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Laboratory Study of Effect Of 1.0mm-Sawdust With Various Types of Viscosifier Additives On Properties of Oil-Based Drilling Mud

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Abstract- Laboratory application of sawdust in oil-based mud was carried out. 1.0mm sawdust sample was used as follow up to earlier experiments. Various viscosifier; bentonite, kaolin and starch were added to the mud samples. Results obtained gave good results for improvement in the density, initial and final gel strength and viscosities of the mud. This proved that sawdust associated with the viscosifier is a good gel and viscosity additives in oil-based mud. The result obtained for the cake formation was not encouraging at 50°C and it was only at 70°C and with the addition of combined kaolin and starch addition that an acceptable mud cake thickness was obtained. Other than this, it is either the mud cake formed is unstable or it is too thick in which either way will result into hole problem during well drilling

.

Index Terms— Sawdust, CO_2 contamination, filtration loss, viscosity, mudcake, oil based mud.

1 INTRODUCTION

Adebayo and Chinonyere in their research concluded that 1.0mm sawdust is the best, among other two sizes, filtrate control agent for a water-based drilling mud [1] and this was applied in this research on oil-based drilling mud.

This research finds application for the wood waste, sawdust and shavings, in drilling mud.

Aged sawdust was used since sawdust contains some amount of phenol in its fresh state but under rain condition or under running water, the phenol would have been leached by the rain [2].

Apart for the investigation of the effect of the sawdust as a possible filtration control additive, further studies were also carried out to investigate the effect of the addition of three types of viscosifier; bentonite, kaolin and corn starch. this is because a drilling mud must, as a necessity, contain a viscosifier.

Viscosifiers were applied because earlier study indicated the need to add viscosifier to mud when sawdust is used as a filtrate control additive in water based mud [1].

The volume of the viscosifier used varies as stated in some earlier studies that more volume of unprocessed kaolin is required as a replacement for equivalent volume of bentonite [5].

2 METHODOLOGY

Aged sawdust was used and this was collected from sawmill and it is a mixture of three most popular west Nigerian woods: mahogany, Ipe and African blackwood. It was sieved and the approximately 1.0mm grade was chosen.

- Fresh oil-based mud sample was prepared with 1.0mm sawdust added to the mud.
- Different samples of the mud were prepared with bentonite, kaolin, starch and mixture of kaolin-starch as viscosifiers in accordance with research by Adebayo [4] [5].
- The densities and pH of various samples were measured.
- Viscosities of the mud were measured together with the gel strength using viscometer.

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- The filtrate and mud cake thickness of the various samples were measured using HPHT filter press.

3 Results

The measurements of the various properties of prepared mud samples obtained were stated in Tables 1 to 5 while the graphical representations are as shown in figures 1 to 7 below.

Figures 1 to 7 below graphically represented the measured and calculated properties of various samples of the oil-based mud with the various viscosifier additives.

