The Development Effect of Oilfield Can Be Improved by Using Injection-Production System Adjustment

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Abstract. Oilfield development has entered into high water cut stage, the development difficulty is increasing, in order to raise recovery ratio and improve the development effect of the block, the injection and production system has been adjusted. The ratio of oil and water wells is reduced by changing the water injection well network; oil and water wells are complemented accordingly, the injection and production relationship of single sand body in this layer is improved; complementation of well network are carried out, and the injection and production relationship of other layers are improved; complementary utilization of well pattern and treatment of inefficient wells are adopted in fault area and so on, good development result is achieved, and it provides reference for development of water-drive remaining oil in future.

1. Implementation of Adjustment Practices of Injection and Production System

The oil field enters into the late stage of high water cut, and the development difficulty is increasing. In order to improve the development effect of the block, the injection and production system is adjusted. Thirty oil wells were converted, twenty-five wells were patched, and six well were patched. The adjustment of injection and production system is transformed from only relying on oil well conversion method to oil well conversion as priority, combined with various measures such as patching holes and complementary use of well networks, the injection and production relationship of various layers is improved entirety.

1.1. Change the water injection pattern and reduce the ratio of oil and water wells

At present, in allusion to unsuitable conditions of secondary infill adjustment well network in water level, the 15 secondary infill wells in 4 rows and 6 rows were converted into injection wells to form a horizontal linear injection pattern. there is no infill adjustment well in 6 rows are changed to polymer well, in allusion to this condition, 14 wells of J5 and J6 row, one infill oil well is converted every other well, three well are patched in the one infill layer of basic well and polymer flooding well in five row and six row. After the adjustment, the one-time infill adjustment well was converted from reverse nine-spot area patterns to five-spot area patterns. After the injection and production system is adjusted, the number of oil and water wells in one infill adjustment layer was reduced from 2.65 to 1.65; the secondary infill layer adjustment was reduced from 2.15 to 1.42. The injection-production ratio reached 1.12 and 1.77, respectively.
1.2. Implement corresponding patching holes of oil and water wells and improve the injection and production relationship of single sand body in this layer

According to the principle of perfecting the injection and production relationship based on single sand body in the layer system, the ratio of multi-directional connection thickness is increased; the water flood control extent is improved, and the remaining oil potential is fully taped. The 17 wells are patched, and the perforation sandstone thickness is 266.3m, and the effective thickness is 63.1m. For example, the perforation corresponding relationship of the surrounding wells and 48 wells is perfected, the PII2-3 is refilled, the sandstone thickness is 5.4 m, and the effective thickness is 3.4 m, moreover, in order to avoid the single-layer breakthrough to cause the water content in the surrounding oil well rises too fast, The layered water is carried out, the whole well is filled with 180m3/d, the actual injection is 133m3/d, and the injection pressure is 12.10MPa. After patching hole, the daily increase liquid of three wells was 149t, the daily oil increased by 6t, and the working fluid level increased by 112m.

1.3. Complement the well network and improve the injection and production relationship of other layers

The basic well pattern and the secondary infill adjustment well open the Pu II Gaotaizi oil layer, and the injection and production relationship of one infill layer was improved.

In order to improve the injection and production relationship of basic well pattern in sixth row, one oil well is patched, one well infill and patches hole, six wells infill and patched. The SII and SIII oil layers were blocked and polymer flooded, refill PII, and 6 wells of Gaotaizi oil layers were complemented. For example, 57t daily fluid output is in the 433 wells, the daily oil output is 1t, water is 97.4%, total pressure difference is -3.49MPa, production pressure difference is 1.29MPa, it is a high water cut well with low water injection cycle. In allusion to the production status and injection and production relationship of this well, the treatment of the Saer tu layer system is not considered, and the 22 small layers of the Pu II and the high-rise system are re-injected. Moreover, the connected 432 wells (block Sa III5+6-Sa III7 oil layer inject Pu II and the high-rise system, and a relatively complete injection and production relationship of the Pu II and high-rise system was formed around the 433 wells, after the measure, daily fluid output increased by 38.2t, daily oil output increased by 8.4t and water content decreased by 7.3%, and a good increased oil production effect was obtained.

