

Influences of water treatment agents on oil-water interfacial properties of oilfield produced water

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Abstract: The emulsion stability of oilfield produced water is related to the oil-water interfacial film strength and the zeta potential of the oil droplets. We investigated the effects of water treatment agents (corrosion inhibitor SL-2, scale inhibitor HEDP, germicide 1227, and flocculant polyaluminium chloride PAC) on the stability of oilfield produced water. The influence of these treatment agents on oil-water interfacial properties and the mechanism of these agents acting on the oilfield produced water were studied by measuring the interfacial shear viscosity, interfacial tension and zeta electric potential. The results indicated that the scale inhibitor HEDP could increase the oil-water interfacial film strength, and it could also increase the absolute value of the zeta potential of oil droplets. HEDP played an important role in the stability of the emulsion. Polyaluminum chloride (PAC) reduced the stability of the emulsion by considerably decreasing the absolute value of the zeta potential of oil droplets. Corrosion inhibitor SL-2 and germicide 1227 could decrease the oil-water interfacial tension, whereas they had little influence on oil-water interfacial shear viscosity and oil-water interfacial electricity properties.

Key words: Water treatment agents, oil-water interfacial properties, emulsion stability, oilfield produced water

1 Introduction

Water flooding is one of the primary methods for increasing the ultimate recovery and the profit in development of oilfields, and the quality of the injection water is critical to achieve highly-efficient development of the oilfields. However, repeated use of injection water leads to increases of the concentration of complicated components of the oilfield produced water, which consists of solid impurities, oil suspensions, dissolved gases, salts, and organic compounds. It brings new problems to the treatment of oilfield produced water (Wang, 1999; Deng et al, 2000; Lin et al, 2012), such as poor treatment effectiveness, a significant increase in the treatment cost, and pollution of drainage and injection water. These problems affect not only the further improvement of oil recovery due to the increase in the cost of oil production, but also the environment and ecological balance. Therefore, treatment of oilfield produced water is an urgent issue of significant importance, and the oil-water interfacial properties are the key factors influencing the stability of the suspension and emulsion (Tsamantakis et al, 2005; Opawale et al, 1998).

The presence of wastewater treatment agents inevitably influences the interfacial properties of the oilfield produced

water (Santini et al, 2010; Allenson et al, 2011; Chen et al, 2007). To investigate the effect of water treatment agents on the stability of the oilfield produced water, the oil-water interfacial properties and the mechanism of these agents acting on the oilfield produced water are studied in this paper. This study can provide a basis and guidance for efficient treatment of oilfield produced water; it also has practical significance for the selection of oilfield wastewater treatment agents.

2 Materials and methods

2.1 Materials and instruments

Reagents

Crude oil, and oilfield produced water which was used as a reference for preparation of simulated oilfield produced water in laboratory, were from the Shengli oilfield (China); Kerosene (the interfacial tension of the kerosene treated by silicone was $46.61 \text{ mN}\cdot\text{m}^{-1}$).

Corrosion inhibitor SL-2 (maleic anhydride copolymer); scale inhibitor HEDP (hydroxyethylidene diphosphonic acid); germicide 1227 (dodecyl benzyl dimethyl ammonium chloride); flocculant PAC (polyaluminium chloride). All these water treatment agents were obtained from Shandong Taihe Water Treatment Co., Ltd. (China), and all these water treatment agents (technical pure) were used as received.

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