Research on polymer flooding inefficient oil well treatment method

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Abstract. During the development of polymer flooding, due to factors such as the heterogeneity of the reservoir, some inefficient oil wells appeared in the area. In order to reduce the effect difference between oil well groups and improve plane contradictions, we the division of the inefficient oil wells and the analysis of the causes, and adopting effective treatment countermeasures, this method promotes the effectiveness of the inefficient oil wells, can improve the overall development effect of the polymer flooding, and the method further perfects the polymer flooding comprehensive adjustment technology.

Key words: Polymer flooding, Inefficient oil wells, Treatment.

1. Introduction
With the continuous expansion of the scale of polymer flooding, it is affected by many factors such as heterogeneity of oil reservoirs, fault shielding, imperfect injection and production, interference from water flooding layers of combined production wells, and effective control degree of polymer flooding. In the process, there are low-efficiency oil wells with small water cuts, low polymer flooding and low economic benefits in some produced wells. If these oil wells are not developed in a timely and effective manner, they will greatly affect the polymerization. The overall development effect of the object drive.

2. Division of inefficient oil wells and analysis of their causes

2.1. Basic overview of the block
This block was put into polymer development in August 2017. The mining layer is Portuguese II-4, the area is 14.03 km², the geological reserve is 2119 × 10⁴ t, the pore volume is 3884 × 10⁴ m³, the total number of oil wells is 232, of which 115 oil wells are injected. 117 oil wells were produced, and a five-point area oil well network was used. The ratio of injection to production wells was 1: 1.02.

2.2. Division of inefficient oil wells
(1) The limit is that the water drop value after polymer injection is less than 8%: There are 17 oil production wells in the whole region with a water drop value of less than 8% at the lowest point of water cut. This part of the oil well produced 3955t of liquid before the polymer injection and 173t of oil per day. The water content is 95.6%. At the lowest value, the daily fluid production is 3875t, and the daily oil production is 312t. The comprehensive water content is 91.9%, and the average single oil well water content is decreased by 3.7 percentage points [1].
(2) Take the cumulative oil increase after polymer injection as the limit (i.e., 1/3 of the cumulative oil increase per unit thickness of the block as the limit value): Of the 19 oil wells in the western block, the cumulative oil increase per unit thickness is the limit. The amount is 262t, which is 1310t less than that in the whole area. The 7 oil wells in the east block have an average oil thickness increase of 176t per unit thickness, which is 1398t less than that in the whole area. There are a total of 24 low-efficiency wells in this block [2].

(3) Economic boundary: According to the increase of the polymer injection income and the polymer injection, the additional cost (variable costs) and taxes due to the increase in production offset the three, the amount of oil increase at this time is the polymer injection income Minimum fuel increase [3].

Increasing production income = measure input + variable cost + sales tax and surcharge

According to the different water wells of single oil wells, the amount of oil increase per ton of polymer to obtain economic benefits is different. After calculation, the amount of oil increase per ton of polymer must reach 20t, otherwise it is a loss. There are 17 oil wells in this area [4].

The inefficient oil wells obtained from these three boundaries are combined to obtain 26 inefficient oil wells in the region, accounting for 22.2% of the total oil wells in the block [5].

![Figure 1. Analysis of Inefficient Oil Well Treatment Principles](image)

2.3. Cause Analysis of Inefficient Oil Wells

2.3.1. Analysis of the influence of faults. Because of the blockage of faults, the relationship between injection and production systems is extremely imperfect, and the average polymer injection direction of oil production wells is only 0.83. Therefore, the influence of faults is an important factor leading to the polymer flooding effect of oil production wells. Of the 26 inefficient oil wells in the region, 6 of them are located in the fault zone, accounting for 23.1% of the inefficient oil wells [6].

2.3.2. Poor reservoir development and poor connectivity between wells. Due to the poor development conditions and poor connectivity of the reservoir, the injection pressure of the injection well gradually increases with the extension of the injection time after the polymer injection, and the injection is difficult and the injection is difficult. Low, the effect of polymer injection is not obvious. Among the 26 inefficient oil wells in the region, 4 oil wells formed inefficient oil wells due to poor reservoir development, accounting for 15.4% of inefficient oil wells.

2.3.3. Interlayer interference of polymer flooding using oil wells is an important factor for inefficient oil wells. The polymer flooding practice in recent years shows that the polymer flooding wells are poorly affected due to the interference of water flooding reservoirs. Among the 26 inefficient oil wells in the region, 8 of them are combined oil recovery wells, accounting for 30.8% of the inefficient oil wells.
2.3.4. **Contradictions within the Portuguese group are prominent.** After the polymer slug enters the high-permeability layer, the water phase permeability is reduced therein, thereby effectively inhibiting the fingering of the injected water along the high-permeability layer, forcing the injection liquid to enter the rock pores with low permeability, and improving the suction capacity of the middle and low permeability layers. However, due to the large differences in the development of small oil layers in some oil well areas, the injected polymer solution did not form an effective slug, and it quickly broke through along the high-permeability layer. As a result, the polymer solution was ineffectively produced in the production well, and the production well appeared. Ineffective situation. Among the 26 inefficient oil wells in the region, due to the prominent interlayer conflicts, there were 8 inefficient oil wells caused by interlayer interference, accounting for 30.8% of the inefficient oil wells.

