WEB OF SCIENTIST: INTERNATIONAL SCIENTIFIC RESEARCH JOURNAL
ISSN: 2776-0979, Volume 5, Issue 5, May - 2024

FEATURES OF SAND REMOVAL FROM THE HORIZONTAL SECTION OF THE WELLBORE AND METHODS OF WASHING THE WELLBORE

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Abstract

This article provides information on methods for eliminating complex sand plugs, as well as on classic and modern ways to achieve the cleanliness of the bottom of the well to create the correct mode of operation in structures.

Keywords: bottom-hole wells, sand plugs, bottom-hole flushing, tuchnological processes, psychoactive substances (surfactants), pumping compressor pipe, coiled tubing, flexible pipe.

Introduction

In this case, the liquid and gas carry a significant amount of sand into the well during the movement along the reservoir. If the speed is insufficient to lift the sand grains, they are deposited at the bottom, forming a plug, terminating the access of fluid from the reservoir. Therefore, in order to resume normal operation of the well, it is necessary to clean the bottom hole from sand.

Direct flushing of a well from a sand plug is the process of removing sand from it by pumping flushing fluid into the deflated tubing and removing the eroded rock with liquid through the annular space of the well (pipe). The end of the pipe suspension is equipped with a pen, milling machine, pencil milling;

High-speed direct flushing - when the flushing pipes are built up, the flushing process does not stop, this excludes the settling of eroded sand and sticking of the tubing string.

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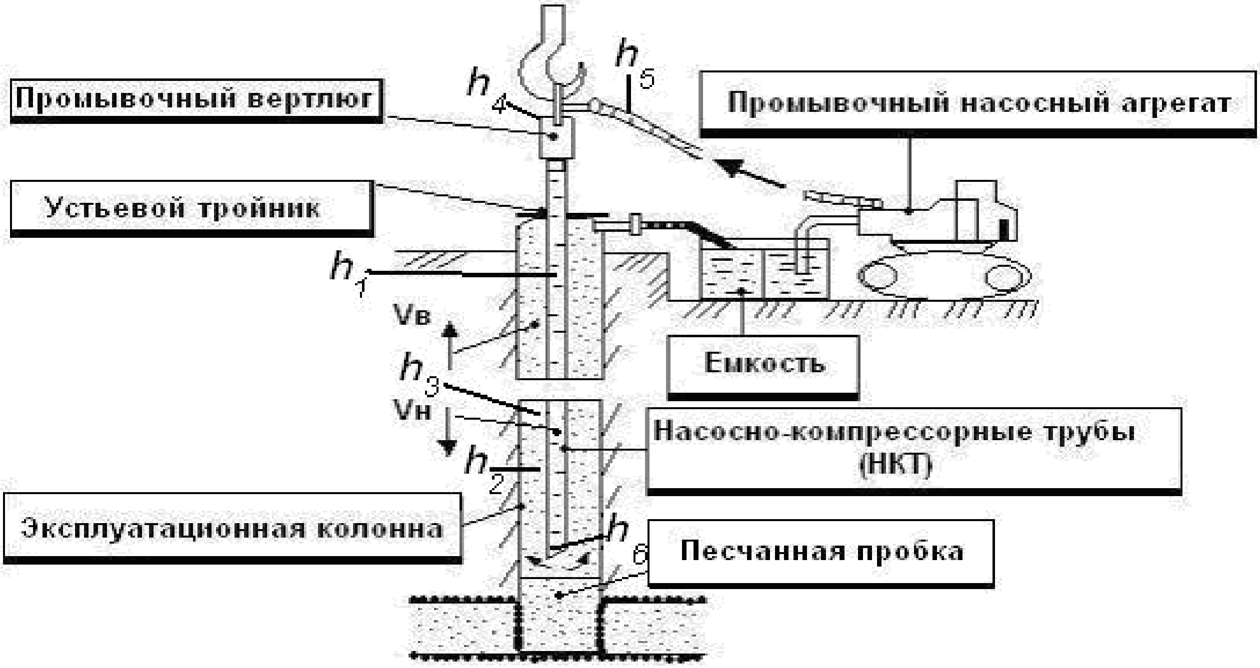

Fig.1. Direct flushing scheme

Reverse flushing of the well is the process of removing sand from the well by injecting flushing fluid into the annular space and directing the upward flow of fluid through flushing pipes. Due to the smaller cross-section, high upflow velocities are created in them, which ensures better sand removal;

