Analysis on Dynamic Characteristics of Polymer Flooding and Influencing Factors of Oil Flooding Effect

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Abstract. At the present stage of scientific research, the chemical industry is an important part, and its influence is very high. Oil industry is the key project of national development at present, especially in the aspect of polymer flooding, whether it is the mastery of dynamic characteristics or the analysis of effect influencing factors, we must insist on starting from a long-term perspective. Only in this way can the practical process of specific work be handled and solved according to the rational mode, reduce the shortage of old work and improve the analytical connotation of polymer flooding. This paper discusses the dynamic characteristics and influencing factors of polymer flooding effect, and puts forward reasonable suggestions.

Keywords: Polymer flooding; Dynamic characteristics; Effect; Influencing factor.

1. Introduction

In the process of China's modernization, the development of the oil industry is constantly improving, and the application of many technologies can be accomplished by rational means. The whole work is on the ground and can be carried out according to the correct mode, without showing serious defects and omissions. However, polymer flooding is a special component, which has a great influence on the safety, stability and benefit improvement of petroleum work. In this case, we are required to make a deep understanding of polymer flooding and minimize the inherent hidden dangers and deficiencies.

2. Dynamic characteristics of polymer flooding

(1) After polymer injection, the water cut of the oil well decreases greatly and the oil production increases exponentially

From an objective point of view, in the application process of polymer flooding, the purpose is to better promote the development of the oil industry, and the arrangement and deployment of all work should be solid from a long-term perspective. According to a single means and system, not only can not get good results, but also at the implementation level of specific work, it will cause more defects and omissions, and it is difficult to better consolidate the utility of comprehensive work. After a great deal of investigation and research on polymer flooding, it is found that after polymer injection, the water content of oil wells shows the characteristics of a substantial decrease, which can continuously achieve better results in the process of increasing oil production [1]. For example, when the standard of 30 mg/L PV-60 mg/L PV is shown in the injection process of polymer flooding, the oil production of the oil field can be continuously increased, and more guarantees can be made for the daily work efficiency and work quality. However, in the process of polymer flooding, after the standard of 245 mg/L PV-330 mg/L PV, the comprehensive water content of the oil well will drop to the lowest standard, which means that the number of oil recovery work can keep on going to a stable stage. Therefore, in the process of polymer application, we must combine practical working standards to promote the dynamic characteristics of oil displacement and get better control. Especially the phenomenon of extreme injection, must be well controlled.

(2) There are three variation characteristics of liquid production index and liquid production volume in the initial stage of polymer injection

In the application process of oil displacement characteristics of polymer, we must start from different angles. The appearance of dynamic characteristics means that the actual operation process of polymer will show different characteristics at different index levels. This is closely related to the local oil working mode and the restrictive factors of the oil project itself. It is suggested that in practice, flexible adjustment should be maintained to reduce unnecessary problems. In the process of investigation, in the initial stage after polymer injection, there will be three different change characteristics of liquid recovery index and liquid recovery of oil wells. First of all, the application of polymer flooding mode, the liquid recovery index of oil wells and the liquid recovery are all characterized by a decline [2]. Generally speaking,

after the flowing pressure of an oil well shows a decreasing state, the formation pressure of injected polymer will also show a decreasing state. This means that the pressure difference in the production process will decrease with it, which will eventually lead to the continuous decline of the production index. Secondly, the recovery index of oil wells decreases, but the strength of recovery fluid will not decrease. For example, during the development of some oil wells, the initial stage of polymer injection and formation pressure can be kept in a stable state. Moreover, in the aspect of the index of liquid production, there will be a significant decline. However, the working modes in most areas are completed according to the mechanized production method, so the strength of the liquid collection can be kept in a relatively stable state. Third, the recovery index and recovery strength did not decrease. The occurrence of this situation is a relatively stable state.

3. Influencing factors of polymer flooding effect

(1) Well group classification implementation and parameter optimization

Taking block injection wells as the center, the development of oil layers in single well groups is studied, and the differences of parameters such as effective thickness, permeability and connectivity among single wells are analyzed.

① Block well group classification

A systematic clustering model is established, and the data are classified by using inter-group connection method, sum of deviation squares method and nearest neighbor element method. Through comparative analysis, the classification results of block well groups are as follows:

The sum of deviation squares method is to group each sample into a group, merge the sum of deviation squares step by step and gradually increase the sum of deviation squares, combine the smallest sum of deviation squares, and use this method to calculate three times of results. Two of them were divided into four categories and one into five categories, and two of them were divided into four categories with similar results. Therefore, according to this method, four kinds of results are adopted. Among them, there are 10 Class I wells, 7 Class II wells, 5 Class III wells and 6 Class IV wells. According to the analysis of their characteristic parameters, the effective thickness of 7 Class II wells is greater than the permeability of Class I wells, and the permeability of 5 Class III wells is greater than that of 7 Class II wells, which is unreasonable.

The method of inter-group connection takes the average of the distance between two groups of individuals as the analogy distance, and applies this method to calculate the three times results. Two of them were divided into four categories and one into six categories. Two of them were divided into four categories and the results were similar. Therefore, according to this method, four kinds of results are adopted. Among them, there are 7 Class I wells, 5 Class II wells, 6 Class III wells and 10 Class IV wells. According to the analysis of its characteristic parameters in the development of various wells, the first-class connectivity rate of 6 wells in Class II is lower than that of Class III and Class IV wells, which is unreasonable.

