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A REVIEW ARTICLE ON DRILLING FLUIDS , TYPES , PROPERTIES AND CRITERION FOR SELECTION

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Abstract :

This article provides a thorough examination of several types of drilling fluid systems as well as technological improvements. Drilling fluids are crucial elements for successful oil and gas drilling. Water-based drilling fluids are the most often utilised fluids in drilling applications. Because they are cost-effective, ecologically friendly, and non-hazardous, water-based fluids are the first fluids of choice for drilling applications. Drilling fluids, on the other hand, are ineffectual when working with water-sensitive shale because they produce shale hydration, which compromises wellbore stability. Water-sensitive geological occurrences may need the use of oil or synthetic-based fluids. Water flow from the fluid into the shale occurrence can be prevented by properly forming oil-based drilling fluid. Oil-based drilling fluid, despite its effectiveness, can have a severe influence on the environment when it is released and then spread into the sea. New materials are being employed to create safe and cost-effective drilling technologies for oil and gas wells. Their improved drilling performance reduces drilling time and improves safety and human health.

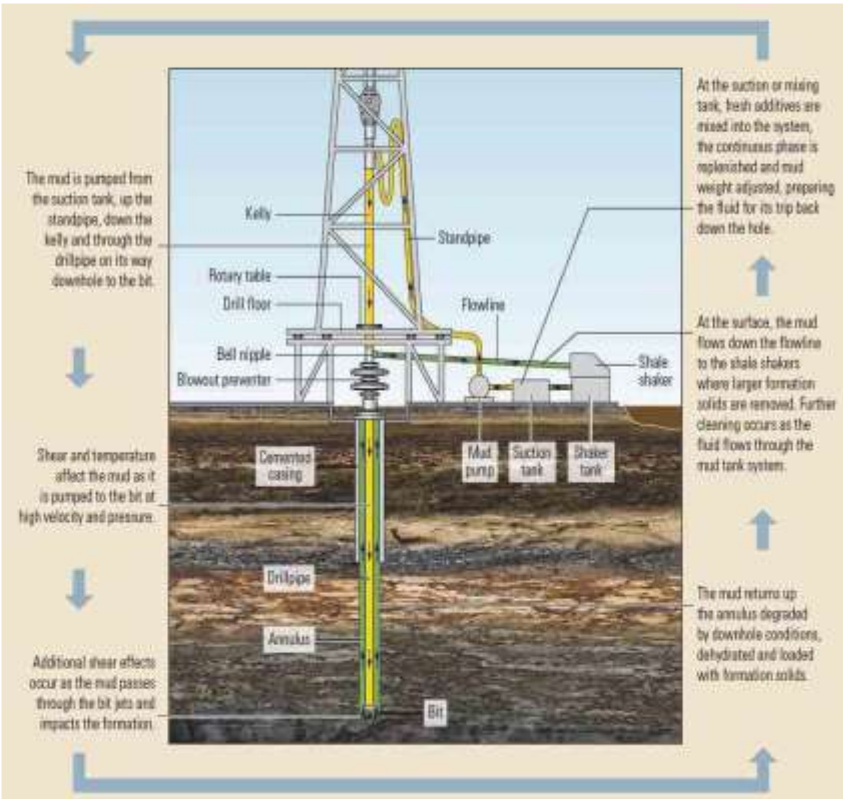
These approaches improved qualities such as filtration control, formation damage reduction, temperature stability, cutting stability, and compatibility with any pollutants introduced into the drilling fluid during drilling operations. This article is intended for recent petroleum post-graduates and entry-level drilling fluid professionals who will find many useful details for a specific drilling difficulty.

Keywords : Drilling, Drilling fluids, Water Based Drilling Fluid, Oil Based Drilling Fluid, Geological occurrence.

Introduction :

Drilling fluids also known as drilling mud can be defined as a special type of fluid which is used in drilling operation where it is continuously circulated and the pathway which it follows starting from mud pump where it is pumped with certain pressure passes through discharge line which connects mud pump to the standpipe , the running fluid passesthrough stand pipe and reaches rotary hose from where via kelly it enters drill pipe and finally reaches to small orifice at drill bit.

(Finger and Blankenship, 2010; Chemwotei, 2011). This small opening at the drill bit is the first point at which drilling mud makes contact with subsurface environment because uptil now it was travelling through pipes only . After reaching the wellbore through the orifice of the drill bit it is pumped back to the surface via annulus.
(Ahmed Wedam et al., 2019) (fig : 01).



Fig;1. A schematic diagram showing the circulation system of drilling fluid (Don williamson 2013)

A drilling fluid has to perform several important functions which includes:

1. cleaning cuttings from the hole
2. controlling subsurface pressure
3. suspension of cuttings in case when circulation is stopped
4. release of cuttings at surface
5. cooling and lubrication of drill bit
6. minimizing formation damage
7. allowing easy formation evaluation
8. preventing the hole from caving in
9. sealing the permeable formations and many more

drilling mud was first used in 1913 in order to control the subsurface pressure. (DRILLING FLUIDS Fred Growcock M-I SWACO Tim Harvey Oiltools, Inc.)

The effectiveness of these functions is determined on the type of formation being drilled as well as the drilling fluid's varied qualities. Compromises are frequently required owing to a variety of causes. The intricacy of the well being drilled, subsurface pressures and temperatures, logistics, cost, and local experience all influence the choice and design of a drilling fluid and its attributes. The drilling equipment utilised has an impact on drilling fluid performance.

