Study on Well Selection and Layer Selection for Fracturing Production in Extended Well Area of Block A

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Abstract. Fracturing reform plays an important role in improving the development effect of peripheral low permeability reservoirs, and fracturing put into production is the key to ensure the completion of productivity tasks at the initial stage of production. In 2012, an oilfield expanded drilling in Block A with good reservoir physical properties. In order to ensure the initial productivity, compare the fracturing production effect of the production well areas and the problems in the development process, and optimize the fracturing production well layers in the expanded well areas in combination with the geological conditions of the well areas themselves.

Keywords: Low permeability, Fracturing and putting into production, Select well and layer.

1. Basic profile
An oil field is located in Z County and is structurally located at the junction of depression a and depression b. It was put into water injection development in 2006, producing P reservoir with a porosity of 17.5% and a permeability of 13.3mD. It was put into production in July, 2006. The well pattern is 300×300m, the development area is 116.3 km², and the geological reserves are 1840.82×10⁴t. A total of 662 oil wells and 229 water wells have been put into production, with daily oil production of 0.6t and daily water injection of 12.9m³, with comprehensive water cut of 28.50%.

An oil field is delta front facies deposition, the reservoir is mainly thin sheet sand, the sand body is stable, but the number of development layers is small and the thickness is thin. The reservoir physical properties are mainly controlled by the structure, and there are great differences among the blocks. From northwest to Southeast, the structure gradually becomes higher, the reservoir becomes thinner and the physical properties become better. In 2012, well expansion was carried out in Block A with the best physical properties, with 47 planned wells and 38 actual wells, including 7 horizontal wells, 21 oil wells and 10 water wells. In order to improve the productivity of single wells, in principle, all inclined and straight oil wells are put into production by fracturing, except the special fracturing method for horizontal wells, and the fracturing layers of single wells are optimized.
2. Principle of well and layer selection for fracturing production

2.1. Whole well fracturing

According to the indicators in the well distribution plan of the well expansion area in block A, the daily oil production of a single well is estimated to be 2.2t at the initial stage of production of the straight inclined shaft. By comparing the output changes of the wells with poor physical properties in the adjacent well area A after putting into production (see Figure 1). The average initial daily oil production of single well is 2.2t and 1.6t, and the predicted output of the scheme can be achieved by fracturing and putting into production.

At the same time, compare the fracturing effects of an oilfield in the late years (see Table 1). Due to the poor physical properties of oilfield, few layers of development and thin thickness of single layer, the number of fracturing wells is decreasing year by year, and the fracturing oil increase is decreasing year by year, so there is little potential for later fracturing reform. Based on the above reasons, integral fracturing and whole-well fracturing are implemented in principle in the expanded well area of Block A.

Table 1. Oil well fracturing effect in a certain oil field over the years

| Year | Well times | Measure thickness | Water injection intensity of correspondi ng well (m³/m) | Half fracture length of fracturing (m) | Formation pressure(MPa) | Average initial daily oil productio n of single well (t/d) | Average cumulati ve oil increase of single well | Validity period (month) |
|------|------------|------------------|--------------------------------------------------|----------------------------------------|------------------------|----------------------------------------------------------|-------------------------------------------------|------------------------|
| 2007 | 71         | 6.3              | 2.7                                              | 725                                   | 85-120                 | 6.18                                                     | 1.6                                             | 154                    | 5.4                    |
| 2008 | 35         | 5.3              | 3                                                | 1652                                  | 85-120                 | 6.54                                                     | 1.4                                             | 159                    | 5.2                    |
| 2009 | 8          | 5.9              | 3.4                                              | 2559                                  | 120-170                | 8.32                                                     | 2.2                                             | 244                    | 7.5                    |
| 2010 | 11         | 6.3              | 3.5                                              | 2936                                  | 100-130                | 8.52                                                     | 1.3                                             | 112                    | 4.2                    |
| 2011 | 8          | 7.7              | 3.4                                              | 3191                                  | 120-170                | 5.84                                                     | 1.9                                             | 142                    | 4.9                    |
| Total/average | 133 | 6.1              | 2.9                                              | 2213                                  | 7.08                   | 1.6                                                      | 157                                             | 5.2                    | |