3. **Analysis of treatment effects of inefficient oil wells**
In order to improve the development efficiency of polymer flooding inefficient oil wells, various measures were taken for 26 inefficient oil wells. 16 well times, the average single oil well increased by 6t per day, the comprehensive water cut decreased by 2.7 percentage points, and the average single oil well accumulated 610t. Good governance effect.

3.1. **Analysis of the low-permeability layer in fracturing reconstruction**
Aiming at the low-permeability layers of inefficient oil wells and low-efficiency oil wells with prominent inter-layer contradictions caused by poor development of the oil layers, fracturing reform measures were mainly adopted to improve the performance of poor oil layers. Five oil production wells were fractured in the past two years. After the measures, the average daily oil increase of a single oil well is 40t, the daily oil increase is 8t, the comprehensive water cut is reduced by 0.5 percentage point, and the average single oil well cumulative oil increase is 1,531t. The percolation conditions of the oil layer were improved, the fluid production capacity of the oil well was improved, and the effect of the low-efficiency oil well was significantly improved.

![Figure 2. Graphical analysis of inefficient oil well treatment](image)

3.2. **Analysis of layered production allocation and water plugging of combined production wells**
Aiming at the contradiction between interlayer interference of water flooding layers of combined production wells and single wells with prominent interlayer conflicts and interbedded oil wells, measures such as layered production and water plugging were adopted to alleviate interlayer contradictions. In the past two years, three co-production low-efficiency wells and two single-production low-efficiency wells have been layered for production. After the measures, the average single oil well drops 9t per day, and the daily oil increase is 3t, and the comprehensive water cut decreases by 1.6 percentage points. The average single oil well Cumulative increase of 160t. High-water-cut non-purpose layer plugging measures were carried out on the N3-2-58 oil well. The original well was combined with three sets of layers: Sasha, Portugal, and Gao. The thickness of the sandstone was 45.7m, the effective thickness was 35.8m, and the formation coefficient was $13.495 \mu \text{m}^3$. * M, in which the
thickness of the non-purpose layer accounts for 85.7% of the whole oil well, and the interlayer interference is serious. After the measures, the daily fluid production will decrease by 108t, the daily oil increase will be 1t, and the comprehensive water content will decrease by 2.9%. In addition, for the original N3-2-62 oil well, due to the failure to overhaul the casing, the side-inclined oil well N3-2-CZ62 oil well was drilled. After the measures, the daily production fluid decreased by 17t, the daily oil increase was 23t, and the comprehensive water cut decreased by 11.4%. 7535t.

Figure 3. Reasonable adjustment of injection and production parameters accurate measurement method

3.3. Analysis of Reasonable Adjustment of Injection and Production Parameters to Improve Oil Well Pumping Efficiency

After the polymer is injected into the oil layer, the seepage resistance increases due to the adsorption and capture in the oil layer. At this time, the oil production well shows a decline in the production fluid index and the formation pressure changes slowly. In order to increase the fluid production of the oil well, it is necessary to zoom in. Production pressure difference to improve oil well development. There are also some inefficient oil wells, because the contradiction between the layers is too large, the injected polymer solution does not form an effective slug, which results in the polymer solution being ineffectively produced in the production well, which cannot achieve the reduction of the water-oil mobility ratio and the expansion of the volume. From the perspective of oil production wells, the polymer pressure in this part of the inefficient oil wells has little change in flow pressure, the polymer breaks through early, and the production fluid concentration rises rapidly.

Figure 4. Computer simulation analysis results

For such inefficient oil wells, reasonable adjustment parameters are mainly adopted to improve the pumping efficiency of oil and oil wells. The first is to make reasonable adjustments to the injection scheme. For the high-pressure region, the principle of reducing the injection intensity and increasing the injection concentration is adopted. For the low-flow pressure region, when the injection pressure allows, the principle of strengthening the injection in the main communication direction is adopted. The block
adjusted a total of 24 oil well injection plans for inefficient oil wells, which played a vital role in improving polymer flooding development results. The second is the high fluid production rate, high flow pressure and high liquid level of the oil production wells, which have large differences in the permeability of the various layers. Profile adjustment effect. For example, in the N2-D3-P70 oil well, the fluid production is high after injection, the flow pressure and liquid level are high, and the water cut is small. After the production pressure difference is enlarged by changing the pump, the daily fluid increase is 15t, and the daily oil increase is 7t. The water cut decreased by 2.6 percentage points, and a single oil well accumulated a cumulative increase of 424 tons. The third is to change the pump for the two oil wells with too large parameters and low flow pressure. After the measures, the flow pressure increased by 1.86MPa, which ensured the normal production of the oil well.

4. Conclusion
(1) During the development of polymer flooding, there are some inefficient oil wells, accounting for about 20%.
(2) The causes of inefficient oil wells are mainly the heterogeneity of the reservoir, fault shielding, imperfect injection and production, and the degree of effective polymer flooding control.
(3) By adopting low-permeability fracturing reforms for low-efficiency oil wells, stratified allocation of combined production wells, water plugging, and reasonable adjustment of injection and production parameters, it can effectively improve its effectiveness and improve the overall effect of polymer flooding.

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