1.4. Fault area adopts complementary utilization of well pattern to control low efficiency wells

The faults of the second team area are most developed, the injection and production relationship of the first, second and third infill adjustment wells are not perfect, therefore, the one-time infill oil wells in J5 row is converted to three wells, improve the injection and production relationship of the one-time infill well network. The typical one is the 25 wells, before the injection and production system is adjusted; this well has two water supply directions, the daily fluid output is 21t, the daily oil output is 4t, and the water content is 83.4%, after 24 wells were converted, the water injection well point on the west side of the well is increased, the original well pattern could not affect the remaining oil, and daily fluid output increased from 23t to 52t, increased by 29t; the daily oil production increased from 4t to 7t, increased by 3t, the water content was stable, and the obvious oil-increasing effect was seen.

2. Results of Injection and Production System Adjustment

2.1. After the adjustment of the injection and production system, the oil well has a good effect

The daily fluid output of 64 untreated oil wells is increased from 3298 tons to 4141 tons, increased by 843 tons; the daily oil output is increased from 305 tons to 336 tons, increase by 31 tons, and the water content is increased from 90.8% to 91.9%, increase by 1.1 percentage points; the average flowing pressure is increased from 2.91 MPa to 4.83 MPa, increase by 1.9 MPa, after adjustment, the cumulative oil increase is 1.11×104t, and the second infill adjustment well and the third infill adjustment well are better than the first infill adjustment well.
The second infill adjustment layer of Saertu began to take effect after converted two months, the 29 connected oil wells increased by 191 tons, the daily oil increased by 21 tons, and the comprehensive water cut decreased by 0.14 percentage points, the flow pressure is increased by 1.0 MPa, and the liquid level is raised by 100 m, the adjustment effect is obvious.

The development effect of the third infill wells has been significantly improved, the third infill wells have been put into production until now, the daily fluid output has increased by 93t, the daily oil output has increased by 63t, the water content has decreased from 79.3% to 70.2%, and the water content has decreased by 9.1%. The main reason is 16 third wells, of which 11 wells are affected by the injection and production system, and it accounts for 39.2% of the total number of wells.

2.2. After the injection and production system is adjusted, the oil layer utilization condition is improved

After the direction of water injection increased, the utilization degree was significantly improved. From the perspective of the utilization section of the oil layer, the ratio of the number of layers of the oil layer with more than 2m effective thickness is increased by 12.5%, the utilization ratio of the sandstone thickness is increased by 15.6%, the utilization ratio of effective thickness is increased by 25.6%, and the utilization ratio of the number of layers with 0.5-2.0m effective thickness is increased by 26.3%, the sandstone thickness utilization ratio is increased by 12.3%, and the effective thickness utilization ratio is increased by 15.4%. The Cl-concentration of the 31 wells tested was increased from 798.84 mg/l to 842.3 mg/l.

2.3. The layer pressure is obviously recovered

After the injection and production system is adjusted, the layer pressure of the affected oil well recovered obviously, 11 wells were measured in the statistical adjustment area, the layer pressure was restored from the 8.77 MPa in the second half of last year to the 9.78 MPa at present, and the total pressure difference increased by 1.01 MPa, half-year pressure difference increased by 0.28MPa, and the annual pressure difference increased by 1.01 MPa. The layer pressure of the three pressure wells in the fault zone was restored from 9.4 MPa in the second half of last year to the 9.97 MPa at present, and the total pressure difference increased from -1.56 MPa to -0.99 MPa, the normal well area measured 8 wells, the layer pressure was restored from 8.13 MPa in the second half of last year to the 9.58 MPa at present, the total pressure difference increased from -2.37 MPa to -0.92 MPa.

2.4. Treatment effect of inefficient well is better

After the Saertu second infill well was plugged by the second-class oil layer, it entered into the inefficient development, by convert the second infill wells in fourth row and sixth row; the seven inefficient wells located in this block were effective. The daily liquid increase was 18t, the daily oil increase was increased by 6t, and the water content decreased by 6.8 percentage points.

