Analysis and Countermeasures of the Causes of Low-Yield Wells in Hailaer Oilfield

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Abstract. Due to complex geological conditions, fault development and great reservoir changes, some inefficient wells appear in Hailaer oilfield after it is put into development. In addition, with the deepening of oilfield development, water cut in some well areas rises abruptly. Through continuous practice and exploration, geological understanding and continuous deepening of development law, no matter from improving oilfield development effect or improving oilfield development economic benefit it is necessary to study systematically. Therefore, through the systematic analysis of the causes of low production wells in Hailaer oilfield, this paper summarizes the treatment methods and effects in the past years, and forms a set of mature treatment methods.

1. Introduction

Hailaer oilfield is a complex fault block oilfield with complex geological conditions. The distribution of oil-bearing blocks is scattered, the fault blocks are narrow, the reservoir thickness changes greatly, and the lithology is complex. Some blocks are affected by multiple factors such as structure and lithology, and the oil-water relationship is complex. Complex geological characteristics and insufficient geological understanding in rolling development lead to some low production wells in the process of oilfield development. It has the following characteristics:

1. The proportion of low production and long shut in is high. There are 426 middle and low production wells in Hailaer oilfield, accounting for 38.6% of the total number of wells. The average daily oil production is only 56 t.

2. The number of wells is increasing year by year. Some ultra-low permeability blocks can not form an effective injection production relationship and have a certain production at the initial stage, but the formation capacity deficit decreases to low production at the later stage.

3. The distribution of low production and long shut in wells is relatively scattered, which is distributed in all oilfields. In some blocks, it has obvious zoning and slice characteristics, with various causes, mainly affected by complex oil-water relationship, poor reservoir development and high water cut.

2. Genesis and distribution characteristics of low production wells

2.1. Classification and distribution characteristics of low yield wells with geological factors

Due to the influence of poor reservoir development, there are 257 wells with low production in the initial stage of production, accounting for 73.0% of the total low production wells. According to the perforation
situation of oil wells, geological low yield wells can be divided into two categories: undeveloped oil layer and poorly developed oil layer. Undeveloped oil layer can be divided into two categories: shooting pure water layer and shooting dry layer. Poorly developed oil layer can be divided into three categories: thin effective thickness, poor reservoir physical property and poor oil-bearing property.

2.1.1. Undeveloped reservoir type. This kind of well is mainly due to the lack of understanding of effective reservoir identification and oil-water layer identification methods in the early stage of development, resulting in shooting dry or pure water layers. It is mainly distributed in the low structural part of Beier oilfield, the extended block of Xing'anling oil layer and the low structural part of Wuerxun oilfield, with obvious piece distribution characteristics; after production, the liquid free wells are mainly distributed in the low structural part of fractured buried hill reservoir and the poor physical property part of the edge of Beier oilfield, with piece distribution characteristics.

2.1.2. Poor reservoir development type. The main characteristic of this kind of wells is that the production of oil wells is low at the initial stage of production, which is widely distributed in all oilfields except Hu and nuoren oilfields. According to the development of effective thickness, reservoir physical property and oil-bearing property, low production wells with poor reservoir development can be subdivided into three types: thin effective thickness, poor reservoir physical property and oil-bearing property.

2.2. Classification and distribution characteristics of low production wells with development factors
This kind of well has high production at the initial stage of production, and then low production due to the influence of production decline and water cut rise. According to the production decline, water cut rise, perfect injection production relationship and water absorption of surrounding wells after production, it can be divided into three categories: low production of elastic production, high water cut of water injection effect and formation water coning

2.2.1. Low yield type of elastic mining. The main characteristic of this kind of wells is that the production of oil wells is high at the initial stage of production, but the low production is caused by the lack of effective supplement of formation energy. According to the improvement of injection production relationship and the water absorption status of surrounding injection wells, it can be subdivided into imperfect injection production type and unable to establish an effective driving system type. And with the extension of time, the number of such wells will continue to increase.

2.2.2. High water content type after water injection efficiency. They are mainly distributed in Bei 301 block, Su 131 block, Bei 16 block and Budate fractured buried hill reservoir of Bei 12 block in sudert oilfield. According to the aquifer level, it can be divided into single-layer high water cut and multi-layer high water cut.

2.2.3. Formation water coning type. This kind of well mainly occurs in Bei 301 block of Huhe nuren oilfield, Xing'anling oil layer of Bei 16 block of sudert oilfield, Budate oil layer of Bei 14 and Bei 16 block and Su 301 block of Suren Nur oilfield. The main reason for the formation is high water cut and low production due to high oil recovery rate or high recovery degree, formation water coning or edge water advancing.

3. Thoughts and Countermeasures of governance

3.1. Thought of low production well treatment
According to the different causes of low production wells, different treatment measures are carried out, and the driving system is established by various means to alleviate the contradiction between plane and interlayer. For the low production wells with undeveloped oil layer, we mainly strengthen the geological
understanding and treatment, find potential layers, and replace the development layers by hole filling; for the low production wells with poor oil layer development, we mainly optimize the treatment process and fracturing technology, and carry out steering fracturing, large-scale mold fracturing, multiple ball casting fracturing and large-scale clean water fracture network fracturing tests; for the low production wells with poor water layer development, we mainly optimize the treatment process, optimize the fracturing process, and carry out the tests of steering fracturing, large-scale mold fracturing, multiple ball casting fracturing and large- In view of the low production wells caused by the elastic production, we mainly carried out the improvement of injection production relationship, water well measures to increase injection, oil well fracturing efficiency, well pattern adjustment and drive mode adjustment and other methods.

