

very high plastic viscosity generates higher resistance in mud which in turns will affect cutting lifting performance. Also, a low PV indicates that the mud is capable of drilling rapidly because of the low viscosity of mud exiting at the bit.

3.3.2 Apparent Viscosity

Table 5 below shows the results obtain from the Rheological analysis – Apparent Viscosity, for the formulated mud samples (A and B).

Table 6: Apparent Viscosity of Mud Samples

Sample	Viscosity	10"	10'	Viscosity	Value
Sample A	18	3	9	10	16
Sample B	18.5	4	16	10	17

3.3.3 Gel Strength

Fig 3: Gel Strength of Samples

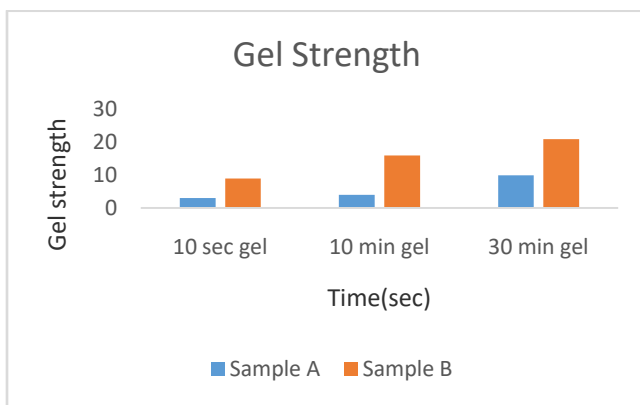


Figure 3 shows the comparison of the Gel Strength property of mud samples A (standard / control mud) to mud sample B (mud with nano particle, SiO₂).

Gel strength measurement was made on viscometer using the 3-rpm reading, which were recorded after stirring the drilling fluid at 600 rpm to break gel. The first reading was noted after the mud is in a static condition for 10 seconds. The second reading and the third reading were after 10 minutes and 30 minutes, respectively. Low gel strength indicates inability to suspend cuttings. It can lead to pipe stuck and hole pack off due to insufficient cutting suspension. From figure 4.8, it can be seen that at 10secs, the nano silica improved the mud gel strength by 53.85%, same as in 10 mins and after 30 mins, the gel strength of the mud was improved by 50%. This implies that with nano silica, the ability of the drilling mud to suspend drill solid and weighting material when circulation is ceased is improved significantly. It is also good to note that excessive gel strength will lead to high pump initiation pressure to break circulation after mud is in a static condition for a period of time. High pump pressure may result in formation fracture and lost circulation, hence optimization is needed here.

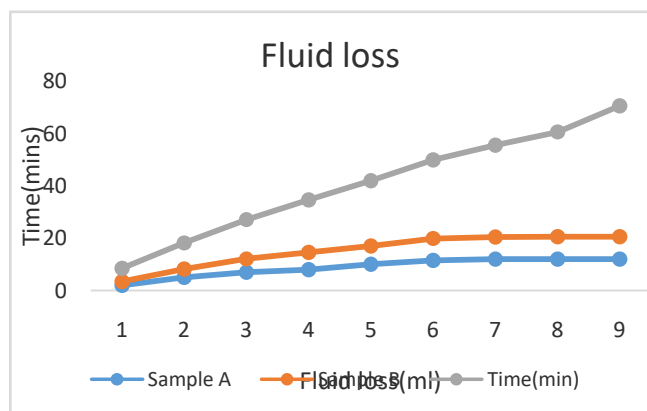
Fluid loss

Table 7 below shows the results obtain from the filtration characterization – Atmospheric HPHT filtration of the formulated mud samples (A and B).

Table 7: Filtrate loss for mud samples

Time(mins)	Sample A	Sample B
5	2	1.45
10	5	3.2
15	7	5.1
20	8	6.6
25	10	7
30	11.5	8.4
35	12	8.5
40	12	8.6
50	12	8.6

As nano silica improves mud viscosity and density, it also reduces fluid loss. At 5 mins, the fluid loss is reduced by 27.5%, at 10 mins there was fluid loss reduction of 36%, at 15 mins, there was 27.14% reduction in fluid loss, at 20 mins, there was 17.5% reduction in fluid loss, at 25 mins, there was 42.9% reduction in fluid loss, at 30 mins, there was 27% reduction in fluid loss, at 35 mins, there was a 29.2% reduction in fluid loss. At 40 and 50 mins, there were 28.3% reduction in fluid loss. Fluid loss prevention is a key performance attribute of drilling fluids. For water-based drilling fluids, significant loss of water or fluid from the drilling fluid into the formation can cause irreversible change in the drilling fluid properties, such as density and rheology occasioning instability of the borehole.



CONCLUSION:

Deeper holes are being drilled more frequently and high temperature holes are becoming a big problem because of the tendency of drilling mud to degrade, thus affecting cuttings transport performance. There are numerous findings on the benefit of using nanomaterials in drilling mud for high temperature environments, this study complements the existing literature by investigating the effect of nanosilica in water-based mud in a laboratory study. The laboratory study was divided into four parts: rheological determination, fluid loss test, sand content determination, and density determination. All these studies were conducted using water-based mud with and without silica nanoparticles. In the course of the study, the rheological, fluid loss properties, the rheological behaviour of the mud, and the cuttings transportation efficiency were directly and indirectly ascertained.

5. ACKNOWLEDGEMENTS:

My profound gratitude goes to God Almighty for without his grace I would have not been able to come this far.

I am so grateful to my project supervisors, Engr. K. K. Dune and Dr. F. O. Wopara. My special gratitude to the Head of Department of Petroleum Engineering, Dr. A. S. Nwosi-Anele; all of the staff; and Mrs. Harmony, the head of Petroleum Engineering laboratory, where this research work was carried out.

My gratitude and appreciation also goes to my dear parents, Sir and Mrs. Fonssouo, who gave me life and support me to scale through my academic huddles. I also want to show a special gratitude to my elder sister, Mrs. Sorelle Fonssouo Mogo, who always gives me advice and financial supports to achieve this work.

I also thank my siblings, Fonssouo Achille, Fonssouo Ghislain, Fonssouo Armand, Fonssouo Estelle, and Fonssouo Maella, who are the strengths pushing me forward. I also thank my course mates Kale Vipene, Ezemdi Emmanuel, Timmibra Sammy, and Takon Njar, for keeping up an excellent, friendly, and motivational learning environment.

I can't finish this acknowledgement without being grateful to my son, Fonssouo Pelap Mike, who changed my life and brought into more reasons to achieve this work and motivation to succeed in this life. I hope this work will serve as an example and allow him to understand that knowledge is irreplaceable in life.

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