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Application of solubilizing surfactant in trenchless drilling fluid

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1 INTRODUCTION

In trenchless construction, the dissolution rate of drilling fluid mixing is too slow, which requires a long time to be pre-hydrated and dissolved. In actual construction, people have to put incompletely dissolved drilling fluid into the hole ahead of time. The drilling fluid with incomplete performance can not achieve the expected effect. It not only affects the quality of the project, wastes materials, but also sometimes brings adverse effects.

In view of the problem of quick dissolution of drilling fluid, the idea of using surfactant to reduce surface tension and improve the dissolution rate of drilling fluid is put forward. The surfactant is selected by measuring the apparent viscosity, and the mechanism of surfactant action is analyzed. Finally, the appropriate surfactant and the optimal dosage are optimized.

2 EXPERIMENTAL MATERIALS AND METHODS

Experimental materials

Drilling fluid materials: HV-PAC, DFD, LV-CMC, bentonite.

Surfactant: L-62; E1303; AEO-3; APEP-108; Span20; PEG400DO; ZG-1; OP-15; OP-50; AEO-23; Levelling Agent O-25; Levelling Agent O-20; Tween-40; Tween-20.

Experimental instruments: HC-TP11-5 drug balance, ZNN-D6S six-speed rotating viscometer, D90 electric mixer, QBZY series automatic interfacial tension meter.

Experimental methods

Selection method of surfactant: The slurry water is treated by adding appropriate surfactant, then adding bentonite powder or drilling fluid additive to mix at low speed for 25 minutes, observing the basic performance of drilling fluid during testing, comparing the effects of different surfactants on the performance of drilling fluid, and selecting the most suitable surfactant.

The optimization of surfactant dosage: adding different concentration of surfactant in water, testing the basic performance of drilling fluid, observing the effect of different concentration of surfactant on drilling fluid.

Principle analysis of surfactant action: Based on the previous experimental results, the surface tension of the formula was measured to analyze the action principle of surfactant on the main components of drilling fluid, bentonite powder and drilling fluid additives.

