Study on water flooding law in high water cut stage of complex fault block reservoir

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Abstract: In recent years, with the progress of science and technology and the development of times, it has brought great opportunities for the development and protection of Tibetan resources in our country. Many reservoirs are located in very complex fault blocks with small fault blocks and many faults, coupled with strong heterogeneous media. After years of waterflooding development, they have entered the high water cut oil recovery stage. In view of this, this paper will focus on the analysis of the water drive law in the high water cut stage of complex fault block reservoirs, and carry out specific strategy optimization for increasing production, in order to promote the exploration of the law of high water cut area in complex fault block reservoirs.

Key words: Complex fault block reservoir; High water cut stage; Water drive law.

1. Introduction

At present, many reservoirs are complex fault block reservoirs, which have entered the late stage of development. Because the structure is very complex, and the waterflood development history is long, and the relationship between oil and water is very complex, also unconsciously aggravate the difficulty of development, but also cause the decline of production. By carefully analyzing the factors of oilfield development effect, understanding the existing problems, and timely taking targeted measures to stabilize production, we can better explore the water drive law of complex fault block reservoirs in the high water cut period. The combination of dynamic and static, and the use of relevant advanced information technology to conduct reservoir numerical simulation, understand the direction of the source water, summarize the law of its water area, and understand the distribution of remaining oil, can provide clear guidance for the formulation of subsequent ideas [1].

2. Geological survey of complex fault block reservoir

The overall development of a complex fault block reservoir is located in the ascending arm structure of fault No. 1, which grows in the northwest direction and is partially affected by the lateral blocking of volcanic rocks, forming a tectonic closed circle. The east-west faults gradually show a complicated trend. The average size is 0.75 square kilometers. The viscosity is 1.8mPas, belonging to a conventional thin oil reservoir [2].

Table 1 Statistical table of water flooding velocity of shallow strata in complex fault block reservoir 1-29 over the years

time	The first year	The second year	Third year	The fourth year	The fifth year	The sixth year
Water drive velocity（m/d）	1.76	1.91	1.93	1.95	2.01	2.10

3. Rules and specific research methods of water flooding in middle and high water cut stage of complex fault block reservoirs

3.1 Rule analysis

For reservoirs in high water cut development period, when faced with such special circumstances, it will intensify the difficulty and intensity of excavation, so it is necessary to seek effective operation rules. The first point is the law of plane waterflooding. The contradictions in reservoir plane of this complex fault block are more due to the control of the original advantageous permeability channels and other aspects, coupled with the influence of injected water inrush, so that the overall permeability shows a gradually increasing trend, and the channel velocity increases year by year and the average channel velocity even reaches 2.1M/D. In addition to the plane Internet alarm is not perfect area so that the water area is relatively weak, Erjing network perfect area when the

water area is relatively strong. The second point is about the rule from the shallow water area. Because the permeability changes among the different layers in the reservoir of this complex fault block have great differences, it shows that the degree of water area also has obvious differences. Because water flow in a water drive reservoir will bypass the permeability zone, the high permeability zone with low channel resistance or some larger pores, the canal with high permeability will have a faster speed, and the water balloon with the highest permeability will have a slower speed [3]. In addition, different water injection methods also have a great influence on the effect of profile control. The third point is that the law of the water zone in the reservoir is complicated, and the fault block reservoir is mainly based on complex rhythm, and the logging curve will show different shapes, and be affected by the reservoir, physical property and other aspects. From the large physical property difference in the section and the high permeability at the bottom, the non-uniform medium strong water area may cause the internal oat surface plane to be in a contradictory state, which is difficult to transform. However, with the continuous maturation and development of the reservoir in the later stage, the pressure and permeability between each small layer increased significantly, resulting in a great change in the number of water-absorbing layers. And the long-term impact of rain erosion and other aspects will cause the middle and lower part of the reservoir is easy to deformation and form high mountain channels, such as water, the main deep channel in the lower part of the sweep or enrichment from the top of the remaining oil of the middle and strong water rock at the bottom. In order to further achieve the purpose of controlling water and stabilizing oil as well as the development effect of lifting cake, in normal production, the staff need to combine the actual distribution of water area on the plane, readjust the flow between production Wells and injection Wells, realize the allocation of resources, and form a state of uniform area on the plane. After a period of comprehensive treatment, it was found that the annual oil production increased by 0.65 million tons, the water driven reserves were 74,000 tons, and the degree of water driven increased by 0.2%, which decreased by 5.63% compared with the same period last year. The increase of the entire water cut was controlled below 2%, indicating that ideal effects were achieved [4].

3.2 Specific research methods

The first point is for the water zone speed discrimination. Due to the heterogeneity of reservoir and other factors, the velocity of the channel on the plane is not mature and uniform. The dynamic connectivity between water injection and surrounding production Wells, as well as the advancing direction and actual velocity of injection can be more objectively and clearly reflected in the relevant construction data. However, with the continuous injection of Wells, the difference of permeability and pressure often leads to the formation and development of large historical permeability channels. When the water content of oil Wells continues to rise, the dominant seepage channels in general high-yield areas will become more mature [5]. Subsequently, after analyzing the dynamic production data of a single well in this complex block, the staff found that the production characteristics of oil and water Wells on the plane were not consistent, mainly because the water content distribution of oil Wells on the plane was not uniform, and the proportion of oil Wells exceeding 60% was increasing year by year, so as to ensure the stability of oil production every year. The industrial chain of oil well will be continuously improved with the increase of water cut, which causes the aggravation of plane contradiction virtually. According to relevant data statistics, when the water content of oil well is greater than 40%, it is easier to create a superior seepage channel. At the same time, because the internal neck water flooding will be affected by rhythm and other aspects, the impact of load rhythm bottom and middle is more serious. The variation of interlayer water zone is more affected by pressure and permeability. Specifically, with the continuous exploitation of post, the contradictions between canals began to increase. Through the general analysis of the water injection well profile over the years, it is found that the water absorption layer presents a trend of decreasing year by year, and the phenomenon of single-layer main water absorption is more and more serious. Moreover, according to the analysis of relevant data, once the interval is greater than 5MPA, it is a multi-layer production well, and the pressure difference caused by the contradiction between the interval will be more significant.

