International Journal of Research
Available at https://edupediapublications.org/journals
p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 04 Issue 05
April 2017

Effect of Adding Fly Ash Replacing Bentonite with Other Additives (Barites, Starch, Carboxymethyl Cellulose (CMC)) On Mud Rhelogy

Dr.Rajesh Kanna[1,$]; Shaik Abdul Waheed[2]; Syed Mansoor Ali[2]; Mohammed Ayaz[2]; Shaik Abdul Wahed[2] & M.Nishanth[3]

[1,$]Professor & HOD, Department of Petroleum Engineering, LORDS Institute of Engineering & Technology, Hyderabad, India.
[2] Undergraduate students, Department of Petroleum Engineering, LORDS Institute of Engineering & Technology, Hyderabad, India.
[3]Assistant Professor, Department of Petroleum Engineering, LORDS Institute of Engineering & Technology, Hyderabad, India.
[$] Corresponding Author Email: rajeshkanna@lords.ac.in

Abstract :- *Good formulations of drilling fluid properties are required in drilling operations. Selection of suitable drilling fluid additives are important criterion in formulating drilling fluid. Investigation on rheological and viscosity, mud weight, sand content, fluid loss properties of water based drilling mud containing barite, cmc, flyash, starch is presented 3%, 5%, and 8% used, aiming at improving performance as a fluid loss agent under extreme drilling.*
Keywords: - Mud Rheology, Viscosity, Mud weight, Loss of fluid, Sand content.(barite, flyash, cmc, starch)

I. INTRODUCTION

Rheology refers to the deformation and flow behavior of all forms of matter. Certain rheologic measurements made on fluids, such as viscosity, gel strength, etc. help determine how this fluid will flow under a variety of different conditions. This information is important in the design of circulating systems required to accomplish certain desired objectives in drilling fluid. Drilling fluid or drilling mud is a component which was initially used to circulate cuttings from the borehole to the surface. Other functions of drilling fluid are maintain wellbore stability, prevent formation fluids flowing into the wellbore, and control formation pressure [1]. The viscosity: The viscosity of a fluid is a measure of its resistance to gradual deformation by shear stress or stress. For liquids, it corresponds to the informal concept of "thickness"; for example, honey has a much higher viscosity than water. Viscosity is a property of the fluid which opposes the relative motion between the two surfaces of the fluid in a fluid that are moving at different velocities. When the fluid is forced through a tube, the particles which compose the fluid generally move more quickly near the tube's axis and more slowly near its walls; therefore some stress is needed to overcome the friction between particle layers to keep the fluid moving. For a given velocity pattern, the stress required is proportional to the fluid's viscosity. A fluid that has no resistance to shear stress is known as an *ideal* or *in viscid* fluid. Zero viscosity is observed only at very in super fluids. Otherwise, all fluids have positive viscosity, and are technically said to be viscous or viscid. In common parlance, however, a liquid is said to be *viscous* if its viscosity is substantially greater than that of water, and may be described as *mobile* if the viscosity is noticeably less than water. A fluid with a relatively high viscosity, such as pitch, may appear to be a solid. The API fluid loss test is used only with Water Based Mud's. The test is used to determine the static filtration characteristics of the mud and

the need for treatment with fluid loss additives. Fluid loss must be maintained within the programmed specification to limit potential for differential sticking and formation damage in the reservoir. Filter cake thickness is also measured and must never exceed 2 mm. Filtrate collected during the course of this test is used for subsequent chemical analysis.

EQUIPMENTS ARE USING:

- Mud balance equipment
- Marsh funnel viscometer
- Ford Cup viscometer
- Filtration and filter cake equipment
- Filter press (API) Standard

1. Mud Weight and Its Importance in Drilling

Mud weight or mud density is a weight of mud per unit volume. It is one of the most important drilling fluid properties because it controls formation pressure and it also helps wellbore stability. Mud weight is measured and reported in pounds per gallon (PPG), pounds per cubic feet (lb/ft^3), or grams per milliliter (b/ml).
Mud weight is normally measured by a conventional mud balance; however, if you have some air inside a fluid phase, reading from the conventional mud balance will give you an inaccurate number. Therefore, the most accurate method to measure the mud weight is with a pressurized mud balance.

Fig.1: Mud balance equipment

The pressurized mud balance looks like the convention one, but it has a pressurized sample cup. When you press a mud sample into the cup, any gas in a fluid phase is compressed to a very small volume so the mud weight measurement is more accurate.

