Comprehensive adjustment method and effect of the second stage oil layer flooding in the west block of a certain area

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Abstract. In the later stage of water flooding and subsequent water flooding, due to the long mining time, the proportion of oil production in the stage is relatively large. Therefore, the comprehensive adjustment in the later stage of polymer flooding plays an important role in the development of the whole polymer flooding. This paper analyzes the main contradictions in the late stage of polymer flooding in the second block of the western block of a certain area, finds corresponding solutions, further improves the development effect of block polymer flooding, and provides reference for the rational development of other blocks in the future.

Key words: Late stage of polymer flooding, comprehensive adjustment, solution.

1. The main contradiction in the later stage of the flooding

After several years of injection and development, the second oil layer in the west block of a certain area has achieved good results of injection and development. However, due to long-term injection and mining, the remaining oil is gradually reduced, and the efficiency of injection is gradually reduced. In November 2012, the water content of the block exceeded 92%, and the water content rose back to the level before the injection. At this time, there are mainly three contradictions in the development of the block:

1.1. There is a difference in the amount of polymer used

From the single-well polymer dosage scale, there are differences in the amount of polymer used. The amount of polymer used was less than 800 PV·mg/L, and 68 wells were produced, accounting for 37.8% of the total number of wells; the polymer dosage was more than 1400 PV·mg/L, and 32 wells were produced, accounting for 17.8% of the total number of wells. The production well with the polymer dosage less than 800 PV·mg/L has low liquid production, low cumulative oil accumulation, low water content, more residual oil, and great potential for injection and potential exploration; the polymer dosage is greater than 1400 PV·mg/L. Out of the well, the liquid production is high, the cumulative oil increase is high, the water content is relatively high, the remaining oil is less, and the potential for injection and potential tapping is small.

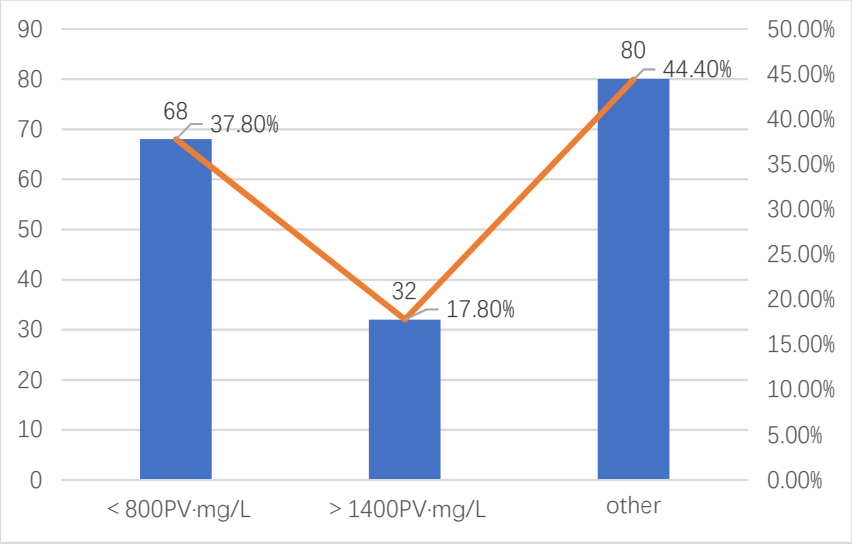

Figure 1. Production well statistics for different polymer dosages.

1.2. There are differences in the use of oil layers

The suction profile of the 17 injection wells was counted. The main active layer was Sa-113-16, and the remaining layers were less used. In particular, the relative inhalation of Sa III5-7 and Sa III8-10 was less than 20%. The proportion of inhalation thickness is also lower than the level of the whole area. Therefore, the two sandstone groups have more residual oil, and the potential for concentration and potential tapping is large.

1.3. Water content difference

From the water classification table, there is a large difference in water content between wells. There are 71 production wells with water content greater than 94%, accounting for 39.4% of the total number of wells; 53 production wells with water content less than 90%, accounting for 29.4% of the total number of wells.

2. Comprehensive adjustment method and effect in the later stage of polymer flooding

The multi-year production practice of the polymer flooding shows that the tracking adjustment of the injection well scheme is the most economical and effective adjustment method in the polymer flooding process, and the adjustment methods of the injection wells are different in different injection phases. Targeted tracking adjustments were made for the main contradictions in the later stage of the flooding, and the remaining oil in the area was mined to the maximum extent.

