IJABR

International Journal of Advanced Biotechnology and Research (IJABR)
ISSN 0976-2612, Online ISSN 2278–599X,
Special Issue-1, 2019, pp265-268
http://www.bipublication.com

Research Article

Development of a Technology for Shutting off the Formation Water Inflow in Wells with Horizontal Tailing-in

Dmitrii LEONTIEV[a] and Viktor MAZURIN[b]

Industrial University of Tyumen, Tyumen, Russia
[a]leontevds@tyuiu.ru, [b]mazurinvs@tyuiu.ru

ABSTRACT

During the operation of oil reservoirs underlaid by bottom water, the rate of oil recovery depends on the deformation of oil-water contacts and the breakthrough of formation water to the bottom of oil-producing wells.The task facing the authors was to increase the efficiency of water-shutoff works, to shut off the formation water inflow in the cased horizontal section of a well.The technology includes withdrawal of downhole equipment; geophysical surveys in the horizontal section of a well; determining the interval of aquifer water inflow; lowering with a coiled tubing the equipment consisting of a connector, a double clapper check valve, an emergency disconnector, centralizers, two expanding packers, between which a perforated nipple is attached by means of coupling joints; dropping the ball into the coiled tubing, injecting the water-shutoff composition into the coiled tubing; dropping the ball down to the emergency disconnector, creating hydraulic pressure; detaching the coiled tubing from the equipment and lifting it to the surface; waiting on cement; lowering the equipment with a mill using the coiled tubing; drilling out the perforated nipple, expanding packers and residues of the water-shutoff composition with washing out to the daylight surface; lowering the downhole equipment; exploring the well and bringing it to stable production.The novelty of the proposed technology lies in the application of the developed two-packer assembly with expanding packers to selectively shut off the formation water inflow in the cased horizontal section of an oil-producing well.

Keywords: Well with horizontal tailing-in, Formation water inflow, Water-shutoff works, Expanding packers.

INTRODUCTION

At the final stage of field development, as the reservoir pressure decreases, bottom water begins to infiltrate into the productive reservoir section. Initially, bottom water begins to move to the bottom of a well in the form of a water cone, and as the oil-water contact (OWC) or gas-water contact (GWC) rises, the water comes to the bottomhole, enters the wellbore through holes of the perforation interval, begins to gradually accumulate at the bottomhole and slowly rise along the wellbore, blocking the perforation interval, preventing oil (gas) from flowing from the well to the surface. The well waters out, and production stops. To restart production, it is necessary to conduct water-shutoff works, for example, pump water-shutoff compositions through non-watered out perforations or newly formed holes to create a water-shutoff screen.

Most often, to shut off the formation water inflow, cement grout is squeezed into the watering-out part of a formation and a well is kept for cement setting [1, 2].

Currently, coiled tubing technologies are a progressively developing area in the field of oil and gas well workover in Russia. One of the promising areas of coiled tubing application is water-shutoff works, including in wells with horizontal tailing-in.

The main advantages of using coiled tubing technologies are [3-5]:

- possibility of conducting works in oil and gas wells without prior killing;
- wellhead tightness at all stages of downhole operations;
- safety of lowering and raising operations (LRO);
- significant improvement in working conditions of the workover crew during the entire complex of operations;
- reduction of time for lowering and raising the downhole equipment to the design depth;
- providing the possibility of drilling, lowering downhole tools and instruments, as well as performing operations of underground repair in horizontal wells and side tracks with horizontal tailing-in;
- no need to explore wells and stimulate the inflow;
- compliance with higher environmental requirements during all operations of well repair and drilling, in particular, due to the smaller size of equipment for this purpose compared to traditional ones;
- potentially high economic effect of the use of coiled tubing during both repair and drilling operations.

METHODS

The task facing the authors was to increase the efficiency of water-shutoff works, to shut off the formation water inflow in the cased horizontal section of a well.

The technical result consists in the development of an effective method for shutting off the formation water inflow in the horizontal cased area of an oil-producing well, injecting a water-shutoff composition into a predetermined interval of horizontal wellbore [6-8].

The technology is implemented as follows.

A well (1) with horizontal tailing-in, which entered a productive formation (2) and watered out due to the breakthrough of formation waters (3) from an aquifer (4), is shut down. Downhole equipment used for production is removed from the well (Fig. 1).