Drilling fluids are known by a variety of different names, acronyms, and slang phrases in the industry. The most common names for this substance are "mud" and "drilling mud," and both words will be used interchangeably throughout this chapter. Water-based mud (WBM), oil-based mud (OBM), synthetic-based mud (SBM), non-aqueous fluid (NAF), inversion emulsion fluid (IEF), high-performance water-based mud (HPWBM), drill-in fluid (DIF), and reservoir drilling fluid are some of the other drilling fluid names and acronyms (RDF). Completion fluids are similar to drilling fluids in that they are used to finish the well after it has been drilled.Workover and completion (WOC) fluids, clear brines, and/or packer fluids are all terms used to describe the fluids utilised during completions.

Drilling fluid consists of a base fluid which can also be termed as solvent and some additives (chemical agents) which are added in order to achieve certain properties. The type of base fluid becomes the base for classifying the drilling fluid (fig : 02) , albeit they can be classified on many bases but classification based on the type of base fluid is the most standard and conventional one. (Mr Hamed Behnamanhar et al, 2014).

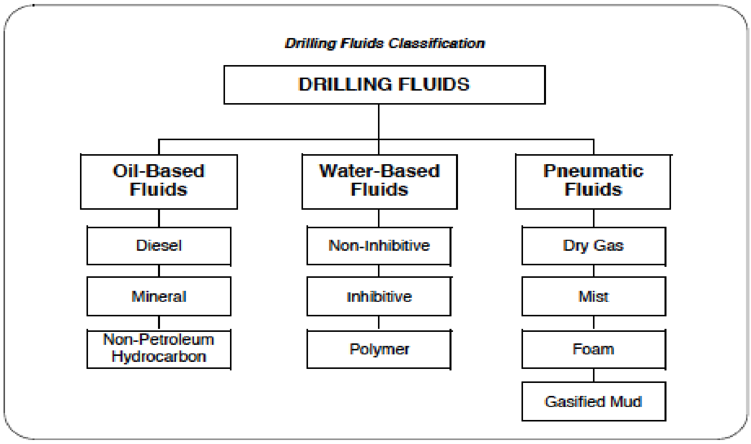


Fig :02, flowchart showing the different type of drilling mud based on the type of base fluid (Schlumberger Oilfield Glossary)

Using oil based drilling mud is more advantageous as it is much needed in special conditions like shale formations and geological formations which are rich in clay because using water based drilling mud in these conditions can result in hydration of clay which results into swelling of the formation ultimately leading to the instability in wellbore , which is matter of concern . drilling is the most important step in the life cycle of an oil field , being the crucial step all possible precautions should be taken . Thus selecting a drilling fluid with accordance to the condition also comes under petroleum economics and risk management . selection of drilling fluid depends on many criteria or factors . (Mr Hamed Behnamanhar et al., 2014).

Drilling fluids :

Drilling fluids are complicated mixes of solids, liquids, chemicals, and, on rare occasions, gases. Depending on the physical state of the components, they can take on the chemical characteristics of suspension, colloidal dispersion, or emulsion. (Tomas, 2001; Barbosa, 2006; Oliveira et al., 2016). Drilling fluids technology is constantly evolving, and it is dependent on specific requirements such as: (Uliasz et al. 2006; Steliga and Uliasz, 2014).

(1)severe conditions such as high temperature and pressure in tight gas and shale formations rapid expansion takes place .

(2) Rising technical demands, such as higher lubricity needs in air drilling, and

(3) increasing limits on oil-based systems, such as environmental cleanup. (Ahmed Wedam et al., 2019)

The most diverse of the three drilling fluid kinds is aqueous drilling fluid, also known as water-based drilling fluid.the main focus of drilling engineers and geoscientists is on improving the inhibition thermal apposition of water based systems in recent years in order to compete with the non aqueous fluids typically used in challenging drilling environments. They range in composition from simple blends of water and clay to complex inhibitions. The continuous phase of non-aqueous drilling fluids, also known as synthetic – base drilling fluids, can be mineral oils, biodegradable esters, olefins, or other varieties.Although more expensive than aqueous drilling fluids, these systems have superior borehole control, thermal stability, lubricity, and penetration rates, which may help the operator save money overall. (Don Williamson 2013).

Drilling fluids with specific physical and chemical qualities are used in borehole drilling for a variety of purposes. These duties are determined by the kind of drilled rock, the thickness of the formation, the presence of formation water and its salinity, the presence of producing formations, the formation pressure, and the temperature, which varies with drilling depth. Weighting material is one of the most common drilling fluid additives used to obtain the needed density to overbalance formation pressure during drilling operations and prevent well control loss. Drilling fluids also serve a variety of purposes, including cycling drilled cuttings to the surface, suspending cuttings while the drilling activity is halted, and chilling and lubricating the drill bit to make the drilling process easier. (Gordon et al., 2017 ; Mohamed et al., 2019)

In high-pressure and high-temperature applications, a unique drilling fluid composition is necessary to fulfil the crucial downhole conditions. Drilling fluids should have a high density in such instances to reduce the high formation pressure while maintaining good stability at those high temperatures. Drilling fluid selection is a crucial component in reducing drilling time and expense; water-based drilling fluids are preferred over oil and synthetic fluids for drilling oil and gas wells in sensitive locations where oil-based fluids are not required owing to cost and environmental implications. As a result of the development of high-performance and ecologically friendly fluids, water-based fluids are preferred. (Ahmed Wedam et al., 2019)

Importance of drilling fluid :

The aspects of drilling operation and performance of drilling fluid techniques is critical to everyone involved with the operation. The primary means of drilling fluid is to keep the well from blowing out and to keep the hole in good condition such that operation of drilling fluid could continue up to desired extent. The most important part of a well construction process is drilling and completion fluids as well as the ultimate performance of the drilling fluid can determine the success or failure of the activity. The selection and application of drilling fluid is to be held jointly between the drilling contractor, the operator and the fluids supplier.(Cheraghian, G. (2021).)

