drilling fluid flow for the above range. From the equation of balance of forces, the forces acting on a spherical particle located in a plane inclined at an angle of inclination to the vertical are A.G. Potapov and S.V. The most probable value of slow motion in a viscous liquid flow at an angle of incidence  $\alpha_1 = 36^\circ$  and  $\alpha_2 = 54^\circ$  was obtained by Vasil'chenko, and it is possible that a dune will form.

To analytically solve the problem of transporting sludge over the ground, it is necessary to clarify the hydrodynamic criterion that determines the ability of the washing liquid to transport the flow. When the slope angle of the borehole is 10°, small particles begin to settle towards the bottom of the borehole under the influence of gravity. At a slope of 10 - 30°, the formation of sand layers begins. As the zenith angle increases, the sludge becomes more viscous and dense, but the tendency to move to the bottom of the well remains.

This traditional state is decreasing, so that the slope of the well reaches 60°, and then the friction force becomes the reason for stopping the sand. The maximum shear angle is higher for hydrocarbon-based drilling fluids and synthetic mixtures, as a rule, due to the high washing properties of the aqueous-based fluid (Figure 1). Many researchers and engineering and technical personnel of manufacturing enterprises believe that the removal of solids is improved in the following cases:

- from a horizontal section - when the turbulence intensity of the washing liquid flow is increased;
- from steep and inclined sections (with a zenith angle of up to 300) - in the laminar flow regime by increasing the dynamic shear stress;
- In the section with a zenith angle of -35° to 60°, the flow regime has little effect on the removal of sediments.



**Figure 1. Conditional classes of horizontal well casings according to the condition of the wellbore.**

The suggestions presented here should not stop there. The range of the upper and lower limits of the slope angles of the wellbore varies under the influence of various factors: the characteristics of the mud (shape, density, particle size); rheological and thixotropic properties of the flushing fluid (the coefficient of friction for a water-based drilling fluid and a hydrocarbon-based drilling fluid can differ by several times, and accordingly the angle of displacement of the lower mud cushion of the wellbore wall); the fit of the wellbore to the surface, etc.

#### **Parameters affecting wellbore cleaning**

It is necessary that the design of modern systems for cleaning horizontal wells add to the design of the rheological properties and washing technology of the washing fluid, that is, let the accepted drilling speed ensure the release of clots without the use of other additional means or other methods of eliminating complications.

**Several factors influence the cleaning of the wellbore from sand in its inclined and horizontal sections.** Some of them can be adjusted during the design phase or during the drilling process. But there are factors that cannot be predicted or controlled. Controllable factors include the consumption of the flushing fluid, the mechanical speed of the passage, the rheological properties of the flushing fluid, the zenith angle, and the diameter of the wellbore. These are practical factors that are taken into account when optimizing hydraulic issues during the design phase and when drilling wells.

At an inclination angle of the borehole greater than  $20^\circ$ , the drill string can rest against the wall of the well at the bottom, which has a significant effect on the profile of the flow of drilling fluid in the annular space and the position of the cuttings. Horizontal well drilling experiments show that the rotation speed of the drilling string should be increased to improve the removal of sand from the inclined section of the wellbore.

Increasing the rotation speed of the drill pipe has a positive effect on the removal of cuttings when the viscosity of the flushing fluid is increased. Here, it is necessary to take into account the possibility of negative effects of the **Kett-Taylor** effect (the occurrence of local instability when the drill string is rotated in the washing fluid) on the effective cleaning of the borehole. [7].

**Feature of cleaning the second table.** In the case of drilling horizontal wells, the properties of the drilling fluid and its flow velocity through the annular space at equal values, and in the case of a small diameter of the lateral horizontal shaft, in the absence of velocity in the latter case, the accumulation of deposits in the shaft of the horizontal well may occur. When such conditions are affected by the reduction of the geometric dimensions of the annular space, the effectiveness of the wall increases.

As a result, the velocity profile of the flushing fluid flow in the annular space changes and the average velocity of the drilling fluid flow core decreases, i.e., the conditions for cuttings transportation deteriorate. As a result, the velocity profile of the flushing fluid flow in the annular space changes and the average velocity of the drilling fluid flow core decreases, i.e., the conditions for cuttings transportation deteriorate.

When flushing horizontal side wells, it is necessary to use fluids with good thixotropic properties, since such drilling fluids are made on the basis of biopolymers. Biopolymer-based washing fluids have strong pseudoplastic and thixotropic properties, form a gel-like structure

when circulation stops, and exhibit low viscosity at high shear rates. To prepare a good solution, it is necessary to use high-quality reagents. At the same time, the price of the biopolymer can vary significantly depending on the degree of purification.

**Reverse circulation.** The reverse flow of the washing liquid can also be used to increase the flow rate of the outgoing sludge.

