Characteristics and adjustment strategies of reservoir agglomeration driving state in narrow channel sand body

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Abstract: With the continuous growth of economy, we are more and more aware of the importance of energy and its preciousness. In the production of crude oil, the narrow channel is the best location for oil storage, and the underlying sand body often has oil resources. In this paper, the effect of reservoir polymer flooding is taken as the purpose, the principle of polymer flooding technology as the theoretical basis, through the analysis of dynamic change characteristics, in order to improve the adjustment parameters, to achieve reasonable and efficient exploitation of oil Wells. The application of this technology, through the development of practice, has been recognized as an effective method of oil recovery.

Key words: Narrow channel sand body; Oil extraction; Poly flooding mining

1. Introduction

Without efficient use of energy, social development and construction cannot be realized. The application of the project of "West-east gas transmission and South-north water diversion" fully shows that energy economy will never be eliminated. In the context of high energy consumption and increasing demand in China, the improvement of polymer flooding technology, dynamic simulation and analysis of data changes for narrow channel sand reservoirs, and improvement of the entire mining process are bound to improve the technical practicability and improve the efficiency of crude oil exploitation [1].

2. Polymer flooding and present situation of oilfield

2.1 Principle of polymer flooding

Macroscopically, the purpose of polymer flooding is to increase the viscosity of the injected fluid, adjust the water-oil mobility ratio in the reservoir, and expand the sweep volume. At the mesoscopic level, firstly, injected polymer flooding can effectively adjust the water-oil mobility ratio and expand the wave capacity. Adding polymers to water will make it more difficult for the solution to penetrate into the formation, increase its viscosity, and reduce the flow of the solution. If the flow of crude oil is enhanced relative to the solution, the sweep range of the solution will be increased, thus making the water flooding effect better. Secondly, the flow resistance of highly permeable water in the reservoir can be increased, which is conducive to improving the permeability of water flooding. Adding polymers to water can increase the viscosity of water. Third, under this condition, a stable oil filament flow path can be formed. Reduce the proportion of participating in water flooding and improve the effect of water flooding. Fourthly, the polymer flooding effect is obvious. Under the action of polymer injection, the low permeability layer can be activated, the vertical sweep effect of the oil layer can be increased, and the flooded area of the oil layer can be increased, which is conducive to improving the exploitation effect [2].

2.2 Current situation of polymer flooding in oilfield

This oil area is located in the front facies - estuary area of lake basin. There is only one set of Lower Cretaceous Yaojia member oil layer in the whole oil area. The fluvial sand body has a small development range and is discontinuous in plane, mainly manifested as intermittent bands or scattered distribution. The reservoir has low porosity and permeability. After more than 20 years of development, the oilfield has entered a period of high water cut on the whole. At present, it mainly relies on the adjustment of water injection structure, which plays a certain adjustment effect on the water injection volume and liquid production of high water content Wells and formations, but has little effect on the adjustment within the formation [3].

The riverbed sandbody of Block 1 and Block 2 is flood plain facies with a large amount of riverbed sand. The riverbed body of Block 3 is distributary plain facies with small scale. The first group of bed of Block 3 is a narrow sand body with an effective thickness of 9.71 meters. Compared with Block 1, the drilling proportion of bed sand body on the plane is very different. The drilling proportion of bed sand body of Block 3 is 41.3%, and that of bed sand of Block 1 is 29.4%.

In 1995, polymer flooding was developed in Block 1, which had an oil bearing area of 15.35 m3. 123 Wells were drilled, 98 of which were injected, resulting in 765 PV.mg /L polymer and a 16 % increase in oil recovery. It is now entering the late stage of water drive development. Sanjie Puyi Formation was flooded in 2000. The reservoir contains 6 square kilometers and has a geological reserve of 762×10* t. There are 46 injection Wells and 45 production Wells in the five-point area well pattern. In December 2005, in the middle and late stages of polymer injection development, a polymerization method of 583PV-1/L was used to increase oil recovery by 13 percent.

