International Refereed Journal of Engineering and Science (IRJES)
ISSN (Online) 2319-183X, (Print) 2319-1821
Volume 6, Issue 3 (March 2017), PP.22- 28

Determination of Effect Bentonite and Additives On Drilling Fluids

Dr. A. Rajesh Kanna[1,*], Preethi[2], Syed Majid Ahmed Savi[3], Mujtaba Ahmed Khan[3], Mohammed Abdul Rahman Khan[3]

[1]*Professor & HOD, Department Of Petroleum Engineering, LORDS Institute Of Engineering & Technology, Hyderabad, India*
[2]*Assitant Professor, Department Of Petroleum Engineering, LORDS Institute Of Engineering & Technology, Hyderabad, India.*
[3]*Undergraduate Student, Department Of Petroleum Engineering, LORDS Institute Of Engineering & Technology, Hyderabad, India.*

Abstract :- Drilling fluids Play a vital role in hole Cleaning suspension of cuttings, prevent caving, and ensure the tightness of the well wall. Moreover they also help in cooling and lubricating the drilling tool, transfer the hydraulic power and carry information about the nature of the drilled formation by raising the cuttings from the bottom to the surface, using a simple mixture of water and clays, to complex mixtures of various specific organic and inorganic products as additives. These additives improve fluid rheological properties and filtration capability, allowing bits to penetrate heterogeneous geological formations The mud used in this work is barite and bentonites at different samples to know the difference in their specific gravity, viscosity, surface tension, and pH of the samples when chemical additives are added.

Keywords: - Mud, Mud rheology, Viscosity, Density, Drilling Fluid, Fluid Loss.

I. INTRODUCTION

Drilling deeper, longer and more challenging wells has been made possible by improvements in drilling tech- nologies, including more efficient and effective drilling fluids. Drilling fluids, also referred to as drilling mud, are added to the wellbore to facilitate the drilling process by suspending cuttings, controlling pressure, stabilizing ex- posed rock, providing buoyancy, and cooling and lubricating. As early as the third century BC, the Chinese were us- ing drilling fluids, in the form of water, to help permeate the ground when drilling for hydrocarbons. The term “mud” was coined when at Spindle top in the US. Drillers ran a herd of cattle through a watered-down field and used the resulting mud to lubricate the drill. While the technology and chemistry of drilling fluids have become much more complex. Drilling fluids are essential to drilling success, both maximizing recovery and minimizing the amount of time it takes to achieve first oil. The cost of the fluid system often represents one of the single greatest capital outlays in drilling an oil well. To minimize the cost of fluids and to ensure an efficient drilling program, the fluid properties must be maintained continuously during the drilling operation. In addition, the high temperature & high pressure conditions faced in ultra-deep oil & gas drilling environments pose major challenges for the fluids used in drilling operations. The degradation of drilling fluids in these environments reduces drilling efficiency by slowing the rates of penetration & creates severe problems that lead to leaving be- hind most of the oil unrecovered.

The rotational viscometer has been designed which permits the measurement of the rheological properties of drilling muds and other non-Newtonian fluids under conditions equivalent to those in a deep borehole (350˚F, 10,000 psi). The important mechanical features of this instrument are described, and its design criteria are dis- cussed [1]. The flow equations for the novel configuration of the viscometer are derived and the calibration procedures are described. The date and their interpretation, resulting from measurement of the flow properties. and static gel strengths of homoionic montmorillonite suspensions at high temperatures and pressures, are presented. Data are also presented for the flow behavior of typical drilling fluids at high temperatures and pressures. The pressure losses in the drill pipe and the annulus de- pend critically upon the flow parameters of the drilling fluid. Their work demonstrates the need to measure these parameters under bottom-hole conditions in order to obtain a reliable estimate of the pressure losses in the mud system. Bentonite is employed by industry to perform a multitude of jobs [3]. Certain industrial applications become apparent from an understanding of the composition and structure of bentonite, and the properties they create. These properties are utilized chiefly when the material is suspended in a liquid, usually water; or as a dried powder or granule. Most industrial applications involve the swelling property of bentonite to form viscous water suspensions. Depending upon the relative proportions of clay and water, these mixtures are used as bonding, plasticizing, and suspending agents. Bentonite disperses into colloidal particles and, accordingly, provide large surface areas per unit weight of clay. This large surface area is a major reason why bentonite functions so well in stabilizing emulsions, or as a medium to carry other chemicals. Bentonites react chemically with many organic materials to form compounds which are used chiefly as gelling agents in a variety of organic liquids. Bentonite is selected for each industrial need on the basis of type and quality. This selection is based principally on physical properties, and chemistry of the bentonite becomes involved only to the extent that it influences the physical properties. Drilling fluids are used in drilling operations to cool and lubricate the drill bit, remove rock debris and drill cuttings from the site and to counteract down hole formation pressures. Research is being conducted to develop nanoparticle-amended drilling fluids with enhanced functionalities. Such enhancements include improved rheological, thermal, mechanical, magnetic and optical profiles. These drilling fluids will have close to real time responsiveness (for example viscosity) to changing conditions down hole.

