IJABR

International Journal of Advanced Biotechnology and Research (IJABR)
ISSN 0976-2612, Online ISSN 2278–599X,
Special Issue-1, 2019, pp254-259
http://www.bipublication.com

Research Article

Elaboration of a Technology for the Development of a High-viscosity Index Oil Reservoir Using High-temperature Geothermal Waters

Dmitrii LEONTYEV[a] and ViktorMAZURIN[b]

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

ABSTRACT.
The proposed by the authors technology of the development of a high-viscosity index oil reservoir supposes using the thermal properties of thermal waters located below the geological section of a high-viscosity index oil reservoir and pumping them into a productive horizon without rising to the earth surface with the purpose of warming the rock and reducing oil viscosity, which will allow the significant facilitation of oil production by producing wells, as well as excluding the use of the equipment for chemical injection (steam, gas, heated water, surfactants, etc.), installed on the earth surface.

Keywords: High-viscosity index oil, Thermal water, Hydraulic reservoir fracturing, Downhole jewelry, Western Siberia.

INTRODUCTION

At the present time, almost all over the world, the oil industry is characterized by the fact that most of discovered and placed under production fields in the 20th century moved into the stage of actively falling production. Increasingly frequently, forums and applied research conferences raise the issues of the development of fields characterized by a complex geological structure, hard-to-recover reserves, high-viscosity index oils, with abnormally low reservoir pressures, etc.

Particular features of the development of such fields include a number of problems faced by almost all oil producing companies: reduction in the overhaul period of operation of surface and well equipment, complications of the operation of oil-field equipment, a high accident rate of the equipment due to increased loads, problems of the recovery and the rational use of associated petroleum gas, and the low profitability of field development [1,2].

The task of developing fields with high-viscosity index oil is to develop new ones and improve the existing methodical and technical and technological solutions which will provide reducing energy and operating costs in the process of extracting hydrocarbons, collecting and preparing products under the production, etc.

It shall be noted that high-temperature geothermal waters are located in the geological cross-section of a majority of oil and gas areas. So, in the territory of the West Siberian artesian basin, there are colossal reserves of geothermal waters. The sedimentary cover from a depth of approximately 1 km is saturated with thermal waters. The Apt-Alb-Cenomanian, Neocomian, Upper Jurassic,and Lower Middle Jurassic aquifer systems are isolated from each other by a series of matured water-resisting strata.

The temperature variation interval of thermal waters for the Apt-Alb-Cenomanian system

averages 50 °C, for the Neocomian system approximately 100 °C, the Jurassic system – up to 140 °C. In the bottom boundary of Jurassic sediments, overheated thermal waters can be present too, the temperature of which reaches up to 200 °C [1-3].

The Object and Research Methods

The authors propose the technology of the development of a high-viscosity index oil reservoir using the geothermal water, which is realized as follows (Figs. 1-2) [4, 5].

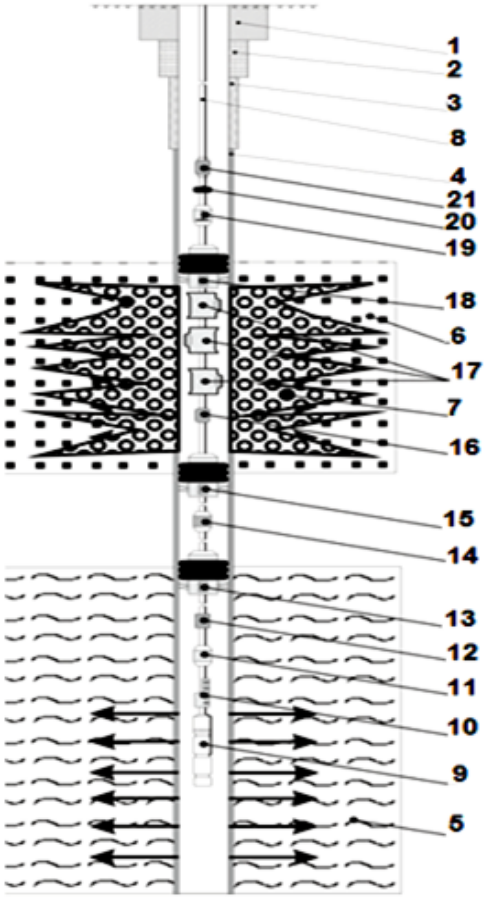
A reservoir with high-viscosity index oil isdrilled out with producing and injection wells.

The design of injection wells 3 shall provide for: the direction 1, the conductor casing 2, the intermediate string 3 and the production casing string 4.

