Study on the Reasonably Liquid Withdrawal Rate under Different Development Conditions of Water Flooding Reservoir

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Abstract. The reasonably liquid withdrawal rate was studied at the different geological characteristics and different development periods of water flooding reservoirs. Through the study we can see: (1) the reasonably liquid withdrawal rate of positive rhythm reservoir is less than that of inverted layered reservoir; (2) with the increase of permeability, the reasonable recovery rate of oil well is also increased; (3) with the increase of the permeability difference and the thickness difference, the reasonable recovery rate of the oil well is gradually reduced; (4) with the increase of water cut, the reasonable rate of liquid increased gradually, indicating that with the development of oil field, raise the amount of liquid production can be used as a measure to improve the recovery rate.

Keyword: Reasonably Liquid Withdrawal Rate; Reservoir Nature; Pattern Configuration

1. Introduction
Water flood development as a simple and low- cost way to add energy is used by most oil fields, it is very important to determine the reasonable production rate of oil wells[1-2]. When the production rate of oil wells is too fast, it is easy to cause injecting water to form an inefficient cycle, which is not conducive to the improvement of oil recovery; when the flow rate is low, the development period is too long, the development efficiency is deteriorated, therefore, it is very important to carry out research on the reasonable production rate of oilfield[3-4]. Due to the complex properties of reservoir property rhythm, permeability difference and thickness difference, the well pattern is different too, so the reasonable liquid production speed will change greatly[5-6]. In this paper, the numerical simulation technique is used to study the reasonable production rate under different development conditions of water flooding reservoirs, and the reasonable extraction rate under different physical condition and development period is given.
2. Determination of liquid production rate of oil wells under different reservoir physical properties

2.1. Different rhythm
When the voidage replacement ratio is 1, use the five-point well pattern, study on liquid withdrawal rate of oil well for different rhyme reservoirs. The study found, The reasonable production rate of the positive rhythm reservoir is \(0.15PV/a\), while the reasonable production rate of the inverted layered reservoir is \(0.20PV/a\).

Figure 1. Permeability distribution of different rhythmic reservoirs

Figure 2. The curves of recovery rate with the reasonably velocity in different rhythm cases

2.2. Different permeability
The five-point ideal model is designed with permeability \(100\times 10^{-3}\mu m^2\), \(200\times 10^{-3}\mu m^2\), \(300\times 10^{-3}\mu m^2\), \(400\times 10^{-3}\mu m^2\) and \(500\times 10^{-3}\mu m^2\) respectively. By numerical simulation, with the increase of permeability, reasonable liquid production rate is gradually increased, however, when the permeability is greater than \(400\times 10^{-3}\mu m^2\), the reasonable production rate is not increasing, \(0.25PV/a\).
2.3. Different permeability difference
The ideal model of the five-point method is designed with 1, 2, 3, 4 and 5, respectively. As can be seen from the calculation, with the increase of permeability difference, the reasonable rate of liquid production is gradually reduced, when the permeability difference is greater than 3, the reasonable production rate is stable, 0.05PV / a. Analysis of the reasons we can see, with the increase of permeability level, the higher rate of liquid production, a lot of water enters the high permeability horizon, resulting in low permeability layer is not used, affecting the region's oil recovery.
2.4. Different thickness differences
When the total thickness of the model is constant, the ideal model of the five-point method is designed with thickness difference of 1, 2, 3, 4 and 5. As can be seen from the calculation, as the thickness difference increases, the reasonable rate of liquid extraction decreases, when the permeability difference is greater than 5, the reasonable liquid production rate is 0.05PV/a.
3. Determination of the Liquid Reasonable Production Rate in Different Water Cut
The initial production rate is 0.05PV/a, when the water content is 0%, 40%, 60%, 80% and 95%, increase the amount of liquid production, The production rate was increased to 0.10 PV/a, 0.15 PV/a, 0.20 PV/a, 0.25 PV/a and 0.30 PV/a. According to the results, with the increase of water content, the reasonable rate of liquid production increased gradually, indicating that increasing the amount of liquid production can be used as an effective measure to improve the recovery rate.
Figure 9 The curve of reasonably liquid withdrawal rate in different water cut

4 Conclusion

(1) For different rhythmic reservoirs, the reasonable production rate is different, and the rate of positive rhythm reservoir is less than that of inverted layered reservoir;

(2) With the increase of reservoir permeability, the reasonable velocity of oil well is gradually increased;

(3) With the increase of the permeability difference and the thickness difference, the reasonable recovery rate of the oil well is gradually reduced;

(4) With the increase of water cut, the reasonable rate of liquid extraction increased gradually, indicating that with the development of oil field, improving production can be used as efficient measure to improve the recovery rate.

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