Several potentiality enhancement techniques of water flooding reservoir in placanticline

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Abstract. The three types of oil reservoirs in water drive have entered the later stage of ultra-high water cut development [1] after three times of well pattern infilling adjustment and years of oil stabilization and water control. With the gradual transfer of high quality reserves to chemical flooding, the development objects of water flooding are mainly three types of oil reservoirs, and the exploitation objects are getting worse and worse, and the difficulty of controlling decline, exploiting potential and benefit development is increasing year by year. To this end, the blocks that have been tested for water control and efficiency improvement are selected to conduct precise potential-tapping tests, to carry out technological breakthroughs of "water control and efficiency improvement", to explore and form a series of high-efficiency development technologies of water flooding, and to guide the deep potential-tapping in the ultra-high water-cut stage of water flooding [2]. This paper mainly focuses on the comprehensive utilization of injection and production well pattern, as well as the principle and effect of injection well comprehensive adjustment program and tracking adjustment program.

Key words: Water control and efficiency improvement; Precise tapping potential; Comprehensive utilization of well pattern; Adjustment plan.

1. Introduction

As the mining object becomes worse, the difficulty of water drive control decreases, measures to tap potential and benefit development increases year by year. The purpose of precise potential mining is to guarantee the scale of injection-production while ensuring the formation energy, optimize injection-production structure and measure effect, strengthen the treatment of low injection and low production Wells and inefficient and ineffective circulation Wells, and focus on the optimization of production structure and potential mining of remaining oil at this stage.

The formation pressure is lower than the original pressure, there is pressure imbalance in some areas, the proportion of low-pressure Wells is high, and there are still certain contradictions in the plane of formation pressure system of each well pattern and well group. For the block with developed faults, the control degree of sand body water flooding is low, and the control degree of water flooding is different among different well patterns [3]. The control degree of basic and primary well patterns is high, and the control degree of secondary and tertiary well patterns is low [4]. Compared with secondary and tertiary infilling well patterns, the ratio of fluid volume and reserves between basic and primary well patterns does not match, resulting in heavy burden on poor oil layers and insufficient potential of good oil layers [5].

To improve the potential of both injection and produced Wells, a detailed understanding of the development history of the block is required to accurately tap the remaining potential.

2. The development process

A, B and C oil reservoirs in S Development Zone Zone are a set of interbedded deposits of gray and gray-green sand and mudstone, which are the strata of Nenjiang Formation, Yaojia Formation and Qingshankou Formation in upper Cretaceous of Mesozoic, and belong to the large fluvial delta sedimentary system of Songliao Basin, and are inner and outer delta front facies deposits [6]. Oil occurrence is diverse, thick oil layer is mainly full of oil and oil, and thin oil layer and outer layer are mainly oil immersion and oil spot [7]. Take a block in S Development Zone as an example:

In 1966, the basic well was put into development, and the mining objects were A, B and C oil reservoirs, adopting the row and row well pattern.

An infill adjustment was carried out in 1984, and the adjustment objects were A, B and C difference oil reservoirs, which were divided into two sets of A and B

I4 difference oil reservoirs for exploitation. Local areas were co-exploited, and the well distribution method of adding Wells between Wells and adding rows between rows was adopted. The inverted nine-point area pattern with a well spacing of 250m was formed between the primary infill adjustment well and the basic well.

In 1996, two sets of well patterns were used for secondary infill adjustment, and the adjustment objects were A, B poor oil reservoirs, off-surface reservoirs and C poor oil reservoirs respectively. A five-point area well pattern with irregular spacing of 250m Wells is formed by the well arrangement mode of adding rows between rows.

In 2002, three infilling adjustments were carried out, targeting A, B, C thin and poor oil reservoirs and off-surface reservoirs. Oil production Wells were used in the first infilling adjustment well row, forming a 250m five-point area well pattern. The newly-drilled injection well should also improve the injection-production relationship of the secondary infill adjustment well, and the tertiary infill adjustment should be adjusted by means of uniform well distribution and selective drilling [8].
In 2002, B I 1-4 oil reservoirs was developed by polymer flooding, and 220m five-point area well pattern was adopted [9].
In 2015, A II 7-12 reservoirs was developed by weak alkali TERnary flooding, and a 125m five-point area well pattern was adopted.

3. Complementary well pattern to improve injection-production relationship

If one is to be encrypted with the secondary encryption, comprehensive utilization pattern will first secondary encryption interval of well pattern was not used to tap potential, reperforating measures aiming at single mining in an encryption adjustment Wells at the same time, poor, poor Portuguese oil Wells, reservoir of not used to fill holes with the original secondary infilling of network connectivity, eventually integrated into a set of development series of strata. The principle of layer selection for oil Wells with supplementary holes is precisely tapping potential, avoiding high aquifer and tapping underutilized oil layer. The principle of layer selection for hole filling Wells is to ensure formation energy and injection scale. At the same time, oil and water Wells fill holes in the selected layer, so as to improve the injection-production relationship and avoid the situation of injection without production or production without injection.
Three times to the secondary encryption and encryption comprehensive utilization of well pattern, because three times encryption commingled producing Wells in block local little deployed against local cloth of tertiary infilling of the actual, based on the existing network, secondary infilling first three encryption commingled producing Wells with existing secondary encryption commingled producing well injection-production relation, perfect in the second pattern with three times after perfecting injection-production relationship, For other non-co-production Wells with secondary infill, filling holes between co-production Wells and non-co-production Wells in the secondary infill well pattern is improved.