Types of drilling fluids:

The types of drilling fluids are given below:

- Water based fluids and
- Oil based fluid or synthetic based fluids
- Pneumatic based fluids

Water based fluids :

Water-based fluids (WBFs) are the most common technique and are considerably less expensive than oil-based fluids (OBFs). Water-based fluids have been used to drill approximately 80% of all wells as compared to oil based fluids. The base fluid can be fresh water, seawater, brine, saturated brine, or a formate brine. The type of fluid selected depends on the condition and specific interval of the well being drilled. (Baker H. Drilling Fluids Reference Manual, 2006).

WBMs are divided into various types based on their compositions or functions and whether they are used for pay-zone drilling or non-pay-zone drilling. To prepare WBM for non-pay zone drilling conventional can be used with less worries about formation damage and taking advantage of its cheap cost. Whereas the most important property for drilling fluid to be used for the pay zone drilling should be minimum damaging effect of its possible non damaging to pay formation. Several modifications in composition and properties must be made for non-damaging water base fluid. (Abduoa M et al., 2016).

Water-base mud types include;

- Spud muds
- Dispersed muds
- Lime muds
- Gypsum muds
- Salt water muds
- Non-dispersed polymer muds
- Mixed metal hydroxide muds.
- Inhibitive potassium muds
- Cationic muds

(Bisweswar Ghosh et al., 2017)

The comprehensive use of water-based muds is to aspects the universal distribution of water, the application of its nature, its low cost and compatibility with human health. The mud cutting is resulted from water base muds which can be used for drilling and can easily be disposed onsite at the locations of offshore and onshore. The total drilling cost is reduced as there is no expensive and extensive treatment or transportation is required prior to cutting disposal(fig 03). (Henaut I et al., 2016).

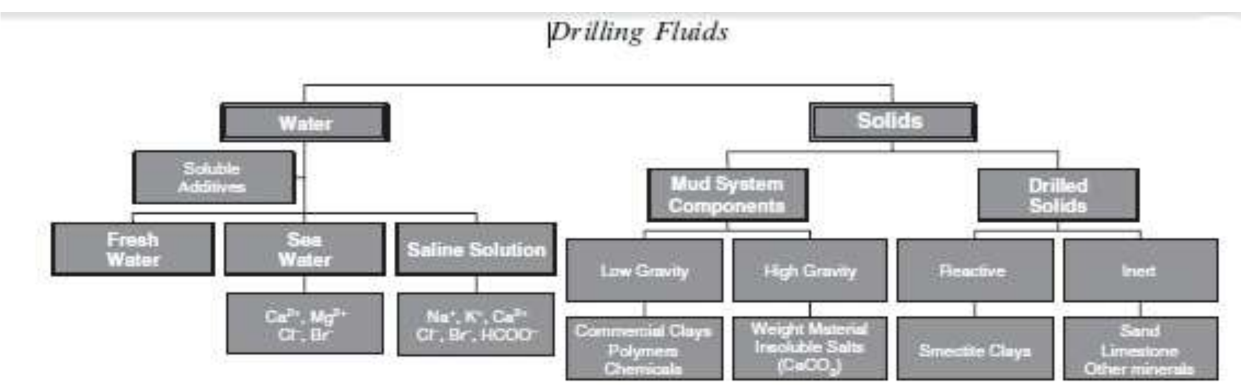


Fig:03 :- Types Of Water Based Drilling Fluid. (Drilling Fluids Fred Growcock M-i Swaco Tim Harvey Oiltools, Inc.)

WBFs is divided into two broad categories: non dispersed and dispersed.

Non Dispersed systems

Non dispersed systems are those in which simple gel and water is used for the top hole. There are many polymers systems containing no or little bentonite. Dilution, encapsulation, and flocculation are managed under natural clays that are incorporated into a non dispersed system. A solid control system can be used to remove the fine solid from the system and maintain the drilling efficiency. (Drilling Engineering Dipl.-Ing. Wolfgang F. Prassl Curtin University of Technology)

The low-solids, non dispersed (LSND) polymer systems depend on high- and low-molecular-weight long-chain polymers to provide viscosity and fluid-loss control. Low-colloidal solids are encapsulated and flocculated for removal at the surface, which decrease in dilution requirements. (Mason et al., 2003).

Dispersed systems:

Dispersed systems are designed to deflocculates clay particles which allow to improve the rheology control in higher-density muds. Mainly used dispersants include lignosulfonates, lignite additives, and tannins. Dispersed systems are required to additions of caustic soda (NaOH) to maintain the pH level of 10.0 to 11.0. Dispersing system can increase its tolerance for solids for making it possible to weight up to 20.0 ppg. The commonly used lignosulfonate system depends on relatively inexpensive additives and it is familiar to most operator and rig personnel. Additionally used for dispersed muds include lime and other cationic systems. A solids-laden dispersed system can also decrease the rate of penetration significantly and contribute to hole erosion. (Gleason et al., 2003).

Oil-based fluids

Oil-based systems was introduced in the 1960s to help in several drilling problems:

- Increasing downhole temperatures
- Formation clays that react, swell, or slough after exposure to WBFs
- Stuck pipe and torque and drag
- Contaminants

Oil-based fluids (OBFs) are used for formulated with diesel, mineral oil, or low-toxicity linear olefins and paraffins. The olefins and paraffins are referred to as "synthetics" and they are derived from distillation of crude oil and some are chemically synthesised from smaller molecules. Internal brine or water phase electrical stability is monitored for strength of the emulsion is maintained at or near a predetermined value. The emulsion should be stable such that it incorporates additional water volume if a downhole water flow is encountered.