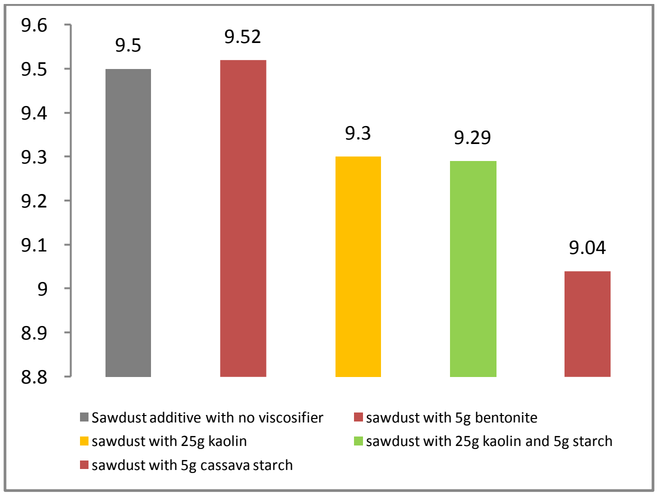


Figure 1: pH measured for various mud samples With Various Viscosifier

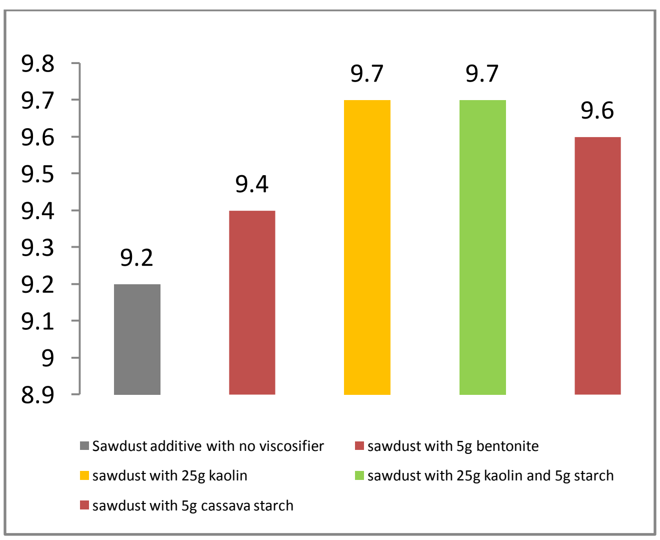


Figure 2: Density of Mud With Various Viscosifier

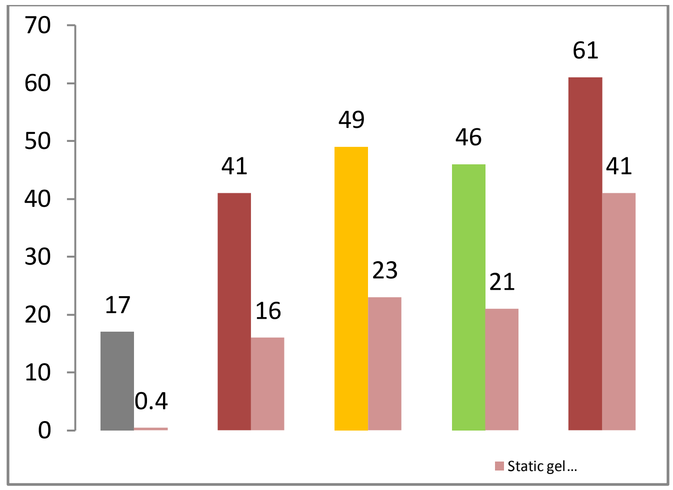


Figure 3: Initial & Final Gel Strengths of Mud With Various Viscosifier Volumes

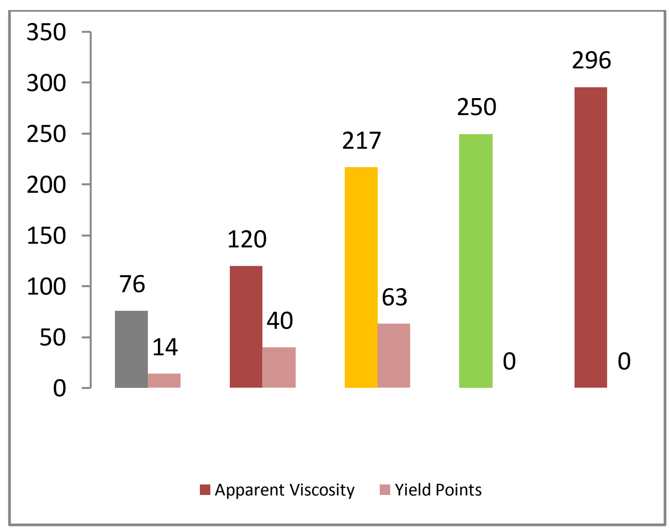


Fig. 4: Apparent Viscosities and Yield Points of Mud With Various Viscosifier

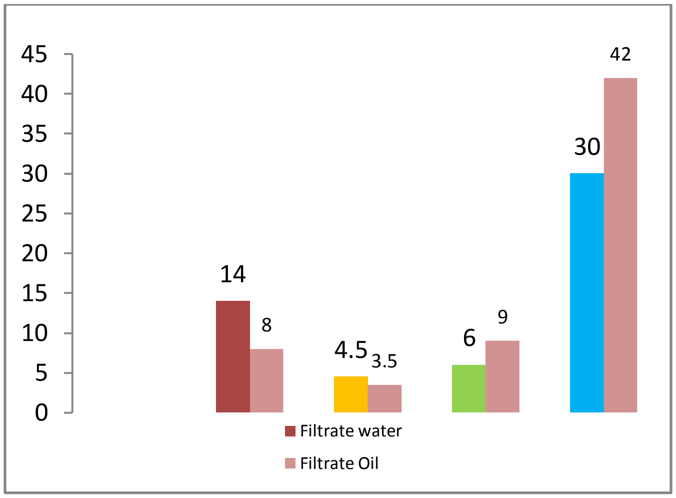


Fig. 5: Filtrates (water and oil) at 50°C Temperature.

