Research on the Tracking and Adjusting Method of Typical Well Group in the Second Class Reservoir

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Abstract. The ternary compound flooding of the second-class oil layer has achieved good effects of increasing oil and dewatering in the field test. However, during the promotion process, the injection and production conditions are unstable. Seems particularly important. This paper selects the typical well group in the weak alkaline ternary compound flooding block of the second-class oil layer in a certain area, conducts potential analysis on the problems existing in development, strictly controls the injection quality at the injection end, and adopts measures such as sub-injection, parameter adjustment and fracturing Injection capacity, improve the utilization of the oil layer; the corresponding fracturing at the production end, improve the connection relationship, improve the utilization of the thin layer, maximize the potential of remaining oil, synchronize the tracking and adjustment methods at the injection and production ends to extend the fracturing During the stable period, the development effect of the well group is improved, which provides a technical basis for solving similar problems in the future, and can further improve the oil displacement efficiency of the ternary compound flooding.

Keywords. Ternary compound drive, Parameter adjustment, fracture, Tracking adjustment.

1. Introduction
Since the beginning of the ternary compound flooding in the Daqing Oilfield in the 1980s, several ternary compound flooding field trials of the strong and weak base systems have been completed, and all have achieved good oil and precipitation effects [1-4]. However, in the process of industrial production, due to the large number of injection and production wells, strong reservoir heterogeneity, and unstable injection and production [5], in order to ensure the development effect, it is particularly important to track and adjust the injection and production well groups in time. This paper selects the typical well group in the weak alkaline ternary compound flooding block of the second-class oil layer in a certain area, conducts potential analysis for the problems existing in the development, formulates the tracking adjustment method, and provides reference for solving similar problems in the future.
2. Basic situation of well group
Well group A is a typical well group using the weak alkali ternary compound flooding method for the second-class reservoir. As shown in Figure 1, production well A connects four injection wells B, C, D, and E. Several methods of blank water flooding, pre-polymer flooding, ternary main slug and ternary secondary slug have been used in production.

Figure 1. Ternary secondary slug have been used in production.

Since Well Group A entered the ternary main slug stage, it has achieved remarkable results. The injection pressure has risen steadily and the water cut has continued to decline. As of the 15th month of production, the injection pressure was 12.8 MPa and the combined water content was 68.1%. Compared with the initial period of the main slug in the seventh month, the injection pressure increased by 1.46 MPa and the water content decreased by 25%.

3. Existing problems and potential analysis
Although the use of ternary flooding in Well A has obvious results, there are also some problems in the development process. The following is an analysis of the problems and potential of the well group:

3.1. Compared with the initial stage of the ternary main slug, the production volume of produced well A decreased by a large margin. At the beginning of the main slug in the seventh month, the daily fluid output of the well was 68t, while the daily fluid output in the 15th month of production was only 16t, and the liquid output decreased by 76.5.

3.2. In the ternary main slug stage, the injection and production of the well group is relatively high, and the liquid supply capacity is strong. In the 10th to 15th months of the production of the well group, the injection rate has remained relatively stable at about 0.16PV for six months, and the liquid production rate has decreased month by month. a. Injection-production ratio is as high as 3.62.

3.3. Vertically, multiple rivers are developed, the oil layers are unbalanced, and there are large differences between layers.
It can be seen from Table 1 that the production well A has a total of 9 layers, and the difference between the layers is large. The minimum permeability of layer I is 0.05 μm2, the maximum permeability of layer IV is 0.726 μm2, and the interlayer permeability is extremely poor 14.5.

Table 1. Basic data table of mining well A mining horizon

| Horizon | Sandstone thickness (m) | Effective thickness (m) | Permeability (μm2) | Horizon | Sandstone thickness (m) | Effective thickness (m) | Permeability (μm2) |
|---------|-------------------------|------------------------|-------------------|---------|-------------------------|------------------------|-------------------|
| I       | 1.0                     | 0.2                    | 0.05              | VI      | 1.3                     | 0.4                    | 0.267             |
| II      | 6.6                     | 4.0                    | 0.387             | VII     | 1.3                     | 0.5                    | 0.144             |
| III     | 2.3                     | 1.8                    | 0.33              | VIII    | 0.4                     | 0.4                    | 0.061             |
| IV      | 7.0                     | 6.6                    | 0.726             | IX      | 0.3                     | 0                      | 0                 |
| V       | 0.7                     | 0.4                    | 0.118             |         |                         |                        |                   |
Querying the layered test data of the connected injection wells of the production wells, it can be seen that the water absorption of the IV layer of the connected B injection well reaches 55.9%, while the water absorption of the VI and VII layers is not absorbed; the water absorption of the VI and VII layers of the connected D injection well reaches 52.6%, while the layers III and IX do not absorb water; the layer E of the connected E injection wells absorbs 75.6% of the water, while the layers I and V do not absorb water. It can be seen that the oil layers of the connected injection wells are unbalanced.