Barite is used to increase density of the system and specially-treated with organophilic bentonite is the primary viscosifier in most oil-based systems.A factor that can also be a contributor to fluid viscosity is emulsified water.

Organophilic lignitic, asphaltic and polymeric materials are added to help control high pressure and high temperature fluid loss. Oil-wetting is essential for ensuring particulate materials remain in suspension. The surfactants are used for oil-wetting and can work as thinners. Oil-based systems mostly contain lime for maintaining an elevated pH and resist adverse effects of hydrogen sulfide (H2S) and carbon dioxide (CO2) gases, and increase emulsion stability. (Yassin et al., 1991)

Shale inhibition is one of the key roles for oil-based systems. The high-salinity water phase helps to prevent shales from sloughing, swelling, and hydrating into the wellbore. Most conventional oil-based mud (OBM) systems are formed with calcium chloride brine, which can appear to offer the best inhibition properties for most shales.

The discharge of whole fluid generated with OBFs is not applicable in most offshore-drilling areas. All such drilled cuttings and waste fluids are further processed and shipped to shore for disposal. Although many land wells continue to be drilled with the diesel-based fluids, in the late 1980s the development of synthetic-based fluids provided new options to offshore operators which depend on the drilling performance of oil-based systems to help in holding overall drilling costs for which we required more environmentally-friendly fluids. In the world such as the North Sea, these fluids are prohibited for offshore discharge (fig 04).

Oil based mud has a special advantage for their unmatched performance for drilling. The good rheological properties such as temperature of 500∘F, has special advantage in OBM and is more inhibitive than water base mud such as effective against all types of corrosion and permits density less than 7.5 ppg. Reduction in production damage, gauge hole in evaporate formations, and resistance to chemical contamination are additional advantages. (Abdullah et al., 1991).

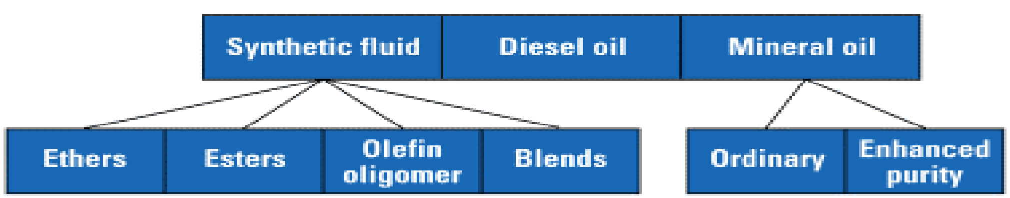


Fig :04 :- Types Of Oil-based Drilling Fluid. (Schlumberger Oilfield Glossary).

Pneumatic-drilling fluids:

In place of drilling fluid, compressed air or gas can be used to circulate cuttings out of the wellbore. Pneumatic fluids can be classified into three categories:

- Air or gas only
- Foam
- Aerated fluid

In pneumatic-drilling operations require many specialized equipment to ensure safe management of the cuttings and formation fluids that return to surface, as well as tanks, lines, compressors, and valves associated with the gas, and it is used for the drilling fluid or foam or aerating the drilling fluid. Except when drilling through high-pressure hydrocarbon formations that demand a high-density fluid to prevent well-control issues. Pneumatic drilling fluids are generally used in the areas where using conventional drilling mud won't give any outcome.It is also used to drill in areas of low reservoir pressure, loss of circulation and where a depleted zone is predicted. It basically consists of dry gases like air, natural gas , NO2 , CO2, and it is best suited where they have less amount of water formations. (Drilling Engineering Dipl.-Ing. Wolfgang F. Prassl Curtin University of Technology).

Pneumatic fluids offer several advantages:

- Rapid evaluation of cuttings for the presence of hydrocarbons
- Little or no formation damage
- Significantly higher penetration rate of hard-rock formations

(A.F.Negra~o et.al 1999).

Properties of drilling fluids:

The large number of functions performed by the drilling fluid that require minimum properties of the fluids can be maintained. The most critical properties are viscosity, density, chemical composition, and fluid loss control. (Mohamed Khodja et al., 2010).

1. Density:

Considering the density as the first parameter of Drilling fluids. For the desired densities greater or lower than one, WBM or OBM can be used, respectively. Generally, for both WBM and OBM, mud density can be increased by adding various soluble materials or solids. Other undesirable solids issued from geologically drilled formations cannot be removed easily but can be reduced to finer particles, which may have some adverse effects on properties of fluid. So, these phenomena need to be avoided and we do it by using high speed shale shakers .(Lummus and Azar, 1986).

In such stages, to remove finer solids to the 1 µm range, these devices are equipped with 50- to 100-mesh screens, using mud cleaners, desilters, desanders. Undesirable solids which are less than 1 µm can be removed chemically using medium to high molecular weight flocculants because solids which are less than 1 µm have 12 times more effect on greater particles. The solids which are less than 1 µm, the shearing stress required to start the fluid motion will be greater than large particles. (Mohamed Khodja et al., 2010).

On Laboratory scale density or mud weight is estimated by mud balance(Fig 05). mud balance is an instrument having a scale with different units . For calibration purposes the cup of mud balance is filled with water first then the scale is adjusted with the help of the rider such that the level glass fluid comes in exactly at center . The mud density value for water comes near 8.83 ppg . After this the same procedure is repeated for the mud sample.

