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Environmentally Friendly Fluid loss Control Agent in Water-Based Mud for Oil and Gas Drilling Operations

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Abstract

The fluid loss properties of mud formulated with concentrations of coconut shell and/or corncobs was studied. This study is focused on formulating water based drilling mud using corn cobs and coconut shell as additives in improving the performance of the mud. The additives were varied in different concentrations and its impact were evaluated on the filtration properties using low pressure low temperature (LPLT) filter press at 90 °C and 100 psi. The result of the formulated mud with corn cobs and coconut shell additives were compared to that of the mud containing corn cobs alone, coconut shell alone, and without any of the additives. The results showed that the combination of corn cobs and coconut shell reveals a lower filtrate volume than individual coconut shell and corncobs. However, Corn cobs is a better fluid loss control agent than the coconut shell.

Keywords: Fluid loss, water based mud, Corn cobs additive, Coconut shell additive

INTRODUCTION

The concern for the environmental safety and environmental regulations is on an increasing demand on the oil and gas drilling industry The petroleum industry is encouraging research on drilling fluids and its additives such as non-toxic viscosity reducers and fluid loss control additives in drilling mud (Dosunmu & Joshua, 2010). The exploration and exploitation of hydrocarbon on offshore and onshore environment suggest the use of environmentally friendly drilling mud and its additives thereby preventing destruction of aquatic bodies such as the fishes, coastal areas and the oceans etc. and also the terrestrial environment such as the pollution of plants. Environmental regulations encourages the use of water based drilling fluid and its application in areas where oil based drilling fluids have previously been used due to their challenges (Tehrani et al., 2009). In many countries engaging in offshore oil and gas exploration and production, the performance of toxicity test on drilling fluid additives and whole drilling mud is required before they can be disposed (Neff et al, 2000).

The technical performance of drilling fluid cannot be over-looked, however, the environmental impact of this mud and its additives plays an important role as it determines the application of the mud. It is important to verify the technical and environmental standard of mud additives before they are been applied (Mohammed Amanullah & Yu, 2005). Researches have been conducted on the use of fluid loss control additives to minimize the volume of fluid loss that sips into the formation during drilling (Olatunde et al., 2012; Omotioma et al., 2015). Samavati et al. (2014) modified *fufu* for an efficient fluid loss control agent using hydrochloric acid. The higher the fluid loss into the formation, the tendency for pipe to get stuck as a result of the cakes deposition on the wall of the wellbore. The performance of water base mud needs to be enhanced by using mud additives that are environmentally friendly and can technically perform, modified starch is used at depths equivalent to 150 ° C below bottom hole temperature (Md Amanullah, 1993).

Drilling fluids have several functions been determined by the additives added to the mud. Soaps, detergents, fatty acids, alcohols, graphite, and gilsonites etc are currently been modified and used to replace diesel which is not environmentally friendly (Kercheville et al., 1986). The major function of drilling fluid are to: cool and lubricate the bit and drill string; clean the hole bottom; carry cuttings to the surface; remove cuttings from mud at the surface; minimize formation damage; control formation pressures; maintain hole integrity; assist in well logging operations; minimize corrosion of the drill string, casing, and that of the tubing; minimize torque, drag, pipe-sticking and contamination problems; and also to improve drilling rate in the wellbore (Adams & Charrier, 1985).

The base fluid is important in determining the properties of a drilling mud but more importantly, it acts as a carrier for mud additives which are the final determinants of the muds properties. Additives are used in drilling fluids during formulation to achieve several purpose such as the viscosity control, weighting control additives, rheology control additives, emulsifiers, pH control additives, and filtration control additives. The filtrate of a drilling fluid refers to that liquid portion of the system that is driven through the filter cake and into the formation as a result of the difference between the hydrostatic pressure of the mud column and the formation pressure. Filtration control additives reduce the amount of fluid lost into the formation during drilling. Bentonite, various manufactured polymers, starches, and thinners or deflocculants

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all function as filtration-control agents. Examples of filtration additives that have gain efficiency are starch, guar gum, polysacchsrides, acrylic polymers, and organic thinners etc. (Adams & Charrier, 1985).

Due to the high environmental demands on the oil and gas industry in preventing the destruction of the marine resources and costal habitat, the need for environmentally friendly mud additives became a priority. This has made the manufacturing of chemicals and mud additives very important by using local materials which are been disposed.

This research work is aimed at investigating the effect of locally sourced biodegradable and environmentally friendly materials usually not exploited for industrial purposes, such as the corn cobs obtained from *Zea mays* and coconut shell from *Cocos nucifera* on the rheological properties which determines the performance of drilling mud. As the demand for oil and gas increases, so does the need for economic techniques to recover these resources. Therefore, there is a need to conduct research on environmentally friendly, cost effective, and technologically acceptable materials that could be used in enhancing the performance of drilling mud.

MATERIALS AND METHODS

The equipment used in this work includes the mud balance, rotary viscometer, agitator, spatula, weighing balance, wash bottle, measuring cylinder, beaker, stop watch, mixer, grinding machine, pH meter and low pressure low temperature (LPLT) filter press. The raw materials used are bentonite, barite, water, corn cobs and coconut shell.

