

THE COMPARISON OF SARALINE, SARAPAR AND DIESEL PERFORMANCES AS BASE OIL AT HIGH TEMPERATURE AND HIGH PRESSURE

ABSTRACT

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The invention of latest and modern technology has leads to the deep water drilling. Deep water drilling required good performance drilling fluid that can withstand high temperature and pressure, therefore oil based-mud (OWB) is preferable in the drilling fluid selections. The purpose of this study is to evaluate the performance of Saraline, Sarapar, and Diesel individually as base oil in High temperature High Pressure (HTHP) condition, based on the fluid loss and the changes of their rheological properties before and after ageing time. A portable HTHP filter press was also used to study the filtrate-loss at pressure differential of 500 psi and temperatures of 250 °F. This experiment showed that, the rheological properties of Sarapar gave better performance compared to Saraline and Diesel, therefore it is the most suitable based oil to be used in formulating drilling fluid for deep water drilling.

Keywords: Saraline, Sarapar, Diesel and Rheological Properties

INTRODUCTION

Drilling fluid are essential part of the drilling process. They are applied mainly to control the downhole formation pressures, transporting the cutting produced from the formation and also acted as lubricant for drill bit and drill string. Besides, they also play an important role in stabilizing the wellbore, allowing free movement during the pipe trip in and trip out process.

Recently, deep water drilling has been emerging as an important drilling activity to all oil and gas companies in order to increase daily crude oil production. Drilling deep-water wells normally associated with HTHP condition. Therefore Oil-Base Mud (OBM) fluid is being chosen as drilling fluid due to its excellent thermal-stability characteristic. Besides

OBM was chosen because it has several advantages over the water based drilling fluid as follow:^{1,2}

- (1) inherent protection against acid gases and corrosion,
- (2) capability of drilling water soluble formation with little or no water washout problem,
- (3) improve lubricity that indirectly assists in drilling deviated or high angle holes and reduced 'stuck pipe' problem, and
- (4) ability drilled in water sensitive shale sections and thus preventing over-gauge hole problem.

Diesel had been widely used as the base oil since the introduction of OBM as drilling fluid for deep water drilling. In early 1980's, many researches^{2,3} on diesel oil as the base oil for drilling fluid. From these researches output showed that diesel is not suitable to be used as base oil due to its high toxicity and aromatic contents exposure to the people and environment. Sarapar and Saraline had been invented to overcome this problem and they are found suitable to be used as base oil for OBM in deep-water drilling.

THEORY OF INVERT EMULSION

Invert emulsion drilling fluid refers to system in which water droplets are uniformly dispersed in a continuous oil phase. The emulsified water droplets act as pseudo solid particles to block the formation pore and reduce filtration loss. In addition these water droplets will assist in support weight material by increasing the viscosity and gel strength of the emulsified system. However excessive water tends to destabilize the invert emulsion system. Hence optimum water content should be for the desired properties of the drilling fluid system.⁴

DRILLING FLUID RHEOLOGICAL PROPERTIES

The rheological behavior is the indication of ability of drilling fluid in (i) hole cleaning and hole erosion, (ii) suspension of drill cutting, (iii) hydraulic calculation, and (iv) requirement of drilling fluid treatment. The rheological properties of drilling fluid are basically represented by plastic viscosity, yield point and gel strength

The yield point is the measured of electrical attractive forces in the drilling fluid system under flowing condition.⁴ No bulk movement of the fluid occurs until the applied stress exceeds the yield point. Plastic viscosity indicates the drilled cuttings suspension and hole cleaning abilities under dynamic condition. It is mainly control by the solid particles inside the drilling fluid. As the drilling process carried on, the plastic viscosity will be increased. This is due to the increase of solid particles.⁴ On the other hand, the fluid thickening effect and suspension capabilities under static condition are controlled by gel strength.

The adjustable and flexibility of the drilling fluid rheological properties plays important role in determined the success of overall drilling operation. In order to obtain

proper function drilling fluid, rheological properties should be continuously measured and modified if necessary.

EXPERIMENTAL PROCEDURE

Different invert emulsion oil base drilling fluid system had been formulated by using Diesel, Saraline and Sarapar oil base. The OBM system was formulated by adding the drilling fluid additives (**table 1**) into the base oil. The based oil was measured and then putting into a suitable size container for mixing process by using Silverson Mixer. Whilst stirring, weighted required amount of primary and secondary emulsifier and added them into the base oil via a syringe. Then lime, brine water, filtrate control agent, oil wetting agent and barite were added into the system sequentially in the interval for two minutes. Finally, the mud system is stirred continuously for another fifteen minutes to complete the mixing process.