2.2. Delayed fracturing of wells with good reservoir physical properties

There are wells with good physical properties in the developed well area A. By comparing the output of these wells with that of wells put into operation with differential pressure of physical properties (see Figure 2), the average daily oil production of each well in the initial stage is 2.1t and 2.3t, and the decline rate of wells with good physical properties is slow in the later stage. After 56 months of production, the daily oil production of single well still reaches 1.5t, which is 0.6t higher than that of physical property differential pressure injection. These wells with good physical properties can suspend fracturing without affecting the initial productivity.
It can be concluded that when the injection direction of water injection wells to horizontal wells is the water breakthrough direction is nearly EW in the direction of the maximum principal stress of the oilfield.

2.5. No fracturing when drilling fault or near fault
Considering the risk of casing damage, two wells whose distance from the block to the fault is less than 80m and one well which encounters the fault are not fractured, and the fracturing scale and fracturing technology are controlled for five wells whose distance from the fault is 80m-120m.

![Figure 2. The production comparison curve of a well-pressing well and a slow-pressing well with good physical properties in well area A](image-url)
3. Results of well and layer selection in fracturing production

Table 2. Analysis of fracturing considerations in the expansion well area

| Serial number | Well No. | Fracturing considerations | Fracturing mode |
|---------------|---------|---------------------------|-----------------|
| 1             | A-1     | Good reservoir physical properties | Transfer injection to dangerous well layers | Whole well fracturing |
| 2             | A-2     | Good reservoir physical properties | Whole well fracturing |
| 3             | A-3     | Good reservoir physical properties | Whole well fracturing |
| 4             | A-4     | Good reservoir physical properties | Whole well fracturing |
| 5             | A-5     | Good reservoir physical properties | Whole well fracturing |
| 6             | A-6     | Good reservoir physical properties | Fault clamping well group | Close to fault |
| 7             | A-7     | Good reservoir physical properties | Fault clamping well group | Whole well fracturing |
| 8             | A-8     | Good reservoir physical properties | Fault clamping well group | Whole well fracturing |
| 9             | A-9     | Good reservoir physical properties | Whole well fracturing |
| 10            | A-10    | Transfer injection to dangerous well layers | Fracturing PI4 layer |
| 11            | A-11    | Good reservoir physical properties | Whole well fracturing |
| 12            | A-12    | Good reservoir physical properties | Transfer injection to dangerous well layers |
| 13            | A-13    | Good reservoir physical properties | Transfer injection to dangerous well layers |
| 14            | A-14    | Good reservoir physical properties | Transfer injection to dangerous well layers |
| 15            | A-15    | Good reservoir physical properties | Transfer injection to dangerous well layers |
| 16            | A-16    | Good reservoir physical properties | Transfer injection to dangerous well layers |
| 17            | A-17    | Good reservoir physical properties | Transfer injection to dangerous well layers |
| 18            | A-18    | Good reservoir physical properties | Transfer injection to dangerous well layers |
| 19            | A-19    | Good reservoir physical properties | Transfer injection to dangerous well layers |
| 20            | A-20    | Good reservoir physical properties | Transfer injection to dangerous well layers |
| 21            | A-21    | Good reservoir physical properties | Transfer injection to dangerous well layers |

Comprehensive analysis of the above factors, finally issued fracturing plans for 15 of the 21 oil wells.

4. Conclusion and understanding

(1) Fracturing production is a necessary measure to improve single well productivity in low permeability oilfield.

(2) The good reservoir physical properties in well block a with good physical properties can delay fracturing.

(3) In order to improve the injection production well pattern of horizontal wells, the wells with the maximum principal stress corresponding to the horizontal wells have the risk of water breakthrough and will not be put into production by fracturing.
(4) Considering the risk of casing damage, the wells with a break point and a distance less than 80m from the fault will not be put into production, and the well with a distance of 80-120m from the fault will control the fracturing scale.

References
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