Experimental Procedure

The corn cobs and coconut shell were prepared according to the method adopted by (Akpan et al., 2006). They were sourced, cleaned, dried, and grinded using a grinding machine. The raw materials used in the mud formulation were measured using the graduated cylinder and electronic balance. The mud samples were formulated without corncobs and coconut shell, in the presence of coconut shell alone, presence of corn cobs alone, and combination of the corn cobs and coconut shell. The raw materials were measured and added one after the other in intervals of 5 minute into a steel cup, and properly mixed using the Hamilton Beach Mixer containing 350 ml of water measured using the measuring cylinder. The mixer is been powered to rotate while mixing the mud samples for 30 minutes until homogeneous mixture is achieved. The first experiment was performed without the corn cobs and coconut shell inorder to properly compare and analyze the effect of the coconut shell and/or corn cobs. Further experiment were conducted in the presence of the coconut shell and/or the corn cobs in different concentrations of 2 g, 4 g, 6 g, 8 g, and 10 g. The mud balance was used to measure the density of the mud, and the LPLT Filter Press after being pressurized, fitted with a filter medium was used to measure the fluid loss i.e. the filtrate volume from the drilling fluid .

Formulation of mud sample

Mud samples without coconut shell and corn cobs (MWTCSCC)

Mud samples with corn cobs (MWCC)

Mud sample with coconut shell (MWCS)

Mud samples with combination of coconut shell and corn cobs (MWCSCC)

Table 1: Concentration of Mud Samples

Mud samples	MWTCSCC	MWCC	MWCS	MWCSCC
Bentonite (g)	20	20	20	20
Barite (g)	80	80	80	80
Water (ml)	350	350	350	350
Corn cobs (g)	NIL	2, 4, 6, 8, 10	NIL	NIL
Coconut shell (g)	NIL	NIL	2, 4, 6, 8, 10	NIL
Corn cobs and coconut shell (g)	NIL	NIL	NIL	2, 4, 6, 8, 10

Table 1 shows the sample materials used in formulating the mud samples without corn cobs and coconut shell, with corn cobs alone, coconut shell alone, and with combination of corn cobs and coconut shell. It can be seen from the table that samples with corn cobs alone, coconut shell alone, and combination of corncobs and coconut shell were varied in concentrations of 2 to 10 g. This is used to compare and investigate what impact corn cobs and/or coconut shell will have on the filtration properties of the water base mud.

RESULTS AND ANALYSIS

The impact of corn cobs and coconut shell applied as a fluid loss control agent in mitigating the filtration properties of water base mud in different concentrations was investigated at 90 °C and 100 psi. The result of the filtrate volume was measured to determine the most efficient fluid loss control agent between the corncobs and coconut shell.

Experimental Result

Mud Samples without Coconut shell and Corn cobs (MWTCSCC)

Table 2: Properties of Mud Samples

Physical properties	Value
pH	10
Mud density (ppg)	8.7
Fluid loss (ml)	27

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Mud Samples with Corn cobs (MWCC)

Table 3: Properties of Mud Samples

Physical properties	Concentration of Corn cobs				
	2 g	**4 g**	**6 g**	**8 g**	**10 g**
pH	10	10	9	9	9
Mud density (ppg)	8.5	8.6	8.7	8.8	8.9
Fluid loss (ml)	22	21	20	19	18

Mud Sample with Coconut Shell (MWCS)

Table 4: Properties of the Mud Samples

Physical properties	Concentration of Coconut Shell				
	2 g	**4 g**	**6 g**	**8 g**	**10 g**
pH	10	10	10	10	9
Mud density (ppg)	8.76	8.81	8.92	9.0	9.18
Fluid loss (ml)	24	23	22	21	20

Mud Samples with Combination of Coconut Shell and Corn cobs (MWCSCC)

Table 5: Properties of the Mud Samples

Physical properties	Concentration of combined Coconut shell and Corn Cobs				
	2 g	**4 g**	**6 g**	**8 g**	**10 g**
pH	10	9	9	9	9
Mud density (ppg)	9.6	9.43	9.21	9.43	9.6
Fluid loss (ml)	20	19	18	17	16