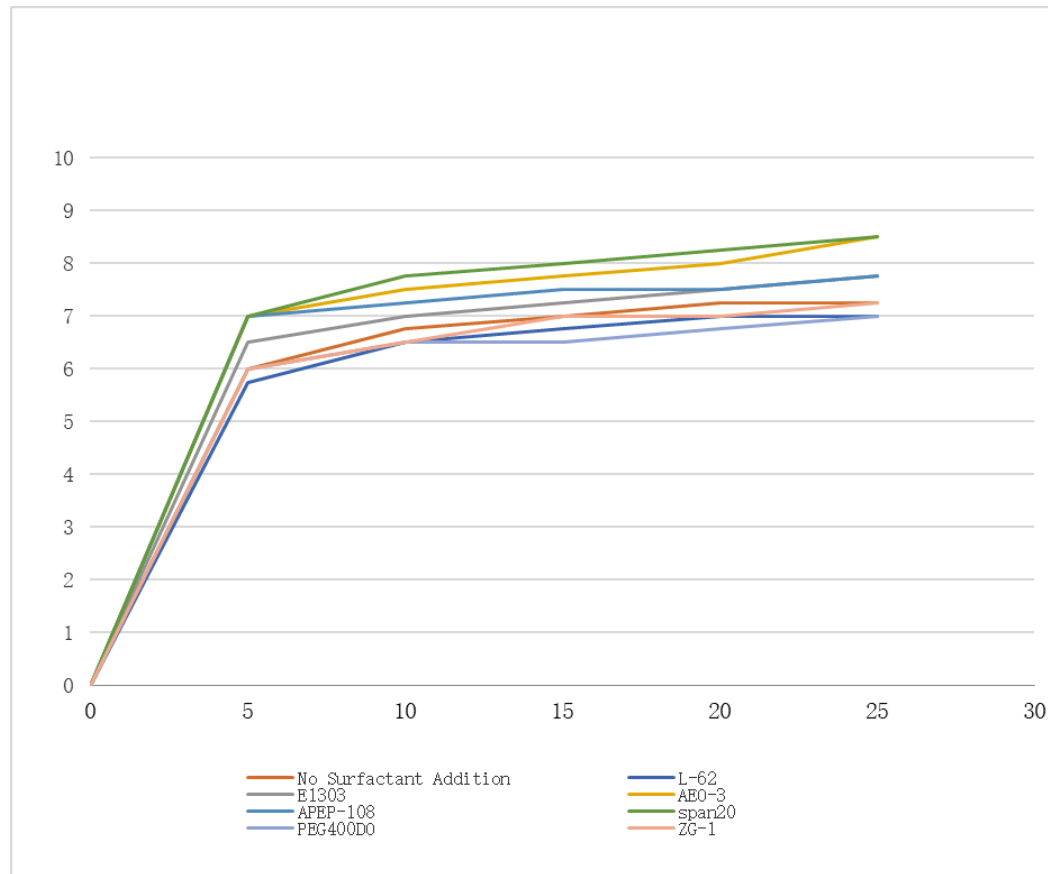


Figure 1. Effect of surfactant on bentonite dissolution

According to the experiment of the effect of surfactant on bentonite dissolution in Fig. 1, the effect of Span 20 is better. Compared with the case without surfactant, the apparent viscosity of drilling fluid increases by 17% in 25 minutes. Adding Span 20 can weaken the water and action of soil powder in liquid, and reduce the wetting speed of powder, so that it will not agglomerate in mixing.

