Application of numerical simulation technology in remaining oil analysis

Yifei Gao
Geological Team of the First Oil Production Plant of Daqing Oilfield Co., Ltd., Daqing, Heilongjiang, China, 163000, China
gaoyifei@petrochina.com.cn

Abstract. Taking the application of numerical simulation technology in remaining oil analysis as the research object, this paper briefly introduces the situation of the remaining oil reservoir and analyzes some problems facing the reservoir at present. Then, in order to promote the solution of the problem, the construction process of the three-dimensional geological model was discussed around the actual geological situation, and finally the application process of the numerical simulation technology in the remaining oil was analyzed, and the follow-up comprehensive treatment plan was proposed. I hope that relevant research can provide certain reference.

Keywords: Remaining oil analysis, Numerical simulation technology, Application.

1. Introduction
With the deepening of reservoir exploitation, the subsequent exploitation will become more complex and more problems will be encountered. Therefore, aiming at the exploitation of remaining oil, it is necessary to strengthen the application of numerical simulation technology, realize the optimization of water injection technology policy, analyze the distribution law of remaining oil, and complete the formulation of follow-up comprehensive treatment scheme in combination with the actual situation, which is of great significance to improve the production and quality level of oilfield exploitation.

2. Overview of Reservoir Development
There are 76 oil wells in an existing oil reservoir. The wellhead produces two 496t fluids per day, 205t daily oil production, a comprehensive water cut of 60.28%, an average working fluid level of 1123 m, and a total number of The water injection is 1014 m3, the monthly injection-production ratio is 1.98, the cumulative injection-production ratio is 1.63, the oil recovery rate of geological reserves is 2.16%, the recovery rate of geological reserves is 7.73%, the recovery rate of recoverable reserves is 10.3%, and the recovery rate of recoverable reserves is 36.71%[1]. With the development of the reservoir, the overall situation becomes more complex. At present, in the actual development and production process, for the remaining oil reservoirs, there are mainly the following problems to be solved: first, the water cut of the remaining oil increases faster, and the distribution law becomes elusive. Second, the reservoir pressure system, the water law and declining law are unclear, and the pressure maintenance level is in a low state. Third, in the early oil reservoir development, the corresponding technical policies were not grasped reasonably, so it is necessary to make an in-depth evaluation of the current development
technical policies, so as to improve the scientific and reasonable technical policies in Southwest China. In order to effectively solve the above problems, the article proposes to construct a three-dimensional geological model of the remaining oil reservoir first, and then through dynamic and static analysis, combined with reservoir engineering methods and numerical simulation technology, proposes a reasonable development technology policy for the reservoir, and reasonably predicts the remaining oil law for subsequent remaining oil. Lay a solid foundation for efficient mining of Tibet.

3. 3D geological modeling of remaining reservoir

In the actual construction of 3D geological model, we need to fully reference the core analysis, logging curve, sedimentary facies and logging data, and on this basis, we need to collect the coordinate data of oil and water wells, layer data and other data information to better guarantee the effect of the model. Through fine microlayer comparison, the structural map of microlayer is drawn manually, and the structural model is constructed by ordinary Kriging interpolation. Combined with the actual logging interpretation results, a single sand body is used as a unit, and the sedimentary facies model is constructed through the marking process of heterogeneous model [2]. When establishing the reservoir physical property model, the idea of facies-controlled stochastic modeling was introduced, and the model establishment was successfully completed. On the other hand, before the construction of the numerical simulation, on the one hand, it is necessary to ensure the accuracy and calculation speed of the model, on the other hand, it is also necessary to refer to the well pattern, spacing, reservoir distribution and other information to coarsen the geological model. In order to reduce the number of simulation grids, the longitudinal conductivity was set to characterize the interlayer. On this basis, with the help of eclipse black oil simulator, adding reservoir fluid parameter data (as shown in Table 1) and relative permeability data, the 3D numerical model was successfully constructed. Finally, it is necessary to fit the model history, first fitting the reserves, and then comparing them with the geological reserves, so as to control the difference between them within a reasonable range.

4. Application analysis of numerical simulation technology in remaining oil

In this remaining oil production, the numerical simulation technology was used to optimize the subsequent reservoir development technical policy, and the distribution law of remaining oil was analyzed. Finally, with the help of numerical simulation technology, the comprehensive reservoir management scheme was deployed. The following is a specific analysis:

4.1. Optimization of remaining oil reservoir development technology policy

(1) First, using the reservoir engineering method, comparing the obtained results with the numerical simulation predictions, the following conclusions can be drawn: it is reasonable to maintain the pressure at 65% to 75%, but the current remaining reservoir pressure is only 57.63 %, so it still needs to be further strengthened. (2) Similarly, the results obtained by reservoir engineering method are compared with the prediction results of numerical simulation, and the following conclusions are drawn: the optimal flow pressure is in the range of 2.3 to 2.8 MPa [3]. However, the current flowing pressure of the remaining
reservoir is 1.96 MPa, so it needs to be further strengthened. (3) By using reservoir engineering method, numerical simulation method and empirical comparison method, the following conclusions are drawn: the best fluid production intensity in the remaining oil reservoir area should be controlled within 0.7-0.8 m³/m d. However, in the eastern and central areas of the remaining reservoir, the fluid production intensity is still low, only 0.62 m³/m d, so it is necessary to improve the fluid production intensity in this area.