Geophysical studies are conducted in the horizontal section of the well (1), and the interval (3) of water inflow from the aquifer (4) is identified. To do this, a geophysical instrument with packed cable is lowered into the cased horizontal wellbore using the coiled tubing; after that, in the case of a multiphase composition of extracted products, the change in phase composition along the horizontal wellbore profile, and the length L of the aquifer (4) interval (3) of the cased horizontal section of the well (1), subject to water-shutoff works, are determined.

Using the coiled tubing (5), the assembly consisting of a connector, a double clapper check valve, an emergency disconnector, centralizers, two expanding packers (6) and (7), between which a perforated nipple (8) is attached by means of coupling joints, is lowered into the well (Fig. 2).

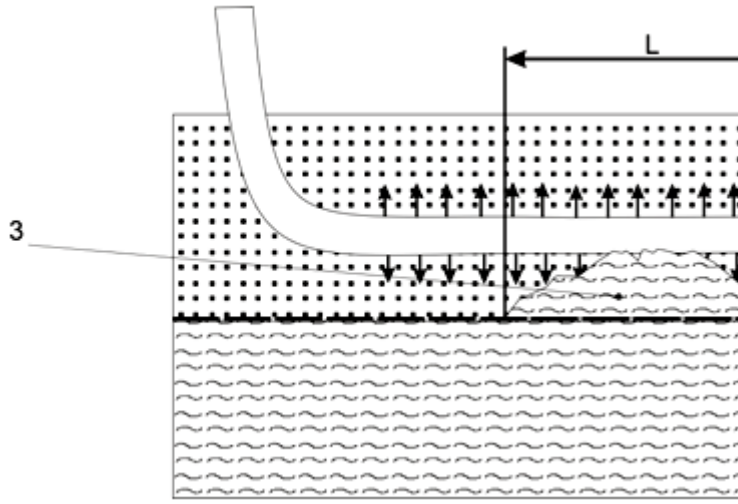

Fig. 1 Well with horizontal tailing-in watered out due to the breakthrough of formation waters. 1 – well; 2 – productive formation; 3 – formation water inflow; 4 – aquifer.

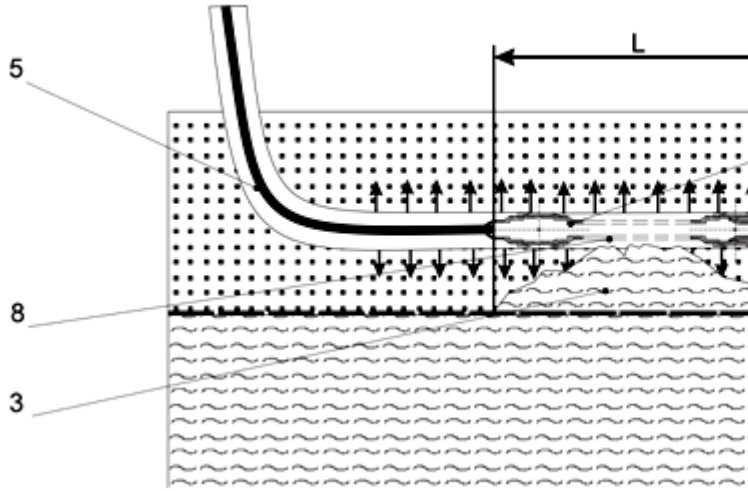

Fig. 2 Lowering the assembly into the well.1 – well; 2 – productive formation; 3 – formation water

inflow; 4 – aquifer; 5 – coiled tubing; 6,7 – expanding packers; 8 – perforated nipple.

Expanding packers consist of bodies (9) and (10) having channels in the form of holes (11) and (12) for injecting process fluid into internal cavities located between the bodies (9) and (10) and the rubber sealing elements (13) and (14). The rubber sealing elements (13) and (14) are attached to the packer bodies (9) and (10) by means of retaining rings (15) and (16) on threaded connections (Fig. 3).

