Water Injection Study in a Block Cycle

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Abstract. Block reservoir sand body main front deposition within the channel sand is given priority to, less layers, the thickness of thin sand body development, small scale, more is given priority to with narrow channel sand, water cut rising too fast in the process of oilfield development, plane, small interlayer adjustment scope, difficult to control the production decline and water cut rising speed, oil use degree is high, poor development effect. Under the condition of steady water injection, it is very difficult to expand the affected volume, and most of the water in the water channel is produced by the water chanelling to the ground, making the injected water use less and less. It can improve the effect of oilfield development by adopting periodic water injection and preliminary exploration of stable yield path. Cyclic water flooding is the use of the existing well pattern, through the adjustment of the pressure field, the remaining oil used up state, improve the utilization rate of injected water and controlling water cut rising speed, delay of water breakthrough time, enlarge the swept volume of injected water, improve water drive recovery factor. It is an effective way to explore the effect of water flooding in high water content period.

1. Basic Situation
A block is located in the north of daqing changyuan anticline structure, and the northern part of the block is divided into five blocks with different sizes. Reservoir is the cretaceous yaojia I oil reservoir of pay zone a is given priority to, Mr II pinchout south of oil reservoir in too 14 rows. The reservoir consists of three sandstone groups and 13 sedimentary units. The block development effect is poor, the contradiction in single sand layer of injection-production imperfect, thickness of oil layer with high proportion, is the fifth production plant using thickness proportion is the largest blocks, but the composite water cut reached 90%, only 24.48% recovery degree, the development effect is poor. Now well pattern conditions in the water flooding control degree is low, only about 63%, and given priority to with unidirectional connected, one-way connecting thickness ratio reached 48.0%, from the research block development present situation, the low degree of water flooding control, multidisciplinary oil reservoir research shows that the injection-production imperfect remaining oil research blocks remaining geological reserves of 16.36%, also have a certain adjustment of remaining potential.
2. Existing Problems And Potential Analysis

2.1. Block well spacing and low oil level
A block spacing is large, low degree of water flooding control, three, four, five block water flooding control degree is low, and connected in a single direction is given priority to, plane adjustment effect is poor, low degree of oil use, unencrypted blocks the water cut has been as high as 82.48%, only 11.66% recovery degree, encrypted block water cut of 85.03%, recovery degree has reached to 24.44%. It is indicated that through the encryption adjustment, it can obviously improve the degree of water flooding control and the extent of reserves. Through the unencrypted block reservoir development situation and the use condition analysis, potentiality of the infilled adjustment of unencrypted block has a certain partial, under the condition of the minimum standard recoverable reserves decline, some wellblock local encryption can be adjust. Improve the water drive control degree of unencrypted block and improve the development effect.

2.2. The inconsumable contradiction is highlighted
The research on the contradiction of block injection is highlighted: from the main mining object of the existing two well network, it can be seen that there is no strict mining stratigraphic boundary between the well meshes, and the perforation layers intersect each other. The water displacement control is more than 95%. Distributary plain facies sand body is the foundation of well pattern, mainly produced fluid layer mining history is long, the use of degree is high, the main development provided a well pattern and water layer, since an encryption adjustment, has been the main object of control water cut. The incomplete injection-production is mainly caused by the damage of the foundation Wells and the water shutoff. The sand body of the inner leading edge, the sand body development is small, the well network control degree is the main factor of the incomplete injection.

The study of block channel is dominated by single direction. The proportion of sandstone thickness in single direction and unconnected channel sand is 70.06% of the total thickness, and the effective thickness is 70.51% of the total thickness. In the process of oilfield development, the oil well water content increases too rapidly, the adjustment of the plane and the floor is small, and the difficulty of controlling the production decline and the water content rising speed is very difficult.

2.3. Multidisciplinary research and three-dimensional seismic data deepen the understanding of sand body and structure
In 2004 began the test block multidisciplinary integrated reservoir study, 2006 research results applied to oilfield development has achieved good results, in 2008 through the fine 3d seismic data interpretation for there is a new understanding of the structure of the test block, according to the above technical test blocks, careful analysis, help all kinds of measures, optimizing scheme, the prediction and reasonable implementation effect.

