The application of deep-penetrating filling technology in the special high water-containing period of blocks

Duan Lunjian
Institute of Geology of NO.3 Oil production factory, Daqing Oil Field, DaQing, HeiLongJing,163000,CHINA
duanlunjian@163.com.cn  or  ljduan@petrochina.com.cn

Abstract: After the oil field enters the ultra-high water-containing period, the residual oil distribution is scattered, the excavation is difficult, the fine geology describes the large area application of the three-dimensional earthquake, the understanding of the underground situation is becoming more and more clear, the explanation of the oil layer is more and more fine, the redistribution of the fault is more clear, so that the excavation of the residual oil is more targeted. In the stage of the special high water-containing period, due to the restriction of the fault to the conventional measures, the residual oil can not dig, and the conventional measures can not dig the water after the effective control measures, and the deep-penetrating filling technology is used to fill the oil wells, which solves the problem of the residual oil excavation difficulties in the fault area, and achieves better development results. This paper expounds the working principle, process and effect of deep penetration filling technology and the effect obtained after the application of block, and puts forward a new management idea for oil and water well measures.

1. Introduction
Deep-penetrating re-porous radial hydropower working principle and increase the yield and increase the injection process

1.1. operating principle
Drilling of deep-penetrating filling technology is carried out according to the mechanism of high-pressure water injection rock breaking, first of all, the casing window is carried out at the destination level, after the window is opened by the ground high-pressure fluid generation device to generate high-pressure fluid, through the high-pressure hose to the nozzle for hydraulic injection, so that the runoff channel perpendicular to the wellhead is ejected at the destination level, through the pollution zone, connecting the dead oil area, increasing the discharge radius, thereby increasing the yield of the well and increasing the yield of the well.

1.2. Increase the yield and increase the injection system

1.2.1. Remove the interface mask and improve the connection of the oil well
After the fine geological description of each oil layer, the accuracy of the description of sedimentary phase between wells is improved, and the river channel is further divided into multi-stage river channels, and the connection of oil wells is more clear. This appears the original thought that oil wells in the same river channel for a type of connectivity, after a fine description that oil wells are located in
two stages of the river, different periods of the river channel between the interface blocking, affecting the injection of wells, if through deep-penetrating holes through the interface in the river channel to block, improve its connectivity, can effectively improve the output of the well.

1.2.2. Penetrate the contamination zone and expand the radius of the oil spill
The stratum pollution caused by well drilling, wells and all aspects of the production process reduces the flow-conducting capacity of near-well areas and reduces the production and injection capacity of oil wells. Deep penetration of the shot hole can effectively penetrate the pollution belt, eliminate pollution, expand the radius of oil leakage, to increase production and injection purposes, on the other hand, small boreholes can be connected to the dead oil area, thereby reducing the water content of the production, improve the output of oil wells.

1.2.3. Increase the injection well point and expand the oil drive radius
Well injection is a well as a circular center to spread around, because of its development differences lead to different wave area in each direction, through the deep perforation hole, water can be directly directed to the end of the hole, at the end continues to expand the area of the wave, equivalent to the end of the hole increased the injection well point, thereby expanding the oil drive radius.

2. The distribution characteristics of the remaining oil in the block
Based on the numerical simulation results of block reservoir, and combined with the sedimentary characteristics of various reservoirs described by fine geology, six types of residual oil distribution were identified.

2.1. The well network can't control the remaining oil
In the middle bank of the water diversion channel in the delta plain, there are a large number of small river sand bodies in the sedimentary units. Its river energy is low, making the sand body narrow and thin, the mud content is higher than the general river, material and oily slightly worse, the river drilling encounter rate is low, the well network control degree is low, resulting in the oil layer is not used or used poorly, forming a well network can not control the type of residual oil.

2.2. Discarded river cover type residual oil
Abandoned river channel plays a serious role in blocking the sand body of the river, has an important influence on the connectivity of the single sand body, the direction of water drive oil, the formation of residual oil, the water injection effect of the waste river well is not good, and the waste river type residual oil is formed on both sides. It is predicted that a rich residual oil will form on both sides.

2.3. Residual oil at the edge of the river
At the edge of the river, due to the side of the river sand body into the river mud rock and the tip, when drilling from the river sand body tip-off line dozens of meters, or even hundreds of meters, in the river sand body tip-off line and drilling between the formation of a wealth of residual oil, especially drilling for oil wells, especially when the drilling for oil wells. This type is most important because it is prevalent on both sides of each river.

2.4. Fault mask type residual oil
There are more faults result in imperfect injection of fault areas, and there is residual oil abundance in the middle area of faults and near faults.

2.5. Thick oil layer top type remaining oil
Large river sand body has the characteristics of wide horizontal distribution, large vertical thickness and good oil content, and the bottom of the oil layer is generally flooded and washed seriously after entering the period of special high water content, so the remaining oil is mainly rich in its top.
2.6. The interface masks the remaining oil
After a fine description of the oil layer, the large river sand body in the study area is subdivided into multi-stage river superimposed forms, and there is a masking interface between the river channels in different periods, which limits the range of the well's reach and forms the interface masking type of residual oil.

