

FEATURES OF FLUSHING AN OIL WELL

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The first flushing of oil wells during drilling was carried out more than 100 years ago, when developing an oil field near the city of Grozny. Ordinary water was used as a washing liquid at that time. Currently, this technological operation is one of the main ones in the rotary drilling method.

The main task of the circulation of the drilling fluid during drilling is to remove the remnants of drilled rocks, in order to avoid additional wear of the rock cutting equipment. The effectiveness of bottomhole cleaning depends on both the rate of passage of the flushing solution and its performance. That is why the flushing fluid is prepared according to established recipes and both geological (rock type, reservoir pressure, reservoir temperature, reservoir water availability, etc.) and technological factors of an oil well (depth, diameter) are necessarily taken into account during preparation.

Along the way, when flushing an oil well, the following is carried out:

- transfer of hydraulic energy from the pump to a turbo- or electric drill, bit, screw downhole motor;
- cooling, lubrication and anti-corrosion protection of the bit, when the flushing fluid passes through the holes of the drill. Oxidative destruction of metal parts of equipment occurs as a result of exposure to oxygen dissolved in the washing solution, hydrogen sulfide and rock salts. Anti-corrosion properties of the working drilling fluid are given by the addition of inhibitors to it.
- flushing of oil wells during drilling allows to reduce the amount of abrasive wear in the drilling process, with timely and proper cleaning of the drilling fluid from solid particles of cuttings;
- facilitating the drilling process, due to the kinetic energy of the fluid when it exits the drill bit and reducing the coefficient of friction. This is especially effective when working on loose soils;
- creating pressure on the wellbore to prevent gas-oil and water intrusions and collapse of the well walls when working in unstable rocks;
- during shutdown of pumps (in an emergency) temporary maintenance of the suspended state of sludge particles. To do this, the drilling fluid is given thixotropic properties by additives, allowing it to transform from a sol to a gel;
- prevention of technological difficulties in the drilling process, including differential sticking of the drill string;
- strengthening the borehole of an oil well while working on weak and fractured rocks, by creating a reinforced clay cake;
- preservation of reservoir productivity in the wellbore zone.

There are direct, reverse and combined methods of flushing an oil well during drilling. The direct circulation method involves running tubing into the well. The high-

pressure mud pump injects the solution, which passes through the leading string. The flushing fluid stream captures cuttings particles and brings them to the surface, moving in the opposite direction along the annular channel between the borehole wall and the drilling rig. The spent solution is purified in many stages, for which it is sequentially sent to:

- preliminary mechanical rough cleaning (vibrating sieve block);
- a system of hydrocyclones, where, under the influence of centrifugal force, solid slurry particles are separated from the drilling fluid. Cleaning of the hydrocyclone is done through the bottom valve connected to the sludge pit;
- sand separators. On this equipment, the working solution is completely cleared of silt and sand particles and can be reused for flushing an oil well during drilling.