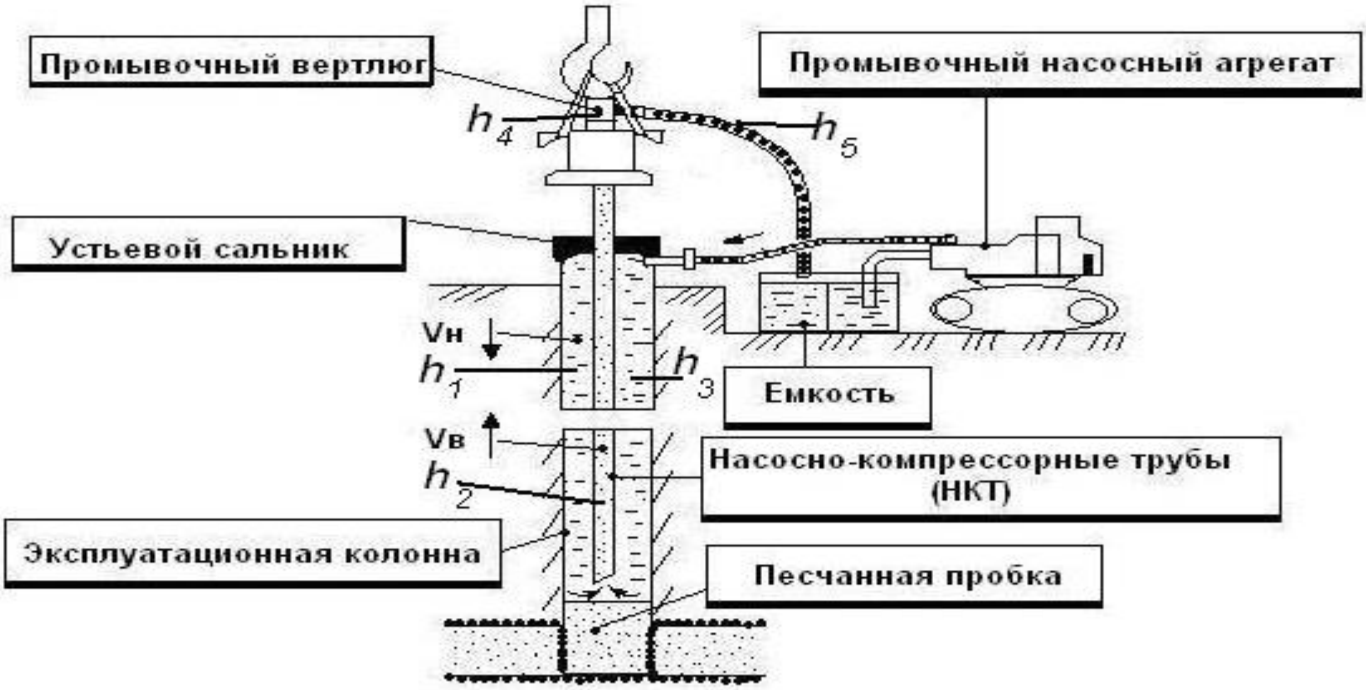

Fig.2. Backwashing scheme

Flushing of wells with jet devices is used in cases where the ex. string has defects. The flushing unit consists of a jet pump, concentrically located pipes and surface equipment (hose, swivel, water pouring device);

Cleaning wells from sand plugs with aerated liquid, foams and compressed air. It is used in wells with a small column of liquid and in the presence of loose plugs at the bottom. An oil seal is used to seal the wellhead. Aerated liquid, foam, compressed air are used as a working agent. The advantages of this method are the exclusion of absorption of flushing fluid by the reservoir; acceleration of the process of putting the well into operation after cleaning from the plug; the ability to clean part of the string below the filter holes (sump);

Rinsing with aerated liquid with the addition of surfactants. It is used in wells with low reservoir pressure, the operation of which is complicated by frequent plugging, and the elimination of plugs is associated with the absorption of flushing fluid by the reservoir;

Flushing of wells with surfactants. It is used to reduce the surface tension at the oil-water interface. The addition of surfactants to hard water contributes to the reduction of its surface tension and the rapid, almost complete removal of this water from the bottomhole zone during well development. Sulfanol, sulfonasodium salts, demulsifiers, etc. are used as surfactants;

Flushing wells with foams. At a certain concentration of surfactant solution in water, a stable foam is formed, which is used for flushing wells;

Cleaning of wells from plugs with troughs. The method consists in sequential lowering of the chute to the bottomhole, filling it and lifting. There are simple, piston and automatic chutes. Despite the simplicity, this method has a number of significant drawbacks - the duration of the process; the possibility of wiping the ex. string; the possibility of breaking the tartal rope or wire; contamination of the workplace. in case of tight plugs - piston, in all other cases - automatic;

Cleaning wells from sand plugs with hydraulic drills. Sand plugs can be removed from the well without running down the flushing pipes. For this purpose, a hydraulic drill lowered on a rope is used. After hitting the plug, the hydraulic drill is lifted by 2-3 m and again hit the surface with the chisel. During the next lift, the plunger sucks liquid with sand from under the bit, then the sand enters the chute and the liquid into the piston pump. With such blows, in several steps, a sand plug settled on the face is sucked into the hydraulic drill. In order to avoid the formation of rope loops or its large tension and breakage, it is recommended to carry out work at a reduced speed of the lift.

