Study on Well Pattern System Optimization of Fuyang Reservoir in H Oilfield

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Abstract. The selection of well pattern system is not only the key content in the process of oilfield development, but also the core problem in the design of oilfield development. It is also the basis for the effective utilization of tight reservoir technology. Through scientific analysis of the geological structure and dynamic characteristics of Yang reservoir in H oilfield, the well pattern system can be reasonably optimized and the development of Chinese oilfield can be vigorous. Starting from the selection of well pattern system for oil and gas field development, this paper analyzes the optimization of well pattern system parameters of Fuyang reservoir in H oilfield.

Key words: Fuyang reservoir, oil and gas field development, well pattern system optimization

1. Introduction

The development of oil and gas fields provides a solid guarantee for our energy supply and lays a good foundation for our economic development. The development and research of low-permeability petroleum resources plays an important role in promoting the healthy and sustainable development of our petroleum industry. The study of well pattern system has always been the key research subject in the process of oil and gas field development. The selection and design of well pattern system should fully respect the geological conditions and geographical characteristics of the exploitation area. The well pattern system chosen should be economically sound. To facilitate the development of oil and gas fields more smoothly.

2. Selection of well pattern system for oil and gas field development

The selection, deployment and adjustment of well pattern system is the key part of oil and gas field production and development, and also an important measure to promote the economic benefit of oil and gas field development enterprises. The form of well pattern is mainly affected by the geological characteristics of oil and gas fields. By observing whether the geometric shape of the well pattern is regular or not, the well pattern in the production site is usually divided into two types: regular well pattern and irregular well pattern. Different oil and gas reservoirs are exploited by different well patterns, and the nature of oil and natural gas is greatly different in nature. Different production methods should be adopted in the actual production process, and the well pattern of the oil field is much more complex than that of the gas field. In the production process of oil and gas fields, when the regular well pattern is used for mining, that is, the area injection well pattern. The common area injection well pattern is divided into linear well pattern, staggered well pattern, four-point well pattern, five-point well pattern, etc. The irregular well pattern is usually caused by the deformation of the regular well pattern. The specific well pattern adopted in actual production and exploitation should be analyzed according to the geological structure characteristics of oil and gas reservoirs, and then the mining method should be decided after detailed study [1].

In the initial stage of oil and gas field development, attention should be paid to the selection and deployment of well pattern. The selection and deployment of well pattern in the initial stage of development of oil and gas field has an important impact on the entire later production. In actual mining, the layout of basic well pattern is usually carried out first, and then the geological conditions and structural characteristics of the mining area are analyzed, and then the actual well layout is carried out. The application of the five-point well pattern in the regular well pattern is conducive to late adjustment and maximizes field production under certain conditions. According to the special geological condition of low permeability oilfield, well spacing should be shortened reasonably, and the density of well pattern should be increased to promote the best development effect. It is also necessary to carefully study formation fractures and rationally arrange injection-production well pattern [2].

The adjustment of well pattern is an essential link in the process of oil and gas field development. With the extension of development time, new problems will constantly appear, and the emergence of new problems requires constant adjustment of well pattern. The common well pattern adjustment methods include encryption and transfer. In the initial stage of oil and gas field development, relatively sparse well pattern is usually used, and the developed reserves are more concentrated. In the case of insufficient use of reserves and large amount of remaining oil and gas, encryption technology is often used to promote the stable and efficient operation of oil and gas fields. For fractured reservoirs, the current water injection method should be adopted to combine the sand body size and strike, and fully consider the uniformity of well pattern layout. For areas where fractures are not well developed, the relative uniformity of the well pattern should be considered. To maximize the development effect, appropriate adjustment methods should be selected according to the actual geological conditions [3].

According to the geological characteristics of Fuyang reservoir, the selection of well pattern system should take into account the well pattern system should adapt to the distribution characteristics of underground reservoir to the greatest extent, and promote the well pattern to have a higher degree of water flooding control, the well pattern system should also have a higher intensity of injection and production, and the well pattern should have a strong flexibility in the process of development adjustment.

3. Optimization of well pattern system parameters of Fuyang Reservoir in H Oilfield

3.1 Density of well pattern

The effect of waterflood development in oil fields is directly related to the density of well pattern. The cost of drilling also occupies a large part of the investment in the construction and development of oil and gas fields. Therefore, the density of well pattern plays a crucial role in the economic benefits of waterflood development technology. In order to achieve better development results, the density of well pattern should be strictly controlled to ensure the economic benefits of well pattern system effectively. The density of well pattern is a key content in the development design of oil and gas field, which involves the calculation of oil and gas field development indicators and the evaluation of economic benefits. The density of well pattern is related to the spacing and size of well pattern [4]. The density subdivision of well pattern can be divided into two kinds: reasonable well pattern density and limit well pattern density. Reasonable well pattern density means that under certain geological and development conditions, the total revenue of oil and gas fields minus the total input is the maximum, at which time the well pattern density will be obtained at the maximum profit. If the total input is equal to the total output and the profit is 0, the limit well pattern density will be obtained. As for the algorithm of limiting well pattern density, iteration method and curve intersection method are generally adopted. In general, the differential method is used to solve the consensus S in order to obtain the reasonable well pattern density. The calculation formula is different, and the calculation results are also different. In order to achieve accurate results, it is necessary to establish a mathematical model suitable for different types of oil and gas fields, considering the comprehensive factors, and select the appropriate well density through modeling analysis.