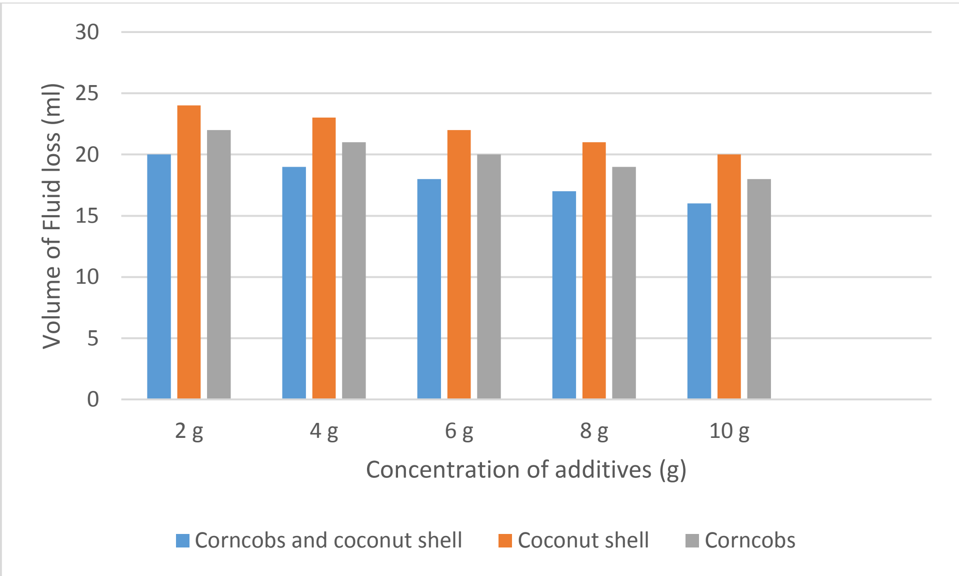

Figure 1: Effect of Additives on the Fluid Loss

DISCUSSION OF RESULTS

Table 2, 3, 4, 5 shows a laboratory measurement of the mud properties from mud formulated without the coconut shell and corn cobs, with corncobs, coconut shell, combination of coconut shell and corncobs respectively. The pH values are determined using a pH meter, mud densities are determined using mud balance, and fluid loss are measured using LPLT filter press.

There is a decrease in the pH values with increase in the concentration of corncobs alone, coconut shell, combination of coconut shell and corncobs. Increase in concentration of corncobs, coconut shell leads to a proportional increase in the density of the mud while a decrease of mud density is observed in the presence of the combination of coconut shell and corncobs. The coconut shell increases the mud density more than that of the corncobs. The filtrate volume is higher in the mud samples without any local material than with the local materials

Figure 1 shows the effect of the local materials on fluid loss of the water based mud. The combination of coconut shell and corncobs reveals a better fluid loss than coconut shell alone or corncobs alone, but corncobs shows a lower fluid loss than the coconut shell.

CONCLUSION/CONTRIBUTION TO KNOWLEDGE

The following conclusions are drawn from the analysis made from the experimental result:

1. The local material is a potential pH modifier
2. Corn cobs is a better fluid loss control agent than coconut shell but the combination of coconut shell and corncobs yield a better result.

REFERENCES

[1] Adams, N. J., & Charrier, T. (1985). *Drilling engineering: A complete well planning approach*. (T. Charrier, Ed.). Oklahoma: Penn Well Publishing Company Tulsa, Oklahoma.

[2] Akpan, U. G., Jimoh, A., & Mohammed, A. D. (2006). Extraction and characterization of castor seed oil. *Leonard Journal of Sciences*, (8), 43–52.

[3] Amanullah, M. (1993). *Shale drilling mud interraction*. University of London.

[4] Amanullah, M., & Yu, L. (2005). Environment Friendly Fluid Loss Additives to Protect the Marine Environment from the Detrimental Effect of Mud Additives. *Journal of Petroleum Science and Engineering*, *48*, 199–208.

[5] Dosunmu, A., & Joshua, O. (2010). Development of environmentally friendly oil based mud using Palm-oil and groundnut-oil. In *34th Annual SPE International Conference and Exhibition* (pp. 1–9). Calabar: Society of Petroleum Engineers.

[6] Kercheville, J. D., Hinds, A. A., Clements, W. R., & Baroid, N. L. (1986). Comparison of environmentally acceptable materials with diesel oil for drilling mud lubricity and spotting fluid formulations, IADC/SPE 14797. In *IADC/SPE Drilling Conference* (pp. 1–5). Dallas: IADC/SPE Drilling Conference.

[7] Neff, J. M., McKelvie, S., & Ayers, R. C. J. (2000). *Environmental impacts of synthetic based drilling fluids*. *U.S. Department of the interior minerals managment service*. Houston, Texas.

[8] Olatunde, A. O., Usman, M. A., Olafadehan, O. A., Adeosun, T. A., & Ufot, O. E. (2012). Improvement of rheological properties of drilling fluid using locally based materials. *Petroleum & Coal*, *54*(1), 65–75.

[9] Omotioma, M., Ejikeme, P. C. N., & Ume, J. I. (2015). Improving the rheological properties of water based mud with the addition of cassava starch. *IOSR Journal of Applied Chemistry*, *8*(8), 70–73.

[10] Samavati, R., Abdullah, N., Tahmasbi, N. K., Hussain, S. A., & Awang, B. D. R. (2014). Rheological and fluid loss properties of water based drilling mud containing HCl-modified fufu as a fluid loss control agent. *International Journal of Chemical Engineering and Applications*, *5*(6), 446–450.

[11] Tehrani, A., Gerrard, D., Young, S., & Fernandez, J. (2009). Environmentally friendly water-based fluid for HPHT drilling. In *SPE International Symposium on Oilfield Chemistry* (pp. 1–8). Texas: Society of Petroleum Engineers.