Experimental Study on Improving Recovery Rate after Polymer Flooding in Class I Reservoir by Computer Monitoring

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Abstract. With the application of polymer flooding technology in improving oil recovery rate more and more widely, its oil recovery efficiency still needs to be further improved, so as to make the oil field can keep stable production. Based on this, this paper first studies the development status and principle of polymer flooding, and then analyses the design of a four layer heterogeneous thickening model for a class of reservoirs. Finally, an experimental method for improving the recovery rate of a class of reservoirs after polymer flooding based on computer monitoring is given, and the results are discussed.

Keywords: Recovery Rate, Computer Monitoring, Polymer Flooding, Reservoir

1. Introduction

With the continuous change and development of oil recovery technology, oil recovery has been continuously improved. At present, there are four ways to improve oil recovery: Hot drive, gas drive, microbial drive and chemical drive. Among them, chemical flooding mainly refers to the injection of polymer which can reduce the interfacial tension of oil and water or improve the sweep efficiency, which is called polymer flooding [1]. Although polymer flooding can improve the efficiency of oil recovery, nearly half of the crude oil has not been exploited, resulting in waste of resources. In order to improve the oil recovery efficiency of polymer flooding and make the oilfield stable, it is necessary to develop a reasonable technical route.

As a newly developed polymer suitable for various reservoir conditions, polymer surfactant has obvious advantages in emulsification, solubilization and salt resistance, and its oil displacement efficiency is significantly improved compared with common polymer. Polymer flooding reservoir, due to the strong carrying effect of polymer, makes the physical properties of reservoir, permeability difference, percolation law and other aspects change. Therefore, it is of great practical value to study the development law and effect of polymer surfactant flooding based on computer monitoring technology for improving the oil recovery rate and stable production requirements of the reservoir.

2. Development Status of Polymer Flooding

2.1. Principle of polymer flooding
Adding polymer into water-soluble polymer can significantly increase the viscosity of water phase, so as to optimize the fluidity ratio and improve the oil recovery of reservoir. The principle of improving oil recovery is shown in Figure 1. In addition, polymer flooding can play a better effect when the water drive mobility of the reservoir is relatively high, such as improving the sweep situation.

2.2. Mechanism of polymer flooding
Firstly, in the aspect of polymer mobility control, the sweep efficiency in the reservoir can be improved by reducing the water oil mobility ratio. Secondly, as a water-soluble polymer, the molecular weight of the polymer is large, which increases the internal friction force generated by relative movement, makes the polymer molecules more stretch and has better viscosity increasing ability [2]. In addition, the stagnant flow in the polymer increases the flow resistance of the fluid in the pores, and the water flooded volume is enlarged by adjusting the water injection profile. By increasing the flow resistance of the high permeability layer, the water absorption index of the low-permeability layer is increased, and the swept volume of the low-permeability layer is expanded.

After the polymer solution is injected, the impedance increases due to the polymer solution entering into the high permeability layer, and then the water absorption index of the high permeability layer and the low permeability layer is balanced to improve the vertical sweep efficiency and finally realize the adjustment of the water injection profile.

2.3. Reservoir characteristics after polymer flooding
It is helpful to master the characteristics of post polymer flooding reservoirs by studying the detailed address, percolation law and reservoir change law of a class of oil reservoir by polymer flooding, so as to have a clearer understanding of the differences between the characteristics of the subsequent oil layers, and based on this, it lays a foundation for the specific process of enhancing the oil recovery after polymer flooding [3]. It can be seen from the mechanism of polymer flooding that the physical properties of the reservoir are changed due to the carrying effect of the reservoir after the polymer, such as the further increase of permeability, so that the seepage law in the reservoir is also changed accordingly.