Rheometer was used to conduct the rheological properties test for formulated mud system. The rheological properties of the mud are tested before and after ageing time. The ageing process can be conditioned by putting the formulated mud into the hot roller oven for 16 hours at 200⁰C. **Table 2** showed the rheological properties of the mud system.

RESULTS AND DISCUSSION

The typical base oil comparison is shown in table 1. Table 2 and 3 showed the function of the drilling fluid additives and rheological properties respectively, whereas figure 1 showed the filtrate loss of the drilling. The following conclusion could be drawn from the experiment conducted in this study as follow:

- (1) From table 3, after ageing period, the electric stability of drilling fluid increase due to increase of PY for all base oil used for preparing the drilling fluid.
- (2) Table 3 also showed that, the value of plastic viscosity (PY) and yield point (YP) of for Saraline and Diesel before and after ageing is same, whereas the PY and YP value for Sarapar is lower due to the chemical composition. Basically is shorter alkane molekul in Sarapar.
- (3) From the figure 1, after ageing process, the filtrate loss of all mud system increased tremendously at the initial stage due to the mud spurt loss. After certain period, the filtrate loss for all system will become constant. The increased of filtrate loss in all mud system also due to the degrade of rheological properties of the drilling fluid.

Table 1: Base Oil Typical Properties

	Saraline	Sarapar	Diesel	Mineral Oil Advantages
Flash Point, °F	> 85	122	135-145	Improved Safety
Aromatics, WT %	< 0.05	< 0.01	30-60	Less Dermatitis & Rubber Swelling
Benzene, PPM	< 1	< 1	>30	OSHA & CA Prop. 65
Viscosity, cST, 40°F	3-4	2.5	2.8-3.4	Faster Drilling
Specific Gravity, 60/60°F	0.79	0.76	0.865	Low Ppg Mud
Aniline Point, °F Typical	165	169	130-140	Less Rubber Swelling
Pour Point, °F Typical	3	+12	0	Winter Performance

Table 2:Drilling fluid Formulation

Ingredient	Function
Base Oil, mL	
Versamul, ppb	1 st emulsifier
Versacoat, ppb	2 nd emulsifier
Lime, ppb	Producing Alkaline medium
Water, mL	Producing brine water
CaCl ₂ , ppb	
VG 69, ppb	Gel forming agent (viscosities)
Versatrol, ppb	Fluid loss control agent
Versawet, ppb	Oil wetting agent
Barite, ppb	Weighting agent

Table3: Drilling Fluid Properties Before and After ageing at 250 °F / 500 psi for 16 Hours

Mud Oil Typical Property Comparison			
Oil/Water Ratio	90/10		
Mud Properties Before ageing			
Base Oil	Saraline	Sarapar	Diesel
600 rpm	38	35	38
300 rpm	29	29	29
Plastic Viscosity	9	6	9
Yield Point	20	25	20
Gel Strength (10s/10m)	5/15	6/15	6/19
Electric Stability	850	850	900
HTHP@ 250 °F/500psi	1.8	1.6	2.6
Mud Properties after ageing			
600 rpm	42	36	40
300 rpm	30	27	28
Plastic Viscosity	12	9	12
Yield Point	18	18	16
Gel Strength (10s/10m)	7/23	5/21	8/24
Electric Stability	950	915	950
HTHP@ 250 °F/500psi	2.6	2.0	3.7

CONCLUSION

Results showed that Sarapar is the most suitable oil base to be used in formulating drilling fluid. This is due to its non degradable capability in rheological properties in HTHP condition. The aromatic and benzene contents are lower in Sarapar base oil compared with diesel and Saraline base oil. This gives the advantages to Sarapar to be used as base oil as it is environmental friendly.