2. Marsh Funnel Viscometer

The marsh funnel viscometer is a rugged, easy to operate instrument that is used for making rapid, on the spot measurements of drilling mud viscosity. Marsh funnel readings are only general measurements, but the frequent reporting of the marsh funnel viscosity will alert the mud engineer to sudden changes in the mud viscosity that could require corrective action. The marsh funnel Viscosity is the ratios of the speed of the mud as it passes through the outlet tube (the shear rate) to the amount of force — the weight of the mud itself, which is causing the mud to flow (the shear stress). Marsh funnel viscosity is reported as the number of seconds required for one quart of mud to flow out of a full marsh funnel.

Fig.2: Marsh funnel viscometer

3. Ford Cup Viscometer

When measuring the viscosity of paint or ink, the cup type viscometer as shown in figure 5 is sometimes used. The same method is also employed for adjusting the viscosity of coating applied to automobile exteriors using an electrostatic atomization paint sprayer.

As shown in the figure, the cup type viscometer measures the time it takes for a sample filled in a cup of a specific capacity to outflow from the orifice of the cup. The Ford Cup Viscometer is a typical cup type viscometer.

Normally, the time the sample takes to outflow from the orifice is measured using a stopwatch. However, the digital Ford Cup Viscometer detects the outflow of the sample with an optical sensor, automatically calculates the time necessary to finish continuous outflow, and digitally indicates it by 0.01 seconds.

Like the capillary and falling-ball viscometers, the cup type viscometer is not suited for a continuous measurement of viscosity because data as an electronic signal is difficult to obtain in the measurement.

Fig.3: The Ford Cup Viscometer

4. Filtration and filter cake

Filter press is simply a kind of machine, which performs Filtration & separation during its Press operation.

A filter press consists of a series of chambers containing square or rectangular filter plates supported in a frame. Once the filter chambers are loaded with slurry, the plates are forced together with hydraulic rams that generate pressures typically in the region of 100 pounds per square inch (70,000kg per m2). For comparison, a car tyre would be inflated to around 30 pounds per square inch.

Each plate is covered by a material or membrane that acts as the initial filter when the press is in operation. As the solid filter cake builds up, the cake adds to the removal of fine particles. The solution coming through the filter, called the filtrate, will be very pure. If it is not wanted the filtrate can be drained away for safe disposal.

Fig.3: The Filter Press

5. FILTER PRESS (API)

The most effective means of determining the filtration properties of drilling muds and cement slurries
The Series 300 API Low Pressure Low Temperature (LPLT) Filter Press consists of a mud reservoir mounted in a frame, a pressure source, a filtering medium, and a graduated cylinder for receiving and measuring filtrate. The basic unit has a cell assembly constructed of Stainless Steel and includes the required screen and gaskets.
Working pressure is 100 psig and the filtering area is 7.1-in^2, as specified in the American Petroleum Institute, *AP*

Fig.5: Filter Press (API)

MATERIAL REQUIRMENT:

1. Barites:
Barite Powder. Baryte or Barite (BaSO4) is a mineral consisting of "Barium Sulfate. Some 84% worldwide is used as a weighting agent for drilling fluids in oil and gas exploration.

p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 04 Issue 05
April 2017

Fig.6: Barite Powder

2. Fly Ash:

Fly ash could be an expensive replacement for portland cement in concrete and using it, improver strength, segregation and ease of pumping concrete,

The rate of substitution typically specified is a minimum of 1 to 1 ½ pounds of fly ash to 1 pound of cement

Fly Ash particles provide a greater workability of the powder portion of the concrete mixture which results in greater workability of the concrete and a lowering of water requirement for the same concrete consistency.

Fig.7: Fly Ash

3. Starch

Pregelatinised Oil Drilling Starch is used for reducing fluid loss in a variety of water based drilling fluids and has beneficial secondary effects on mud rheology.The most important physical characteristics of the drilling fluid are the viscosity and the water holding/retaining characteristics.

It is highly effective in all waters including high salinity and high hardness brines. It works well in all water including fresh water, highly saline water, and hard water and can be used effectively in most mud systems. It reduces fluid Loss and increases viscosity.

Fig.8: Starch

4. **Carboxymethyl cellulose (CMC):**

Four carboxymethyl cellulose (CMC) polymers were characterized by molecular weight, degree of substitution, and intrinsic viscosity. These polymers were used to make simple water-based muds with various polymer and bentonite contents. API fluid loss and high shear viscosity were determined for each mud.

