Cognition and Discussion on the Effect of Comprehensive Adjustment in the West of a Block

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Abstract. In the late stage of oilfield development, water drive reservoir development is faced with many unfavorable factors, such as decreasing new recoverable reserves, increasing number of ultra-high water cut wells, decreasing oil increment by measures, increasing liquid-oil ratio and decreasing cost-effectiveness. In order to improve oil recovery and productivity of new wells with tertiary infilling, this paper discusses the understanding of the comprehensive adjustment plan for the western block of Xingshi District, and probes into how to slow down the decline of production.

Introduction

Geological Survey. The oil-bearing area of the western block of the pure oil area in A District is 7.4 km², and the geological reserves are 2294.9 x 10⁴ t. The reservoir type is anticlinal structural reservoir. There are 71 subdivision sedimentary units of Sa II, Sa III and Pu I reservoirs in the whole area. Portugal I 2-3 is the main reservoir, while the others are non-main reservoirs. The main reservoirs are delta distributary plain facies and inner front facies. The non-main reservoirs are delta front facies except that Sa II 15 is offshore bar deposit and Pu I 12 is delta inner front facies deposit, the others are delta outer front facies deposit. Reservoir burial depth is 840-1200 M. Each reservoir belongs to the same hydrodynamic system. The original formation pressure is 11.07 MPa, the saturation pressure is 6.61 MPa, and the earth saturation pressure difference is 4.46 MPa.

Development Brief. The western of a block pure oil area was put into development in 1971. The average single well perforated sandstone thickness is 28.5 m and the effective thickness is 21.0 M. Self-spraying mining before 1982, successive pumping after 1983, and comprehensive pumping in 1986. From 1988 to 1993, an encryption adjustment was made, a secondary encryption adjustment was made in 1998, and three encryption adjustments were made in 2007.

Production of Oil and Water Wells. There are 327 oil and water wells in the west block of the pure oil area of A District, including 219 oil production wells and 108 water injection wells.

Potential Situation of oil and Water Wells and Formulation, Implementation and Effect of Various Schemes

Major Programmes and Implementation of Western Block in a District. Since 2011, drawing lessons from various effects and experience of the fine potential tapping demonstration area in a certain area, it has been gradually implemented in the western part of a certain area. In the past two years, 180 wells have been planned to be adjusted, and 124 wells have been implemented by the end of June.

Combining with the results of multidisciplinary research, find the remaining oil potential of oil wells, constantly improve the injection-production relationship, and adjust the measures of oil-water well filling and fracturing.

Firstly, in order to improve the injection-production relationship of narrow channel sand, reduce the injection-production spacing of thin and poor reservoirs, and implement hole-filling measures for oil wells. In 2012, 11 wells were drilled to fill holes. The average daily fluid increase of single well was 14.4 T and the daily oil increase was 2.9 t. After the oil well measures, 11 connected water injection wells have been adjusted. The daily actual injection has risen by 138 m³, and the oil wells have maintained a good adjustment effect. At present, the effect of increasing oil by 31.1 t per day is still achieved.
The second is to implement fracturing modification measures for oil wells with poor reservoir utilization, high formation pressure and certain remaining recoverable reserves, so as to increase the reservoir utilization thickness and improve the oilfield development effect. In 2012, two wells were fractured, with an average daily fluid increase of 9 t per well and 2.1 t per day oil increase. After the oil well measures, three connected water injection wells have been adjusted. The daily actual injection has increased by 44 m³, which still achieves the effect of increasing oil by 4.0 t per day.

Combining with the adjustment idea of "three lifts, three controls and one stability", the water injection wells are tested and adjusted, the combination of intervals is optimized, the difference between layers is narrowed, and subdivision adjustment is carried out, focusing on the former measure wells and the wells with lower formation pressure. In the first half of 2012, 30 wells were tested and adjusted in this area, and daily injection decreased by 378 m³. Thirty wells were subdivided and adjusted, the number of water injection intervals increased by 53, and daily injection increased by 150 m³. In the past two years, after the adjustment of water injection scheme, the formation pressure of the block has risen. Compared with 38 wells of the same well number, formation pressure increased by 0.30 MPa, and the pressure distribution tended to be more reasonable in terms of pressure classification.