4. Measure adjustment potential

4.1 Comprehensive utilization potential of well pattern

For blocks with complex well pattern relationships, each well pattern will be developed with multiple sets of layers. Based on existing water flooding well pattern, the comprehensive adjustment mode of the reorganization of each well pattern will be sorted out first [10]. The control degree and operation condition of water flooding can be improved by optimizing layers and well spacing. Clear layers, perfect well pattern, convenient for later tracking and adjustment, and guide the development, adjustment and potential tapping of water flooding in ultra-high water cut stage [11].
According to the characteristics of existing well pattern deployment, the remaining unadjusted area is divided into two potential areas, and the comprehensive utilization mode of well pattern is established respectively. The secondary infill Wells are combined with the primary A reservoir wells and the primary B&C reservoir wells respectively to strengthen the exploitation of the A and B&C oil reservoirs. The horizontal injection and production well spacing is shortened from 250m to less than 200m, and the liquid flow direction is changed by matching the new and old water bodies. Based on the existing well pattern, the comprehensive utilization of the second and third well patterns is the main, and the comprehensive utilization of the local primary and secondary well patterns is also taken into account. The plane can shorten the injection-production well spacing and change the direction of liquid flow.
The object for filling holes is preferred. Focus on tapping the potential of five types. 1. Due to the blocking of sand body phase change, the potential of existing well pattern cannot be controlled [12]. Second, tapping potential due to the thin thickness of sand body development, poor physical properties, poor potential. 3. Excavate the potential that can not be controlled locally due to the large distance between basic and primary Wells. 4. Low working density of underground well pattern leads to uncontrollability of well pattern; 5. Partial injection-production potential without injection-production, partial development of flat sand body, etc.

4.2 Hydraulic deep penetration horizontal drilling technology

Radial hydraulic jet technology can be used to drill holes at fixed points and in fixed orientation. It has the characteristics of large aperture and deep penetration. It is an extension technology of perforation and fracturing. Can accurately select the required depth, horizon, direction, distance. After the string is run, multiple deep penetration perforations can be performed at different depths in the well or at different directions of the same

depth by adjusting the depth and orientation of the string. Compared with conventional fracturing, casing loss is more tolerant, and uncertainty of pressure selection is more likely to be eliminated compared with selective fracturing.

4.3 Potential of multi-well targeting

For local remaining oil rich areas, multi-well efficient potential tapping methods such as ultra-short radius horizontal Wells and small-aperture directional window horizontal drilling are implemented to achieve accurate potential tapping of remaining oil.

One is to apply ultra-short radius horizontal well technology for Wells with single remaining oil enrichment layer that are not suitable for filling holes and tapping potential. The target layer is required to have an effective thickness of more than 2m, and there is no high water cut perforating layer within 10m above the target layer, and the sand body is developed to a certain scale to meet the needs of sidetracking.

The second is to apply small-aperture directional window horizontal drilling technology for casing variable Wells that cannot be filled normally, and the minimum variable diameter is between 90-108mm.

4.4 Well fracturing potential

Multi-disciplinary research results are applied to quantitatively describe the distribution of remaining oil. Pressure flooding, moderate scale fracturing and fine control fracturing are carried out for the relatively rich remaining oil, and the potential remaining oil is precisely tapped.

One is to apply reverse pressure flooding technology to the sand body which can not be controlled by well pattern, and excavate the potential of well and layer which can not be effectively utilized by current well pattern. The two types of oil layers with imperfect injection and production and isolated sand body are selected as pressure flooding objects. Second, for Wells with small thickness of single layer and poor effect of conventional fracturing, the scale of sand addition can be increased and the potential of measures can be expanded by fine fracturing intervals. Thirdly, for the Wells with too large injection-production well spacing, low water flooding control degree and poor conventional fracturing effect, the effect of measures can be guaranteed by increasing sand quantity scale.

4.5 Control inefficient and ineffective cycles

Aiming at the well layer with high local production degree, combining with the distribution characteristics of remaining oil, water plugging is carried out at the well end to improve the flow field and expand the sweep. Water plugging of high aquifer can be divided into chemical plugging and mechanical plugging. Chemical plugging can temporarily plug the high aquifer with high utilization degree and achieve the purpose of water control, water improvement and water reduction. Through mechanical plugging, stratified production distribution can be realized. In addition to real-time monitoring of oil and liquid production in intervals, stop-production intervals can be selected to control the situation of high production and high water cut without harming reservoirs.

5. Optimization and adjustment potential of injection-production structure

The new method of injection-production structure optimization and adjustment is applied to improve the scale of injection-production of foundation and primary well and improve the development effect [13].

For the comprehensive adjustment plan of the year, the main adjustment is to adjust the three-low well area, and to raise the water injection Wells in the well area to achieve the purpose of increasing the well fluid production in the well area; Control the three-high well area, analyze the strata that affect the occurrence of the three-high situation, and control water to control the water cut rise rate of the well in the well area. At the same time, the water flow of casing damage layer is controlled to avoid casing damage.

For the tracking adjustment program, the main purpose is to double guarantee: to guarantee the formation energy and ensure the injection production scale. The adjustment of well layers is to lift water as a whole and to control water between layers. Periodic control should be carried out for the sections with high water injection intensity, and the potential improvement should be carried out for the sections with still potential improvement to ensure the stable improvement of the overall injection-production scale.

6. Conclusion

After a relatively high degree of development, changyuan water flooding implemented water control and efficiency improvement and achieved good results. On the basis of water control and efficiency improvement, the following technologies can be summarized on how to accurately tap potential: Comprehensive utilization potential of well pattern, horizontal drilling technology of hydraulic deep penetration, multi-well targeted potential tapping, fracturing potential of oil well, control of inefficient and ineffective circulation and adjustment of injection-production structure optimization. And the effective coordination and combination of a variety of technologies, to accurately tap the remaining oil.

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