3.2 Well pattern density and recovery efficiency

With the expansion of the development degree of oil and gas fields, many domestic and foreign oil and gas fields have analyzed through practical studies that there is a great relationship between the well pattern density and the ultimate recovery factor. For homogeneous oil reservoirs, the influence of well pattern density on the ultimate recovery factor is not particularly obvious, but for heterogeneous oil reservoirs, especially in the case of complex geological structure, The density of well pattern has a great influence on the recovery efficiency, and this influence is most obvious in the middle and late period of oil and gas field development. In the middle and late period of oil and gas field development, the effect and quality of well pattern density development will directly affect the development effect and recovery efficiency of oil and gas field. If a thin well pattern is applied to an heterogeneous reservoir, the loss of reserves will increase. It can be seen from a large number of practices that the

higher the well pattern density, the higher the recovery rate and the smaller the increase [5].

The density of well pattern should be adjusted according to the actual situation of the oilfield in the middle and late stage of oilfield production. Usually, the case is to carry out infill treatment. The practical research shows that the adjustment of the infill pattern can reduce the reserves loss, effectively improve the rate of oil production, and has a direct impact on the final recovery efficiency. Infill well pattern is an important way to solve the discontinuous oil field recovery efficiency. Improving the drilling rate of oil sand body is an important measure to improve the water drive recovery efficiency.

Waterflooding control degree refers to the percentage between the thickness of a producing well drilled on the sand body that can be effectively affected by water flooding and the total drilled thickness. This method mainly studies the influence of different well pattern densities and various development adjustment measures on the waterflooding control degree. In the actual development process of oil and gas fields, the density adjustment of well pattern is usually encrypted along with the development progress of the oil field. With each encryption, the control degree of the well pattern on water flooding will be continuously improved. The monkey method has obvious advantages, because it is relatively simple and the results are highly accurate. It has important reference value to compare the effect of different well pattern density on water flooding degree. The improvement principle of well pattern density is to take the total input of oil and gas field development as a function of well number, that is, well pattern density, convert the total output into a function of well pattern density through Serkachev formula, subtract the total input from the total output, and then adjust the well pattern density according to the profit value, which is also an economical and reasonable calculation method of well pattern density [6].

According to the basic principles of injection-production well pattern deployment in fractured reservoirs, diversified well patterns should be adopted on the basis of conventional injection-production well pattern deployment. For the square reverse five-point injection-production well pattern, the side-by-side direction is parallel to the fracture direction, and the well locations between rows are staggered. Well spacing should be controlled at twice the row spacing, and injection-production well rows should be alternated with each other, water injection should be parallel to the fracture direction, and the number of oil and water Wells should be 1:1. The well row direction of the linear injection-production well pattern is parallel to the fracture, and the well position between rows is staggered, and the row spacing ratio should be more than 2 times. The injection and expulsion Wells are alternated, and the linear water injection is conducted in parallel direction.

To rationally arrange vertical well pattern spacing, the rational spacing should be determined first. Fuyang reservoir belongs to low-ultra-low permeability reservoir, which has start-up pressure gradient. If the injection and production row spacing is too large, it will be difficult to establish an effective driving system. In the process of development, the production of a single well will decline, and the decline range will increase.

3.3 Horizontal well pattern

Horizontal well is an efficient oil and gas field development technology, which is widely used in the field of oil and gas field development. In view of this, horizontal well is introduced into the development well pattern, which is an expansion of vertical well pattern. With the continuous improvement of horizontal drilling technology and the gradual reduction of drilling cost, horizontal well pattern has received more attention from more people, and the academic circle has studied it more deeply. However, the domestic research on horizontal well pattern is more focused on theory, which provides a solid theoretical basis for the development of oil and gas fields, but the research on practice needs to be improved [7].

Reasonable well pattern has a serious impact on the exploitation and production of oil and gas fields, and can effectively promote the improvement of economic benefits of oil and gas fields. However, under the background of constantly updating oil and gas field development technology, the way of displacement is also constantly changing, and the development system of oil and gas fields is gradually complicated. From the perspective of system, a single well is an integral part of the well pattern system. Well pattern is a subsystem of the whole system of oil and gas field development, and the whole system of oil and gas field is a part of the complex system of society. Therefore, in order to solve the problem of well pattern system in oil and gas field development, we should start from the perspective of the whole. Firstly, we should optimize the single well, deal with the problem of each single well, and coordinate the relationship between the single well and the whole well pattern system. The optimization of well pattern should follow the principle of fewer Wells, large controlled drainage area and high recovery rate. The selection of well pattern density should start from the perspective of system, take diversified factors into consideration comprehensively, increase the study of irregular well pattern form, combine theoretical research with actual production, effectively solve the problem of well pattern system deployment and adjustment in the process of oil and gas field exploitation, and work out a better well pattern optimization strategy.

Conclusion: To sum up, the development of oil and gas fields is the main way to supply oil resources. In the actual development work, we should do a good job in the optimization design of well pattern system, to promote the fine system, and should be the best geological survey and inspection, development work according to the actual situation. Taking into account the density of well patterns and the economic benefits of reservoir controlled recovery, the establishment of a sound digital model, and strengthening the study of irregular well patterns, combining production experience with actual production, to promote a more reasonable and scientific well pattern study, explore more methods of well pattern system optimization for the development of our oil and gas field.

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