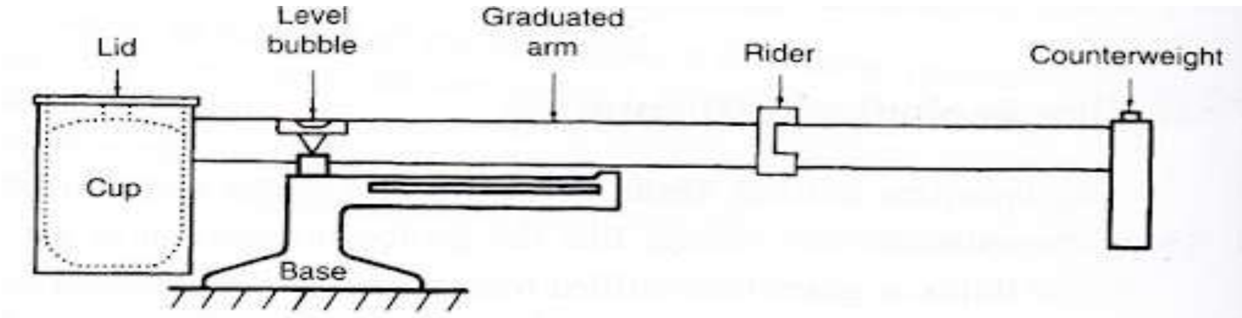


Fig 05;- Mud Balance (Martin Klempa et al., 1996).

2.Viscosity:

Considering the viscosity as the second parameter of Drilling fluids. It is defined as the internal friction generated by a fluid when a force is applied to flow. The internal friction is a result of the interaction between the molecules of a liquid and it is related to a shear stress. As the resistance of shear stress increases, viscosity also increases. The standard viscosity measurements do not define flow nature within shear rate ranges imposed at the pits, bit, annulus. (Mohamed Khodja et al., 2010). The viscosity at the bit affects the rate of penetration, which can be better when viscosity is lower. The viscosity in the annulus affects efficiency of cleaning holes and the viscosity in the pits influences the effectiveness of solids separation techniques. Numerous chemical agents are added to the formulation in order to reach specific purposes which are sometimes contradictory. For example, mud has to be more viscous in order to lift the cuttings to the surface, but on the other hand, viscosity must not be very high in order to minimize friction pressure loss. (Caenn et al., 2011).

At the rig site viscosity of mud is measured by the marsh funnel viscometer(Fig 06) . A marsh funnel viscometer is a simple funnel shape which is used at rig sites due to its simple use for determining the viscosity of the fluid with respect to reference fluid . The unit in which the viscosity is measured in the marsh funnel system is in seconds and the standard and generally used unit of viscosity is centipoise .The Marsh funnel is usually referred to as "funnel viscosity" since it is used to track relative changes in viscosity. The amount of seconds necessary for a given fluid to flow a volume of 1 qt into a graduated mud cup is described as the Marsh funnel viscosity. Water can be used to test its design and calibration. At a temperature of 70 (5) °F, one quart of fresh water should be gathered in 26 (0.5) seconds.

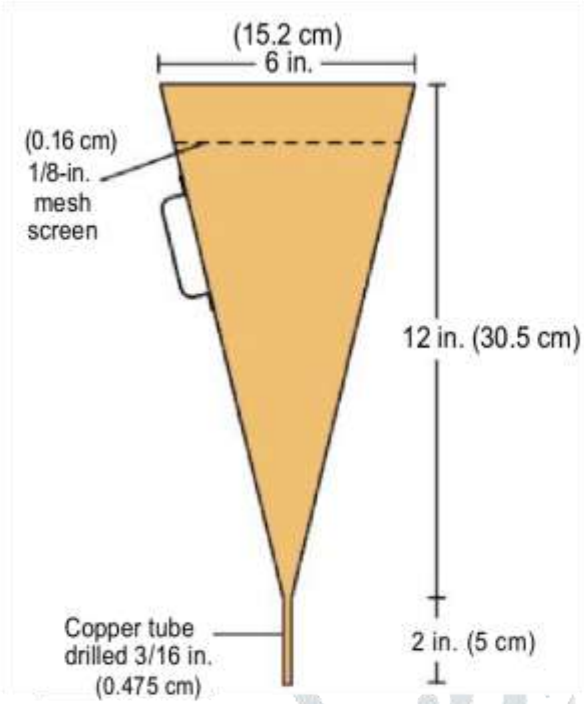


Fig:06 :- Marsh Funnel Viscometer. (Afshin Davarpanah et al., 2016).

In a complex system the approximated value of viscosity of a mud sample can be determined by the Fann V-Gmeter or rotational viscometer(fig 7) or multi-speed rheometer .It measures viscosity by Shear rate and shear stress .

Fig:07 :- Rotational Viscometer. (Adewale Folayan et al., 2018).

3. Fluid loss:

Considering the fluid loss as the last parameter of Drilling fluids. It is defined as the volume of the drilling mud which is passed into the formation through the filter cake obtained during drilling. It can be prevented by blending the mud with additives. A large number of factors affected by the fluid-loss properties of a drilling fluid, including time, temperature, compressibility, nature, amount and size of solids present in the drilling mud.

In high-pressure-temperature environments, above mentioned three parameters are essential for lightening instability problems when drilling through shale sections. In some cases, it has been widely experienced that random factors related to drill bits, surface equipment, and soil layers, greatly affect drilling performance. (Jean Paul Canselier et al., 2010).

Five important parameters that have been proposed for drilling mud additives are:

1. Recommended treatment range and cost.

2. Main function and chemical nature.

3. Compatibility/salt tolerance with other additives and temperature limitations.

4. Interferences, damage and risk such as geological interpretation effects, formation damage, health safety and environment (HSE) and waste treatment.