3. Design of A Four Layer Heterogeneous Thickening Model

3.1. The basis of establishing a kind of reservoir model after polymer flooding
Due to the different sedimentary background of different oilfields, the model should be built based on the regular changes caused by the sedimentary characteristics. First of all, the main characteristics of post polymer flooding reservoirs are as shown in table 1 below. Secondly, the applicability of the model needs to be analyzed in the process of simulation for the main reservoir of polymer flooding, especially in heterogeneous reservoirs and oil wells [4]. Generally, the similarity principle is used to determine its parameters, and the final model is constructed based on the parameters. In addition, it should also focus on the analysis of the areas of multi-stage and multi rhythm distribution, positive rhythm distribution and compound rhythm distribution of a class of reservoirs.
Table 1. Main characteristics of post polymer flooding reservoirs

| Distribution area                              | Characteristics                      |
|------------------------------------------------|---------------------------------------|
| Plane distribution of sand body                | Diversity                             |
| Heterogeneity in reservoir                     | Huge vertical difference              |
| Physical properties of reservoir and underground fluid | There is obvious regularity          |

3.2. Core making technology and parameter control method based on computer

In the process of physical simulation, it is necessary to ensure that the physical properties of the model and the actual reservoir are consistent, and the model is constructed by controlling the technical parameters such as the size of the model, so as to ensure the practical applicability of the model. Secondly, in the aspect of pressure mode, the heterogeneous model is established by static pressure to make the quartz sand and crosslinking agent uniform. In addition, controlling the physical parameters of cement can control the size and time of pressure control [5]. In the aspect of cementation mode, based on the quartz sand epoxy resin cementation method, the pressure is stirred on the press.

In the determination of permeability, the ratio of standard sand to fine sand is controlled and the standard deviation is used to determine the permeability of core. In order to determine the porosity of artificial core, different proportions of quartz sand are used to prepare flat core. Through computer analysis, the core permeability curve with pressure as shown in Figure 2 is obtained, so as to determine the targeted large flat core model.

![Figure 2. The core permeability curve with pressure](image)

By determining the porosity of large plate artificial core and large plate artificial core, there is a certain pressure range in the selection of overlying pressure for core production. In addition, in the control method of core wettability, the wettability of artificial flat core is determined by adding additives to change the wettability of flat core.

4. Experimental Method for Improving Oil Recovery after Polymer Flooding in Class I Reservoirs based on Computer Monitoring

It is helpful to improve the oil displacement efficiency by expanding sweep volume and ASP flooding [6]. Secondly, when selecting the oil displacement system after polymer flooding, it is necessary to improve the profile control ability based on the viscosity of the oil displacement system, and further improve the oil recovery after polymer flooding by reducing the tension of oil-water interface.

4.1. Compound flooding experiment after polymer flooding based on computer monitoring

The experimental conditions of compound flooding experiment after polymer flooding based on computer monitoring are shown in Table 2 below. First, quantitative distilled water is weighed for formation water and placed on the electric stirrer to weigh all mineralized substances. After the mineralized substances are completely melted, the configuration is completed.
Table 2. Experimental conditions of compound flooding experiment

| Experimental conditions | Contents                                      |
|-------------------------|----------------------------------------------|
| Model                   | Artificial square core                       |
| Experimental oil        | Simulated oil made by mixing crude oil and kerosene |
| Experimental water      | Artificial brine                             |
| Chemical reagent        | Surface active agent                         |
| Experimental temperature| 45 Celsius degree                            |

4.2. Experimental scheme and results

Based on the above experimental conditions and steps, through the processing of computer detection results, it can be seen that the large model has more significant advantages, which can better reflect the situation of oil displacement experiment after polymer flooding in a class of reservoirs. Based on the experimental results, it can be found that binary composite flooding can improve the overall pressure of the model, so it can significantly improve the recovery of a class of reservoirs after polymer flooding. Therefore, the effect of binary composite flooding for enhanced oil recovery after polymer flooding is better.

5. Conclusion

In summary, it is of great practical value to study the development law and effect of polymer surfactant flooding based on computer monitoring technology for improving oil recovery rate and stable production requirements. After polymer flooding, due to the strong carrying effect of polymer, the physical properties of the reservoir, permeability difference and seepage law in the reservoir are changed. Binary composite flooding improves the overall pressure of the model, so it can significantly improve the recovery rate of the first class reservoir after polymer flooding.

Acknowledgments

The class one oil reservoir description and chemical oil-driven reagent study.

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