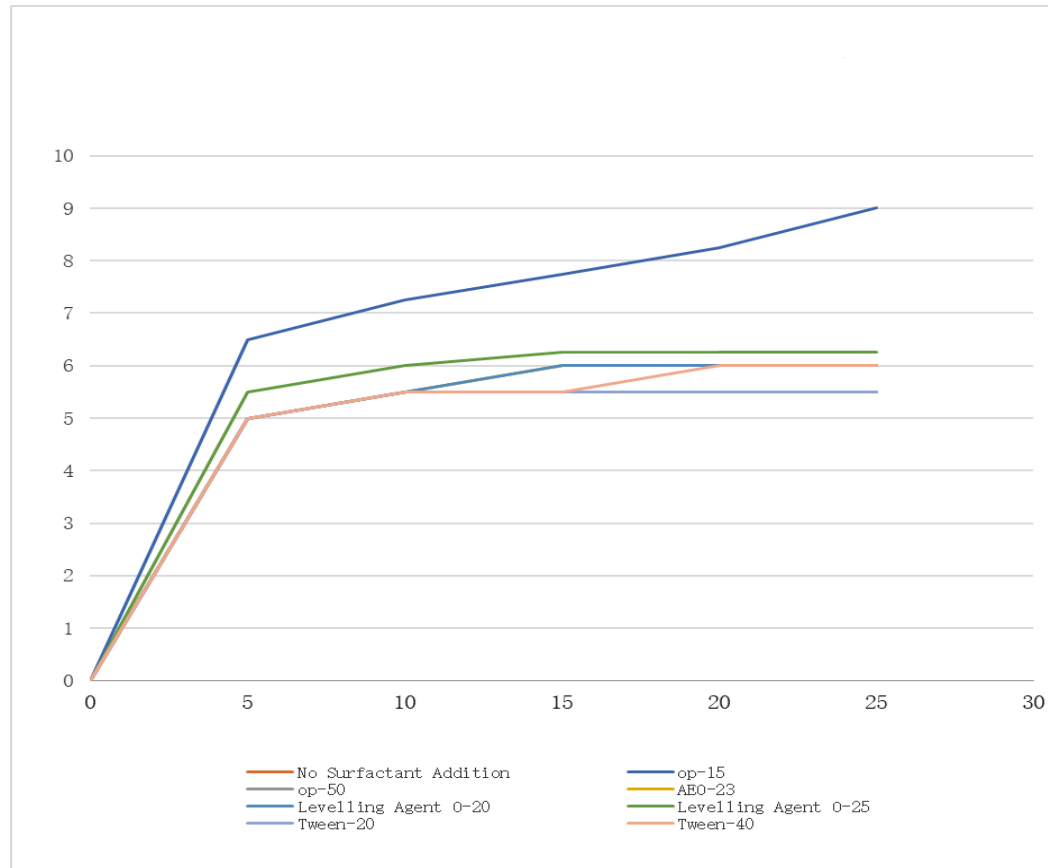


Figure 2 shows that OP-15 has better effect. Compared with the case without surfactant, the apparent viscosity of the treatment agent solution increases by 64% in 25 minutes, improves the wetting humidity and dispersion of hydrophobic powder, eliminates the mutual exclusion between fat and water, and enables drilling fluid additives to quickly wet and dissolve in the liquid.

Figure 2. Effect of surfactant on dissolution of drilling fluid additives

Using 6% bentonite + 0.2‰HV-PAC + 8‰DFD + 3‰LV-CMC, the first group without surfactant, the second group with 0.5‰OP-15 and 1‰Span 20, stirring for 30 minutes to test their basic properties such as table 1, while observing the formation of mudcake, as shown in Figure 3. Figure 3 shows the mud before adding surfactant on the left and the mud after adding surfactant on the right.

Table 1. The comprehensive effect of surfactant on formula

Serial number	AV /mPa·s	PV /mPa·s	YP /Pa	YP/PV /ks-1	φ6	φ3	FLAPI /mL	lubrication factor	Surface tension /N/m
1	8.5	9	-0.5	-0.06	17	8	9.8	0.43	26.04
2	14	14	0	0	28	14	10.8	0.27	15.20

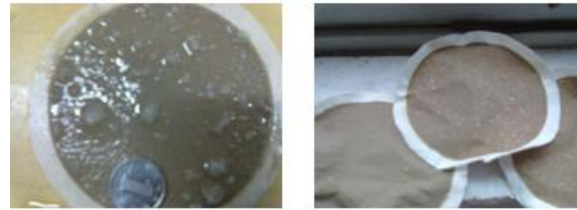


Figure 3. Comparison of mudcake before and after adding surfactant

From Table 1 and Figure 3, the apparent viscosity of the formulation can be increased by 65% in a short time after adding surfactant, the lubricity of the formulation can be increased by 37%, the surface tension can be reduced by 42%, and the performance can be enhanced at low speed, which has little effect on the water loss. It can be seen from the observation of mud peel that surfactant is a macromolecule material which disperses more evenly in a short time, and at the same time makes the overall dispersion more uniform and mud peel more compact.

3 CONCLUSION

First, surfactants can wet and solubilize drilling fluid materials, reduce the surface tension, interfacial tension and free energy of drilling fluid materials, but also affect the basic performance of drilling fluid.

Secondly, Span 20 and OP-15 can promote the solubilization of drilling fluids to a certain extent, among which Span 20 can promote the solubilization of bentonite powder, reduce the wetting speed of powder, so that it will not agglomerate in mixing. OP-15 promotes the solubilization of drilling fluid additives, improves the wettability and dispersion of hydrophobic powders, eliminates the mutual exclusion between fat and water, and enables the additives to quickly wet and disperse in the liquid.

Thirdly, in 30 minutes, Span 20 and OP-15 can increase the apparent viscosity of the formula (6% bentonite + 0.2‰HV-PAC + 8‰DFD + 3‰LV-CMC) by about 65%, increase the lubricity of the formula by 37% and decrease the surface tension by 42%. At the same time, the performance at low speed is also enhanced, which has little effect on the water loss and makes the mudcake more compact.



THANK YOU!