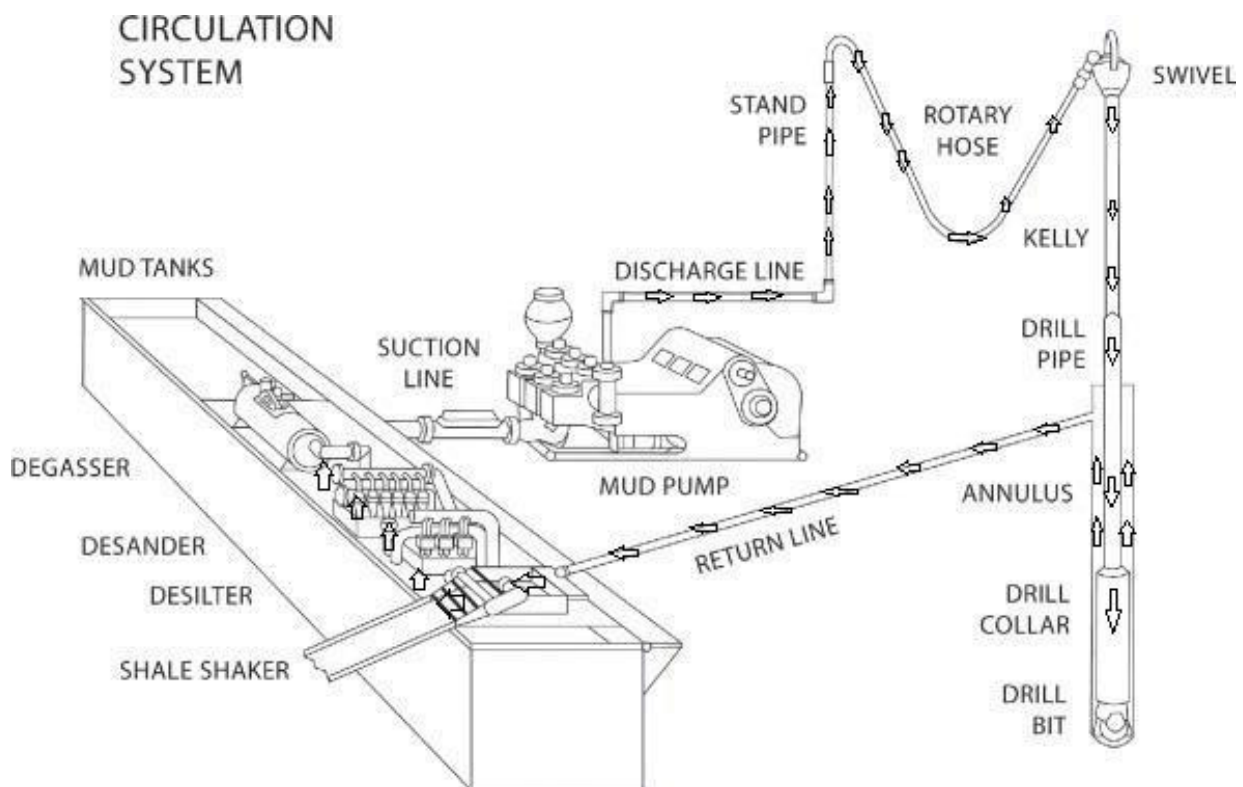


Fig. 1 Drilling mud circulation system

The advantage of the direct flushing method is an increase in the speed of the well passage. This effect is achieved due to the wedging effect of the flow of the working fluid, thereby reducing the mechanical strength of the rocks. In addition, when drilling in soft soils, it is possible to select a special composition of the flushing fluid, which will ensure the fixation of the walls of the oil well.

The disadvantage of the method is the appearance of sand plugs during drilling due to thermal effects on deposits. As a result, additional time is spent on flushing the oil well “to clean water” before pipe extension. It is also important that the direct circulation method requires a large amount of working fluid, especially when drilling with a bit of maximum diameter.

In general, due to technological simplicity and efficiency, the direct method of

flushing an oil well has become the most widely used in drilling.

The backwash method is used in case of emergencies, with low power drilling equipment, as well as with an increased diameter of the mine. This method involves lowering the drilling fluid into the mine through the inter-annular space of the face, along the shaft walls and its further supply to the holes of the bit. The rise of the working fluid occurs through the internal channel of the drill pipes. According to the technology, a flushing head with a stuffing box is hermetically installed at the mouth of the mine. After flushing an oil well, a more intensive removal of large particles of cuttings is achieved, and it also becomes possible to raise the core without stopping the drilling process.

Among the main disadvantages of the reverse flushing method of an oil well during drilling, it should be noted, first of all, the destruction of the walls when working on soft rocks and frequent emergencies due to the rupture of horizontal layers. In addition, when the core is exposed to the flow of flushing liquid on its end part, it is partially destroyed during its rise to the surface, due to which the volume of its production is reduced.

The combined flushing method can only be used if there is special equipment with an airlift and three channels, through which the following occurs separately:

- supply of a solution for flushing an oil well during drilling;
- pulp elevation;
- compressed air supply for airlift operation.

In this case, the flow of the flushing liquid to the core tube occurs similarly to the direct method, and below it, the reverse. When performing combined flushing, the reverse channel can be a leading well of the minimum diameter, in the bottom hole of which larger particles settle. The main part of the sludge is brought to the surface by an airlift. Combined circulation allows you to thoroughly clean the bottom hole from sludge residues and get the highest possible output of high quality core. However, this method is rather complicated technologically, which is why it is rarely used.

Separately, it is necessary to consider the method of bottom-hole circulation of the drilling fluid. It is used in the case of drilling with a complication in the form of highly absorbing layers. Bottom-hole (local) flushing of an oil well is carried out using submersible pumps or a plunger pulsator. The cuttings in these cases are collected in sludge traps, which can be placed both inside the drill string and on the surface.

References

1. Kozhevnykov, A., Khomenko, V., Liu, B., Kamyshatskyi, O., & Pashchenko, O. (2020). The History of Gas Hydrates Studies: From Laboratory Curiosity to a New Fuel Alternative. *Key Engineering Materials*, 844, 49-64.
2. Pashchenko, O.A., Ihnatov, A.O., Vladyko, O.B. (2021). Some Features of Rock Destruction at the Bottom of the Well. *Tooling materials science*, 24, 121-134.