5. History/success of using. (Mohamed Khodja et al., 2010).

The primary properties of drilling muds which can be controlled within a given limits are:

• Particle size and shape.

• Lubricity.

• Flow properties.

• Alkalinity.

• Filtration.

• pH.

• Properties of colloidal.

• Conductivity. (Ismail Mohammad Alcheikh et al., 2014 and API Recommended Practice 13B-2: Recommended Practice for Field Testing).

Gel strength :

The shear stress required to initiate the flow after a static period of time is referred to as gel strength. The degree of gelation occurred due to the attractive force between particles over the period of time measured. Higher gel strengths have units as YP (lb/100 sq ft). During the connections and other static conditions the sufficient gel strength can be suspended with drill cuttings and weighting materials. While making connections, running casing or tripping pipe the gel strength is directly affected by surge and swabbing pressures. For releasing entrained air or gas which is also affected by the pressure is required to "break circulation". The gel strength is measured by using a direct indicating rotational viscometer which is used for viscosity. Gel strength is determined by observing the maximum shear stress while after some period of time the rotor is turned off. After 10 min or sometimes after 30 minutes, standard value of gel strengths should be taken. If the fluid is contained to gel with a longer period of time (called progressive gels) or if it reaches a relative constant value (called flat gels) that is indicated due to change in gel strength values between this period of time. (Schlumberger 2020)(fig 08).

Figure 08:- Exercising the gel strength of a fluid mixture in order to suspend sand for transportation.(Trenchless Technology 2013)

Gel strength can be determined at laboratory scale by the Fann V-Gmeter or rotational viscometer or multi-speed viscometer(Fig 09) .

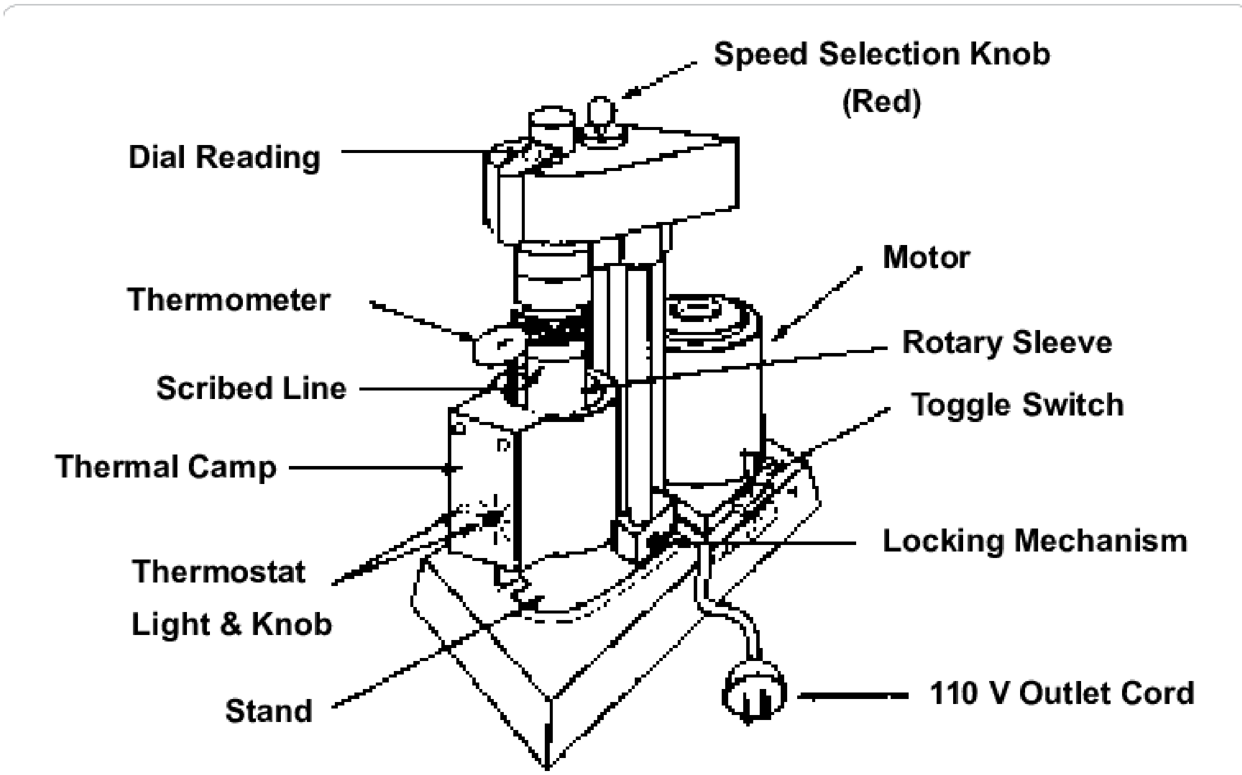
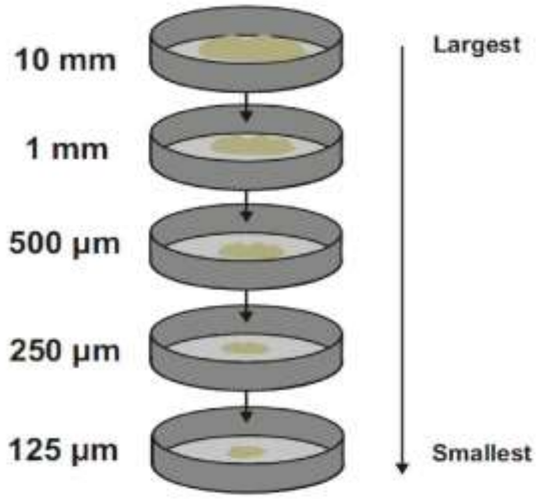


Fig 09:- Fann Model 35 6-Speed Viscometer. (Afshin Davarpanah et al., 2016).