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Fig.3. Sand from tubing

At present, in oil and gas field practice, two methods are used to combat sand removal from wells, in particular, mechanical and chemical.

Mechanical methods to prevent the destruction of the productive reservoir are based on shielding the fracture zone by installing various types of filters in the well or their formation in the bottomhole zone by alluvium.

Chemical methods to prevent the destruction of the productive layer are based on the injection of chemical reagents with cementing properties into the productive layer, as a result of which there is an artificial fixation of loose sands in the bottomhole zone.

Mechanical methods are advisable to use in the following cases:

- wells have very dense perforations;
- the reservoir is mainly composed of clay sands;
- the column is in poor condition near or along the entire productive interval;
- poor-quality cementing of the column;
- low bottomhole pressures;
- Insignificant residual reserves of natural hydrocarbons, and as a result, the inexpediency of using chemical methods of fastening.

It is advisable to use chemical methods in the following cases:

- small perforation interval (does not exceed 3 m);
- absence of conditions for sand removal with the presence of caverns or zones of deep drainage of layers;
- the well is located in the zone of limited sand flow;
- The sand is well sorted with good vertical permeability.

Features of sand removal from the horizontal section of the wellbore

As mentioned earlier, the process of sand accumulation in the wellbore of the horizontal section of the well is different from the same process in the vertical section of the wellbore. For the vertical section of the wellbore, the vectors of the rates of rise and fall of rock particles are directed only upwards and downwards. For the horizontal section of the wellbore, the flow velocity vectors are downward and horizontal. A distinctive feature in the latter case is the profile of the horizontal shaft itself, which has a zigzag appearance, which ultimately increases the likelihood of sand accumulation. If the well is equipped with tubing, centralizers are installed in its lower part, which does not completely exclude the formation of sand plugs.

Fig.4. Sand plug

Coiled tubing is a coiled tubing unit (coiled tubing) for the development and workover of oil and gas wells. Coiled tubing technology was developed in the 1950s, but was not widely used until the late 1980s. This is what makes coiled tubing technology cheaper and more environmentally friendly than classical methods.

Coiled tubing application

First of all, coiled tubing is used in field exploration, drilling and repair and restoration work. However, coiled tubing is now used to produce high-viscosity, "heavy" oil. The technology is most widely used in the northern regions of Canada and the United States (in Alaska), but recently it has been actively used in fields in Russia.

Coiled Tubing Equipment

The coiled tubing unit is used to transport and supply coiled tubing of the required diameter to the well. As a rule, coiled tubing equipment is installed on a self-propelled chassis or semi-trailer. Figure 1 shows the main components of the plant:

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- power plant,
- control cabin,
- working coil,
- injection head,
- blowout prevention equipment.

The size of the pipe is selected depending on the work being performed. Usually, the diameter of the pipes varies from 19 to 114 mm.

Fig.5. Coiled tubing installation

Next, the pipe passes through the injection (wellhead) head, which creates the necessary force to move the tubing inside the well, taking into account the overcoming of friction and pressure in the wellbore.
Coiled tubing units are used for well workover and testing, in particular in the following technological operations:

- Geophysical research.
- Induce inflow by lowering the level in the well.
- Repair of directional wells.
- Repair of horizontal wells.
- Gas lift operation of wells.
- Killing wells.
- Removal of fluid from gas wells.
- Well cementing.

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- Operation of wells through flexible pipes.
- Balanced well drilling.

Drilling of side pillars.

- Underbalanced well drilling.
- Removal of traffic jams.
- Casing and tubing cutting.
- Acid treatment of the bottomhole zone of the formation.
- Drilling hard sediments.
- Hydraulic fracturing.
- Perforation of wells.
- Installation of gravel filters.

Cleaning the bottom of the well from sand

Application

To ensure the normal operation of wells, sand accumulating at the bottom of the well must be removed. Otherwise, an increase in its volume above the level of perforation holes leads to a decrease in the flow rate of wells, and sometimes to the termination of their operation. Causes of sand plugs The process of sand plug formation occurs in almost all oil and gas wells. Its intensity is due to the properties of the productive reservoir and the technology of operation.

