Study on Reasonable Pressure System of Water Flooding Reservoir

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Abstract. For water flooding heterogeneous reservoir, the reasonable formation pressure, injection pressure and flow pressure were studied, under different injection speed conditions. Through research we can see: (1) When the formation pressure is maintained near the saturation pressure, the recovery rate is the highest and the development effect is the best; (2) When the water flooding injection rate is 0.10PV/a, reasonable flow pressure range of (4.0-5.5) MPa, reasonable injection pressure range of (10.5-12.0) MPa. When the water flooding injection rate is 0.15PV/a, reasonable flow pressure range of (3.5-5.5) MPa, reasonable injection pressure range of (11.5-13.0) MPa. When the water flooding injection rate is 0.25PV/a, reasonable flow pressure range of (3.5-4.0) MPa, reasonable injection pressure range of (13.0-14.0) MPa; (3) By controlling the reservoir pressure, the injection pressure and the flow pressure, the pressure distribution is maintained within a reasonable range, and the streamline distribution is more uniform and the recovery rate can improve 1.34%.

Keywords: Reservoir Pressure; Injection Pressure; Flow Pressure; Recovery Ratio.

1. Introduction
Oilfield development is the process of energy consumption for production, the energy is too low will affect the development effect, so to determine a reasonable pressure system is essential [1-2]. When the pressure system is maintained at a high level, the viscosity of the oil phase increases, and the injection capacity is reduced [3]; When the pressure system is maintained at a low level, the deaerate occurs in the oil layer, oil phase viscosity will increase, at the same time due to deaerate, easily lead to gas breakthrough, affecting oil field development [4-5]. Due to formation pressure, injection pressure and flow pressure affect each other, so all three must be maintained at a reasonable level to maximize oil recovery [6].

2. Model establishment
In this study, a heterogeneous multilayer model with permeability of (50, 100, 300, 500 and 500) $\times 10^{-3} \mu m^2$ was established; Saturation pressure is 9.0MPa; Well spacing is 150m; Well pattern is a five-point area of well pattern.
3. The effect of formation pressure on recovery ratio
In the early stages of development, control injection-production ratio, after the formation pressure is maintained at different levels (5.0, 7.0, 9.0, 10.0 and 12.0) MPa, in this case, the injection-production ratio will be set as 1, when water content 98% stop calculating, evaluation of the final waterflood development effect. Through calculation, we can see that, when the formation pressure closes to the saturation pressure development best. When the injection speed is 0.10PV/a, when the average formation pressure increases from 5.0MPa to 9.0MPa, the recovery rate decreases by 2.39%; the average formation pressure increased from 9.0MPa to 12MPa, and the recovery rate decreased by 0.42%. It can be seen from the analysis that when the pressure in the formation is too low or too high, the viscosity of the oil phase crude oil increases, the fluidity becomes worse, and the overall development effect of the reservoir becomes worse.
4. The effect of flow pressure on recovery ratio
When the well injection rate is 0.10PV/a, flow pressure (3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0) MPa, when water content 98% stop calculating, evaluation of the final water flooding development effect. In the case of a certain injection speed, when the flow pressure is too high, formation pressure is significantly higher than saturation pressure, at the same time, the ratio of liquid absorption in middle and low permeable layers decreased, the effect of use became worse, and the overall development was less effective; When the flow pressure is too low, degassing around the well is serious, seepage resistance at low oil saturations such as high permeability zones and main flow lines is low, water absorption increased, high oil (high resistance) site has not been better use, and the inefficient circulation is formed, the development of less effective.

5. The effect of injection pressure on recovery ratio
When the oil well production rate is 0.10PV/a, injection well injection pressure (10.0, 10.5, 11.0, 11.5, 12.0, 12.5, 13.0, 13.5, 14.0, 15.0) MPa, when water content 98% stop calculating, evaluation of the final waterflood development effect. When the injection pressure is too high, the phenomenon of water channeling in the high permeability layer is serious, the water absorption ratio in the low and middle layer is low, and the overall development effect is poor; When the injection pressure is too low, the injection speed is too slow, the formation pressure is lower than the saturation pressure optimum, medium and low permeability is not better used, the development effect is poor.
6. Comprehensive application
Using the results of this study, by controlling the pressure system, the formation pressure, pressure and injection pressure maintained within a reasonable range. According to the streamlined results, injected water distribution is more uniform, the spread of the situation before the adjustment range larger, the recovery rate is 1.34% higher than the uncontrolled solution.

Fig. 5. The curve of recovery rate with injection pressure changes

Fig. 6. The whole area streamline distribution before the adjustment
7. Conclusion
(1) The formation pressure is maintained near the saturation pressure; the development effect is well.
(2) Water injection speed of 0.10PV/a corresponds to a reasonable flow pressure of (4.0-5.5) MPa; speed 0.15PV/a corresponds to a reasonable flow pressure of (3.5-5.0) MPa; speed 0.20PV/a corresponds to a reasonable flow pressure of (3.5-5.0) MPa.
(3) A reasonable injection pressure of (10.5-12.0) MPa at a production rate of 0.10PV/a; speed of 0.15PV/a at a reasonable injection pressure of (11.5-13.0) MPa; speed of 0.20PV/a at a reasonable injection pressure of (13.0-14.0) MPa.
(4) After adjusting the pressure system to a reasonable range, the recovery rate increased by 1.34%.

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