Key Techniques of Tertiary Oil Recovery in Medium and Low Permeability Reservoirs Based on Computer Display Technology

DangYuan Li*
Tertiary Oil Recovery Project Department in No.7 Oil Production Plant of Daqing Oilfield Company Ltd, China, 163515
*Corresponding author e-mail: Dangyuan@163.com

Abstract. Oil is a kind of non-renewable energy. Our demand for oil is on the increase. With the continuous exploitation of oil resources, China's oil reserves gradually decrease. As a result, China imports a lot of crude oil every year. With the exploitation of oil, China's large oil fields will gradually dry up, which requires China to develop medium and low permeability reservoirs. However, there are many difficulties in the development of medium and low permeability reservoirs, such as dense matrix, complex fracture system and low permeability, which will lead to low recovery. With the development of science and technology and the combination of computer technology, eor technology has gradually matured and can be used in low and medium permeability reservoirs. In this paper, the technology of eor is analyzed firstly. Then, according to the characteristics of low and medium permeability reservoirs shown by the computer, the fracturing, percolation, enhanced oil recovery technology and microbial oil displacement technology are analyzed to better develop low and medium permeability reservoirs.

Keywords: Middle and Low Permeability Reservoir, Key Technology of Tertiary Oil Recovery, Enhanced Oil Recovery Technology of Fracturing and Filtration, Computer Display

1. Introduction
At present, there are many low and medium permeability reservoirs in the old area of Daqing Oilfield. However, through water flooding, gas flooding, chemical flooding and other ways, we found that the development effect of the oilfield is not ideal, which can not be very good recovery. Therefore, this paper introduces the technology of enhanced oil recovery by fracturing and percolation and the technology of microbial oil displacement, which can improve the oil recovery of low and medium permeability reservoirs. Through the performance evaluation of oil displacement agent, we have selected oil displacement agent with various functions, such as low interfacial tension, wetting reversal performance, good emulsification performance, strong anti adsorption performance, which will be better for exploitation. At present, most of China's oil production comes from old oilfields, which are rich in geological remaining reserves. However, most of the old oilfields have entered the stage of
high recovery and water cut, which has become a major challenge to the oil industry in China. Therefore, we must continue to explore new technologies, which will improve the oil recovery of old oilfields. In low and medium permeability reservoirs, the key technologies of tertiary oil recovery mainly include six categories, such as water drive, gas drive, chemical drive, microbial oil recovery, physical method oil recovery, thermal oil recovery, etc. At present, the three types of oil with medium and low permeability are mainly adjusted by water drive, and the recovery degree is between 33% - 42%, which has a lot of remaining reserves. Therefore, the low and medium permeability reservoir will be the future development focus, which requires us to solve the problem of low recovery[1].

2. Key technologies of tertiary oil recovery in medium and low permeability reservoir

2.1. Main problems of oil recovery in low and medium permeability reservoir

The three types of reservoirs with medium and low permeability will be limited by the physical properties of fluid, which will lead to the limited control range of conventional fracture. Therefore, conventional fracturing fluid formation will be difficult to control and filter, which will cause fracturing fluid plugging or formation damage. Therefore, it is difficult for us to control the equilibrium of cracks, which will cause serious local penetration. Therefore, it is difficult for us to enhance the recovery range[2]. The three types of reservoirs with low and medium permeability have many characteristics, such as large physical property difference, high clay content, complex micro characteristics, small pore throat radius, etc., which will result in the limited effect of conventional chemical oil displacement agents. Therefore, we must strengthen the fracturing and filtration, which will form the tertiary oil recovery technology of the combination of fracturing, filtration and oil displacement. The technology of enhanced oil recovery by fracturing and percolation makes it a way to open the formation by replacing fracturing fluid with low viscosity oil displacement agent. Through rapid injection of oil displacement agent, we can supplement formation energy, which will drive out remaining oil in pores. The basic principle of mining medium low permeability reservoir is shown in Figure 1.