A better Adjustment Effect has been Achieved in the Western Block of a Certain Area. The development situation of Western blocks a districts is getting better. In the first half of 2012, the overall oilfield development situation in this block is that the water injection volume has risen, formation pressure has risen, and the oil production has remained stable due to the recovery of drilling gates, adjustment of water injection schemes, injection time rate of new wells and measures to increase injection.

The Phased Adjustment Effect of the Western Block of a District. First, for two consecutive years, production and water injection have remained stable.

Secondly, the thickness of reservoir is increased. According to the statistical data, through the measures of oil well filling, water injection well subdivision, test adjustment and profile control, the producing thickness of the reservoir has been improved compared with that before adjustment. Among them, the ratio of layers before and after adjustment ranged from 51.49% to 59.30% in 2012,
the ratio of sandstone from 61.64% to 70.65% in 2012, and the effective ratio from 81.46% to 87.65% in 2012.

Thirdly, the contradiction of uneven formation pressure has been alleviated and the pressure distribution has become more reasonable. From the annual pressure statistics, it is obvious that after adjustment, the number of wells less than 1 MPa of original formation pressure is reduced by 8, and the number of wells higher than 1 MPa of original formation pressure is zero.

Table 1 Formation Pressure in a Area in 2011

<table>
<thead>
<tr>
<th>Well Pattern</th>
<th>Well Number (mout h)</th>
<th>Primiti ve formation pressure (MPa)</th>
<th>Formation Pressure in 2011</th>
<th>&lt;-1.0</th>
<th>-1.0~0.5</th>
<th>-0.5~0.5</th>
<th>0.5~1.0</th>
<th>&gt;1.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundation well</td>
<td>6</td>
<td>10.95, 10.33</td>
<td>1, 8.17</td>
<td>5</td>
<td>10.76</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary well</td>
<td>3</td>
<td>10.94, 10.26</td>
<td>3, 10.26</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two or three well</td>
<td>29</td>
<td>10.96, 9.90</td>
<td>12, 8.51</td>
<td>14</td>
<td>10.64</td>
<td>3, 11.97</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
<td>10.95, 10.00</td>
<td>13, 8.48</td>
<td>3</td>
<td>10.26</td>
<td>19, 10.67</td>
<td>3, 11.97</td>
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</table>

Table 2 Formation Pressure in a Area in 2012

<table>
<thead>
<tr>
<th>Well Pattern</th>
<th>Well Number (mout h)</th>
<th>Primiti ve formation pressure (MPa)</th>
<th>Formation Pressure in 2011</th>
<th>&lt;-1.0</th>
<th>-1.0~0.5</th>
<th>-0.5~0.5</th>
<th>0.5~1.0</th>
<th>&gt;1.0</th>
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</thead>
<tbody>
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<td>1, 8.74</td>
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<td>10.72</td>
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<tr>
<td>Primary well</td>
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<td>10.94, 10.53</td>
<td>1, 9.85</td>
<td>2</td>
<td>10.87</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Two or three well</td>
<td>29</td>
<td>10.96, 10.26</td>
<td>10, 9.68</td>
<td>12</td>
<td>10.72</td>
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<td></td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
<td>10.95, 10.30</td>
<td>12, 9.62</td>
<td>19</td>
<td>10.74</td>
<td></td>
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</tbody>
</table>

Some Understandings

Perfect the injection-production relationship by filling holes in oil and water wells, improve the degree of water drive control, effectively slow down production decline and control the rate of water cut rise.

By fine adjustment of water injection scheme, the difference between layers can be reduced and the pressure distribution can be rationalized.

Through fine water injection subdivision and profile control, the production thickness can be
increased and the thin and poor reservoirs can be well used.

References


