ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 8, Issue 2 , February 2021

Multi-stage Hydraulic Facing-method of Intensification of Oil Production

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ABSTRACT: The modern methods of multi-stage fracturing are considered; their disadvantages are revealed. The developed scheme of the installation for a new method of multistage hydraulic fracturing and the principle of operation of the installation are presented. The advantages of this installation are shown.

KEY WORDS: hydraulic fracturing, multistage hydraulic fracturing, hydraulic fracturing in horizontal wells, new method, inflatable packer, multistage hydraulic fracturing.

I.INTRODUCTION

The oil and gas industry is one of the main in the structure of the national economy of our Republic. According to the forecast of the development of the national economy in the near and distant future, its role will not decrease.

The formation of the oil and gas industry of the Republic is inextricably linked with the development of the theory of the development of hydrocarbon deposits. A characteristic feature of the theory of the development of hydrocarbon deposits in the twentieth century was the creation of various methods for predicting development indicators due to the need to take into account the variety of geological and physical features of the old and new facilities put into operation.

At present, heterogeneous, weakly drained, low-permeability and dissected reservoirs, which are classified as hard-to-recover reserves, are widely introduced into development. To ensure a high level of oil and gas production, along with the exploration and development of new fields, much attention is paid to increasing oil recovery by methods of intensifying oil production.

II. METHODOLOGY

In the development of hard-to-recover hydrocarbon reserves, horizontal wells (HW) and hydraulic fracturing (HF) have become widespread. The main advantage of the HS is the creation the maximum area of contact with the reservoir, leading to an increase in the drainage area and a decrease in the drawdown in the reservoir. Hydraulic fracturing is used in the development of low-permeability reservoirs, as well as to stimulate the flow in the event of deterioration of the filtration characteristics of the bottomhole zone. One of the most effective development methods applied recently is the combination of these two technologies: horizontal wells with a series of hydraulic fractures.

Hydraulic fracturing (hydraulic fracturing) is the most effective and widespread method of increasing the productivity of injection and production wells worldwide and provides more than 40% of additional oil production.

Hydraulic fracturing increases the productivity of wells, at the same time boosts oil production and increases the level of oil recovery by affecting the reservoirs. An increase in permeability, as a result, an increase in oil production, determines the widespread use of this method in the exploration and development of oil fields [1].

In wells with horizontal ends reaching several thousand meters, one hydraulic fracturing will not cause a large increase in well production. Therefore, multi-stage hydraulic fracturing is used.

Today, multi-stage hydraulic fracturing (MSHF) has become a daily enhanced oil recovery technology. It is used both on traditional reserves and on hard-to-recover ones. Nevertheless, this method is constantly being improved and developed in accordance with new challenges. In particular, in the development of complex low-permeability reservoirs with poor filtration-volumetric properties, the inefficiency of standard spherical multi-stage hydraulic fracturing, which has certain limitations, became obvious. As a result, a new type of hydraulic fracturing assembly appeared - ballless, which is fundamentally different from the previously used ones.

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Figure: 1. Schematic representation of multistage hydraulic fracturing

Currently, there are several ways to carry out multistage hydraulic fracturing.

1. Lowering the selective packer into the liner with zones separated by the packers, followed by moving the selective packer from the bottom to the wellhead while sequentially fracturing the formation at different intervals.

2. Running the packer, which isolates the screen installed in the wellbore in the fracturing interval, after the hydraulic fracturing, the isolating packer is installed, and the unit is moved to a new fracturing area. After all hydraulic fractures have been completed, all isolation packers are drilled out.

3. Run the packer to isolate the wellhead. Hydraulic fracturing is carried out through filters, first in the intervals of the reservoir with the highest permeability, then in the intervals with lower permeability with the previously removed cake in the filter interval.

These methods have many disadvantages, the main ones being: high material and time costs, difficulties in unpacking the anchor unit of the packer, complex design of double packers, etc. [2]

The development of a method that eliminates the above disadvantages is a promising direction, since it solves the following technical problems: increasing reliability, reducing the time of running and lifting mechanisms, tightly cutting off hydraulic fracturing intervals from each other, increasing the accuracy of hydraulic fracturing in specified intervals, reducing material costs, reusable installation.

The unit uses TAM-J twin reusable inflatable packers. The setup diagram is shown in Fig. 2.