![Figure 1. Basic principle of medium low permeability reservoir exploitation](image)

2.2. Basic types of EOR technology

The technology of EOR has different characteristics, including: surface miscible water flooding, polymer flooding, composite flooding and so on. Among them, the basic principle of surface miscible water flooding technology is as follows. By reducing the interfacial tension among injection water, oil and soil, we can improve the oil displacement efficiency. The basic principle of polymer flooding technology is as follows[3]. By reducing the viscosity difference between oil and injected water, we can
improve the viscosity of injected water and the volume involved, which will be better for oil recovery and displacement. Through physical way, we can add energy to oil reservoir, which is the key technology of secondary oil recovery and displacement technology. However, the EOR technology is to inject water into the reservoir. By ensuring the reservoir pressure, we can change the viscosity and phase state of oil and water in the reservoir, which is a combination of chemistry and physics. By re-accumulating the dispersed oil resources in the reservoir, we can improve the volume of injected water in the reservoir, which will improve the displacement efficiency of injected water in the reservoir[4].

3. Key technologies of tertiary oil recovery in medium and low permeability reservoir

3.1. Fracturing and percolation enhanced oil recovery process
We can replace the fracturing fluid through the high-efficiency oil displacement system, which will break down the low-permeability and remaining oil enriched well layers. By injecting a large number of oil displacement agents into the target formation quickly and efficiently, we can supplement the formation energy[5]. Through the conventional flooding method, we can displace the remaining oil, which will realize the uniform displacement of the middle and low permeability layers. Therefore, we will greatly enhance the purpose of oil recovery. Fracturing and filtration enhanced oil recovery technology can also be called pressure drive technology, including forward pressure drive technology and reverse pressure drive technology.

3.2 Forward pressure drive technology

![Diagram](image)

**Figure 2.** Forward fracturing and oil displacement diagram of injection well
The technology of forward pressure flooding is a method of only making fractures at the injection well end and injecting oil displacement agent. Through the fracture extension, we can drive the oil displacement agent up and down along the fracture and into the formation pores at the far end. When the construction of the joint is finished, we do not add sand to fully close the crack. Then, the injection well section will return to the conventional continuous injection mode, which will further drive to the production well end. Therefore, the technology of forward pressure flooding plays a dual role of displacement pressure difference and oil displacement agent. The working principle of forward pressure drive technology is shown in Figure 2[6].

3.3. Reverse pressure drive technology
The technology of reverse pressure drive is a way of injecting oil displacement agent only in the end of production well. Through the diffusion of oil displacement agent, the formation crude oil will undergo imbibition displacement, which will restore the conventional continuous injection at the well end. The working principle of reverse pressure drive technology is shown in Figure 3.
4. Conclusions

EOR technology of low permeability reservoir is a large-scale system engineering with high difficulty and complexity, which needs multi-disciplinary integration. By deepening the oil displacement mechanism, we can innovate the EOR, which will make full use of different EOR technologies. In the current oil field exploitation activities in China, secondary oil recovery and displacement technology is still the main part of exploitation activities. However, we need to use the technology of EOR to exploit it scientifically and reasonably, which will fully realize the advantages of the technology of EOR in the face of traditional technology.

References

[1] Zhang Zhiqiang, Zheng Junwei. Technical progress in exploration and development of low permeability oil and gas resources [J]. Progress in Geoscience, 2009, 24 (8): 854-64.
[2] Zheng Junwei, Yu Ling, sun Deqiang. Main influencing factors and characteristic technology of exploration and development of low permeability oil and gas resources [J]. Natural Gas Geoscience, 2009, 20 (5): 651-655.
[3] Wang Yan. Current situation and key technologies of global tight gas exploration and development. Petroleum knowledge, 2014 (2): 8-9.
[4] Yang Hailong, Zhuo Xingjia. Present situation and development trend of tertiary oil recovery technology [J]. Inner Mongolia petrochemical industry, 2010 (8): 142-145.
[5] Pang Lili, Ning Yuqing. Development status of chemical flooding technology in tertiary oil recovery [J]. Inner Mongolia petrochemical industry, 2012 (8): 142-145.
[6] Hou Tao. Discussion on the application of EOR technology in oil field [J]. Chemical engineering and equipment, 2014 (04): 110-111.