Procedure for using reverse washing:

- By reducing the cross-sectional area of the drill pipe, the incoming flow rate is increased by 2.5 – 5.5 times compared to the annular space area;

- In urgent cases, additional cleaning of the wellbore is carried out using the hydroimpulse method, for which the level of the flushing fluid in the drill string is reduced using a compressor, ensuring its safety;

- The resistance force in the movement of the sludge is reduced, that is, the friction of the sludge particles in the movement is much smaller than the coefficient of friction in the movement of the sludge particles in the unreinforced well wall.

If reverse circulation is used, it can cause significant problems when drilling, as the complexity of the wellbore cleaning process can be eliminated at the well design stage.

When drilling and grading horizontal sections, the following should be taken into account: the strongest direction of drilling the well; mud weight during drilling of the front vertical well; Effect of mud weight and hole length on ECD (avoidance of bottleneck due to differential pressure or prevention of hydraulic fracturing when finishing wells).

A computer program has been developed to determine the working range of the density of diesel-based drilling mud for oil and gas named after I.M. Gubkin, which is based on the analysis of the elastic state of the rock, without causing unexpected negative consequences (cracking of the well wall, hydraulic fracturing of the formation). The results of the calculation confirmed the results of studies conducted by B.S. Ladnou and M.I. Chenevert, P.V. Kiselev and V.A. Makhoro, etc.

The diagram constructed using this program is based on the following data (Figure 3.3): Poisson's ratio  $\nu = 0.3$ ; well depth  $z = 3000$  m, formation pressure at this depth  $P_{lay} = 45$  MPa, rock pressure  $P_{rock} = 69$  MPa.

According to the conducted calculations, the greatest difficulty in ensuring the stability of the well wall occurs at an angle of  $45 - 90^\circ$ . At this time, when horizontal wells are drilled through the interval, complications arise due to the incomplete removal of the sands. The complexity of the well wall surface and the condition of the well wall collapse are due to the insufficient retention of the flushing fluid. Improved borehole cleaning tools can have positive results in preventing wellbore collapse. In this case, the best option is to increase the density of the washing liquid.

### References:

1. Самадов, А. Х., & Мирзаев, Э. С. (2021). ПРИМЕНЕНИЕ ИНГИБИРОВАННОЙ БУРОВЫХ СМЕСЕЙ ДЛЯ ПОДДЕРЖАНИЯ ПРОЧНОСТИ СКВАЖИНЫ. Экономика и социум, (4-2 (83)), 1328-1331.
2. Джураева Г. Х., Самадов А. Х., Мейлиева М. Ш., Исмаатов Б. А. МЕТОДЫ ПЕРЕРАБОТКИ НЕФТЯНЫХ УГЛЕВОДОРОДОВ // Экономика и социум. 2026. №1-2(140). URL: <https://cyberleninka.ru/article/n/metody-pererabotki-neftyanyhuglevodorodov-1> (дата обращения: 25.04.2026).

3. Samadova, M. X., Nurmatov, J. T., Samadov, A. X., Abdiraximov, I. E., Tog'ayev, A. I., & Kurbanov, A. T. (2022). Neft va gaz konlari asoslari.
4. Samadov A.X., Ashurov Sh.M., Bekmuratov J.A. BURG'ILASH MINORASINI MONTAJ VA DEMONTAJ QILISH TEXNOLOGIYASINI ASOSLASH // Экономика и социум. 2024. №5-1 (120). URL: <https://cyberleninka.ru/article/n/burg-ilash-minorasini-montaj-va-demontaj-qilish-texnologiyasini-asoslash> (дата обращения: 25.04.2026).
5. Samadov A.X., Kasimova A.Y., Umedullayev A.G. USE OF GEONAVIGATION SYSTEM IN CONTROLLING AND FAST CONTROL OF HORIZONTAL WELLS' STEM TRAJECTORY // Экономика и социум. 2024. №3-1 (118). URL: <https://cyberleninka.ru/article/n/use-of-geonavigation-system-in-controlling-and-fast-control-of-horizontal-wells-stem-trajectory> (дата обращения: 11.11.2024).
6. Самадов А. Х., Бойқобилова М. М., Мажидова Ю. С. ТЕХНОЛОГИЯ ВОЗДЕЙСТВИЯ ПАРОВОГО ТЕПЛА И ГОРЯЧЕЙ ВОДЫ НА ПЛАСТ ЧЕРЕЗ НАГНЕТАТЕЛЬНУЮ СКВАЖИНУ // Экономика и социум. 2023. №10 (113)-1. URL: <https://cyberleninka.ru/article/n/tehnologiya-vozdeystviya-parovogo-tepla-i-goryachey-vody-na-plast-cherez-nagnetatelnyuyu-skvazhinu> (дата обращения: 11.11.2024).
7. Nomozov B.Yu., Samadov A.X., Yuldashev J.B., Boyqobilova M.M. ISM TURDAGI QATTIQ QOTISHMALI BURG'ILAR // Экономика и социум. 2023. №9 (112). URL: <https://cyberleninka.ru/article/n/ism-turdagi-qattiq-qotishmali-burgilar> (дата обращения: 11.11.2024).

INNOVATIVE  
ACADEMY