3. Improve methods for improving polymer displacement efficiency

3.1 Stratified injection

In the case of polymer injection production in reservoirs, due to the large difference in lithology of reservoirs, the effect of polymer flooding as a whole cannot be guaranteed. In order to improve the oil displacement effect, it is necessary to take the initiative to use the method of stratified injection to effectively solve the contradictions between different layers of the reservoir and avoid the problem of mutual influence between different layers. In order to control polymer flooding accurately, we must work out a set of scientific and effective polymer flooding scheme according to the specific conditions of each reservoir. According to the study, the stratified injection method can increase the oil utilization efficiency of the reservoir by 10%, control the rate of increase of water injection pressure in the reservoir formation and reduce the water cut in the producing well during the oil development process. At the same time, in the process of injection molding, technicians should scientifically control the time of injection molding. For the reservoir to be stratified injection molding, the injection molding time will become longer, and the effect can become worse. The greater the permeability difference between different reservoirs in the reservoir, the earlier the stratified water injection time of polymers. For reservoirs with very different permeability between the two reservoirs, stratified injection of polymerization agent can achieve more ideal oil displacement effect compared with no stratified injection [4].

3.2 Alternate injection

At present, in the process of polymer flooding, there are often some difficulties or high costs. In order to effectively solve these problems, it is necessary to use alternate injection to develop heterogeneous reservoirs, so as to effectively reduce the impact of heterogeneous characteristics of the reservoir, so as to achieve the purpose of saving the economic cost of polymer flooding. The use of scientific compatibility mode and technology is the fundamental and precious treasure to ensure the compatibility efficiency can be fully played. The data show that polymer flooding by alternate water flooding can significantly improve the liquid absorption capacity of heterogeneous reservoirs under low permeability conditions, reduce the heterogeneity of heterogeneous reservoirs, improve the use level of each reservoir, and promote the polymer flooding effect. In the process of oilfield development, the alternate water injection method can obviously prolong the operation time of the oilfield under the condition of low water cut, so as to improve the oilfield development effect and increase the oilfield production. The effect of polymer flooding can be maximized by appropriately setting different injection times under different injection times. If the total amount of polymer injected remains unchanged, and the cycle set by the alternate injection is relatively short, the number of alternate injection will increase, resulting in the reduction of the amount of polymer injected each time, thus restricting the effect of the alternate injection, and thus increasing the difficulty of water injection profile adjustment, thus causing an adverse impact on the improvement of oil displacement efficiency. The results show that the effect of polymer flooding can be significantly improved and the oil production can be significantly increased by alternating polymer flooding at the later stage of polymer flooding. Compared with the conventional injection method of polymer, the injection of alternating polymer can not only effectively enhance the oil displacement effect, but also reduce the amount of polymer and maximize the oil displacement efficiency of the reservoir polymer, which is of great significance to the production increase [5].

4. Analysis of dynamic change characteristics and optimization measures

4.1 Characteristics of reservoir agglomeration driving state in narrow channel sand body

（1）Injection pressure changes

After polymer flooding, due to the high viscosity of polymer solution, the retention of polymer solution in the reservoir leads to the decrease of permeability, the increase of permeability resistance, and the increase of water injection pressure. The initial water injection pressure and growth range of polymer pools in Block No. 3 and Donggou No. 1 are different in development degree. The initial water injection pressure of polymer reservoirs such as Block 3 and Donggou Strip 1 was 10.5-11.5MPa, with an increase of about 3.2MPa. In the pure oil area, the initial water injection pressure of Xigou No.1 and No.2 blocks is only 9.0 MPa, with an increase of 3.8 MPa and 3.6 MPa.

(2) Changes in water content

In the process of increasing the amount of polymerization agent added, the comprehensive water cut first increased,

then gradually decreased, and then continued to increase after reaching the lowest level. In the first and second blocks, the water cut in the central well of the first and second blocks with river development decreased by 25-30% within 12 months, while the water cut in the third block with narrow river development decreased by 20%. There was only a small change in six months.
(3) The change of polymer flooding concentration
According to the polymer injection practice in the pilot test and industrial extension block, after polymer injection, the polymer content in the produced fluid of the well has been increased to a certain extent, and the first and second blocks take effect first and then polymerization, but in the third block, a narrow river channel, it takes effect first and then polymerization, and the increase of the concentration is smaller than that in the first and second blocks.