Sand control :

The volume percent of whole mud that are "sand sized" particles is referred to as sand content, which means they do not pass through 200 mesh screens and are larger than 74 µ. These may be the coarse-sized barite particles or quartz sand, LCM,sized bridging solid,drilled solid or any particles larger than 74 microns. Using a funnel, 200 mesh sieve and graduated tube the sand content is measured. The effectiveness of solid control equipment, the shale shaker screen condition and potential for increasing the abrasion to mud pump in circulating systems including drill string and downhole equipment is monitored.(Salahi, A., Dehghan, A. N., Sheikh Zakaria, S. J., & Davarpanah, A. (2021))

The percentage of sand in the mud is measured using a mesh sieve(Fig.10) and a graduated tube(fig 11) .



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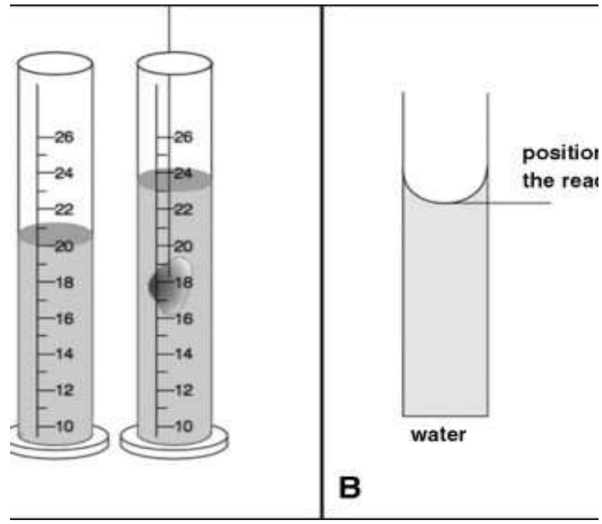

(2)

Fig 10 :- Mesh Sieve (Luke A. Barlow 2019).

Fig 11 :- Graduated Tube (Leandro de Freitas Spinelli 2012).

Solid content:

Using distillation report solids, oil and water content is measured. A complete breakdown of composition of the drilling fluid can be made with the information and other data form chemical analysis is often called as solids analysis which contain drill solids, barite, oil content, brine content or liquid content. Gel strength, drilling rate, flow property and the overall strength of mud is affected by the solid content. The result obtained from the analysis is based on frequency of dilution and chemical treatment. For superior mud performance good solids control and optimum solid content are essential. (Kinif, I., Irawan, S., & M. Bharadwaj, A. (2016).)

Chemical component:

To monitor specifications and to identify contamination, chemical tests are carried out on the whole mud and filtration. On the basis of types of drilling fluid, these test can include: methylene blue test (MBT), H2S, lime content, chloride (or salt), pH, calcium (or total hardness), carbonate/bicarbonate, sulfate, electrical stability, water activity, various measures of alkalinity (PM, PF , and MF for WBM and POM for NAF), and others. (Wolfgang F. Prassl).

Selection criterion :

The most important selection criteria to design a drilling fluid program in minimum overall cost are given below. The drilling fluid program involves production issues, exploration, performance and logistics are other factors. The drilling fluid program involves many factors such as :

1- Environmental Impact :

For planning and implementation of drilling fluid, the most important factor is environmental issues. For ex- in offshore operations, mineral or synthetic oil-based systems are used other than the diesel oil-based system (Fig.12) . (Ahmed Wedam et al., 2019).

The drilling exploration and production of oil and gas while helping to maintain well control and to remove the drilling cutting from the drill hole, specialised drilling fluids is used by drillers. (Burke et al., 1995). The drilling industry has developed various types of synthetic based fluids that combine the operating qualities of oil based drilling fluid with the lower toxicity, in response to current global environmental situations.(Cobby et al., 1999).

Oil based fluids are well planned in areas prone to shale swelling, when the pollutant is dispersed and discharged into the sea which pose an adverse impact to the environment and become highly unfavourable for plants, fishes and other aquatic bodies. Furthermore , when man consumes fishes then it can be harmful and toxic. Also, during onshore drilling the pollutants may have adverse impact on soil quality which leads to serious effects on the chemical properties of the soil and thus affects wildlife and habitat of people . Water-based fluids scatter more than oil based fluids during cutting when it is discharged under water. The blanket parts of seabed are formed by the piles of cutting. The bottom-dwelling organisms close to the rig are affected by these conditions. (Seang et al., 2001). The new class of drilling mud is synthetic based-drilling fluid which is particularly used for deviated hole drilling and deep water. They use a new class of materials to provide cost-effective and safe technology for drilling oil and gas wells. Enhanced drilling performance provides advantaged safety like human health and decreases the drilling time, and in some cases, it performs above diesel oil fluids, to provide an environmentally superior alternative to oil-based drilling fluids (Neff et al., 2000; American Chemistry Council (ACC), 2006).

Fig 12 : The oil drilling rig Deepwater Horizon on fire in the Gulf of Mexico in April 2010.

2- Well Type :

Generally drilling can be classified into two types: exploratory operations and development operations. . In exploratory drilling, to design mud properties the information about the region is not enough. To obtain the geological information easily and safely the designed mud system has to contribute. In case of unexpected changes or problems the mud composition has to allow for quick change. In development drilling, the geological conditions can help to design effectively the drilling fluid program whereas to enhance the other programs which are related to it like hydraulic design.

