The research of Oil Producing Evaluation on Northern-2 Daqing Blocks and Solution Scheme

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1 The Second Oilfield Technical Work Area of the Third Oil Production Plant of Daqing Oilfield Co.Ltd.Daqing, Daqing, HeiLongjiang, ZIP 163000, China

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Abstract. Among current oil in place in Daqing Oilfield, a large part of which is in oil reservoir of the pilot area on Northern-2 Blocks of Daqing oilfield, whose natural flow potential is very low. A Theoretical Analysis of producing state for the pilot area in west of Northern District of Daqing oilfield is studied to find affecting factors on producing state in reservoir and some renovations are presented, in order to provide theory evidence for effective development in reservoir. Based on evaluation of data points of producing state from 261 wells, the pilot area on Northern-2 District of Daqing oilfield is studied to establish mathematical model of injection-production ratio and water-oil ratio. The paper finds affecting factors on producing state in reservoir and ascertain major limitations on technical policy, in order to provide main measures for effective development in reservoir. The study on the effect of producing state in reservoir of the pilot area in west of Northern District of Daqing oilfield, especially carrying on the theoretical analysis to form a set of reasonable limitation on technical policy, have important directive significance on reservoir development.

1. Introduction

With the statistical analysis of the water drive injection profile on Northern-2 Blocks of Daqing oilfield, it has measured about 102 water well injection profiles totally in 2018. As classified by the effective thickness of the reservoir, from the sheet about the hygroscope producing rate condition by counted(sheet 1), we may find that the rate of the water well injection profile producing between 2017 and 2018 remained steady, and the numbers of the producing reservoirs which effective thickness not lower than 2m accounts for 82.8%, the rate of the producing sand stone thickness accounts for 80.3%, the rate of the producing effective thickness accounts for 79.2%. Form the hermetic well interpreting data, it shows that the rate of the break through from the reservoirs which effective thickness not lower than 2m accounts for 100%. From that, we can find that the reservoir which effective thickness not lower than 2m has a lower producing.[1]

| The number of the wells in 2017 | The number of the wells in 2018 | The level of the effective thickness | Hygroscope in 2017% | Hygroscope in 2018% | Difference(%) |
|-------------------------------|-------------------------------|------------------------------------|------------------|------------------|--------------|
| 131              | 102              | >=2.0                              | 81.8             | 82.8             | 1.0          |
|                  |                  | 1.0-2.0                            | 64.2             | 67.1             | 2.9          |
|                  |                  | 0.5-1.0                            | 55.6             | 56.0             | 4.4          |

Table 1. The condition of the water drive hygroscope producing rate from north area

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2. The analysis of the factor which impact the isotope injection profile producing degree

2.1. The difference of the connection

The difference of the connection of the profit well is an important factor of impact the injection profile. In the water flooding in west of the north two, the reservoir which effective thickness higher than 2m appeared a condition that it was not hygroscopic, and most of them. Because the connection was not very well with the oil well which around it. Most of them are belong to the second type connection, they have developed the interstream and out side, or they have exists the part which sand stone go bad and located in the middle of the connected oil-water wells. Such as the implantation well in north well #1, the whole well shoot sand stone thickness is 10.8m, and the effective thickness is 9.3m. In April 20, 2018, the isotope injection profile showed that the level 6-8 has not hygroscopic, the shoot sand stone thickness is 3.7m, and the effective thickness is 3.5m. The north well #2 has developed the lump sand in level 6-8, and with the north well #22, the north well #18 and the north well #20, they were both belong to the second type connection, and both developed the interstream, and they have exists the part which sand stone go bad. The average sand stone thickness which connected with these wells is 0.8m, and the average effective thickness which has connected is 0.5m. Because of these wells belong to the high inject and low product, they have caused the difference producing in level 6-8 in north well #9. [2-3]

2.2. The relationship between injection and production is not consummate

The relationship between injection and production is not consummate may impact the producing degree of the reservoir, although the water well developed well, there has a little oil wells to connect around it, may caused the difference of the thick reservoir producing.

For example, the injection well in north well #31, according to the isotope injection profile, the north slanting well #31 has not produced in level PII2, the shoot sand stone thickness of it is 2.8m, and the effective thickness is 2.6m. According to analysis, the injection well has connected 7 production wells around it, but it was only connected with the north slanting well #045 in level PII2, and the north slanting well #045 has developed the outer level in this level, and the shoot sand stone thickness is 1m, belong to the second type connection. Because of the little wells has connected, the level PII2 has not produced.