For the remaining oil types of fault blocking type, thick reservoir top type and interface blocking type, if conventional fracturing and hole filling methods are adopted, the production situation of the oil well can be improved to a certain extent, but after years of water injection production, in the bottom has formed the superiority channel, the recovery degree is high, the water flooded level is high, uses the conventional way to tap the potential although the output has increased, but can not control the water cut after the effective measure. If the short radius radial hydraulic jet technology is used to repair the hole, directional hole repair at the top of the hole can be more targeted to tap the remaining oil on the top, to achieve the goal of increasing oil and water.

3. Concrete application and effect analysis
Combined with the distribution of remaining oil and the characteristics of fault development in the study area, in order to excavate more effectively the remaining oil of fault block type, thick reservoir top type and interface block type. According to different types, 5 wells were selected for hydraulic deep penetrating hole mending, and good development effect was obtained after hole mending.

3.1. Excavate the remaining oil of the edge type of fault.
In order to excavate the remaining oil in the edge of the fault, a pair of oil and water wells, one oil well and one water well were selected in the study area. From the new results of fine geological research, it can be seen that the two wells in A sedimentary unit are located in the same channel sand body, the oil well is located near Fault, according to the water flooded interpretation of the new wells around the formation, the bottom of the formation is high water flooded. There is some residual oil in the area near the east of the well, which is blocked by the abandoned channel and fault, and the remaining oil saturation is high. Around the well, Arai explains that bottom flooding is high and top flooding is low, it can also be seen from the oil saturation diagram that there is a lot of remaining oil, which has a certain potential for tapping.

3.2. Excavate the remaining oil of interface block type.
According to the research results of fine geology. The water flooding of surrounding new wells is interpreted as high water flooding at the bottom and medium and low water flooding at the top. Due to the blocking of the interface, water can not be effectively injected into the oil well area, as a result, the well has been unproductive and inefficient. The analysis shows that after removing the barrier of the interface, the well can lift water, and the effect will be better after a certain effective period. Combined with the distribution of remaining oil, it is decided to re-perforate oil and water well in perforated horizon, in order to drill through the interface and lead water to the oil well area, so as to increase production.

3.3. Excavating the top type of remaining oil in thick oil reservoir
A well is a low-yield well selected for tapping the remaining oil of the top type of thick oil layer. Combined with the fine geological research results, the well is located in the channel sand body in the upper sedimentary unit and excavates the remaining oil of the top of thick oil layer while improving the injection-production relationship, according to the watered-out interpretation of the new wells around it, it is concluded that the bottom of the formation is highly watered-out. From the oil saturation diagram, it can be seen that the remaining oil saturation is high and has certain potential. Based on the above analysis and combining with the strike, dip and dip of faults in each well area, the deep penetrating hole repair plan for some wells has been worked out.

The perforation depth, Azimuth and penetration depth are designed according to the development
and water flooding of each well in the target zone, so as to excavate the remaining oil in the fault zone. Other well has some holes to make up the remaining oil in the top of the thick oil layer, well have a few of holes to make up the holes respectively. Deep penetrating perforations were carried out in wells, the average daily fluid oil increase was 5.1 t in wells, and 65 m³ was injected in water wells, ensure the follow-up energy supply of oil wells, oil wells after the measures have achieved good results.

| Categories    | Before the measures | After the measures | increase |
|---------------|---------------------|--------------------|----------|
|               | fluid (t/d)         | oil (t/d)          | Water content (%) | fluid (t/d) | oil (t/d) | Water content (%) | fluid (t/d) | oil (t/d) |
| oilwell       | 20.0                | 1.0                | 95.0      | 50.0        | 6.1        | 87.8            | 30.0        | 5.1       |
| waterwell     | 30                  |                     | 95        |             |            |                |             |           |

4. Conclusions

4.1. The application of deep-penetrating hole-filling technology to excavate the remaining oil in the top of thick oil layer can achieve better development results.

4.2. There is residual oil on the edge of the fault, the technology can be used to excavate the remaining oil when fracturing measures can not be taken because the wells are close to the faults.

4.3. The application of new technology provides a new direction for the selection of oilfield development measures.

References

[1] RENJIANMIN, Jet Drilling Mechanism of ultra-short radius horizontal well. Petroleum Machinery. 1994; (10): 50–55.
[2] ZHANG YI, Study on stimulation mechanism of high pressure water jet deep penetration perforation. Journal of the China University of Petroleum. 2004; (4): 40-42.
[3] QIAN JIE FUYUCHUN, Application of fine geological research in water injection adjustment Foreign oil field engineering. 2001; (9): 30—32
[4] JINYUJIE, Production Geological Engineering. Petroleum Industry Press. 2006; (2): 22-23.
[5] CHEN HUIJIE WAN XINDE, New Understanding of new technology in Sabei development zone of Daqing Oilfield. Petroleum Industry Press. 2003; (5): 28-29.