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The technology of radial drilling as a method of improved oil recovery

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Abstract

Currently, the volume of difficult oil in the world is increase and amasses close to 70%. Electric submersible pumps (ESPs) and jack pumps (SRP) used ever more 80% of the wells. Mechanical method of production is not always effective due to the low coefficient of efficiency pump units operating in marginal wells. There is a limit for well production rate below which produce oil is technically impossible or economically unprofitable. Many wells, currently stopped oil production due to unprofitability of oil wells with hard to recover reserves. It leads to their conservation or liquidation. The number of such wells is of these wells is about 25000-30 000. Pressure communication suffers from lack of quality in a "well-formation". It is caused by technological problems in the construction of wells, particularly in the productive intervals. It leads to excessive pressure in the reservoir, and then plugging reservoir mud filtrate or the cement slurry reaches a depth of several meters.

Keywords: Radial drilling, horizontal well, perforation channel, branching;

1. Introduction

Radial drilling system designed for deep perforation producing interval with the completion of construction of oil and gas wells or their repair. The system allows to increase the product ion rate of producing wells, injection wells to increase throttle response and eliminate the cones water-gas-oil contacts in the bottomhole formation zone. It is done by creating a system of spiral-shaped perforations with a predicted trajectory [5,6,7].

Secondary formation exposing of the well`s productive zone remains one of the main and difficult stages of the well completion. It includes creating a perfect hydrodynamic connection between the well and the productive format ion without negatively affecting on reservoir properties and destruction of cement zone.

Currently, cumulative perforation that does not meet the requirements is widespread. There are "gentle" methods. Chink hydromechanical and sandblasting punchers do not le ad to catastrophic destruction of cement stone. It also does not allow obtaining deep channels to establish a hydraulically perfect connection between the formation and the well [2].

2. Radial drilling technology

One of the modern "gentle" methods of secondary drilling in, is drilling of small diameter channels and radius of curvature along a predicted trajectory. It became possible to build such

highly curved channels by the creation of the radial drilling technical system [3]. Using the new drill design will allow drilling of perforation channels longer than 14 meters, a diameter of 58 to 60 mm with radii of curvature from 3.5 to 12 meters, and controlling their paths along the zenith and azimuthal angles, discretely changing the design of the system layout, under rig [7].

The use of perforation technology will make many thousands of idle wells profitable, increase oil recovery factor, optimize the grid of field development. Moreover it will allow for directional hydraulic fracturing of formation, acid treatment, as well as apply other methods of oil recovery intensification due to the possibility of re-entering in the drilled channels.

The use of a radial drilling allows to drill in without preparatory operations including: removing part of the casing string, creating a cement bridge and drilling a spare port in it. It also helps to increase economic efficiency from the application of this method, and the system of removable whipstock- deflectors will significantly reduce the time required for multi-network construction of branched channels.

Figure 3 shows the operation of the technical system in a horizontal wellbore.

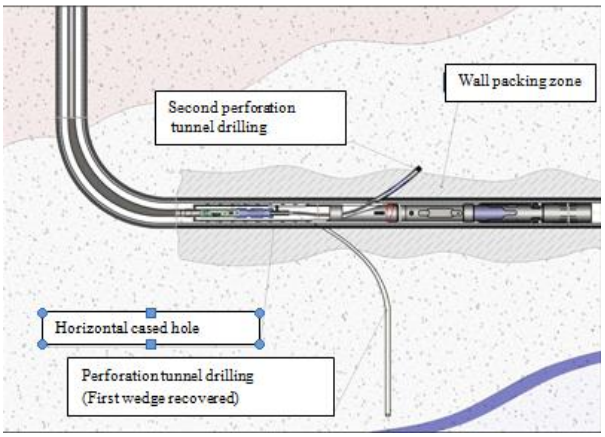

Fig 1. Radial drilling system in a horizontal wellbore

The packaging arrangement of the bottom-hole assembly have been designed, to perform various technological operations, such as milling the drive pipe, array for a set of zenith angle, its (zenith angle) smooth reduction and stabilization. Figure 4 shows comparative profiles of perforation channels with calculated radii of curvature obtained analytically and experimentally.

This system allows drilling perforation channels with radii of curvature from 3.5 to 12 meters, controlling their lengths and trajectories along the zenith and azimuthal angles, discretely changing the design of the packaging arrangement, in the conditions of drilling during tripping process [2,3].

Using of various the packaging arrangement of the bottom section of column allows not only to mill the drive pipe, but also to set, reduce or stabilize the zenith angle at the stages of construction of perforation channels [1,10].

So, for example, if productive formation contains reservoir, radial drilling allows you to bypass such areas, which will also help reduce the level of water cut, and positively distinguishes the technology from competitors (Figure 6).

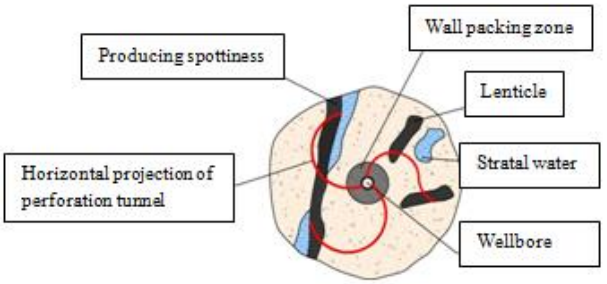

Fig 2. The projection of the perforation channel within one tier made using the radial drilling Technical System

1.

To achieve the required parameters of the perforating complex, the drilling the arrangement must have high strength characteristics. In the case of small-sized drill string arrangment, this takes on even more importance, since the bending and torsional rigidity of the perfobur hole equipment is several times lower than that of large-sized analogues [3,6,7,8,9]. The use of high-quality alloy steels solves only part of the problem, and a competent statement of the problem: from compiling models and single-valuedness condition, to choosing a solution algorithm, significantly increase the quality and quantity of drill string arrangment, and therefore increase the overhaul period of operation [6,8].

3. Conclusion

The radial drilling system is designed to improve the quality of the hydrodynamic connection of a productive formation with a drilled well at the final stage of its construction or overhaul deep perforation of productive interval, of oil and gas wells, by a system of directional channels. This system allows you to increase the production rate and injectivity of injection wells.

- The proposed of the perforation system's basic elements is intended for the secondary exposing of carbonate reservoirs of oil and gas wells, as the most common and explored in the framework of the reseach both experimentally and analytically.
- The packaging arrangement of the drill string perforated, allows to get into the reservoirs of low power and provide communication the main wellbore with the reservoir, overcoming the zone of mudding.
- Carrying out deep perforation of wells, allows to increase oil recovery factor by several times, as evidenced by analytical calculations, confirmed by the hydrodynamic model. As a result of geological and technological measures, there is an increase in oil production in the first year of implementation, which continues with a slow decline over 10 years.

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