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Research and application of combinational demulsifier

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Abstract. The dehydrationrate of Daqing crude oil was not stable and the amount of chemical demulsifier used too much, which caused serious environmental pollution and enlarged the difficulty of dealing with crude oil. Therefore, PRJ-1 bio-demulsifier was selected to combine with chemical demulsifiers SP-169 and GT-D01, respectively, to resolve the crude oil emulsion of Daqing. The results showed that PRJ-1 can combine with SP-169 efficiently. The demulsification efficiency was high and dehydrated water was clear. However, the demulsification efficiency increased a little with GD-D01. The study shows that efficient synergetic effect between PRJ-1 and SP-169 was confirmed. The suitable proportionality of combinational demulsifier is 1:1 and the demulsifying effect can meet requirement of oilfield demulsifiers currently.

Introduction

Chemical demulsifier is a kind of nonionic surfactant. The backbone is polyether structure and the terminal group contains various hydrophilic functional groups, such as hydroxyl, amino, ether group and carboxyl [1]. The demulsification efficiency of chemical demulsifier is high and the dehydrationrate is quite stable, but it can not be satisfied with the demand of oilfield due to serious environmental pollution. Demulsifying bacteria are microbial strains which can produce hydrophilic, oleophylic surfactant. This surfactant which can separate the crude water-oil emulsification is called bio-demulsifier. Bio-demulsifier contains hydrophilic and oleophylic surfactant which is difficult to compound by chemical methods. The surfactant can lower water-oil interfacial tension and has high demulsification efficiency [2]. However, the demulsifying effect of bio-demulsifier is not enough stable which limits to its industrial scale [3].

Efficient demulsifier must have strong surface activity, good wetting function, enough flocculating ability and high coalescence effect [4]. But a single type of demulsifiers is quite difficult to satisfy these requirements. One of develop efficient demulsifier methods is combination which is to combine with two or more demulsifiers by synergetic effect [5]. Combinational demulsifier would be got by bio-demulsifier combining with chemical demulsifier. Its demulsifying effect is better than any single demulsifier [6]. The dosage of chemical demulsifier would be reduced by using combinational demulsifier which can lower the environmental damage. Combinational demulsifier can also make up the shortage of bio-demulsifier whose demulsifying effect is not stable [7].

Materials and methods

Experimental material. Bio-demulsifier is microbial strains which are sifted from oilfield pollution soil. Chemical demulsifier SP-169 is a kind of nonionic surfactant which is got by purchasing. GT-D01 is a kind of special cationic polymer with high inverting demulsifying ability. There are positive charge groups on its backbone which can remove oil in the water efficiently. The crude oil is from Daqing oilfield.

Solution preparation. Effective mass 1.0g chemical demulsifier SP-169 and GT-D01 are placed in 100ml volumetric flask, respectively, to prepare solution. 1% chemical demulsifier solution would be got by putting 100ml water into volumetric flask. 1% bio-demulsifier solution can be got by same method.

The water is evaporated out from crude oil by distillation. Then, the right amount of water and crude oil are put in homogenizer with 5000 r/min for 30 min to prepare crude oil emulsion. The emulsion will be used for crude oil demulsification which contains 20% and 80% water, respectively.

Demulsification experiment. The demulsification experiment adopts graduated test tube method. 40ml crude oil emulsions which contain 20% and 80% water were placed into ten 50ml graduated test tubes, respectively. The right amount of bio-demulsifier and chemical demulsifier were put into crude oil emulsions. The tubes were placed into 60℃ bath thermostat for 5mins. Then, the tubes were taken out to shake 200 sequences. Last, the tubes were placed into 60℃ bath thermostat again to start demulsification experiment. The volume of dehydration was recorded in different time. Meanwhile, the turbidity and interface performance of dehydration was observed to evaluate the demulsifying effect of combinational demulsifier.

Crude dehydrationrate. Dehydrationrate is a vital criterion to weigh demulsifier efficiency. Demulsifier is put into crude oil to make oil-water separate, which could ensure crude oil water content reach standard.

$$R=\frac{V_1 - V_2}{V}\times 100\% \quad (1)$$

Where R, V_1, V_2 and V denote crude dehydrationrate, dehydration volume, demulsifier volume and crude containing water volume, respectively.

Results and Discussions

Demulsification efficiency of combinational demulsifier. PRJ-1 bio-demulsifier was selected to combine with chemical demulsifiers SP-169 and GT-D01, respectively, to resolve the crude oil emulsion. The proportionality of PRJ-1 compare SP-169 and GT-D01 are both 1:1. All dosages of combinational and single demulsifier are 0.4ml/40ml. 100ppm dosage is quite little. However, the synergetic effect can be expressed obviously due to little dosage. The demulsifying results are shown in Fig. 1 and Fig. 2.

