Discussion on the problems and treatment methods in the development of Aonan low permeability oilfield

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Abstract. Although the geological conditions of low permeability oilfield are poor and the development is difficult, with the rapid development of China's economy, the demand for petroleum products is increasing, and the rich oil reserves of low permeability oilfield are attracting more and more attention. This paper discusses the problems existing in the development of Aonan low permeability oilfield, analyzes the main factors affecting the development effect, and discusses how to effectively develop and treat low permeability oilfield.

Keywords: Low permeability oilfield; Existing problems; Development; Governance.

1. Introduction
Aonan oilfield is structurally located in the central depression area in the north of Songliao Basin. It is mainly thin sandstone with small scale and scattered distribution. The edge water is not active enough, the elastic energy is small, the reservoir property is extremely poor, and the reserve abundance and average air permeability are very low. In view of the generally poor development effect of low permeability oilfield and the problems encountered in development, we have targeted to optimize the development plan to improve the overall development effect when developing each block of Aonan Oilfield[1-2].

2. Main problems in development
2.1. Major problems in development

2.1.1. There are many low-yield and low-efficiency Wells with low productivity. Due to the increase of water cut in high-yielding Wells in the main block and the operation of low-yielding blocks at the wings and edges, the number of low-yielding and low-efficiency Wells in Aonan oilfield is gradually increasing. At present, there are altogether 296 Wells with low yield and low efficiency (Wells with daily fluid output ≤2t and daily oil output ≤1t) in Aonan area, accounting for 41.05% of the number of Wells opened, and the average daily oil output per well is 0.36t. Among them, 127 Wells with daily oil production of 0.5 ~ 1t, average daily oil production of 0.77t per well, 169 Wells with daily oil production of less than 0.5t, average daily oil production of less than 0.1t per well (including 100% water content, 135 Wells with daily oil production of 0t).
2.1.2. Oil well flooding along fracture direction is serious, and there are many high water-bearing Wells. Aonan oilfield is a sandstone oilfield with fractures, and most of its matrix blocks are low permeability reservoirs, thus forming the fractured and low permeability sandstone oilfield. The water injection Wells in the fracture development area have strong water absorption capacity, and the water channeling and flooding along the fracture direction are very serious. For example, water was reported from oil well Ao 316-65 9 days after its east-west connected well Ao 316-63 was put into operation. The total salinity of the water quality was only 2991, and it was flooded by storm. At present, there are 206 Wells with high content of over 80% in Aonan Oilfield, accounting for 28.57% of the number of Wells opened. But crack has dual function, if adjust, control properly, also can obtain better development effect.

3. Analysis of the main geological factors affecting the development effect

3.1. Small scale of reservoir sand body and low degree of water drive control
The main reservoirs in Aonan area are mainly deltatic deposits with small sand bodies distributed in narrow and short strips. The number of sand bodies whose width is less than 30Om accounts for 60% of the total sand bodies, and the drilling rate of sandstone is 30% ~ 40%. The control degree of these sand bodies in the 30Om square well pattern is 50% ~ 70%. The fuyu reservoir developed next is mainly fluvial deposits, dominated by narrow and intermittent strip channel sand bodies with a width of 300 ~ 600m. With the addition of fault cutting, the water displacement control degree is only 55% ~ 75% under 300m square well pattern condition[3-6].

3.2. In some fracture development blocks, the well arrangement direction does not match the fracture orientation
In the development of low permeability reservoir development in different levels of natural fracture, the fracture strike and well drainage direction 0 ° and 11.5 ° and 22.5 ° Angle, the well pattern in the water injection mode at 9 o’clock after water flooding development, may result in injector-producer direction parallel to the crack or approximate parallel to the direction of oil Wells and water cut rising fast, quick results with vertical cracks or approximate vertical direction of the well water injection response slow or doesn't work, caused the water cut oilfields or blocks up fast, production decline[7-9].

4. Comprehensive treatment measures

4.1. Implement fracturing to increase production and improve the development effect of low permeability oilfield
Aonan oilfield is a low permeability oilfield with thin oil layer and poor reservoir physical property[10]. The main measure to improve the current development effect is fracturing. According to the development and connectivity of the reservoir, the fracturing layer is optimized. There were 14 fracturing Wells with 45 layers, with the average single well fracturing sandstone thickness of 7.5m and effective thickness of 3.2m. Before and after fracturing, the average daily fluid increase of a single well was 2.4t, the daily oil increase was 2.4t, and the submersion increased 555m. At present, the average daily increment fluid of a single well is 2.2t, the daily increment oil is 2.0t, and the submersion degree increases by 226m.

4.2. Determine the adjustment mode of injection-production system according to the relationship between fractures and well arrangement direction
Comprehensive analysis has been developed oilfield and adjacent zone in old Wells of aobao tower water breakthrough, in order to avoid the injection-production well direction parallel to crack or approximate parallel to the direction of water cut rising fast, AoNa oilfield put into production in Ao 157 and put into production MAO 72 well array, Ao 21 blocks, compared with that before put into production before block well drainage direction by NE90 ° is adjusted for NE45 ° (Figure 1). Compared
with Wells put into operation before, the time to see water was relatively late due to adjustment of well drainage direction.

(a). NE90° before adjustment     (b). NE45° after adjustment of well row direction

Figure 1. Is a schematic diagram of Aonan well row adjustment

5. Conclusion
1). The reservoir water in Aonan Oilfield has obvious directionality, that is, the water appears quickly in the east-west direction, and the water cut rises especially quickly after the water appears, which is caused by the existence of natural fractures in low-permeability oilfield.

2). Based on understanding the reservoir properties, water injection status and water flooding characteristics of the oilfield, targeted measures can be taken for comprehensive treatment to improve the development effect of low-permeability oilfield.

3). Due to the low oil well productivity of low-permeability oil fields, timely transfer effect and fracturing effect can achieve better development and adjustment effects while the injection-production relationship is adjusted.

4). Implementing water shutoff and water control for high water-bearing Wells and well groups is an important measure to slow down the rising speed of water cut in low permeability oil fields and ensure the development effect.

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