Comprehensive Evaluation of Influence Factors upon Productivity for Complicated Faulted-block Reservoirs

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Abstract. Currently there are many complicated faulted-reservoirs discovered in Niger. For this kind of reservoir, comprehensive evaluation of oil rate or productivity is essential, because it is crucial for the construction and investment of the oilfield. Oil rate variance is closely related to tectonic characteristics, natural energy, reservoir physical property or quality and so on. The research results indicated that aquifer energy of monocline is stronger than that of horst and faulted block. Consequently production plateau and recovery factor of monocline is also higher than horst and faulted block. With the decrease of oil viscosity, initial production, production plateau and recovery factor is relatively higher. With the increase of permeability, initial production, production plateau and recovery factor is relatively higher. Single well initial production is sensitive to drawdown pressure. While the drawdown pressure is increased to some extent, growing rate becomes smaller. For the natural energy adopted stratified reservoir with strong heterogeneity, one set well pattern and the type of upward layer by layer is more suitable. Reasonable offtake rate is around 2\% and could be modified according to natural energy. If the natural energy is sufficient, offtake rate could float upward properly and vice versa. In general case, water injection is not suitable in consideration of desert conditions and large investment. Only for the blocks with insufficient natural energy and large OOIP, water injection could be taken into account.

Introduction

CNPC has been cooperating with Niger government for oil exploration for several years. All of the discovered reservoirs are complicated faulted-block reservoirs. For this kind of reservoir, comprehensive evaluation of oil rate or productivity is essential, because it is crucial for the construction and investment of the oilfield. Oil rate variance is closely related to tectonic characteristics, natural energy, reservoir physical property or quality and so on [1,2]. The research in this paper is aimed at summarizing influence factors upon single well production or oilfield production and putting forward development principle for complicated faulted block oilfield groups of Niger.

Tectonic Characteristics

Based on the statistics of structural types and reservoir geology features for all the faulted blocks in Niger, 5 major structural mechanism models are established. They are low-dip
monocline, high-dip monocline, monocline with second-order fault, horst and faulted block. Simulation models are also established for the 5 structural types to study influence on well productivity. As shown in the Fig.1, structural types have little effect upon single well initial production, but have a significant impact upon production plateau and recovery factor. Aquifer energy of monocline is stronger than that of horst and faulted block. Consequently production plateau and recovery factor of monocline is also higher than horst and faulted block. Through the comparison of production curves, production plateau and recovery factor of high-dip monocline is slightly greater than low-dip monocline. That is due to gravity driving with the increase of dip angle.

**Fluid Property**

With regard to the influence of fluid property, oil viscosity is mainly considered, because viscosity determines fluid ability in the formation. According to the viscosity statistics of faulted blocks, oil viscosity of most blocks is in a range of 2-10 cp. As shown in Fig. 2, oil viscosity has a significant impact upon single well initial production. With the decrease of oil viscosity, initial production, production plateau and recovery factor is relatively higher.
Figure 2. Production curves of different oil viscosity.

**Reservoir Physical Property**

Reservoir physical property refers to porosity, permeability, net pay and so on. Porosity and net pay are both related to OOIP calculation, whereas permeability and net pay will affect initial production and production plateau. As shown in Fig.3, with the increase of permeability, initial production, production plateau and recovery factor is relatively higher.

Figure 3. Production curves of different permeability.

**Drawdown Pressure**

As shown in Fig. 4, single well initial production is sensitive to drawdown pressure. While the drawdown pressure is increased to some extent, growing rate becomes smaller.
Series Partition

For the natural energy adopted stratified reservoir with strong heterogeneity a, in light of investment and cost, one set well pattern and the type of upward layer by layer is more suitable. As shown in Fig.5, development effect of layer by layer is better than commingling production and single layer.

Off take Rate

Reasonable offtake rate indicates optimal offtake under existing technology and injection-production well pattern. It can make full use of production capacity of producers and injection capacity of injectors.
As shown in Fig. 6, reasonable initial offtake rate may be around 2% and could be modified according to natural energy. If the natural energy is sufficient, offtake could float upward properly and vice versa.

**Water Injection**

In general case, water injection is not suitable in consideration of desert conditions and large investment. Only for the blocks with insufficient natural energy and large OOIP, water injection could be taken into account. In addition, water injection could be carried on after utilization of natural energy and the injection wells should come from abandoned oil wells instead of new wells.

**Conclusions**

On the basis of practical development data statistics and numerical simulation, comprehensive evaluation of influence factors upon productivity for complicated faulted-blocked reservoirs is carried on. The research results could provide experiences and references for the development of other similar complicated faulted-blocks.

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**References**