4.2 Adjustment measures of narrow and small channel sandstone reservoir polymer flooding

(1) Ensure injection quality
By observing the dynamic changes of polymer flooding, the pressure tends to rise throughout the underground mining site. In the case of pressure rise, attention was paid to recording the injection rate of the well during the design operation. The real-time injection rate of the sand body was observed at all times, and the injection amount and method of polymer were adjusted according to the injection rate. In view of the problems existing in the development of wellhead in the riverbed, the method of high density rapid injection can be adopted to solve them. Polymer flooding is an enhanced oil recovery method that features high density rapid injection as follows: Polymer flooding High density rapid injection is a rapid injection method that can inject large amounts of polymer solution into the reservoir in a short period of time. This reduces the retention time of the polymer solution in the reservoir and increases the viscosity of the polymer solution, resulting in improved oil recovery. Polymer flooding also has a relatively low cost of high density and rapid injection because it can deliver large amounts of polymer solution to the reservoir in a short period of time and can be calculated by using efficient oil recovery calculation methods. Polymer flooding is also safe with high density and rapid injection. Because it can inject large amounts of polymer solution into the reservoir in a short period of time without causing damage to the reservoir. In addition, this method of injection ensures the required polymer concentration in the reservoir, thus enhancing oil recovery. However, to ensure the safety of high density and rapid injection in polymer flooding, strict controls and monitoring are required during implementation to ensure that the polymer solution does not cause damage to the reservoir. The low permeability of Wells and the poor connectivity of subsurface Wells can lead to reservoir failure. To prevent this from happening, the polymer injection rate and concentration in these Wells must be reduced to ensure the continuous supply of polymer, thus achieving polymer flooding in the narrow riverbed.
(2) Pay attention to the initial injection volume
Both theoretical and numerical simulation show that the larger the molecular weight of polymer, the greater the increase of the amount of crude oil, but the selection of molecular weight should also take into account the matching with the reservoir. According to the calculation, block 3 is based on the polymer of medium molecular weight, and its pore volume is the smallest, so I400×10 polymer should be selected at the beginning of polymer injection.
(3) Alleviate the contradictions between layers
The numerical simulation results show that when the reservoir is relatively stable and the permeability difference of uneven reservoir is 5, the recovery rate of forward jointed reservoir can be increased by 5% than that of cage injection, and the earlier the injection process, the better. Due to the short existence time of low-value reservoir in Block 3, in the early stage of reservoir rise, the reservoir with separated layers is selected, and the annular decompression tank injection technology is used to control the injection of high permeability layer and increase the injection of thin layer in the reservoir, so as to achieve the purpose of controlling the rise rate of the reservoir. On this basis, the developed oil fields are injected 19 times, and some oil fields are divided into different layers to achieve the purpose of the contradiction between the liquid production of high water cut section and the regulation zone. On this basis, the corresponding adjustment is made to maintain the suction profile at a higher level while the water content is restored. After the injection of well I0, the injection rate of Portuguese II_4 in the control zone decreased from 6.3 m/m to 7.3 m/m, while the injection rate of Portuguese I5.7 in the reinforcement zone increased from 7.9 m/m to 15.9 m/m. The combined water cut growth rate of the surrounding 10 producing Wells was relatively slow.
(4) Expand the sweep volume
In Block 3, the rate of increase in injection pressure slowed after the water cut was restored. Based on the pressure distribution, about 30 percent of the reservoir was not utilized in 50.5 percent of the Wells during this period. However, in this period, if the injection volume of macromolecular polymer is used, the wave volume can be larger. Therefore, when the injection volume is 14OPV-mg/L, the polymer is used. When the injection volume is 14OPV-mg/L, the polymer of I900×10 is used. The injection pressure in this block increased from 111.44MPa to 102.06MPa, while the pressure only increased by 0.62MPa. After the fourth month of injection, the pressure remained stable. In the condition of reservoir and reservoir, the reservoir of the reservoir and the reservoir of the reservoir are stable.
After the above adjustment, the water content of Zone 3 is still 88.53% at 439 PV.mg /L, and the recovery rate is 1% higher than that of Zone 2.

5. Conclusion

In the development of narrow reservoirs, the application of polymer flooding technology can effectively increase the development output of oil fields and increase the national crude oil reserves. In view of the relevant problems encountered in the current development, some adjusting measures are put forward to ensure that the "polymer flooding" technology can be successfully applied to the development of narrow and miniaturized sandstone reservoir.

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