II. 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].

III. WATER-BASED MUD (WBM)

Water itself can be used as a drilling fluid. However, to maintain a better circulation of the Cuttings, WBM requires some degree of viscosity. The viscosity of WBM is generated by the addition of clay or polymers. There are two main purposes of adding clay which are first, increasing viscosity of the mud so that improves the lifting capacity of cuttings and second, Building a filter cake (mud cake) in permeable zones to prevent fluid loss [1].

IV. VISCOSITY

The viscosity of a fluid is a measure of its resistance to gradual deformation by shear stress or tensile 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* 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.

pH

pH a numeric scale used to specify the acidity or basicity of an aqueous_solution. It is approximately the negative of the base 10 logarithm of the molar_concentration, measured in units of moles per liter, of hydrogen_ions. More precisely it is the negative of the logarithm to base 10 of the activity of the hydrogen ion. Solutions with a pH less than 7 are acidic and solutions with a pH greater than 7 are basic. Pure water is neutral, at pH 7, being neither an acid nor a base. Contrary to popular belief, the pH value can be less than 0 or greater than 14 for very strong acids and bases respectively

Filtration

Filtration occurs any time a permeable formation is exposed to a mud at a pressure higher than the formation pressure. The pressure causes filtrate to flow into the rock and deposit mud solids on the walls of the borehole. Thus, filtration causes two distinctly different types of problems-those due to filtrate invasion and those due to filter cake deposition. The problems caused by filtrate invasion are not drilling problems, but are formation evaluation and completion problems. Excessive fluid loss may cause flushing of the zone around a wellbore to the extent that logging and formation test information is incorrect. This is normally not a problem with weighted muds where filtration control is necessary for control of filter cake deposition. In clear water or low solids muds, excessive flushing may present problems. Another problem is invasion of a formation by a liquid that will greatly reduce the formation permeability. Consequently, the volume of filtrate lost is not as important as the type of filtrate. From the standpoint of the drilling operation, the filter cake is of more concern than the volume of filtrate. The filter cake has a direct bearing on such problems as differential pressure sticking, torque and drag, lost circulation, and poor primary cement jobs. Our basic aim is to minimize the thickness and permeability of the deposited cake. High solids content can cause the fluid loss to be low but result in a thick cake. (Baker Hughes 2011).

Density

The starting point of pressure control is the control of mud density. The weight of a column of mud in the hole necessary to balance formation pressure is the reference point from which all pressure control calculations are based. The required weight of the mud column establishes the density of the mud for any specific case. Fortunately, density is one of our most accurate measurements. With a simple mud balance we are able to weigh a mud to the nearest 0.1 lb. / gal, which is equivalent to 5.2 psi per 1000 ft. of mud column.

Bentonite: - Prehydrated bentonite is used to viscosify KCl-Polymer Muds. Bentonite also provides a colloidal solid that can improve filter cake quality in freshly- prepared muds. Since bentonite will dehydrate from the high salt content of the mud and lose viscosity over time, constant additions of bentonite may be needed. When feasible, API "Nontreated" bentonite is recommended because it provides a noticeable reduction in material requirements and also provides better mud performance.

Fig.1 Bentonite

PAM (polyacrylamide)

PAM is a polymer (-$CH_2CHCONH_2$-) formed from acrylamide subunits. It can be synthesized as a simple linear-chain structure or cross-linked, typically using N.N methylenebisacrylamide. In the cross-linked form, the possibility of the monomer being present is reduced even further. It is highly water-absorbent, forming a soft gel when hydrated, used in such applications as polyacrylamide gel electrophoresis, and can also be called ghost crystals when cross-linked, and in manufacturing soft contact lenses. In the straight-chain form, it is also used as a thickener and suspending agent [2].

Fig.2 PAM (Polyacrylamide)

Carboxymethylcellulose

Cellulosic polymers are added for filtration control. When chloride concentrations are below 50,000 mg/L, either technical-grade or regular- grades CMC are used for filtration control rather than PAC. High-viscosity CMC is generally not used because it can have a deflocculating effect; therefore, pilot testing should always be performed prior to treatment.

Fig.3 CMC

Starch:

Starch or amylum is a polymeric carbohydrate consisting of a large number of glucose units joined by glycosidic bonds. This polysaccharide is produced by most green plants as an energy store. It is the most common carbohydrate in human diets and is contained in large amounts in staple foods such as potatoes, wheat, maize (corn), rice, and cassava.