2.1. Optimize the amount of polymer and prolong the development of polymer flooding

First, the use of a low amount of polymer, the use of a uniform well area between layers, the surrounding injection wells continue to improve the injection concentration and strength adjustment ideas, expand the volume of the volume, tap the remaining oil. Adjust 71 wells, adjust the post-adjustment from 3925m m^3/d to 4630m^3/d, increase 705m m^3/d, the mother liquor ratio is adjusted from 1:2.2 to 1:1.9, and the injection pressure is increased from 10.84MPa to 11.14MPa. The viscosity was adjusted from 1644 mg/L to 1800 mg/L, and the injection viscosity was adjusted from 46 mPa·s to 53 mPa·s. Compared with the surrounding 91-hole production wells, the adjusted production fluid was 4555.6t/d, the oil production was 393.6t/d, and the comprehensive water content was 91.36%. Compared with before the adjustment, the production liquid increased by 158.6t/d, and the oil production increased by 37.6t/d. The comprehensive water content decreased by 0.54 percentage points.

Table 1. Data sheet.

project	past	at present	effect	
Matching	3925m^3/d	4630m^3/d	Production fluid	
Mother liquor water ratio	1/2.2	1/1.9	4555.6t/d	↑158.6t/d
Injection pressure	10.84MPa	11.14MPa	Oil production	
Injection concentration	1644mg/L	1800mg/L	393.6t/d	↑37.6t/d
Injection viscosity	46mPa·s	53mPa·s	Integrated water	↓-0.54%

The second is to use a small well area with different polymer usage and different interlayer interactions. The surrounding injection wells adopt the idea of interlayer adjustment, expand the differential layer volume and excavate the remaining oil. In the early stage, the main active layer and the currently inhaled Sa-113-16 layer were controlled to be injected. At present, the injection is strengthened with respect to the Sa III 5-7 and Sa III 8-10 layers with lower inhalation. Adjust 59 wells. After adjustment, the blending is reduced from 3795 m^3/d to 3675 m^3/d, down 120 m^3/d, the mother liquor ratio is adjusted from 1:1.7 to 1:2.1, and the injection pressure is reduced from 11.64MPa to 11.52MPa. The viscosity was adjusted from 1714 mg/L to 1620 mg/L, and the injection viscosity was adjusted from 58 mPa·s to 53 mPa·s. The injection strength of the control layer decreased from 1.96 m^3/d·m to 1.59m^3/d·m, and the injection strength of the reinforcement layer increased from 6.59 m^3/d·m to 6.86 m^3/d·m. Compared with the surrounding 75-hole production wells, the adjusted production liquid was 3298.7t/d, the oil production was 285.0t/d, and the comprehensive water content was 91.36%. Compared with before the adjustment, the production liquid decreased by 38.1t/d and the oil production increased by 14.5t/d. The comprehensive water content decreased by 0.53 percentage points.

The third is to use a high-polymer, high-level interaction difference in the large well area, the surrounding injection wells to take the "stop layer without stopping the well" adjustment ideas, reduce inefficient and ineffective loops, improve the use of conditions. Adjust 56 wells, 60 stop injection layers, reduce the injection volume by 1125 m^3/d, 58 water-lifting layers, and increase the injection volume by 775 m^3/d. After adjusting, the ratio of mother liquor to water is adjusted from 1:1.5 to 1:2.0. The 1836 mg/L was adjusted to 1646 mg/L, and the injection viscosity was adjusted from 68 mPa·s to 57 mPa·s. The injection strength of the control layer decreased from 2.55 m^3/d·m to 0.76 m^3/d·m, and the injection strength of the reinforcement layer increased from 5.63 m^3/d·m to 6.77 m^3/d·m. Compared with the surrounding 51-connected wells, the adjusted production liquid was 2478.1t/d, the oil production was 192.3t/d, and the comprehensive water content was 92.24%. Compared with before the adjustment, the production liquid decreased by 77.5t/d, and the oil production increased by 0.5t/d. The comprehensive water content decreased by 0.25 percentage points.