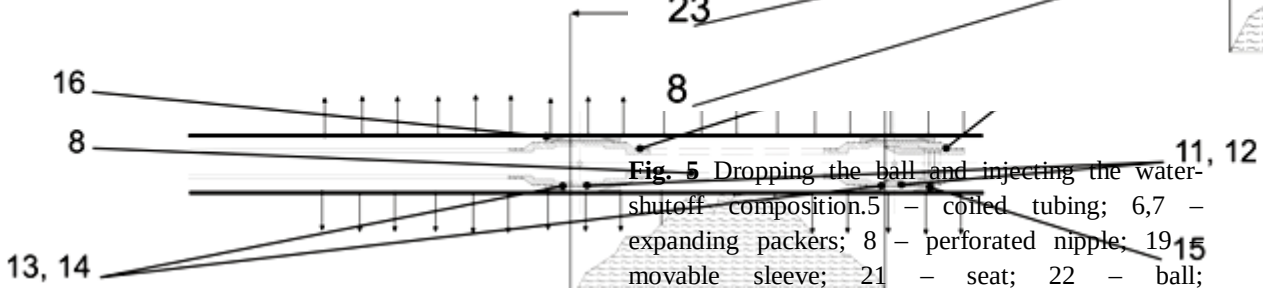

Fig. 3 Expanding packers.8 – perforated nipple; 9, 10 – bodies of expanding packers; 11, 12 – channels in the form of holes; 13, 14 – rubber sealing elements; 15, 16 – retaining rings.

Inside the packer (6), there is a spring (18) above a collar (17), which has a movable sleeve (19) on the top. From above, the movable sleeve (19) is supported by a protrusion (20). The movable sleeve (19) has a seat (21) (Fig. 4).

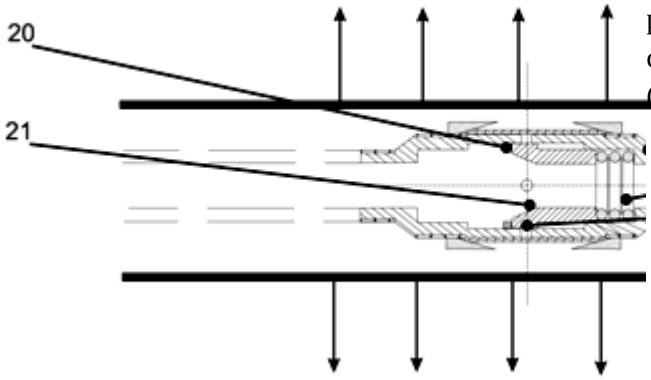

Fig. 4 Design of the first packer.17 – collar; 18 – spring; 19 – movable sleeve; 20 – protrusion; 21 – seat.

After lowering the assembly to the required interval of water shutoff, a ball (22) is dropped into the coiled tubing (5). The ball (22) passing through the coiled tubing (5) and the packer (6) falls into the seat (21) of the packer (7) movable sleeve (19). After that, the required volume of the water-shutoff composition is injected (23) into the coiled tubing (5) (Fig. 5).

Fig. 5 Dropping the ball and injecting the water-shutoff composition.5 – coiled tubing; 6,7 – expanding packers; 8 – perforated nipple; 19 – movable sleeve; 21 – seat; 22 – ball; 23 – injection of the composition.

During injection, the ball (22), which is in the seat (21), squeezes the packer (7) movable sleeve (19) under hydraulic pressure of the grouting mortar, the spring (18) is compressed, the channel (12) opens. The water-shutoff composition, pumping into the channel (12), stretches the rubber sealing element (14) of the packer (7), thereby ensuring its contact with the casing wall in the horizontal section of the well (1) (Fig. 6).