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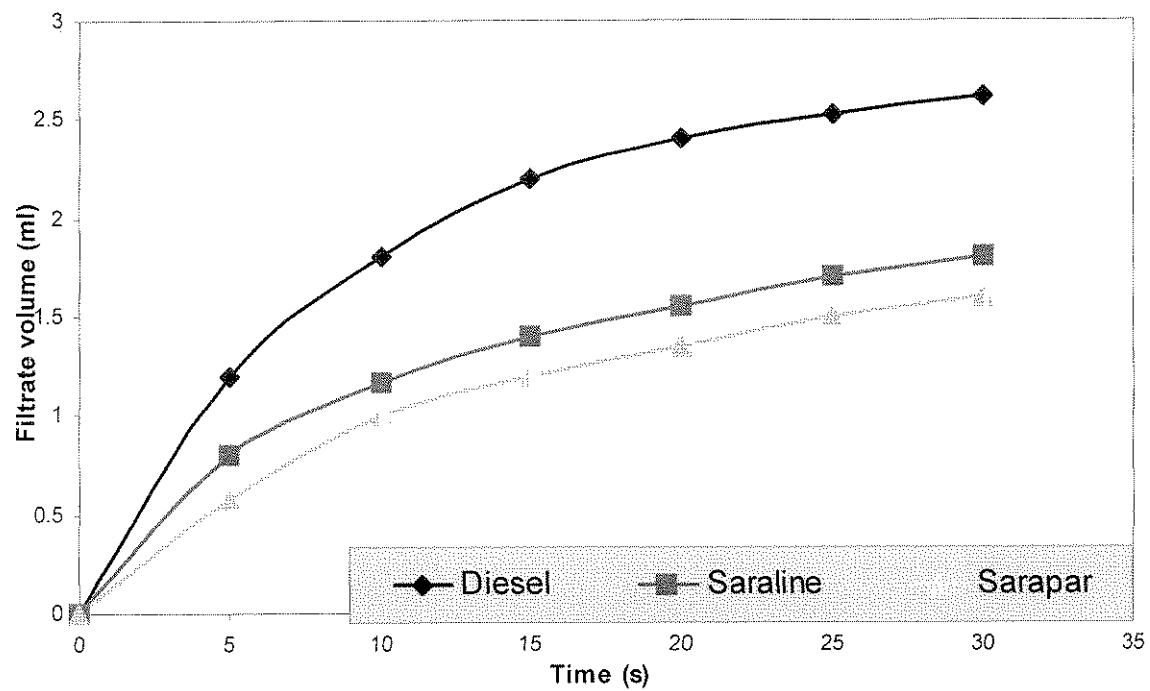


Figure 1: filtrate loss for the base oil before ageing

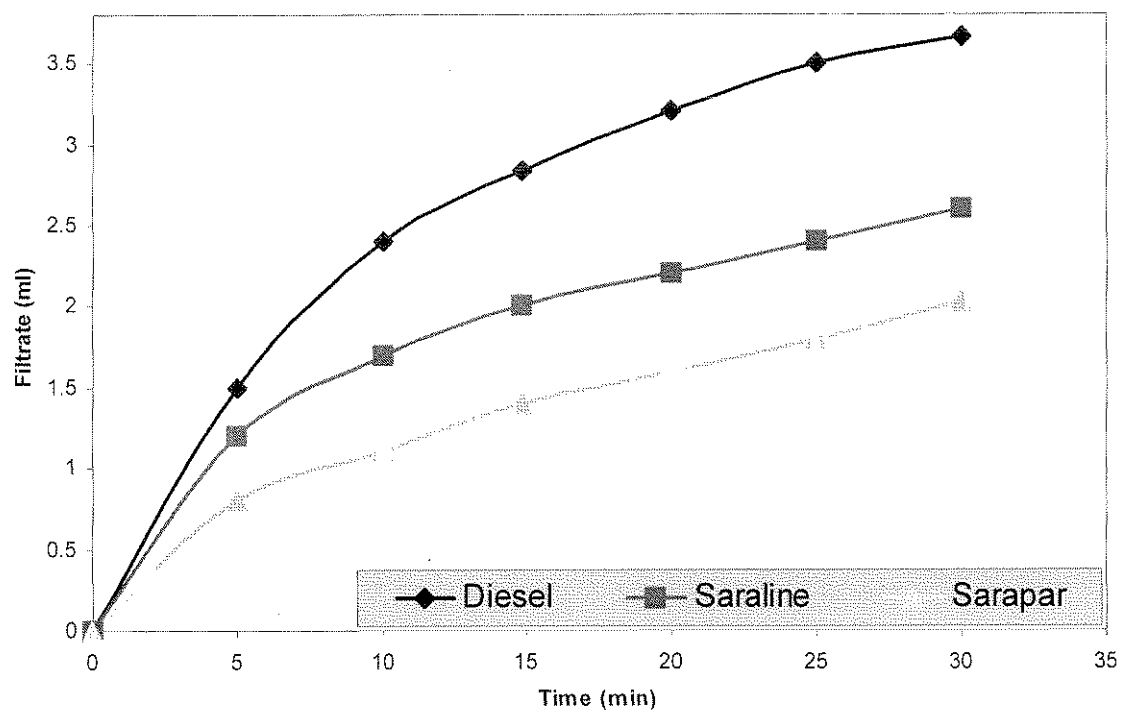


Figure 2: filtrate loss for the base oil after ageing process