2.3 The reservoir pollution

When the injection well was under pit operating, the kill mud may enter the formation and make it jam, or we may take some measures such as acidify not very well to make the formation rock texture be damaged or caused the bridge over both can caused the information jam and impact the reservoir producing degree. For example, the injection well in north well #28 had a heavy repair reset operation in April, 2013. Before the operation, the relative water intake rate in level SII7+8 is 23.6%, and the level SII10+1(1) is 22.9%. But after it, they were both not hygroscopic (in sheet 2), and the reservoir producing became not very well. From the well test data, we can find that before the operation, the skin coefficient of that well is -3.30, but now is 1.64, so we think after the well operation, the reservoir may be polluted and then caused the reservoir producing go bad. [4-6]
Table 2. The vary condition after the well operation of the north well #28

| Stratigraphic position | Sand stone thickness (m) | Effective thickness (m) | The relative water intake rate before the operation (%) | The relative water intake rate after the operation (%) |
|------------------------|--------------------------|-------------------------|--------------------------------------------------------|------------------------------------------------------|
| SII7+8                | 6.4                      | 5.2                     | 23.6                                                   | 0                                                    |
| SII10+11(1)           | 2.6                      | 2.3                     | 22.9                                                   | 0                                                    |

3. Analysis of reasonable injection-production ratio and water-oil ratio

Injection-production ratio for Water-Flooding Oilfield can be shown by the following exponential equation[7-8]

\[ \log (W_i + F) = C + DN_p \]

Formula:
- \( W_i \) — cumulative water injection, 104m³;
- \( N_p \) — cumulative oil production, 104m³;
- \( C, D, F \) — fitting coefficient.

Relation of injection-production ratio:

**IPR** = \( \frac{dW_i}{dN_p} \frac{(\beta_o + WOR)}{\gamma_o} \)

Formula:
- \( IPR \) — injection-production ratio, dimensionless;
- \( WOR \) — water-oil ratio, dimensionless;
- \( \beta_o \) — oil volume factor, dimensionless;
- \( \gamma_o \) — the density of dead oil, dimensionless.

The calculation formula of injection-production ratio in sandstone oilfield is derived.

**IPR** = \( \frac{WOR^\beta_o}{\gamma_o + WOR} \)

Formula: \( G, H \) — comprehensive coefficient

In west of 2nd Northern District of Daqing oilfield, oil volume factor was \( \beta_o = 1.15 \) and the density of oil was \( \gamma_o = 0.816 \). According to dynamic Datas of west of 2nd Northern District of Daqing oilfield, draw curves of \( IPR \times (\frac{\beta_o}{\gamma_o} + WOR) \) and WOR. In logarithmic coordinate system, \( IPR \times (\frac{\beta_o}{\gamma_o} + WOR) \) has a linear relationship with WOR.

The values of G and H were drawn by linear regression as shown in Figure 1.
According to Fig.1 Comprehensive Coefficient Nomogram, G was 0.39 and H was 0.843. From G and H, Relation Diagram of injection-production ratio and water-oil ratio was drawn as shown in Fig 2.

According to Fig.2, when the current water content was 94.15%, water-oil ratio was 14.1765 and reasonable injection-production ratio was 1.61.

4. The method to improve the injection profile

4.1. Improve the data accuracy of the injection profile
When we measure the injection profile, we should choose different isotope by its diameter in different geology condition, and make up the well clean-up system to make sure the injection well pit clean and remove the impact of the absorb pollution.

4.2. Improve the relationship between injection and production
When the reservoir connected condition not very well due to the condition that no product, we should perforations adding the correspondent position of the well, and improve the relationship between injection and production.

4.3. Resolve the plane contradict problem
If the well had the product problem made the reservoir hygroscope go bad, we should resolve it by above ground operation on time, and improve the hygroscope condition.
4.4. Avoid the reservoir pollution
In order to avoid the mud make inroads on formation, and the bottom bridge over caused by the wrong measures or operations, we should adopt the operation such as no killing the well and no beaming up when we work for well.

4.5. Improve the quality of the injection water
We must guarantee the water quality well, and do better in water quality treatment in all respects. Make sure the water quality in sewage plant exits, main line, metering plant and well head “four points” both reach the standard, and then reduce the reservoir pollution to a minimum degree.

5. Conclusion
Based on evaluation of data points of producing state from 261 wells, the pilot area on Northern-2 Blocks of Daqing oilfield is studied to establish mathematical model of injection-production ratio and water-oil ratio. In the reservoirs which higher than 2m and have producing difference, the inaccuracy factors of the injection profile data accounts for a huge rate. When the current water content was 94.15%, water-oil ratio was 14.1765 and reasonable injection-production ratio was 1.61. The paper finds affecting factors on producing state in reservoir and ascertain major limitations on technical policy, in order to provide main measures for effective development in reservoir. The study on the effect of producing state in reservoir of the pilot area on Northern-2 Blocks of Daqing oilfield, especially carrying on the theoretical analysis to form a set of reasonable limitation on technical policy.

Acknowledgments
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