The depth and subsequent descent of a production casing string of an injection well must be provided for so that its bore-hole bottom is completed in the horizon with thermal waters 5, located along the geological cross-section below the reservoir with high-viscosity index oil 6 (Fig. 1).

After carrying out the service connected with lowering and cementing casing strings, the injection well is perforated at intervals with thermal waters, as well as in the reservoir with high-viscosity index oil [6-8].

Then, in the interval of the reservoir with high-viscosity index oil 9, service is carried out on the hydraulic reservoir fracturing with the injection of propping material (for example, the proppant) into the created technological breakings 7. Conducting the hydraulic reservoir fracturing in the injection well is necessary to increase the injection capacity of the well in the reservoir interval.



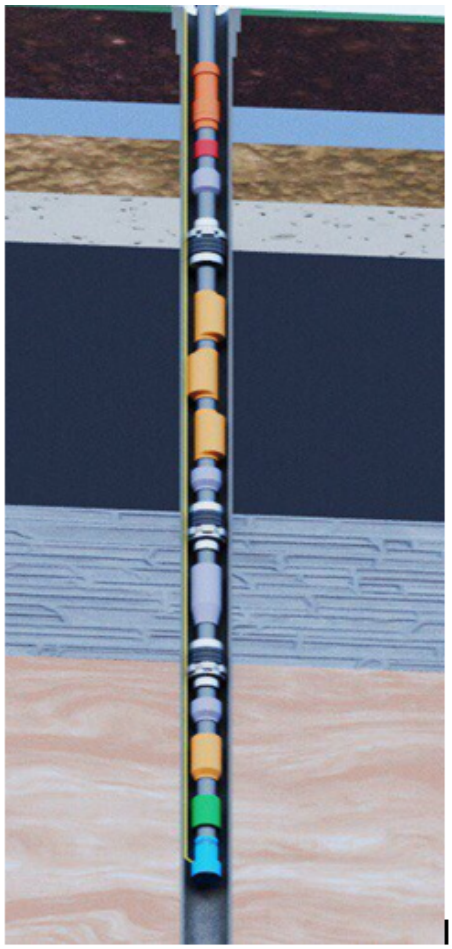


Fig. 1 The design and equipment of the injection well.

After that, the sucker-rod string 8, whereon the pump 9 with the cable(bottom-up),the cable damage indicator with depth sensors for measuring the pressure and the temperature at the suction and the discharge of the pump 10, the drain valve/tubing drain 11, the landing

nipple 12 for the installation of plug caps, the mechanical packer 13, the circulation valve 14, the thrust packer 15 with the hydraulic anchor, the fit nipple for the borehole choke 16, the set of borehole chambers with valves for water injection 17, the thrust packer 18, the back pressure valve 19, the on/off tool 20, and the temperature compensator 21 are lowered.

The distance between the packers 15 and 18 must be observed so that the packer 18 is located in the well at the top of the reservoir with high-viscosity index oil, and the packer 15 at the bottom of the reservoir with high-viscosity index oil. It is necessary to install the packer 13 at the top horizon with thermal waters.

In the design of producing wells, it is necessary to provide for: the direction 22, the conductor casing 23 and the production casing string 24.

The depth and the subsequent descent of the production casing string 24 of the production well must be provided for in such a manner that its bottom is completed at a depth of 50-100 m below the bottom of the reservoir with high-viscosity index oil (i.e., provide for a drilling sump). After carrying out the service connected with lowering and cementing casing strings, the production well is perforated in the reservoir with high-viscosity index oil (Fig. 2).