The second point is about the research method of reservoir numerical simulation. This method is a kind of high quality reservoir numerical simulation technology based on theory and practical means of introducing advanced information technology. It can well solve a series of complex problems in the process of oilfield development. By simulating the variation of the saturation of melaleuca reservoirs in areas 1 to 29, the specific water flooding rule can be obtained. After specific research, it is found that the internal contradiction of LiuXiaozeng is the most serious in the section, mainly because the reservoir is dominated by the composite rate reservoir, the difference of physical properties in the reservoir is large, the non-uniform medium is strong, and the long-term impact of rain erosion. It is easy to form a deep channel in the middle and lower part of the reservoir. In addition, the effect of in-layer utilization in some reservoirs is not ideal, and the oil collected in the top and middle of the rhythm layer, plus the existence of advantageous penetration channels, leads to an intensified ineffective circulation of water between the injection well and the production well, which reduces the efficiency of water area spread and leads to the intensified contradiction between layers.

4. Study on stable production technology of complex fault block reservoir in middle and high water cut stage

Firstly, the waterflood project should be implemented to improve the effectiveness of waterflood development and improve the recovery efficiency by improving the well pattern. Dynamic detection, seismic and other related technical means are used to deepen the research on the connectivity of complex fault block reservoirs, optimize well patterns, and promote the effective improvement of double-direction benefit efficiency and corresponding rate of oil and water injection and production. Through the bridge matching commissioning linkage and injection eccentric technology, it can carry out matching commissioning linkage and electrodynamic inspection and sealing, and has the linkage inspection ability of commissioning injection polymerization well. At the beginning of the test, the number of intelligent metering oil and water Wells with throttling core is 8. Currently, they are used on 5 caliber, all of which have normal metering and fishing capabilities. In order to cater to the multi-layer detailed injection on the basis of thin reservoir and thin interlayer, the integrated sealing technology was used in the test to promote the realization of the goal of fine water injection. At the same time, the water drive wave and volume should be improved through the optimization of deep profile control. Focusing on the significant effect of water flooding, the large pore generated by long-term water injection is selected with higher strength and less damage to the bottom layer for the well area with obvious interzonal conflict. Based on the test results of the dominant front, for the direction of water injection near the fracture, the oil well is prefered with significant effect and the water cut is increased quickly. For Wells with low water injection pressure, profile control should be implemented to improve the direction of water flow, increase the volume of water injection and water injection wave, reduce the ineffective circulation of water injection, and improve the development efficiency of water flooding. Through the implementation of dynamic water transfer method, the effect of unstable water flooding can be brought into play. Through the simulation study of flow line simulation parameters, pulse irrigation, plane water transfer, intermittent irrigation and corresponding control can be carried out according to the basic principles of seepage dynamics, thus promoting the improvement of well group water flooding efficiency and reducing the decline of production. Based on the changes in the beneficial Wells and the timely description of the flow field changes, periodic irrigation and dispensing perfusion can be used to reduce the injection volume in the tight flow line oil-well zone and the supplementary injection in the sparse flow line oil-well zone. The well group decline has been effectively solved.

The second point is the scientific development of oil and gas fields by using multiple dynamic monitoring methods. Orderly monitoring is an important method to have a reasonable understanding of oil and gas reservoirs, so as to correctly evaluate the quality of oil and gas reservoirs and promote the effective increase of recovery. In the process of studying the whole oil field natural gas resources, the injection profile and production of oil field gas popularization are studied. The most important method of exploration well production is to detect the saturation of reservoir, test casing damage, monitor the ability of cementing, etc., which also involves testing the well pressure, recovering the pressure drop, detecting the edge, measuring the pulse in the interference well, can avoid the situation of ineffective water injection. As the development cycle of water injection continues to increase, the problem of well underinjection is becoming more and more serious, because of the low water quality, repeated well opening, high sensitivity to rock formation and other factors caused by the problem of rock formation pollution is becoming more and more serious. By using the coefficient of skin in well test studies, the fault blowdown situation is evaluated. The problem of under-injection in well can be solved reasonably by using acidizing process interpretation and formation energy can be reasonably supplemented. It is necessary to reasonably increase the injection water distribution in the weak water reservoir and non-mainstream line, so as to increase the injection and production pressure difference and increase the sweep range. For Wells in normal state, it is necessary to ensure the stability of water allocation, so as to maintain the stability of injection and production pressure difference and promote the steady growth of water content.

5. Conclusion

In a word, after an objective analysis of the water flooding laws of some alpine channels in many complex fault block reservoirs, the differences between different layers can be understood, so that the permeability, grade difference detection and pressure level difference in the reservoir are also decisive factors to determine whether profile control can be real and effective. The implementation of interval recombination according to its profile situation can achieve the effect of improving production and technology. With the continuous development of reservoir exploitation technology, we can further analyze the characteristics and distribution law of oil reservoir distribution, further optimize the reservoir exploitation process, effectively deal with the contradictions between various oil layers, effectively do all the work in the high water cut development stage, properly solve the relationship between different layers, and then achieve good exploitation effect.

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