2.2. Implement deep profile control to control inefficient invalid loops

Aiming at the characteristics of high polymer content, high water content and prominent intra-layer contradiction in the mining area of the second type oil layer in the west block of a certain area, 10 wells were deeply profiled, the profile control radius was 50m, and the average single well profile control thickness was 3.0m. The injection pressure in profile control reached up to 11.30 MPa. Compared with before profile control, the injection pressure increased by 0.97 MPa. In November 2014, the injection pressure was 11.17 MPa, which was 0.84 MPa higher than that before profile control.

Five injection wells with continuous inhalation profile data were counted, and the total well suction thickness increased by 0.8 percentage points. The proportion of the inhalation thickness of the low permeability layer with a permeability of less than 0.3 μm 2 increased by 19.0 percentage points, and the relative inhalation volume increased by 3.6 percentage points; while the permeability of the high permeability layer with a permeability greater than 0.8 μm 2 decreased by a large margin, a decrease of 27.9 percentage points. Inhalation decreased by 3.8 percentage points.

The surrounding wells were connected with 19 wells. After one month of profile control, the effect was observed. The liquid production was 1231.0t/d, the oil production was 81.2t/d, and the comprehensive water content was 93.4%. Compared with before the profile control, the production liquid increased by 16.0t/d. The oil production increased by 5.9t/d, the integrated water content decreased by 0.4%. In November 2014, the liquid production was 1221.0t/d, the oil production was 73.1t/d, and the comprehensive water content was 94.0%. The comprehensive water content rebounded slightly, but still lower than the adjustment. At the level before the cut, the monthly water recovery rate is only 0.02%.

2.3. Optimize the method of stopping the injection to ensure the subsequent development of water flooding

The polymer flooding has a strong stage, and it needs to enter the subsequent water flooding after the polymer flooding. Due to the difference in the amount of polymer in the block, the overall stop-injection is not taken when the block as a whole reaches the stop-injection standard, but the basis of selection The amount of polymer and the area of water content were divided into areas where the standard of stop-and-fill polymerization was implemented. Since 2013, 11 batches of 129 injection wells have been stopped. Although the water content in the well area is above 94%, there is still a small amount of remaining oil to be excavated. In the stop injection polymerization scheme, the injection strength of the medium and low permeability layers is appropriately increased, and the remaining oil potential is continuously explored. After stopping the injection, in order to improve the development of the block, tracking adjustments were made to the injection wells. After stopping the injection, the water cuts in the block are stable, and the monthly water recovery rate is controlled at 0.07 percentage points.

2.4. Implement subdivision adjustment to improve the use of medium and low permeability layers

After entering the subsequent water flooding, the injection pressure is obviously reduced, and the water absorption capacity of the low permeability layer is relatively increased. Therefore, the injection wells with the potential for subdivision can be subdivided, the utilization degree of the medium and low permeability layers can be improved, and the remaining oil potential can be tapped. The implementation of subdivision adjustment of 23, which in the general system to stratify 10 wells, further subdivided 13 wells, the average number of single well intervals after adjustment increased from 2.1 to 3.7, the permeability difference was adjusted from 12.5 to 7.6, the allocation by 1125 m^3/d is adjusted up to 1260 m^3/d. Compared with the four injection wells subdivided at the end of 2014, the output of the wells was 637.2t/d, the oil production was 26.9t/d, and the comprehensive water content was 95.78%. Compared with before the adjustment, the production liquid increased by 32.5t. /d, oil production increased by 3.9t/d, and integrated water content decreased by 0.42 percentage points.

Through a series of targeted adjustments, the block has achieved better development results of the polymer flooding. Currently, the block contains 96.44% water, and the stage improves oil recovery by 15.20%, which is 6.96 percentage points higher than the digital model prediction. The water recovery is stable and has been running below the digital mode.

3. Some understanding

Firstly, in the later stage of polymer flooding, the targeted program adjustment was implemented according to the difference in polymer dosage, and the development effect of polymer flooding was prolonged.

Secondly, according to the amount of polymer and water content, batch-stop polycondensation is carried out to maximize the development of polymer flooding.

Thirdly, the subdivision adjustment of the subsequent water flooding stage can control the blasting of the high permeability layer and improve the utilization degree of the medium and low permeability layers.

Acknowledgments
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