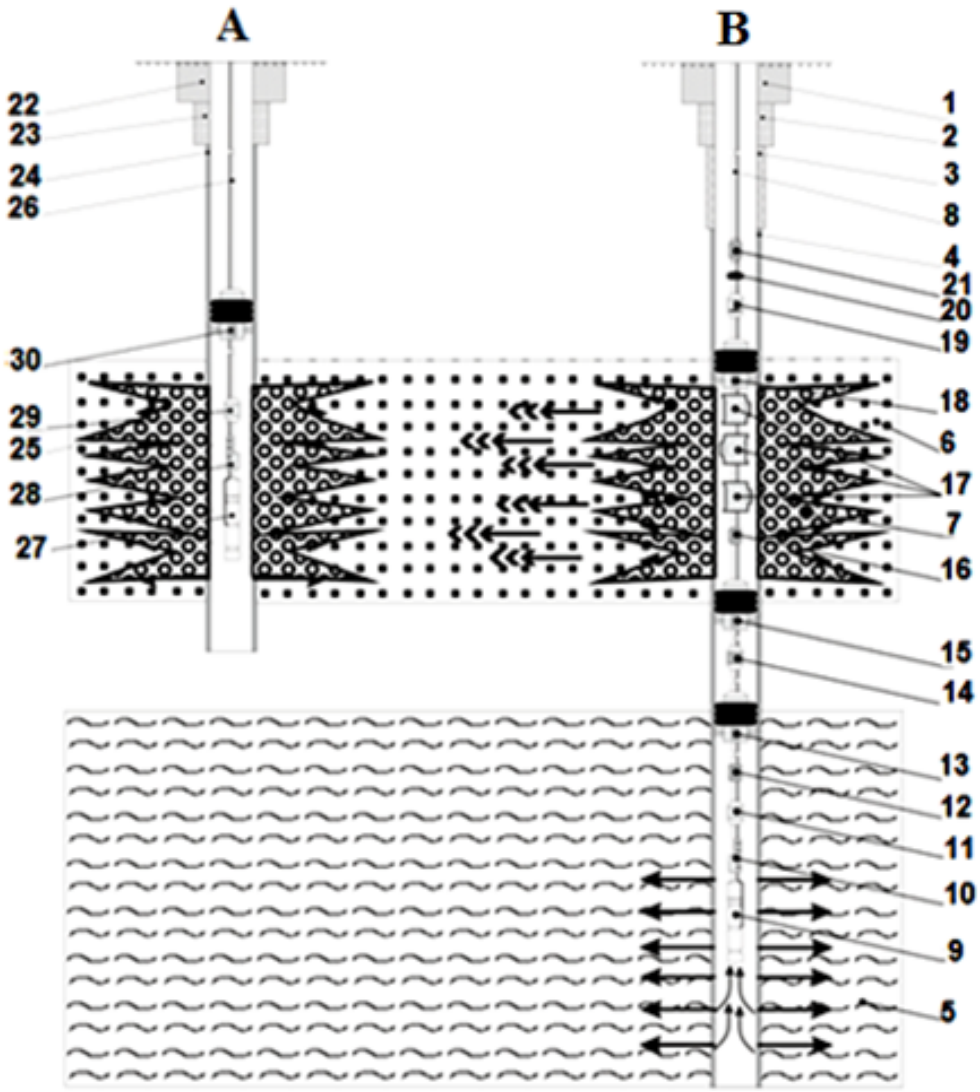


Fig. 2 The design and the equipment of producing (A) and injection (B) wells.

Then in the production well, in the interval of the reservoir with high-viscosity index oil, the fracturing of the hydraulic reservoir is carried out with the injection of propping material into the created technological breakings 25.

After that, the production tubing string 26, on which the centrifugal pump 27 with the cable, the cable fault indicator with depth sensors for measuring the pressure and the temperature at the inlet and discharge of ETsN 28, the drain valve/tubing drain ETsN 29 and the mechanical action packer 30 are lowered (bottom-up), is lowered into the production well.

The injection well is put into operation as follows.

After the descent of the tubing string NKT 8 with the downhole equipment, the mechanical action packer 13, and then the thrust packers 15 and 18 are released. The tubing string NKT 8 is suspended in the tubing head of the production X-tree located on the landing head. The production X-tree is placed on the tubing head.

Then, using the cable-cable technology on a wire in the combination with a lock, the rod, the spang jars,and a connector, the plug-cap is lowered to the landing nipple 12, the plug-cap is installed and the wire with the lock, the rod and the connector is lifted. After that, the circulating valve 14 is activated and the casing string-borehole annulus is filled with the interpacker fluid of a certain density, which will be injected between the packers 13 and 15. After injecting the required interpacker fluid volume, the circulating valve 14 is closed. Then, with the use of the cable-cable equipment, the plug-cap is removed from the landing nipple 12. The pump cable is connected to the field control station and the well is put into the operation.

Due to the fact that the back pressure valve is provided for a set of the downhole equipment on the tubing stringer NKT, produced thermal waters of the horizon do not rise to the earth surface, but are pumped into the reservoir with high-viscosity index oil through pocket mandrels with valves, which allow heating up the rock, decreasing oil viscosity and significantly facilitating the movement of the latter to borehole bottoms of producing wells.

The producing well after the installation of the packer 30 is put into the operation by developing and commissioning the electric centrifugal pump 28.