Fig.4 Starch

V. EXPERIMENTAL PROCEDURES

1. Viscosity

To measure the viscosity we have two methods 1 is marsh funnel for higher quantity and method 2 viscosity 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 [3].

Fig.6 Viscosity cup

2. pH

pH can be measured by two ways one litmus paper and pH meter.

Fig.7 pH meter

3. Density

To find density of any fluid 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 [4].

Fig. 8 Mud Balance

Filtration

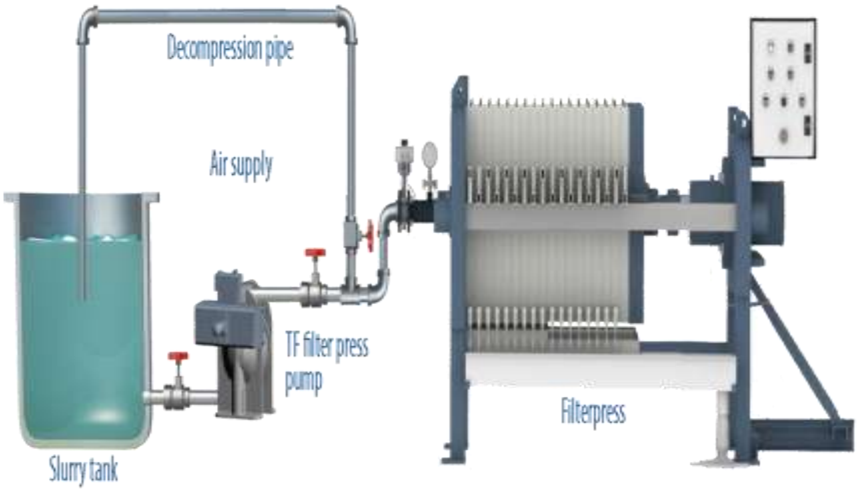

Fig.9 Filter press equipment

III Observations

Table 1

	Sample1	Sample2	Sample3
Bentonite	30gm	60gm	100gm
Barite	100gm	100gm	100gm
Water	100ml	100ml	150ml
Viscosity(Time in Sec)	27.392cp	21.998cp	5.55cp
pHValue	7.0to 7.5	7	7
Specific Gravity	1.60 & 100lb/cu ft	1.68 & 107 lb/cu ft	1.57 & 98 lb/cu ft
Fluid loss (ml)	10	14	20

Table 2

Samples	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
Bentonite	5gm	5gm	5gm	5gm	5 gm	5 gm
Barite	10gm	10gm	10gm	10gm	10gm	10gm
Water	150ml	150ml	150ml	150ml	150ml	150ml
Pam	5gm	10gm	N/A	N/A	N/A	N/A
Cmc	N/A	N/A	2 gm	4gm	N/A	N/A
Starch	N/A	N/A	N/A	N/A	5gm	10gm
Vicosity	18.94	22.33	130	139.3	16.94	21.20
PH Value	7.5	7.5	6.5	7	7	7.5
Specific Gravity	1.54&96lb/cuft	1.89&106lb/cu ft	1.081/122 lb/cuft	1.91&148 lb/ cu ft	1.03&64lb/cuft	1.21&72 lb/cuft
Fluid Loss(ml)	12	11	0	2	0	4

IV RESULTS

According to the studies difference between adding bentonite and other additives, we got standard readings. But when comparison of Bentonite and additives CMC has more viscosity than PAM and Starch. Whereas pH Comparison PAM was found to be the highest and also fluid Loss in CMC is very Low compared to other additives.

V CONCLUSION

Optimized drilling involves the selection of operating conditions that will require the least expense in reaching the desired depth, without sacrificing requirements of personnel safety, environmental protection and productivity. Correct formulation of drilling fluid and its additives will be based on its relative ability to drill the formations anticipated, while affording effective hole cleaning and well-bore stabilization. Based on this, formulation 2 and 4 are preferable for cost effective and optimal design. The water based mud can be used in low fluid loss region where as oil based can be used in high fluid loss region. The water based mud can be used in high formation pressure region.

REFERENCE

[1] API (2004): Specification for Drilling–Fluid Materials, API Specification 13A, sixteenth Edition, February, 2004.
[2] Baker Hughes (2011) Rheological properties, (synthetic-based mud)
[3] Trevor L. Hughes (2006), Schlumberger-Doll Research, Old Quarry Road, Ridge field.
[4] Z. Jiangeng (2011), Drilling and completion fluid, Editorial Board of Drilling and completion fluid, Hebei China.