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The Experimental Study of the Acoustic Characteristics of Polymer Solution

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Abstract:- The technology of polymer flooding is a cost-effective method to enhance oil recovery. After polymer flooding, the characteristics of fluid and pore structure of the reservoir changed, due to high molecular weight, high concentration and high viscosity of the polymer, and resulting in the changing of the acoustic characteristics of the reservoir. Based on the experimental study of acoustic characteristics of the polymer solution, this paper concludes that the variation of the acoustic characteristics of the polymer solution and the effects of polymer solution for reservoir pore and fluid from four areas: density, acoustic velocity, acoustic impedance and apparent viscosity.

Key words:- *polymer flooding, acoustic characteristics, pore space*

I. INTRODUCTION

Polymer flooding effect is very significant and broad prospects. When the polymer solution flows through the pores of the reservoir, the pore space changes caused the adsorption. The changes directly affect the computing result of porosity after polymer flooding, and have a great influence on saturation interpretation. Therefore, the study of the acoustic characteristics of the polymer flooded core samples is necessary and essential. It is absolutely necessary to know well the acoustic characteristics of polymer solution before studying on the acoustic characteristics of the polymer flooded core samples. The paper studies the acoustic characteristics of polymer solution from four areas: density, acoustic velocity, acoustic impedance and apparent viscosity [1-3]. Through this experimental study and analysis of the results, it provides an important fundamental data in studying the acoustic characteristics of the polymer flooded core samples for future generations.

II. THE PRODUCTION OF THE POLYMER SOLUTION

The Production of the polymer solution and common salt solution is different. The polymer is easy to become lumps when it mixed into distilled water due to the nature of its high molecular weight and high viscosity. And once lumps, it is extremely difficult to separate. The solution is stirring constantly with distilled water with a glass rod when the polymer powder was slowly poured into a beaker in this experiment, then using a stirrer for stirring the mixed solution last one hour until the polymer solution is uniformly dissolved in the solution. The four data measured in this experiment were carried out at ambient temperature and pressure.

III. THE STUDY OF ACOUSTIC CHARACTERISTICS OF POLYMER SOLUTION

3.1 Density

The density values of polymer solution of different concentrations from 0mg/L to 5000mg/L are measured in this experiment. The measurement results are shown in Figure 1.Density values decrease slowly with the concentrations increasing when the concentrations in range of 1500mg/L; when the concentrations are greater than 1500mg/L, density values decrease faster with the concentrations increasing.

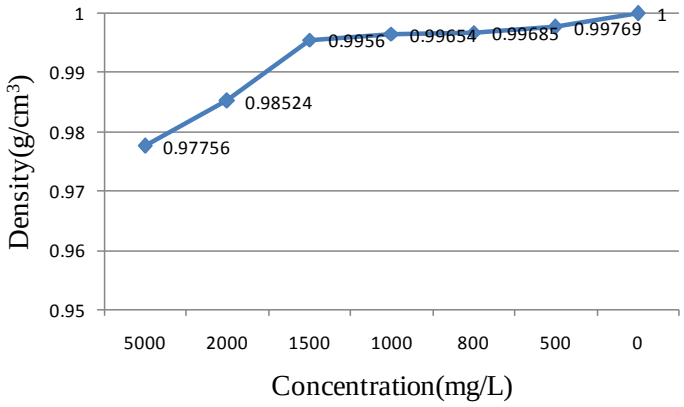

Fig.1 The density values of the polymer solution of different concentrations

3.2 Average acoustic velocity

Fix the spontaneous self-closing ultrasonic transducer on the bracket and place a container filled with polymer solution in. Then hold the emission surface of the transducer parallel to the bottom surface of the reflector. Change the distance L between the transducer and the bottom interface of the reflector. By recording the propagation time difference Δt between the incident wave and the first reflected wave, sound velocity $V=2L/\Delta t$ of the polymer solution can be obtained.

The acoustic velocity values of polymer solution of different concentrations from 0mg/L to 5000mg/L are measured in this experiment. The measurement results are shown in Figure 2.The acoustic velocity values decrease slowly with the concentrations increasing when the concentrations in the range of 1000 mg/L. When the concentrations are greater than 1000mg/L, the acoustic velocity values reduce faster with the concentrations increasing.