3- Problems Related to Formation Types

Anhydrite:

While using bentonite drilling fluid through anhydrite formation, the released calcium ions into the mud system can retard the bentonite hydration which can be affected by the mud viscosity and the loss of fluid. To overcome the presence of ions, there are two solutions which can be treated in a mud system by converting the drilling fluid to an inhibitive system or by adding sodium carbonate (Na2Co3).

High Temperature Environment :

In case of drilling in a high temperature environment, generally the ability of chemical additives is reduced and can increase the changes in viscosity and loss of fluid. Drilling fluids which can resist such an environment can be used in oil based mud systems.

Abnormal Pressure formation :

While drilling through abnormal pressure formations, fluids can flow into the mud system which can lead to undesirable kicks or contamination of mud. To avoid these types of problems an adequate mud weight has to be planned for such formations.

Loss Circulation Intervals :

The fluid circulation can be lost in the formation. This problem can be classified into circulation of partial loss and circulation of total loss. In partial loss circulation, the inlet flow rate can be greater than the flow rate out of the hole. In the total loss circulation, no mud is returned to the surface. If the fracture pressure is exceeded the lost circulation can occur while circulating through the drilling fluids or the mud can flow in the fractured formation.

Shale :

While drilling through the shale intervals many problems can be encountered, it can be listed as follows:

a. High drag and high torque
b. Mechanical pipe sticking
c. Drilling fluid contamination
d. Hole cleaning problems

4- Drilling Rig :

The selection of the drilling fluids can be limited by the solid control system and chemical treatment, the hydraulic horsepower is available for the circulating system To achieve the target's drilling is directly related to the rig selection and its boundary.

5- Casing Program :

Casing depth is planned according to many ways such as changes in lithology, isolation of troublesome zones and pore pressure trend. To design the drilling fluid program these requirements are also used. To optimise the drilling fluid program for drilling deeper sections which can reduce the overall well cost.

6- Water Requirement :

For designing the mud program, the availability of water used for making the drilling fluid has to be considered. Diluting can be the most economical treatment if the making water is available on site. In the other case the solid control treatment is the best choice when the water is transported to the rig site.

7- Corrosion :

The combination of the corrosion and the mechanical cyclic loading can fail drill strings. The life of drill pipe gets reduced when carbon dioxide and hydrogen sulphide get dissolved in drilling fluids. (Burke et al., 1995).

Conclusion :

The performance of drilling fluid is key for any drilling operations. Several factors depend on the performance of drilling fluid such as drilling formation damage and wellbore. with high performance of drilling fluid, it should compare with general concerns and requirements of industry. The performance of drilling fluid is not only key but also on its effect on health, safety, cost and environment. Generally, there is no such kind of drilling fluid which can fulfil all requirements of drilling. it will continue to develop new types of formulations in drilling fluid and continue to develop new types of formulations in drilling fluid.

The drilling fluids are essential materials for the success of oil and gas drilling. Fluids are the complex mixture which are formed from solids, liquids, chemicals, and sometimes even gases. From a chemical point of view it assumes the aspect of emulsion, suspension or colloidal dispersion, depending on the physical state of the components. Generally the drilling fluids are divided into three classes such as WBDF (water based drilling fluids), SBDF (synthetic based drilling fluids) and OBDF (oil based drilling fluid). For proper selection of drilling fluid there are some leading agents such as temperature and pressure of formation, type of formation encountered, ecological and environmental consideration and cost needed has to be put into consideration for proper selection of drilling fluid. As the effect of oil based fluids can also give a negative impact to the environment when the pollutant is discharged and dispersed into the sea. The high drilling performance decreases drilling time and can provide advantaged safety, human health. They are developing to provide an environmentally superior alternative to oil based fluids.

Discussions:

Drilling fluid properties have the largest impact on the quality of the drilling operation and the prevention of difficulties during drilling. Mud engineers are most concerned about undesirable changes in mud properties during exposure to wellbore conditions. When mud qualities change, it becomes impossible for it to fulfil its functions properly, hence it is vital to continuously monitor and maintain the properties of the drilling fluid.It is feasible to switch from a traditional drilling fluid to one that adjusts its properties in response to downhole conditions. Different drilling fluid systems with self-treating and regulating features were researched in this paper, as well as their mode of action. Drilling time, treatment time, and drilling fluid cost are all decreased greatly when smart drilling fluids are used, which could aid in a more effective drilling operation. Drilling fluids that are smart may be advantageous not just during the drilling process but also throughout the well finishing phase.Drilling fluid is an important aspect in the drilling program's performance and should be thoroughly investigated. However, the scope of this paper's discussion is restricted to its general features.The drilling fluid's qualities should be tailored to the hydraulics available for the drilling operation and the well design. Optimizing the hydraulic horsepower at the bit helps enhance the rate of penetration (ROP) and bit life, especially for roller cone bits. When a sufficient flowrate is employed with little overbalance, the ROP and bit life of polycrystalline diamond compact (PDC) cutter bits are improved. The parasitic pressure losses in the drill string and the available pressure at the bit are determined by the drilling fluid characteristics and circulation rates for optimal drilling performance.The density of the mud and the composition of the suspended materials have an impact on the ROP. Controlling the qualities of mud necessitates regular and thorough testing. The ability to understand the findings of these tests and treatments in order to maintain suitable fluid characteristics is critical to the drilling program's success.

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This is to declare that the submission is our own and that, to the best of our knowledge and belief, it contains no material previously published or written by another person nor material which has been accepted for award of any other Degree or Diploma of the University or other Institute of Higher Learning, except where due acknowledgement has been made in the text.

Conflict of interest :

On behalf of all the authors, the corresponding author states that there is no conflict of interest.

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