The proposed technology for the development of the reservoir with high-viscosity index oil suggests usingthe thermal properties of thermal waters located below throughout the geological cross-section of the reservoir with high-viscosity index oil and pumping them into the productive horizon without lifting up to the earth surface in order to heat the rock and reduce the oil viscosity, which will significantly facilitate the oil production by producing wells, and also exclude the use of the equipment for the injection of chemical reagents (steam, gas, heated water, surfactants, etc.) installed on the earth surface.

Also, the technology for multilateral wells was developed and is proposed in elaboration, which is realized as follows.

The well 1 is drilled to the horizon 3 with thermal waters located below throughout the geological cross-section of the reservoir 2 with hard-to-recover oil.

Services for lowering and lining holes (not shown) are carried out, perforation works are carried out in the horizon 3 with thermal waters and in the reservoir 2 with hard-to-recover oil (for this purpose, the perforator is lowered and perforations of the production string (not shown) are formed to form the perforations 4).

After this, works are done on drilling and sidetracking A and B with horizontal ends at the roof 5 and the bottom boundary 6 of the reservoir 2 with hard-to-recover oil.

Next, the casing string 7 is lowered through the window 8 in the lateral hole A to the upper boundary of the reservoir 2 with hard-to-recover oil and cemented. The liner filter 10 is lowered down and installed by means of the suspension device 9. The section of NKT 11 with the centering funnel 12 is lowered down and installed to the head of the suspension device 9 and fixed in the lateral hole A by means of the suspension device 13. Similar operations are repeated in the lateral hole B.

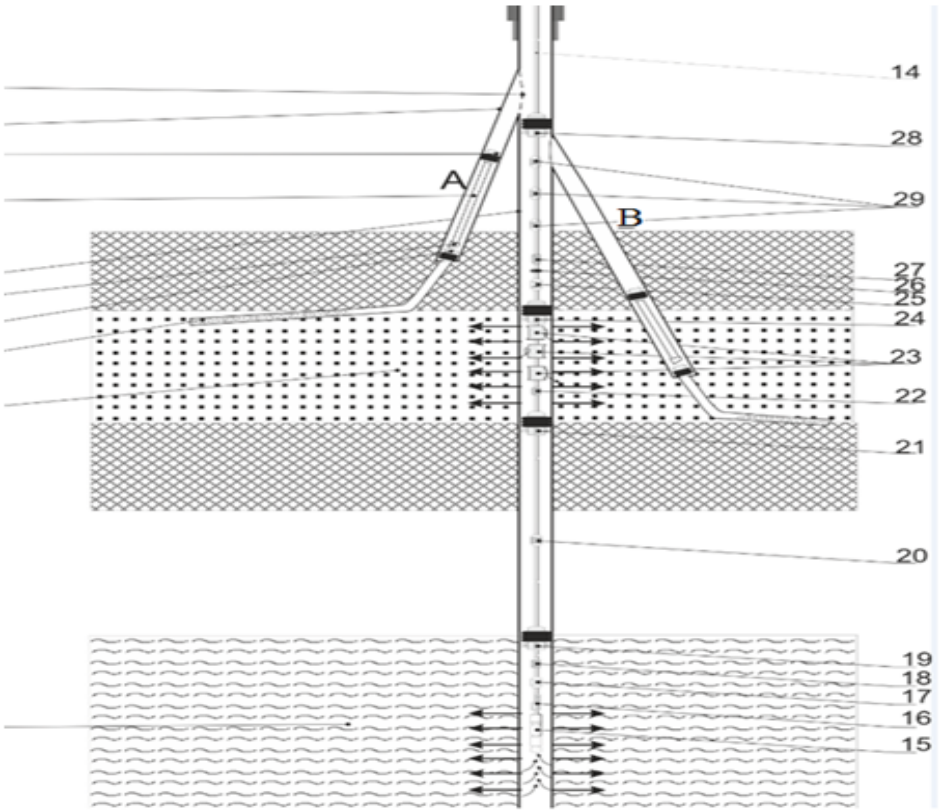


Fig. 3 The design of a multi-lateral well for the technology implementation.

After that, the tubing string NKT 14 with ETsN with the cable 15, the indicator of the cable damage with depth sensors for measuring the pressure and the temperature at the intake and the discharge of ETsN 16, the drain valve/tubing drainETsN 17, the landing nipple 18 for the installation of the plug-caps, the mechanical action packer 19, the circulation valve 20, the mechanical packer 21, the landing nipple for the borehole choke 22, the set of borehole mandrels with valves for the water injection 23, the resistantpacker 24, the double back pressure valve 25, the on/off tool NKT 26, the temperature compensator 27, the set of circulation valves 29 and the packer resistant 28 are lowered in the main hole of the well 1.