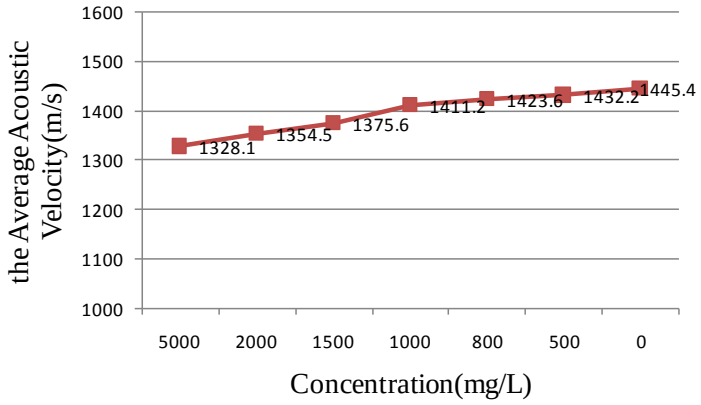

Fig.2 The average acoustic velocity values of the polymer solution of different concentrations

3.3 Acoustic impedance

When the density values of the polymer solution of different concentrations are multiplied by acoustic velocity values, the acoustic impedance values of the polymer solution of different concentrations can be obtained, as shown in Figure 3. The figure shows, the acoustic impedance values decrease with the concentrations of the polymer solution increasing.

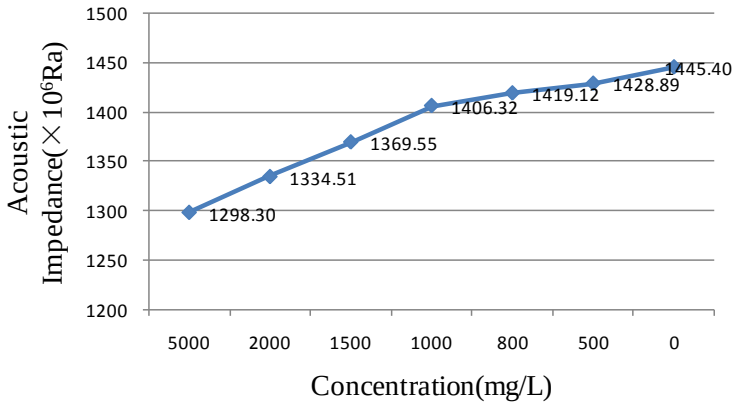

Fig.3 The acoustic impedance values of the polymer solution of different concentrations

3.4 Apparent viscosity

The apparent viscosity values of polymer solution of different concentrations from 0mg/L to 5000mg/L are measured in this experiment. The measurement results are shown in Figure 4. The figure shows, the apparent viscosity values of the polymer solution increase with the concentration increasing. The result shows that the concentrations of the polymer solution have a great influence on the apparent viscosity.

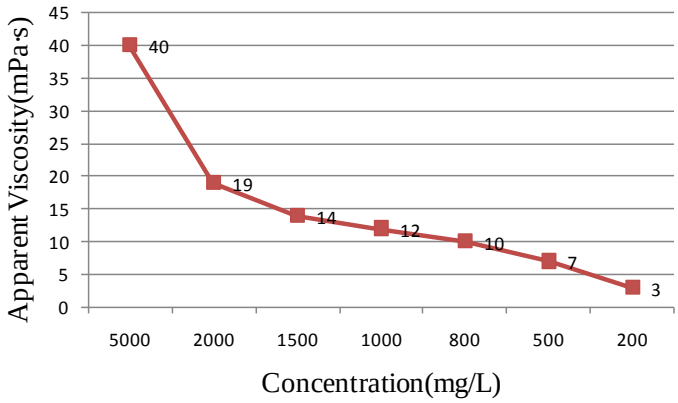

Fig.4 The apparent viscosity values of the polymer solution of different concentrations

IV. EXPERIMENTAL RESULTS ANALYSIS

In the actual process of displacement, the fluid filled in the pore of the reservoir is mainly water before polymer flooding. The polymer solution may carry away some muddy due to the viscosity after polymer flooding, thus the pore spaces will be larger than before, but the polymer solution remained in the pore make the pore volume smaller. So the pore spaces in the reservoir will be larger and the fluid content especially the content of the polymer will increase after polymer flooding [4]. The polymer remained in the larger pores of the rocks are mainly affected by adsorption, so the residuals are few and the decrease in pore volume is relatively small. The polymer remained in the smaller pores of the rocks are mainly affected by mechanical collection, so there are more residuals and the decrease is relatively big [5-6]. Combining with the experimental results, we conclude:

1）The density values of the fluid of pore in reservoir are reduced after polymer flooding, average acoustic velocity values decrease, acoustic impedance values decrease and apparent viscosity values increase.

2）The permeability of the part with low penetration will be lower, the permeability of the part with high

penetration will be higher and the rock porosity will be relatively more uneven after polymer flooding.

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