3. Existing Problems and Suggestions after the Adjustment of the Injection and Production System

3.1. The first infill adjustment layer system, Pu II and Gaotaizi second infill adjustment layer system greatly increase the liquid production and the oil production, and the water content increase sharply

The first infill adjustment layer was converted to 14 oil wells, and the water injection effect was seen after 4 months. Compared with the 18 non-measure oil wells at present, the daily liquid increased by 438t, the daily oil increased by 2.3t, the comprehensive water content increased by 1.9 percentage points, the flow pressure increased by 1.0MPa, and the liquid level raised 357m. The Pu II and Gaotaizi secondary infill adjustment layer increased by 143t of daily liquid, 8t of daily oil increase, the comprehensive water content increased by 2.3%, the flowing pressure increased by 2.2MPa, and the liquid level raised 236m.
This block has undergone two infill adjustments through analysis, and the Pu II and Gaotaizi oil layers adopt a five-point area patterns, which makes the water drive control extent of this layer higher, and reaches 94.9%, cause water of some well to rises faster in two layers. For example, well 542, the well mine PII, Gaotaizi layer, and four injection wells are connected, it is a regular five-point area patterns with good water injection. Before the injection and production system is adjusted, the daily fluid output of this well was 13t, the daily oil output was 3t, the water content was 79.5%, well 33 was converted, the daily injection was 170m3, and the daily injection was 160m3. The connection thickness between well 33 and well 542 is much larger than the connection thickness of the two wells in the same layer of well 542, moreover, the well spacing is close, so that the prior water injection in the direction of well 33 in north 42 is effective, and the water rise sharply, according to the output profile before and after adjustment of injection and production system, the ineffective circulation of injected water in the oil layer with larger development thickness is aggravated, and the increase of water production is greater than the increase of oil production. For example, GI1—GI12+131, sandstone thickness is 9.0m and effective thickness is 2.6m, they account for 30.4% and 63.4% of the total well, respectively. After the injection and production system is adjusted, the daily fluid output of the small layer increased by 10.1t, the daily oil output did not increase, and the water content increased from 78.1% to 86.6%, therefore, it is recommended to control the water injection in the layer around the well.

3.2 The difference of layer pressure in some well areas on both sides of the fault is large

Affected by the recovery of drilling and the adjustment of injection and production system, the layer pressure in this block obviously rises. However, the layer pressures in some well areas on both sides of the fault are quite different and urgently need to be managed. For example, Well 547 is a production well located at the edge of the fault, the original layer pressure of this well is 11.53 MPa, and the layer pressure has been maintained near the original layer pressure for several years. Affected by drilling, the layer pressure dropped to 9.5 MPa. In November, the drilling well opened, and the well 48 was converted, the injection well point was increased, and the layer pressure gradually increased, however, the pump loss occurred in the well 547, which caused the static pressure of the layer measured in April to be as high as 15.77 MPa, the water absorption in the three sections connected to well 548 is deteriorated, and cause the layer pressure of the well 547 fail to 12.89 MPa. The conversion of the oil well 47 on the west side of the fault is effective, the layer pressure has reached 15.44MPa, the flow pressure is 6.03MPa, and the liquid surface is 205m. At present, the pressure difference between the two sides of the fault is 2.55 MPa, and it is easy to cause casing damage. Therefore, it is recommended to check the pump around the well 547, and the well 47 amplifies the production parameters.

4. Conclusion

1). The oilfield enters the high water cut stage, and the injection and production system is adjusted, which can improve the development effect of the block and fully excavate the remaining oil.
2). The adjustment of injection and production system is transformed from relying on oil conversion to well conversion as main, various measures such as patching holes and complementary utilization of well pattern, and it can improve the injection and production relationship of each layer.
3). After the injection and production system is adjusted, the oil layer utilization condition is improved. The layer pressure is obviously restored, and the governance effect of inefficient well is obvious.

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