Fig.9: Carboxymethyl cellulose (CMC) Powder

Fluid loss is independent of polymer molecular weight at low ionic strength. The high shear viscosity of muds and polymer solutions is related to the product of the intrinsic viscosity of the polymer and its concentration.

II. PROCEDURE

Experimental Procedure:

1. Mud Weight

To find mud weight of any fluid the mud balance can be used keep the scale on the fulcrum with the help of knife edge now fill the cup with fluid and place the lid on it so that extra fluid flow out of the cup move the rider according water bubble so the it comes in center now note the readings of the rider

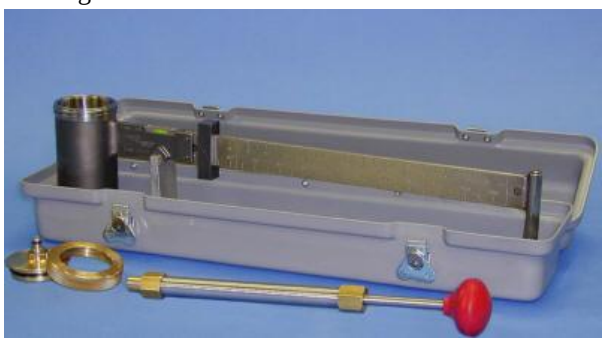

Fig.10: Mud Balance

2. Viscosity

To measure the viscosity we have two methods 1 is marsh funnel for higher quantity and method 2 Ford cup for low quantity up to 100ml in the work we have used viscosity cup method for 100ml.prepare the sample as required and pour the fluid in the cup by closing its hole which is present at the bottom of the cup with the finger .now remove the finger and start the stopwatch and note the time required to empty the cup

Fig.11: Ford Cup Viscometer

3. Mud Filtration and filter cake

STEPS INVOLVED IN FILTER PRESS PROCESSES ARE AS FOLLOWED:-

- CLOSING OF THE PRESS
  As the filter is completely empty, the moving head is activated by the jacks that clamps the plates. The closing pressure is self-regulated through the filtration.
- FILLING
  During this short phase, the chamber is filled with the sludge or slurry to be filtered. The filling time depends on the flow of the feed pump. For sludge of good filterability, it is best to fill the filter quickly to avoid caking in the first chamber before the last ones are filled.
- FILTRATION
  Once the chambers are filled, further input of sludge increases the pressure from the increasingly thicker layer of filtered sludge on the cloths. The filtration can then be stopped manually, by a timer, or, more conveniently by a filtrate flow indicator automatically when no more filtrate is passing through.
- FILTER OPENING
  The moving head is drawn back to disengage the first filtration chamber. The cake is released by its own weight. A mechanized system pulls out the plates one by one, the speed of which can be adjusted for the cake texture.
- WASHING
  Washing the cloth should be done every 15-30 runs. For mid or large units, this can be done on the press itself using high pressure water sprays (80-100 bar). However, the washing requirements will depend on the type of sludge.

p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 04 Issue 05
April 2017



Fig.12: Filter Press Fig.13: Loss of fluid reading Fig.14: Membrane filter cake

2. **Filter Press (API)**

The API fluid loss test is used only with Water Based Muds. The test is used to determine the static filtration characteristics of the mud and the need for treatment with fluid loss additives.Fluid loss must be maintained within the programmed specification to limit potential for differential sticking and formation damage in the reservoir.

Fig.15: Filter cake thickness is also measured and must never exceed 2 mm.

International Journal of Research
Available at https://edupediapublications.org/journals
p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 04 Issue 05
April 2017