4. Tracking adjustment practices and effects

In view of the problems and potentials of the well groups analyzed above, the following tracking and adjustment countermeasures were formulated. After adjustment, the production conditions of the well groups have been improved:

4.1. Strictly control the injection quality to ensure the injection volume of the well group and the qualification rate of the injection system quality. The injection rate qualification rate, concentration qualification rate, alkali injection qualification rate and table injection qualification rate are all within 100% [6-7].

4.2. In view of the large drop in fluid production of the produced wells and the high injection-production ratio of the well group, fracturing the produced well A to improve the connection relationship, increase the utilization of thin layers, and maximize the potential of remaining oil.

In the choice of fracturing method, ordinary fracturing is adopted for layer I; for layer II, layer III to layer V with high water flooding layer, selective fracturing is conducted [8]; for layer VI to VII with small thickness The layer adopts multi-fracture fracturing [9-10], and the amount of sand added per seam is 10-12m3. The produced wells achieved good results after fracturing. The daily fluid production increased by 53t, the daily oil production increased by 14.9t, the water cut decreased by 0.3 percentage points, and the flow pressure recovered by 0.58MPa.

4.3. Timely adjust the parameters of injection wells and increase injection measures, do a good job of fracturing protection of produced wells, and ensure the balance of injection and production of well groups.

First, after fracturing the production wells, the injection wells C and E with larger pressure space were adjusted up to ensure the injection capacity of the well group. After adjustment, the total daily injection of the two wells increased by 45m3 and the injection pressure increased by 0.4MPa, as shown in Table 2.

| Well number | Before adjustment | After adjustment | Difference |
|-------------|-------------------|------------------|------------|
|             | Oil pressure(MPa) | Daily actual     | Oil        | Daily actual     | Oil        | Daily actual     |
|             |                   | injection(m3)    | pressure(MPa)| injection(m3)  | pressure(MPa)| injection(m3)  |
| Well E      | 12.16             | 50               | 12.22      | 70               | 0.06       | 20            |
|             | 12.22             | 70               | 13.3       | 85               | 1.08       | 15            |
| Well C      | 12.97             | 100              | 13.02      | 110              | 0.05       | 10            |
| total       | 12.45             | 220              | 12.85      | 265              | 0.4        | 45            |

Secondly, in response to the imbalance of oil layer utilization, three injection wells B, D and E were injected to strengthen the injection of thin layers and improve the utilization of the oil layer. After injection into the injection wells, the original non-water-absorbing layers have absorbed water, and the utilization of each oil layer tends to be balanced. The utilization ratio of the number of layers reaches 77.3%, an increase of 31.8%; the utilization ratio of sandstone reaches 90.7%, an increase of 30.9%; Reached 94.6%, an increase of 33.3%.
The third is to fracturing wells D and E in the well group to improve the connectivity between the well groups and the injection capacity of the well groups.

Through the adjustment of the above two injection and production ends, the injection and production conditions of Well A group have been improved. As shown in Figure 2, the current injection pressure is 11.33MPa, the injection volume is 265m³, the daily liquid output reaches 47t, and the daily oil output is 13.5t. The comprehensive water content is 71.3%, the effective period of fracturing is up to 13 months, and the cumulative oil increase is 6118t.

![Figure 2. Comprehensive mining curve of well group A](image)

5. Conclusion

5.1. For well groups with complex correspondences and prominent contradictions between planes and layers, when production stimulation measures are taken, the pre-measure training and post-measure protection work should be done to ensure the effectiveness of well group development;

5.2. The targeted synchronous adjustment of both ends of the oil and water wells in the well group is conducive to extending the effective period of fracturing.

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