4.2. Research on the Distribution Law of Remaining Oil

In the development of remaining oil reservoir, it is very important to study the distribution law of remaining oil. Only in this way can we have a comprehensive understanding of the distribution form and reserves of remaining oil, facilitate the follow-up targeted production measures, and promote the steady improvement of oilfield development level. Through the reservoir numerical simulation, we can deeply understand the factors related to the dynamic changes of the reservoir, and realize the visualization and quantitative control of the remaining oil. In practice, it is necessary to know the distribution characteristics of remaining oil. Combined with the plane remaining oil saturation of each sublayer, in the numerical simulation model, the remaining oil layer named T312-1 is divided into four sublayers, specifically 18, 19, 20 and 21. Influenced by structures, the initial oil-bearing property is concentrated in the central, southern and northern regions. For the oil layer named T312-2, in the numerical simulation model, it is also divided into 4 small layers, specifically 22 layers, 23 layers, 24 layers, and 25 layers. The oily state is concentrated in the central and northern parts. In this remaining reservoir, the following information can be obtained by numerical simulation. The above two reservoirs have higher storage capacity, which makes it possible to exploit.

On the other hand, when analyzing the controlled factors of remaining oil, the following three factors should be considered: (1) Structural influencing factors. Now, for the remaining reservoirs, they have gradually entered the stage of water flooding. At this time, the waterline range will go along the structural line and gradually shrink. In the lower part of the reservoir, the water saturation will become higher and higher, while in the upper part, the water saturation will decrease, thus there is a large amount of remaining oil in the high part of the structure. (2) For the oil reservoirs on both sides of the water cone, local bottom water bodies are developed. During actual mining, the water bodies will taper along the bottom of the well, thus forming a water cone. The reason lies in the fact that the intensity of the actual production liquid extraction is too high, which causes the bottom water to rise. Therefore, it is necessary to adjust the fluid extraction intensity in the follow-up [4]. (3) For the remaining oil between wells, it is necessary to analyze the front of water drive. In this area, the front shape of water drive has two types of anti rhythmic and spindle type. For the former, it is mainly affected by river deposition, and the physical properties will gradually improve from bottom to bottom. For the latter, it will be affected by the perforation location, and then refer to the profile of the residual oil saturation model. At present, there are two forms of remaining oil between wells: remaining oil after displacement and remaining oil without displacement. Based on the morphological difference of water drive front, the following conclusions can be drawn: reverse rhythm water drive front, remaining oil distributed below wells, spindle water drive front, and remaining oil above and below water drive front forms a detention area.

4.3. Comprehensive treatment plan analysis

Combining the above-mentioned research results obtained by using numerical simulation technology, the following comprehensive treatment plan can be formulated for the remaining oil reservoir exploitation:

(1) Optimized content of water injection technology policy. Since the eastern part of the reservoir has a large injection-production ratio and water injection intensity, attention should be paid to weakening the water injection. In the middle of the reservoir, for water-cut rising areas, water injection adjustment operations can be given priority, which is more conducive to solving water-flooding contradictions. In the southern part of the remaining reservoir, it is suggested to keep the current water injection policy.
unchanged, but it is necessary to make targeted adjustment according to the change of actual water injection profile. For key well groups, it is necessary to implement well profile control. From the prediction results of numerical simulation, the water cut will decrease by 3% after weakening water injection, and the cumulative oil production will increase by 8500t before and after weakening water injection.

(2) Water well profile control. Based on the actual block production performance, combined with the water absorption profile test data, and with the help of numerical simulation water drive front analysis and dynamic monitoring results, the profile water drive is optimized. In the subsequent plan, fine microsphere profile control and balanced water drive are needed. From the results of numerical simulation predictions, for a certain well group, after profile management, the water absorption form changes from a peak shape to a uniform form. It is predicted that by the end, the oil production will be increased by 3100t.

(3) Cyclic water injection test. Based on the actual development performance, the cyclic water injection test is carried out well. In the remaining reservoir area, three cyclic water injection schemes are formulated, and the water injection cycles set in the schemes are 15, 20 and 30 respectively. At the same time, with the help of numerical simulation, the indexes of water injection and oil production under different water injection cycle schemes are predicted. The results show that the scheme with a period of 20 days has the best oil increase effect, and the water cut rising rate is in a low state.

(4) Optimization of oil well measures. Based on the previous remaining oil distribution rules, 10 wells for measures are selected. At the same time of prediction, in the selection process, around the current low oil production wells, five wells with good oil layer conditions, initial fracturing, and good bottom water were selected, and acidification measures were implemented on them, which can be effective. Increase the output of oil wells. For the oil wells with closed fractures, especially for the oil wells with this result due to the lack of initial transformation strength or energy, five of them are selected and the refracturing operation is carried out, which can improve the production of oil wells. By means of numerical simulation, the results of oil increase of single well with the above improvement measures are predicted, and the following results can be obtained: In the initial stage, the maximum daily oil increase can reach 4 t, and the cumulative oil production is increased by 4305 t. In addition, the above-mentioned improvement measures also have a positive impact on the increase of oil production speed.

5. Conclusion
In summary, judging from the current development of remaining oil reservoirs, there are still some problems. In order to effectively solve the problem, the article completed the research on the optimization of development technology policy and the distribution of remaining oil by constructing a three-dimensional geological model reflecting the geological structure of the oil reservoir and using numerical simulation technology. Finally, based on this, the following comprehensive treatment scheme is brake, which is very important for the solution of the current mining problems of remaining reservoir wells. In the whole process, numerical simulation technology plays a very important role. It is suggested that in the follow-up mining process, the development contradiction should be combined. Research on injection-production connectivity and periodic injection-production is carried out, and the application of numerical simulation technology is further deepened on the existing basis, so that it can play a better role and provide accurate information support for formulating reasonable development strategies in the later stage of the reservoir.

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