It is necessary to observe the distance between the packers 21 and 24 so that the packer 24 is located in the well at the roof of the reservoir 2 with hard-to-recover oil, and the packer 21 at the bottom of the reservoir 2 with hard-to-recover oil. It is necessary to install the packer 19 at the roof of the horizon 3 with thermal waters, located below throughout the geological cross-section of the reservoir 2 with hard-to-recover oil.

After the descent of the tubing string NKT 14 with downhole equipment, the packers of mechanical action 19 and 21 are released, then the resistant packers 24 and 28 are released. The tubing string NKT is suspended in the tubing head of the X-mas tree (not shown) located on the column head. A X-mas tree(not shown) is placed on the tubing string head.

Next, using the wire-line equipment on a wire (not shown) in the combination with a lock, a rod, spang jars,and a connector, the plug-cap is lowered to the landing nipple 18, the plug-cap is installed and the wire is lifted with the lock, the rod and the connector. After that, the circulation valve 20 is activated and the annular space is filled with the interpacker fluid of a certain density, which will be injected between the packers 19 and 21. After the required amount of interpacker fluid is injected, the circulation valve 20 is closed. Then, using again the wire-cable equipment, the plug-cap is removed from the landing nipple 18. After that, a set of circulation valves 29 is opened again using the wire-cable equipment. The ETsN 15 cable is

connected to the field control station and the well is put into the operation.

Due to the fact that the double back pressure valve 25 is lowered into the downhole equipment set on the tubing 14, extracted thermal waters do not rise to the earth surface, but are injected into reservoir 2 with hard-to-recover oil through the valve set 23, thereby heating the rock, which reduces the oil viscosity and significantly facilitates the movement of the latter to bottomholes of sidetracks.

The oil production from the lateral hole A relative to the reservoir 2 with hard-to-recover oil is carried out in the well annulus, and the production from the lateral hole B relative to the reservoir 2 with hard-to-recover oil is conducted through the pipe borehole space (through the set of circulation valves 29).

Fig. 3 shows the design of a multi-lateral well for the technology implementation.

CONCLUSION

The novelty of proposed technologies lies in the application of a new method of influencing a reservoir with high-viscosity index oil, making it possible to use the thermal properties of thermal waters, inject them into the productive horizon without lifting onto the earth surface with the purpose of warming up the rock and reducing the oil viscosity, which will significantly facilitate the extraction of oil by producing wells and also exclude the use of an equipment for the chemical reagent injection (steam, gas, heated water, surfactants, etc.) installed on the earth surface.

REFERENCES

[1] N.M. Kruglikov,V.V. Nelyubin, O.N. Yakovlev,Hydrogeology of the West Siberian Megabasinand Features of the Formation of Hydrocarbon Reservoirs, Nedra, Leningrad, 1985.

[2] A.R. Kurchikov,HydrogeothermalCriteria for the Oil-And-Gas Content, Nedra, Moscow, 1992.

[3] A.R. Kurchikov, B.P. Stavitsikiy,The Geothermyof Oil and Gas Regions of Western Siberia, Nedra, Moscow, 1987.

[4] D.S. Leontyev, A.G. Pasynkov, V.M. Aleksandrov et al., Patent RF No.2669950. E21B 43/24 (2006.01), E21B 43/267 (2006.01). The Method of the Development of a Reservoir with High-Viscosity Index Oil, 2017.

[5] D.S. Leontyev, E.V. Pasynkov, I.I. Kleschenko et al., Patent 183771 of the Russian Federation,E21B 33/122 (2006.01), E21B 43/24 (2006.01). The injection well equipment for the simultaneous production of thermal waters and their injection into the hard-to-recover oil reservoir, 2018.

[6] KHEIRY, M. V., HAFEZI, A. M., &Hesaraki, S. (2013). Bone Regeneration Using Nanotechnology–Calcium Silicate Nano-Composites, UCT Journal of Research in Science, Engineering and Technology, 1(1): 1-3.

[7] Akoz A, Yildiz V, Orun S, Turkdogan KA, Duman A. Management of Poisonous Snake Bites: Analysis of 29 Cases. J Clin Exp Invest. 2018;9(4):140-4.

[8] Savenkova, I., Didukh, M., Mukhina, L., & Litvinenko, I. (2018). Large biological cycle duration in patients with respiratory organs disorders. Electronic Journal of General Medicine, 15(6).