3. The Theoretical Basis Of Cycle Water Injection
Periodic water flooding is also called intermittent water injection, pulse injection or unstable water injection. It is a periodic change of water injection and injection pressure, which forms an unstable pressure state in the oil layer, which causes the interchanging between different permeability layers or cracks and the liquid between the bedrock blocks. At the same time, it promotes the infiltration of the capillary and increases the depth of its infiltration. The greater the permeability difference between the layers, the stronger the interlayer liquid exchange capacity when the pressure is redistributed, the better the period water injection effect.

3.1. The mechanism of periodic water injection under the condition of non-uniform quality
In the case of conventional water injection, the trend of high and low permeability is balanced due to the exchange effect. In half cycle injection water stop or reduce injection cycle, due to the differences between oil saturation and permeability, make high permeable interval pressure falling fast, low
permeable interval pressure drop slowly, caused the high permeable zone within the same time period of low pressure, low permeable interval pressure is higher, resulting in an unstable potential difference between the layers, forming additional pressure difference. On the contrary, in the half cycle of refilling or injection of water injection, the pressure of high permeability is fast, the pressure of low permeability is slow, and the pressure of reverse pressure is poor. In the two and a half cycles of the periodic injection, two unsteady flows occur in the opposite direction. In the first half of the cycle of oil and water are moving from low permeable formation to the high permeable zone, while in the latter half cycle oil and water are moving from the high permeable zone to low permeable formation, just because of the difference of mobility, there is more water in a complete cycle from high permeable zone to low permeable formation, more oil from low permeable formation to the high permeable zone, thus increasing the uniformity of water flooding.

3.2. The feasibility of the cycle water injection
The main form of pore in block reservoir is intergranular pore, and the mean pore radius is 5.59 μm and the effective porosity is 23.1%. The effective permeability is 120×10^{-3} μm², the air permeability is 219×10^{-3} μm², which belongs to the middle hole of medium viscosity and permeates the oil layer, which can fully apply the capillary action to use the oil layer. The crude oil quality is better, the underground crude oil viscosity is only 5.85 mPa.S, the rate of spontaneous osmosis is faster than the oil layer with high oil viscosity, which is beneficial to carry out the water injection test. The heterogeneity of both interlayer and layer is stronger. Influenced by sedimentary environment, sedimentary microfacies and sedimentary structure, the direction of channel sand has obvious directivity, which directly affects the direction and homogeneity of water drive. The difference of oil layer in vertical phase is large, the size of sand body and pore permeability vary greatly, and the channel sand layer is unstable. The channel sand is affected by abandoned river channel, discontinuous thin sandwich, prosodic and permeability, which makes the inhomogeneity of the channel sand body serious, the remaining oil in the layer and the inefficient circulation of water. From the injection mechanism, it is feasible to carry out water injection. From the characteristics of reservoir, the conditions of periodic water flooding are provided.

4. Programming And Implementation Effect

4.1. Programme preparation
Using dynamic data and seismic data, and multidisciplinary research, the combination of the composite water cut oil well end more than 95%, fluid producing intensity greater than 10 t/m., wide river exist two wellblock of waterflood direction, in order to reduce the intensity of water injection, control inefficient invalid loops, with different direction of water injection well point crossover method implementation cycle water injection, water injection has compiled the 27 Wells cycle water injection scheme.

4.2. Effect of implementation
In 2016, there were 27 water injection cycles, 140m³ of water control and 103m³ water control. Statistics of the 84 unmeasured oil Wells connected in the surrounding area, the daily fluid volume was increased by 11.4t from 1917.0t to 1928.5 t. Daily oil production from 103.0t to 108.0 t, increasing 5.0 t; The water content decreased by 0.23 percentage points from 94.63% to 94.40%. The flow pressure was reduced by 0.15MPa from 3.16MPa to 3.00 MPa. Through the cycle water injection, the production decline and the water content rising speed are slowed, and the effect is very good.

5. Conclusion
1) In the middle and low permeability reservoirs, there are heterogeneity between layers and layers, and the cycle water injection is an effective means to improve the development effect of these fields.
2) Cycle water injection can effectively reduce inefficient and inefficient circulation, and has less investment and high efficiency, which is suitable for the development of oil fields in the later stage of high water content.

3) After the water injection is stopped, the pressure in the vicinity of the oil layer can be reduced, which is beneficial to the reverse seepage of the residual oil in the roof ridge and the corner area, and the extent of the reserves is increased.

4) High water content period is better than that of water injection. The fluid in the high permeability layer is injected with water. In the case of low water flooding in the reservoir, the fluid in the high and low permeability zone is basically the same as crude oil, the flow exchange is meaningless, and it can aggravate the imbalance of water flooding.

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