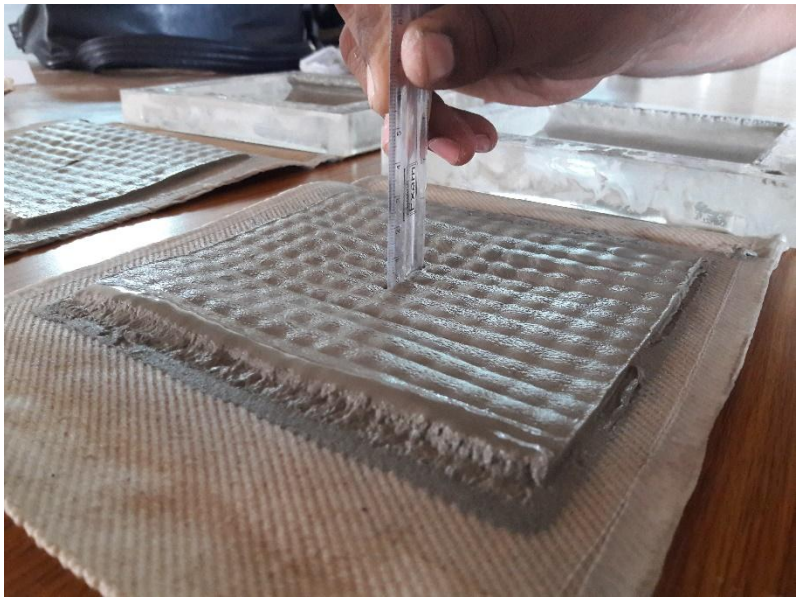

Fig.16: Filtrate collected during the course of this test is used for subsequent chemical analysis.

III. RESULTS

As we got the result of mud rheology

By using material fly ash, starch, cmc, barites in an equipments are marsh funnel, ford cup viscometer, sand kit, and mud balance we get the results as viscosity, mud weight and sand content.

3% With100ml of water 5% With 100ml of water 8% With 100ml of water

Material	**Sample 1**	**Sample 2**	**Sample 3**
Water	**100ml**	**100ml**	**100ml**
Flyash	**0.3gm**	**0.3gm**	**0.3gm**
Barite	**0.5gm**	**0.8gm**	**2.0gm**
CMC	**0.3gm**	**0.3gm**	**0.8gm**
Starch	**0.4gm**	**0.4gm**	**0.9gm**

Results:

	3% With100ml of water	5% With 100ml of water	8% With 100ml of water
Viscosity (time in sec)	**4.84**	**13.86**	**40.56**
Mud weight	**1.10**	**2.68**	**3.38**
Sand Content	**2ml**	**2.3ml**	**5ml**

After conducting the lab test the loss of fluid, thickness, and weight as we got the best result that

With respect to Fly ash = 500 gms, Barites = 500 gms , CMC = 300 gms, Starch = 400 gms, and Water = 20 liters

Time in sec	Height	Pressure
0	**0**	**2.1**
30 sec	**0**	**2.1**
60 sec	**0**	**2.1**
120 sec	**0**	**2.1**
150 sec	**2.5**	**2.1**
210 sec	**3**	**2.1**
378 sec	**5**	**2.1**
504 sec	**6.5**	**2.1**
690 sec	**7.5**	**2.1**

Results:

Thickness	**Membrane:1** **0.3 mm**	**Membrane:2** **0.2**	**Membrane:2** **0.1**
Weight	**233gms**	**200gms**	**167gms**

With respect to Bentonite = 500 gms, Barites = 500 gms, Distilled water = 20 liters

Time in sec	Height (water level)	Pressure
0	0	2.1
60 sec	7	2.1
90 sec	13.3	2.1
180 sec	17.5	2.1
210 sec	22.8	2.1
240 sec	27	2.1
270 sec	28.5	2.1
300 sec	31.5	2.1

Results:

Thickness	Membrane:1 0.2 mm	Membrane:2 0.1 mm
Weight	196gms	163gms

VI. CONCLUSION

The API fluid loss test is used with Water Based Mud's. The test is used to determine the static filtration characteristics of the mud and the need for treatment with fluid loss additives.

Fluid loss must be maintained within the programmed specification to limit potential for differential sticking and formation damage in the reservoir.

Filter cake thickness is also measured and must never exceed 2 mm.

We got very best result the cake thickness is 0.3 mm and 0.2 mm.

VII. REFERENCE

[1] A. P. Tchameni, Lin Zhao, effectiveness of waste vegetable oil biodiesel and soybean oil biodiesel and additive in water based mud system, Asian Transactions on Engineering, 2221-4267.

[2] Okorie E. Agwu, Anietie N. Okon, A Comparative Study of Diesel Oil and Soybean Oil as Oil-Based Drilling Mud: Hindawi Publishing Corporation Journal of Petroleum Engineering, 828451,2015

[3] Abdul Razak Ismail ,NurulJannah Ismail , The Application of Biodiesel as an Environmental Friendly Drilling Fluid to Drill Oil and Gas Wells: proceedings of The 5th Sriwijaya International Seminar on Energy and Environmental Science & Technology, 2014

[4] Anawe Paul A.L, Efeovbokhan, Vincent E, Investigating Alternatives To Diesel In Oil Based Drilling Mud Formulations Used in the Oil Industry: Journal of Environment and Earth Science, 2224-3216, 2225-0948,2014.