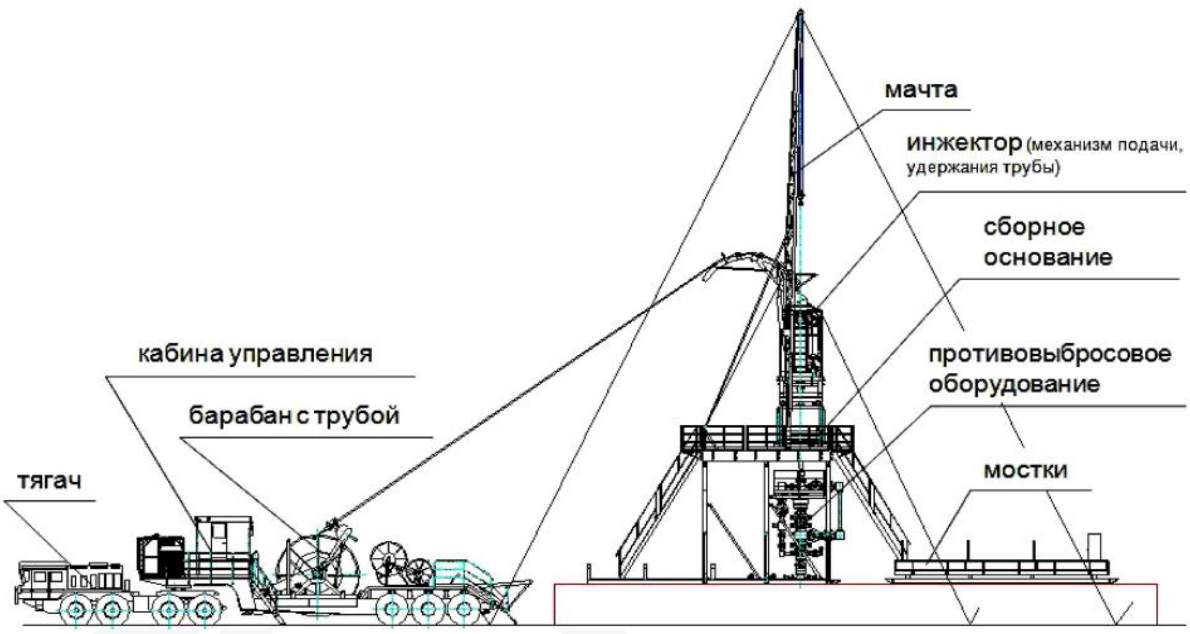

Fig.6. General view of the coiled tubing unit. M-20 repair and technological unit

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Causes of sand plugs:

The process of sand plugging occurs in almost all oil and gas wells. Its intensity is due to the properties of the productive reservoir and the technology of operation. The appearance of sand at the bottom of the well can be due to several factors:

• sedimentation of reservoir particles carried out through perforation holes in the production string into the inner cavity of the well;
• particle sedimentation after operations using hydrosandblast perforators;
• particle sedimentation after hydraulic fracturing operations;
• the presence of sand washed into the borehole cavity when creating an artificial bottomhole, etc.

Equipment and Materials

• coiled tubing unit (a flexible pipe must have a check valve and a flushing nozzle at the end);
• pumping unit;
• tanks for process fluid;
• process fluid, which is used as Newtonian fluids, non-Newtonian fluids, two-phase mixtures, inert gases. Newtonian fluids include (water, salt solutions on water, hydrocarbon liquids (diesel fuel, refined oil, etc.), non-Newtonian fluids include drilling fluids and gels.

50

Максимальное тяговое усилие инжектора, кН (кгс)	355 (36 200)
Скорость перемещения БДТ при спускоподъемных операциях, м/с (м/мин): – минимальная – максимальная	0,015 (0,9) 0,70 (42)
Диаметр БДТ, мм	44,45
Максимальная длина БДТ на барабане, м – при диаметре БДТ 44,45 мм (толщина стенки до 4,0 мм)	5500
Максимальная масса БДТ, допускаемая конструкцией, кг	23 000
Максимальное давление на устье скважины, МПа	70
Максимальное давление закачки технологической жидкости, допускаемое конструкцией установки, МПа (максимальное давление закачки при проведении операций определяется исходя из прочностных характеристик применяемой БДТ)	70
Габаритные размеры (могут измениться в процессе разработки) мм, не более: – длина – ширина – высота	15 200 2 550 4 490
Полная масса, кг (без жидкости в БДТ), не более	65 000
Максимальная скорость передвижения, км/ч	50

Conclusion

The result of the above-mentioned methods at high rates depends on the correct organization of the process of its application. It is advisable to use each method depending on the condition of the wells, that is, taking into account the degree of their contamination with sand. Of course, among them, in addition to the classic methods that are constantly used to this day, some modern, convenient technologies are also effective. The "coiled tubing" technology given as an example is widely used in countries with large deposits, for example, at fields located in Russia. Such clean-up work ensures that the product extracted from the well will continue in a different range. High efficiency is achieved by the use of wells at the Khojaabad gas storage facility located in Uzbekistan, and wells at such fields as Andijan, Mingbulak, North Ortabulak, Shortepa, Kruk, Istiqlol, South Kemachi and many others.

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