3.2. Evaluation of governance effect

3.2.1. Treatment of low efficiency wells in water injection affected well area.

(1)Through the adjustment of water injection, the wells with low liquid production and high water content can be treated

First, for sandstone and glutenite reservoirs, through the combination of "lifting and controlling" water injection adjustment, strengthen the water injection of connecting wells with different facies zones and different facies zones, and control the injection of dominant facies zones. Through the comparison of the results before and after the treatment of 8 wells, the average liquid production of a single well remains unchanged, the daily oil production increases by 0.5T, and the water cut decreases by 17.5%.

The second is to reduce water cut and control decline by cyclic water injection for network buried hill reservoir. In the Budate reservoir of bei19 and bei21 blocks, 11 high water bearing well groups are selected to carry out cyclic water injection test, and the initial effect is good. Compared with before and after cyclic water injection adjustment, the daily liquid drop of 15 oil wells is 4.5t, the daily oil increase is 12.5t, and the water cut is reduced by 40.4%.

Table 1. Effect table of cyclic water injection adjustment for network buried hill reservoir in Bei 19 and Bei 21 fault blocks

| Time | Number of oil wells | Fluid production before adjustment | oil-producing contain water (%) | After adjustment | Fluid production contain water (%) | Difference |
|------|---------------------|----------------------------------|-------------------------------|-----------------|----------------------------------|------------|
| 2016 | 15                  | 38.3                             | 10.2                          | 34              | 22.7                             | -4.3       |
| 2017 | 3                   | 10.9                             | 0                             | 9.0             | 7.2                              | -1.9       |
| 2018 | 2                   | 3.1                              | 0.4                           | 2.9             | 1.1                              | -0.2       |

(2) Controlling high yield and high water content well by water plugging

Because some blocks in Hailaer oilfield are affected by large dip angle, strong vertical non-uniformity or fracturing, the phenomenon of injected water inrush along the main reservoir, low position or fracture is serious, resulting in high water cut and low production. For example, Bei 6-8 well in Bei 31 block is connected with two wells. Due to the small injection production well spacing and good physical properties of main production reservoir, the injection effect of Bei 6-8 well is obvious. In September 2013, through plugging the main high aquifer of bei6-8, the daily liquid drop is 33.5t, the daily oil increase is 1.3t, and the water cut is reduced by 45.5%, so the water plugging effect is obvious.

3.2.2. The effective driving system is established by reducing well spacing in low production area.

In view of the poor reservoir physical properties, the well pattern can not establish an effective driving system, the water injection is not effective, and the production decline of oil wells is large, which leads to the low block size. Therefore, the well spacing should be reduced to improve the injection production relationship. For example, it is difficult to inject water in the low part of Wu 3 block, the block is in elastic production, and the formation pressure is constantly decreasing. Compared with the oil wells in
the edge and low parts, the production decline rate of oil wells in the low part is 77.8%, which is 25.6 percentage points higher than that in the affected well area in the high part. After 7 additional wells were drilled, the average well spacing was reduced from 250m to 170m, and the degree of water drive control was increased from 41.9% to 69.6%.

3.2.3. For the blocks with good material foundation and large thickness, large-scale fracturing is adopted to realize the treatment. In Hailaer oilfield, the reservoir physical properties are poor, the injection of water wells is difficult, and it is difficult to establish an effective driving system between oil and water wells. The Bei 2 block with relatively concentrated reservoir development, undeveloped formation water, high initial oil production and low efficiency of 91.4% oil wells is selected for treatment. Large scale fracturing is carried out in 6 wells, and the oil increase effect is obviously better than that of ordinary fracturing. The initial oil increase intensity is more than 4 times of that of ordinary fracturing, and good effect is achieved.

3.2.4. By strengthening the formation energy supplement, the effective driving mechanism is established and the treatment is implemented. In order to solve the contradiction of low production and rapid decline of single well in no energy supplement mining block, CO2 huff and puff is implemented for well groups with poor reservoir physical properties and well blocks with no injection production relationship due to fault shielding, so as to supplement formation energy near the well zone and achieve the purpose of increasing production. At present, 27 wells have been treated by huff and puff, including 20 effective wells, with an average daily oil increase of 2.1t at the initial stage of single well, and good huff and puff effect has been achieved.

4. Conclusion
(1) The diversity of causes of low production wells determines the diversity of treatment methods. Through several years of practice, targeted treatment methods should be adopted to ensure the treatment effect for low production and long shut in wells caused by different reasons.
(2) The poor reservoir physical property is the main controlling factor of the overall low production of the block. According to the principle of "overall deployment, classified research and batch treatment", the comprehensive treatment countermeasures should be considered for the purpose of overall utilization.
(3) According to the geological origin, the control measures should be adopted flexibly for scattered low production and long shut in wells.

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