Nearest element method classifies individual wells according to the similarity between wells. Similar methods of approaching each other and individual wells being far away from each other, this method is used to calculate three times of results. Among them, four categories, five categories and six categories are once each, and the results of four categories are relatively reasonable through analysis. Among them, there are 5 Class I wells, 6 Class II wells, 7 Class III wells and 10 Class IV wells. Analysis of its characteristic parameters shows that the permeability of Class III wells is higher than that of Class II wells, which is unreasonable.

Based on the above methods and the well group classification results of the three methods, it can be divided into four categories. Through reasonable adjustment, the types of wells are determined: including 5 Class I wells, 6 Class II wells, 9 Class III wells and 8 Class IV wells. (Table 1)

Table 1 Classification table of block injection well groups

Classification	Number of wells	Proportion of well number (%)	Effective thickness (m)	River sand thickness (m)	Class I connectivity rate (%)	Permeability (μm2)
Class I	5	17.9	10.2	6.9	40.6	0.528
Class II	6	21.4	9.7	4.3	39.4	0.434
Class III	9	32.1	6.1	3.8	32.2	0.403
Class IV	8	28.6	3.9	1.2	25.5	0.304
Whole region	28	100.0	7.4	3.7	35.4	0.447

Example of Class I well group: Well W-2 is developed with sandstone of 12.7m, effective thickness of 8.9m, effective permeability of 548mD, channel sand thickness of 7.3m and first-class connectivity of 50.0%. Example of Class II well group: Well W-1 is developed with sandstone of 12.3m, effective thickness of 9.3m, effective permeability of 383mD, channel sand thickness of 4.5m, and Class I connectivity rate of 38.7%. Example of Class III well group: Well W-2 is developed with sandstone of 10.3m, effective thickness of 5.0m, effective permeability of 394mD, channel sand thickness of 2.9m and first-class connectivity of 34.6%. Example of Class IV well group: Well W-3 has developed sandstone of 8.4m, effective thickness of 6.3m, effective permeability of 271mD, no channel sand body, and Class I connectivity of 23.2%.

(2) Effect of injection rate

Nowadays, the development and production of petroleum industry must be carried out according to the rational mode during the application of polymer. In order to better improve the control of polymer flooding, we must strengthen the control of injection speed, otherwise it will easily lead to the follow-up work and more challenges and hidden dangers. Generally speaking, among the factors affecting the oil displacement effect of polymer, the injection speed is the focus of attention. For example, there are different standards and influencing factors of polymer application in different regions, especially in geological conditions and physical factors, which are quite different [3]. At this time, the injection speed of polymer solubility must be well controlled. For example, in the process of polymer injection, the injection speed basically has no great influence on the minimum water content of polymer flooding production wells. The main reason is that the index that it can influence is the time of water content, but it will not have a serious impact on the change of water content itself. During the investigation, different injection speeds were found, which showed great characteristics in view of the influence of the peak period of the block. The occurrence of this phenomenon means that it will have a certain effect on the staged oil production. Especially under the condition of peak output, the higher the injection speed, the higher the peak output will be, and there will be a proportional relationship between them.

(3) Influence of polymer flooding on layered injection

The application and development of polymer has been highly recognized in many places, and the value created on the whole is very remarkable. However, from a long-term perspective, in the implementation level of polymer flooding, we must stick to the injection influence of polymer flooding stratification and make a good grasp. Therefore, in the process of arranging various tasks, it is no longer done by a single method, and the guarantee that the overall work can get will be better improved. During the popularization of polymer flooding industrialization, the permeability between oil layers in some areas is characterized by poor performance. Moreover, under the influence of low permeability, the thickness of oil layer itself is relatively high. The emergence of this problem directly leads to the general injection of polymer, which will not improve the mining effect well, or even produce the opposite effect. This point needs to be highly concerned in the future work. In addition, during the development of separate injection wells, we must adhere to the relevant working principles actively, otherwise it will easily cause new challenges. For example, the difference of flooding conditions within intervals will show a larger situation; The permeability difference between layers cannot exceed the standard of 2.5. The effective thickness of oil layer by layer should not exceed the standard of 3m. All of these need to be carried out in the future with the correct mode.

(4) Reservoir water cut

During the development of polymer flooding, the response and solution of many influencing factors must be continuously improved. Moreover, for different optimization methods, we should make good control, and we can't choose extreme modes to implement them. This will easily lead to the implementation of future work and fall into a big dilemma. According to the related investigation and study, it is considered that the water cut of oil reservoir is a relatively important influencing factor, and the attention must be greatly improved. Before the start of polymer flooding, the higher the water cut of the formation, the lower the degree of enhanced oil recovery. Under normal circumstances, in the scope of improvement, it will be reflected in the standard of 2%-11%. If the water content exceeds the standard of 98%. At this time, if the strata are mined again, there must be more basis for error calculation and interpretation, otherwise, there will be some deviations in the application of polymer. The calculation and analysis of water cut in oil reservoir must be integrated with the oil displacement effect of polymer itself and the characteristics of local oil projects, so as to promote the related calculation work and get good results.

4. Conclusions

Nowadays, polymer flooding is being carried out continuously through rationalization mode. The mastery of dynamic characteristics is remarkable, and the influencing factors of the effect are constantly improved. Many regional oil work can be carried out according to the correct route. In the future, we should continue to

carry out in-depth research and development and innovation in polymer flooding.

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