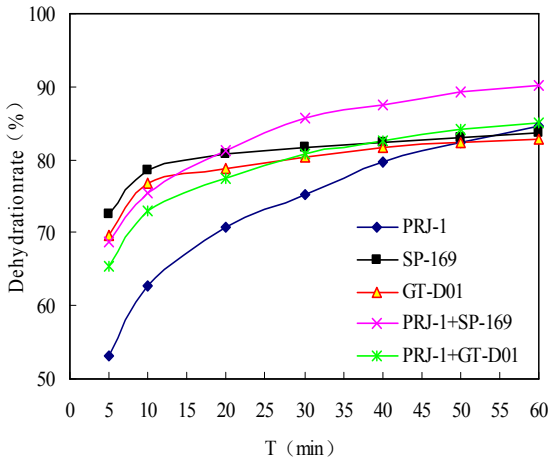

Fig. 1. Dehydrationrate of 20% containing water emulsion

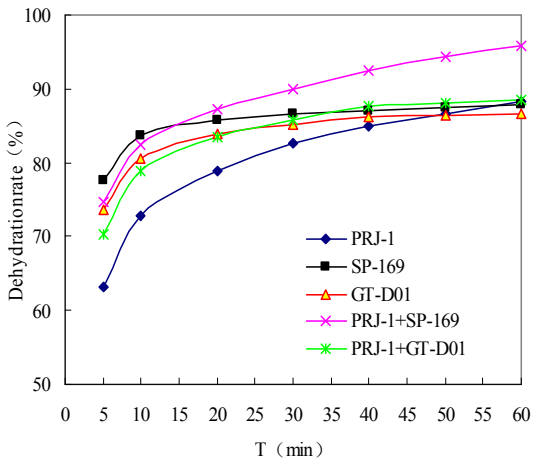

Fig. 2. Dehydrationrate 80% containing water emulsion

Fig. 1 showed that the dehydrationrate of 20% containing water emulsion can reach to 80% when the dosage of demulsifier was 100ppm. The demulsification speed of PRJ-1 was slow but demulsification efficiency was high and had growth trend. However, SP-169 and GT-D01 were contrary to PRJ-1. Dehydrationrate turned stable after 30mins. The demulsifying effect of combinational demulsifiers increased to some extent. PRJ-1 and SP-169 combinational demulsifier increased obviously. The demulsification efficiency can reach to 90% at 60mins and had growth trend. However, PRJ-1 and GT-D01 had bad synergetic effect due to biological degradation.

Fig. 2 showed that the demulsifying trend was similar with Fig. 1. However, the dehydrationrate can reach to 85% for 80% containing water emulsion which is higher than 20%. The demulsification efficiency was higher for thin oil contrast with thickened oil. PRJ-1 and SP-169 combinational demulsifier dehydrationrate can reach to 96% which is higher than others. It had stable dehydrationrate and dehydrated water was clear.

The influence of combinational proportionality. PRJ-1 and SP-169 had efficient synergetic effect. Different proportionalities were used for 80% containing water emulsion to gain suitable proportionality. Demulsification efficiency and dehydration turbidity need be considered at 60mins when the dosage of demulsifier is 0.4ml. There is 32ml water in the 40ml emulsion. The demulsifying result is shown in Table 1.

Table 1 Dehydrationrate of PRJ-1 and SP-169 combinational demulsifier

V_{PRJ-1}:V_{SP-169}	3:1	2:1	1:1	1:2	1:3
60min dehydration volume (ml)	29.1	30.3	30.9	31.2	30.1
Dehydrationrate (%)	89.7	93.4	95.3	96.3	92.8

Table 1 showed that the dehydrationrate of PRJ-1 and SP-169 combinational demulsifier was high. Dehydrated water was clear in the experiment. Under guaranteeing high demulsifying speed and dehydrationrate circumstance, the combination was chosen whose chemical demulsifier was little dosage, to lower the environmental pollution. The dehydrationrate can reach to 95% when the proportionality of V_{PRJ-1}:V_{SP-169} is 1:1 and 1:2. Therefore, the suitable proportionality is 1:1 to lower the environmental damage and cut down demulsifier cost.

Conclusions

Combinational demulsifiers would be got by PRJ-1 combining with SP-169 and GT-D01 whose demulsifying effect was better than any single demulsifier. PRJ-1 and SP-169 combinational demulsifiere had high demulsification efficiency especially and dehydrated water was clear. The demulsification efficiency can reach to 96% for 80% containing water emulsion at 60mins, which showed that PRJ-1 and SP-169 had efficient synergetic effect.

The synergetic effect of combinational demulsifier had suitable proportionality. The suitable proportionality of PRJ-1 and SP-169 was 1:1. The dosage of combinational demulsifier was just 100ppm which can lower the environmental damage and cut down demulsifier cost. Therefore, combinational demulsifier can meet requirement of oilfield demulsifiers currently.

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