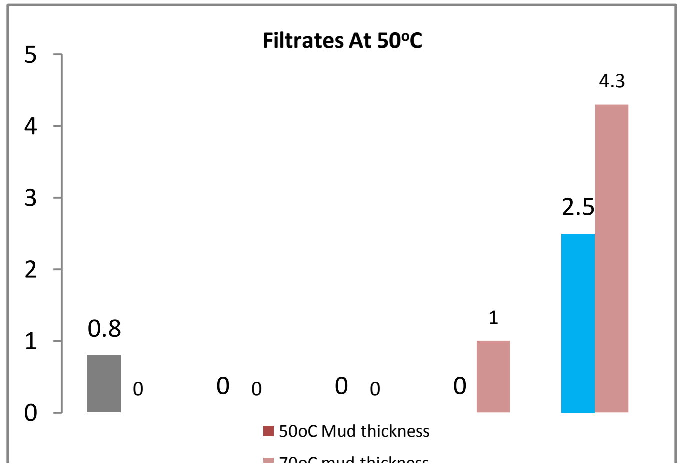


Fig. 7: Mudcake Thickness For Various Sizes of Sawdust

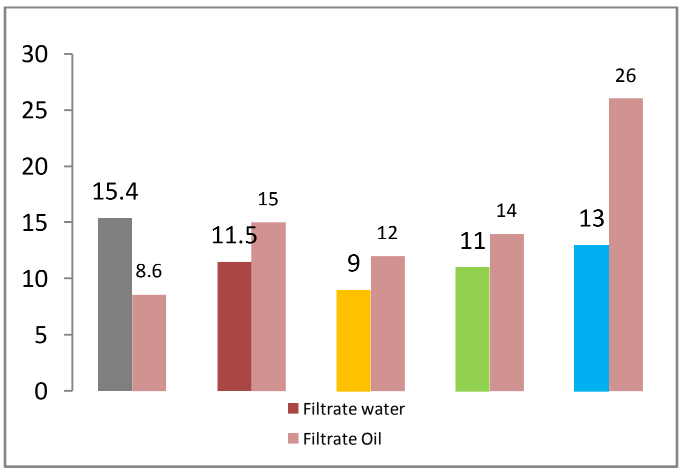
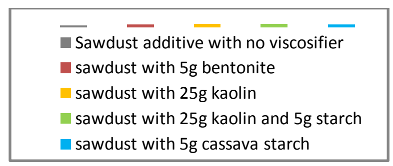


Fig. 6: Filtrates (water and oil) at 70°C Temperature.

Key: Fig. 3 to 7



4 Conclusions

The density graph, fig.2, indicated that addition of viscosifier caused a general increase in the density of the oil based mud. Fig.1 shows that while addition of bentonite caused an increase in the pH of the mud, addition of kaolin made the mud to have lower pH values while the addition of starch caused the greatest reduction in the pH values among the used viscosifier.

The initial and final gel strengths of the mud samples increased with addition of viscosifier. Bentonite caused a 200% increase in the initial gel strength while kaolin gave higher increase and addition of starch gave the greatest increase. Addition of starch to the mud with kaolin caused a depression in the value of the gel strength. the final gel strength followed the same partern as that of the initial gel strength.

Fig. 4 indicated that viscosity of the mud increased with the addition of viscosifier in the order of bentonite, kaolin, kaolin-starch and starch only. This proved that starch is a powerful viscosifier with an increase of almost 290%. The yield point also increased with addition of bentonite and kaolin respectively. The yield point for samples with starch additive was undeterminable with the percentage of oil in the mud sample.

Figs. 5-7 shows the effect of the viscosifier on sawdust filter control mud. At 50oC, samples with kaolin additive gave lower filtrate volume while the one with starch gave excessive filtrates. The filtrate given by sample with kaolin was lowest at 70°C followed by that of bentonite while the starch added sample gave too high filtrate values. The mud cake formed was not good with all the samples at 50°C except with the mud without viscosifier while the one with starch gave excessive cake that could create hole problems. At 70°C, the sample D with kaolin and starch additives gave reasonable mud cake thickness.

References

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APPENDIX

Table 1: pH & Density Readings For Various Mud Samples

	Composition	pH	Density ppg
Sample A	Sawdust additive with no viscosifier	9.5	9.2
Sample B	sawdust with 5g bentonite	9.52	9.4
Sample C	sawdust with 25g kaolin	9.3	9.7
Sample D	sawdust with 25g kaolin and 5g starch	9.29	9.7
Sample E	sawdust with 5g cassava starch	9.04	9.6

Table 2: 10secs & 10mins Gel Strength For Various Samples

	Initial gel strength lb/cu.ft	Final gel strength lb/cu.ft
Sample A	17	0.4
Sample B	41	16
Sample C	49	23
Sample D	46	21
Sample E	61	41

Table 3:Calculated Viscosities & Yield Point Values From Viscometer Reading

Sample	Calculated Values From Viscometer Reading	
	Apparent Viscosity	Yield Point
A	76	14
B	120	40
C	217	63
D	250	unknown
E	296	unknown

Table 4: Filtrates Measurement at 50°C

Sample	Filtration At 50°C	
	water	oil
A		
B	14	8
C	4.5	3.5
D	6	9
E	30	42

Table 5: Filtrates of Samples at 70oC

Sample	Filtrate 70°C	
	water	oil
A	15.4	8.6
B	11.5	15
C	9	12
D	11	14
E	13	26

Table 6: Measured Mud Thickness For Various Samples

Sample	Mud thickness at 50°C	mud thickness at 70°C
A	0.8	nil
B	nil	nil
C	nil	nil
D	mi;	1
E	2.5	4.3

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