High efficiency emulsifier of complex surfactant with authigenic viscosity

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Abstract. In this study, a new surfactant compounding system was selected based on emulsifying performance. Finally, the prescription was made up of 0.5wt% oleate amide propyl betaine 0.1wt% octadecyl ammonium oxide. And its emulsification ability were systematically evaluated. At the same time, the emulsion types formed by different concentrations of surfactants was observed. The factors affecting emulsifying performance are analyzed. The research results obtained show that the compounding system has good emulsifying properties. All results reflect the fact that compounding system can expand their application range in different environment with various extents, which will benefit the design and use of compounding system.

Keywords: Surfactant; emulsifying performance; compounding system.

1. Introduction
Among the proven reserves of heavy oil in the world, Canada, Venezuela, South America and other countries or regions occupy the most prominent share, accounting for about 90% of the world's heavy oil resources [1]. China's common crude oil resources are poor, and heavy oil resources are relatively rich, but because heavy oil (international name: heavy oil) has high viscosity, low temperature fluidity and other characteristics, it brings great difficulties to mining and transportation. The commonly used heating mining and transportation method has high energy consumption and poor economic benefit, and its application is limited at present. How to develop heavy oil resources economically and efficiently is of great significance for alleviating the contradiction between supply and demand of domestic crude oil and ensuring the energy strategic security of our country. With the development of secondary (mainly water flooding) and tertiary (mainly chemical flooding) technology, a large proportion of crude oil is extracted in the form of emulsion. The technology of emulsification and emulsification of crude oil has attracted much attention [2]. Emulsifier is a substance which can make emulsion stable, mainly composed of surfactant, and its main function is to reduce the surface tension and form a strong interfacial film around the dispersed phase droplets [3]. In this study, a new surfactant composite system based on emulsifying performances was selected. All results reflect that the composite system can...
expand its application in different environments. The combination emulsifier can reduce the environmental damage and reduce the amount of chemical emulsifier.

2. Experimental

2.1. Materials
Oleate amide propyl betaine was purchased from Huainan hua Jun new Material Science & Technology Co., Ltd. Octadecyl ammonium oxide was purchased from Yongrun Chemical Co., Ltd. The crude oil was obtained from Yanchang Oilfield, China.

2.2. Emulsion stability
Preparation of different surfactant solution (0.083% oleate amide propyl betaine and 0.017% octadecyl ammonium oxide, 0.25% oleate amide propyl betaine 0.05% octadecyl ammonium oxide, 0.5% oleate amide propyl betaine 0.1% octadecyl ammonium oxide, mass fraction). The volume ratios of the above solution and crude oil of the total volume 10mL were 1:9, 2:8, 3:7, 4:6, 5:5, 6:4, 7:3, 8:2, 9:1, respectively, and placed in the 10mL test tube. Place them in a water bath, set the temperature of the experiment to 50℃, take it out after 10 minutes of constant temperature, shake for 50 times, form an emulsion, then put it in a water bath again, and record the volume of the precipitated water at regular intervals until the change is small, and note the water separation rate. The water separation volume at different times was recorded with a stopwatch to calculate the water separation rate[4].

\[
E_d = \frac{V_w}{V} \times 100\% \quad \cdots \cdots \cdots \cdots \cdots \cdots (1)
\]

In the formula:
- \(E_d\) - water splitting rate, %;
- \(V_w\) - volume of precipitated water, mL;
- \(V\) - The volume of the aqueous phase at the time of preparation of the emulsion, mL.

3. Results and Discussion

3.1. Emulsion stability
The stability of foams and emulsions is of high importance for many practical systems in the food, paint, oil, pharmaceutical and other industries. It has been found that the rate at which the liquid beads of ordinary emulsions aggregated into larger ones and eventually caused the rupture of emulsions depended on a variety of factors, among which the strength of the interfacial membrane was one of the main factors affecting the stability of ordinary emulsions, and the surfactant stabilized the emulsions by reducing the interfacial tension of the system [5-7]. Emulsion system is a kind of thermodynamic instability system, which is usually measured by the change of emulsion performance with time. As can be seen from Fig.1, the emulsion produced by the surfactant solution with a total concentration of 0.6% is significantly slower than the emulsion formed by the surfactant solution with a total concentration of 0.3%. The final precipitated water at each oil/water ratio was 0.6%<0.3%<0.1%, which indicated that the lower the total concentration of the surfactant solution, the worse the emulsification ability. When the ratio of water to oil increases gradually, the emulsification effect becomes better first, then worse, 5:5 is a turning point. The reason for this phenomenon may be the density difference between crude oil and water. On the one hand, an increase in the proportion of surfactant solution increases the diameter of the resulting emulsion particles, resulting in accelerated separation of crude oil and water [8]. On the other hand, when the proportion of surfactant solution is large, the density of dispersed emulsion droplets is also large, which makes the probability of the droplets colliding with each other and eventually gathering into large droplets greatly increased.
Fig. 1 Emulsification capacity of surfactant solution with different concentration
(a) 0.1%, (b) 0.3%, (C) 0.6%
The appearance of the emulsion after 24 hours is shown in Fig. 2. As can be seen from Fig. 2, when placed for a period of time, the emulsion will appear obvious stratification, and the emulsion formed by three different concentrations of surfactants can be roughly divided into three layers, arranged from top to bottom in the order of crude oil, emulsion and water.

Fig. 2 Appearance pattern of different concentrations of surfactant emulsion after 24h

In this study, the emulsion types formed by different concentrations of surfactants at different water/oil ratios were judged by filter paper wetting method. Fig. 3 shows that the emulsion system is of type w/o when the total concentration of surfactant solution is 0.1% and 0.6%, and the ratio of water to oil is less than 4:6. When the ratio of water to oil is more than 5:5, the emulsion is reversed phase o/w. When the total concentration of surfactant solution is 0.3%, when the ratio of water to oil is more than 6:4, the emulsion system is reversed, at this time, the emulsion is o/w type.

Fig. 3 Determination of the type of surfactant emulsion by filter paper wetting method
4. Conclusion
The effect of initial pH value of simulated water, the molar ratio of sodium persulfate and sodium sulfide, reaction time, reaction temperature, the effect of prepared catalyst and initial concentration of simulated water on removal rate of sulfur ion were investigated. The experimental results show that when the initial concentration of simulated water was 75 mg/L, the pH=8, the molar ratio of sodium persulfate and sodium sulfide was 1.2:1, the reaction time was 30 minutes, The maximum removal rate of sulfur ions by sodium sulfate can reach 96.11% at 35℃.

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