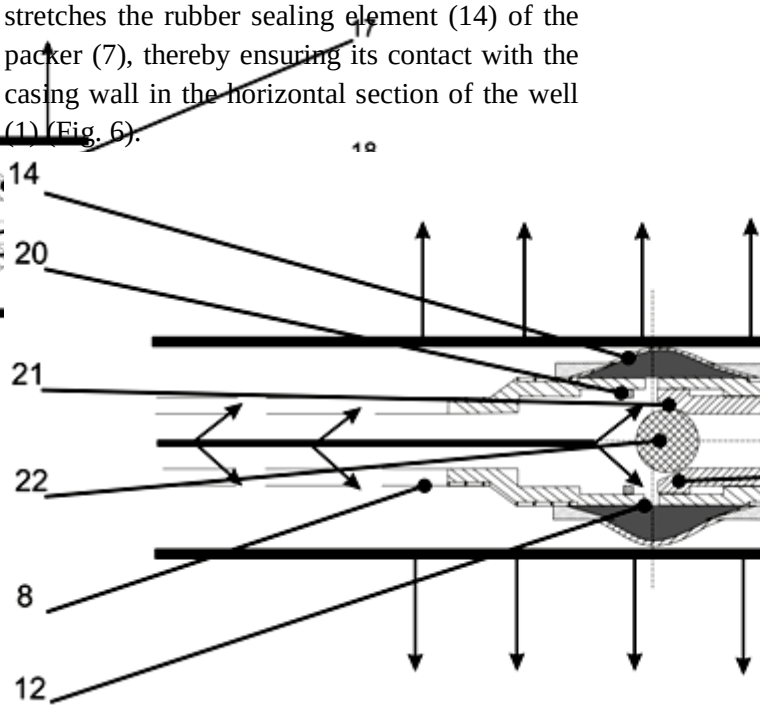

Fig. 6 Actuation of the first packer.8 – perforated nipple; 12 – channel in the form of hole; 14 – rubber

sealing element; 17 – collar; 18 – spring; 19 – movable sleeve; 20 – protrusion; 21 – seat; 22 – ball.

Further, in the process of injection, the grouting composition enters perforations of the perforated nipple (8), as well as into the channel (13) of the packer (6). The rubber sealing element (13) of the packer (6) begins to stretch out and contract with the well (1) casing wall. In the process of injecting the water-shutoff composition, the rubber sealing elements (13) and (14) of the packers (6) and (7) are in an inflated state, and the composition is pumped through holes of the perforated nipple (8) into the watered out interval of the formation.

Then the ball is dropped into the coiled tubing (5) down to the emergency disconnector, hydraulic (for example, water) pressure is supplied, the coiled tubing (5) is disconnected from the assembly and raised to the surface (not shown). After this, the well (1) is left for WOC (waiting on cement).

After WOC, the assembly with a mill is lowered into the well using the coiled tubing, and the perforated nipple, packers and residues of the water-shutoff composition are drilled out with washing out to the daylight surface.

After completion of works, downhole equipment is lowered into the well, the well is explored and brought to stable production.

CONCLUSION

1. The technology proposed by the authors allows increasing the efficiency of water-shutoff works, and prolonging the water-free operation of wells with horizontal tailing-in.

2. The novelty of the proposed invention lies in the application of the developed two-packer assembly with expanding packers to selectively shut off the formation water inflow in the horizontal section of an oil-producing well.

REFERENCES

[1] I.I. Kleshchenko, G.P. Zozulya, A.K. Yagafarov,Theory and Practice of Repair and Shutoff Works in Oil and Gas Wells: Textbook,TIU, Tyumen, 2010.

[2] Yu.A. Nifontov (Ed.), Repair of Oil and Gas Wells, Autonomous Non-Profit Organization, Scientific and Educational Organization “Professional”, St. Petersburg, 2005.

[3] S.M. Weinstock, A.G. Molchanov, V.I. Nekrasov, V.I. Chernobrovkin, Underground Repair and Drilling of Wells with the Use of Coiled Tubing, Publishing House of the Academy of Mining Sciences, Moscow, 1999.

[4] A.D. Amirov et al., Reference Book on the Maintenance Repair and Workover of Wells, Nedra, Moscow, 1979, pp. 238-241.

[5] A.V. Kustyshev, Yu.V. Vaganov,Shutting off the formation water inflow using a coiled tubing unit at gas fields in West Siberia, Time of Coiled Tubing 2 (2013) 30-36.

[6] DAVOODABADI, F. M., &Shahsavari, H. (2013). GIS Modeling of Earthquake Damage Zones Using ETM Data and Remote Sensing-Bojnoord, Khorasan Province, UCT Journal of Research in Science, Engineering and Technology, 1(1): 7-11.

[7] Dyachuk, P. P., Dyachuk, P. P., Shadrin, I. V., &Peregudova, I. P. (2018). Dynamic adaptive testing and peculiarities of its use with medical students. *Electronic Journal of General Medicine*, *15*(6).

[8] Kilitci A, Kaya Z, Acar EM, Elmas ÖF. Scrotal Calcinosis: Analysis of 5 Cases. J ClinExp Invest. 2018;9(4):150-3.