New is that this design runs into the production casing, which is less costly than running a liner. It is mobile, compact, with a length not exceeding 4 m. The inflatable packers used do not require unpacking of the anchor unit, provide high tightness of the required interval, have a large range of outer diameters - from 42.9 to 178 mm, which ensures high applicability in various conditions. Descends on tubing pipes. One phenolic ball it is used twice, first for setting packers, then for opening the channel for proppant release.

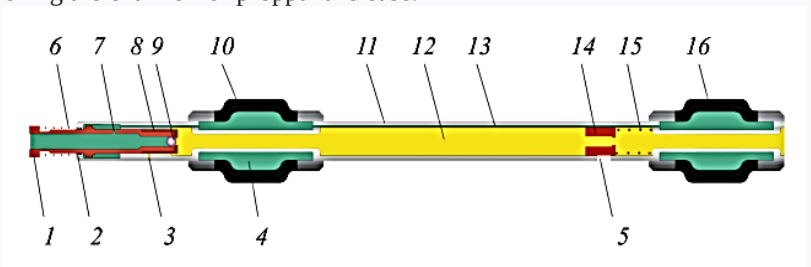

Figure: 2. Scheme of multistage hydraulic fracturing installation:
1 - control mechanism of the “J” bayonet in the inflation position; 2 - bearing; 3 - outlet port; 4 - packer filler; 5 - proppant outlet channel; 6 - spring;
7 - port for inflating packers; 8 - collet clamp; 9 - phenolic ball; 10 - packer 1; 11 - installation body; 12 - installation workspace; 13 - capillary connecting packers; 14 - multipurpose valve; 15 - spring; 16 - packer 2.

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In fig. 3 shows the proposed method of operation of the installation for multiple hydraulic fracturing.

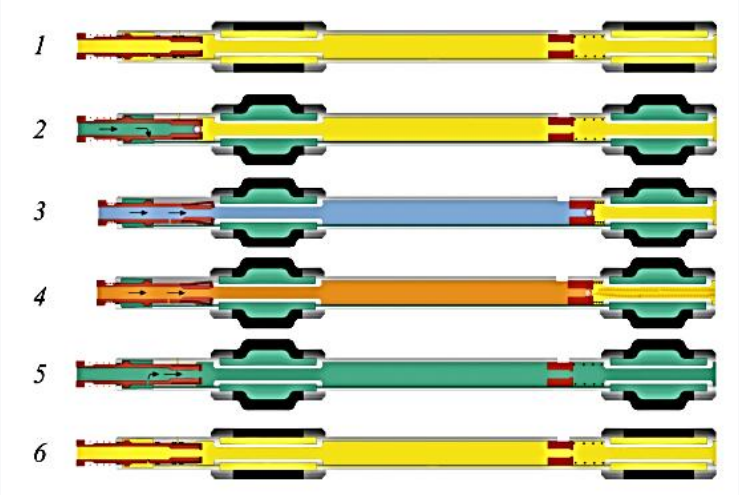

Figure: 3. Scheme of the multi-stage hydraulic fracturing method

The principle of operation of the installation is as follows. Hydraulic fracturing in a horizontal wellbore is performed from the bottom hole to the wellhead at intervals.

1. The rig is lowered along the production casing to the bottom of the well on the tubing in the transport position, the "J" bayonet control mechanism is in the inflation position.

2. A phenolic ball is lowered into the rig, pressurized to inflate the packers. The installation takes the working position.

3. The column is unloaded. Due to the presence of a port for inflation and equalization of pressures between the seals, the packer element is isolated from the pressure in the working string. The collet is opened, the phenolic ball is lowered to the multi-purpose valve, which, under the action of pressure, compresses the spring and opens the proppant outlet. Portions of proppant are injected into the well. Hydraulic fracturing is performed.

4. With the last portion of the injected proppant, smooth water is pumped, which dissolves the phenolic ball in 8 hours. The multipurpose valve returns to its original position, closing the proppant outlet.

5. The string is unloaded, the port for inflation of the packer is opened, through which the packer is deflated. The liquid flows both into the working string and into the annulus.

6. The rig assumes a transport position; in which it is lifted to the next fracturing interval. [3]

III. CONCLUSION

The presented method makes it possible to carry out multi-stage hydraulic fracturing directly in the production casing. The packers used ensure high tightness of the fracturing interval. The simple installation mechanism helps to reduce the cost of its production. Reuse of phenolic balls helps to reduce the time and cost of multistage fracturing.

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