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Evaluation of Local Materials as Filtration and Loss Control Additive for the Drilling Mud

(تقييم مواد محليه كمواد تحكم لراشح وفقدان سائل الحفر)

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الإستهلال

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قال تعالى :

﴿وَيَسأَلونَكَ عَنِ الرّوحِ قُلِ الرّوحُ مِن أَمرِ رَبّي وَما أوتيتُم مِنَ العِلمِ إِلّا قَليلًا ﴾

صدق الله العظيم

الآيه (85) : سورة الإسراء

Dedication

We dedicate this work to

Our Mothers

Our power resource and the candle

That lighting our darkness

Our Fathers

The one who taught us the

Meaning of principles and give

Our teachers

Our prideness icon

Acknowledgement

We would like to thank Allah, our guide to right path, for the mercy, kindness, strength, for been Muslims and all his blessings.

This project has been greatly availed from the extensive effort and continuous support of many people, whom we would like to acknowledge and recognize them:

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Abstract

Fluid filtration occurs in the loose sand and high preamble formation as shale, and this lead to problems during drilling operation such as stuck of the pipes and increase of equivalent circulation density (ECD), etc…. .

Different materials and additives are used to prevent the increase of filtration into formation such as Pac lv (Polynomic cellulose low viscosity), in the project Hyphaene thebaica fruit, Zizyphus ,spina-Christi fruit and adansonia fruit crust used to applied as filtration and loss control additives .

The objective of this project is to investigate the performance of a local materials (Hyphaene thebaica fruit , Zizyphus ,spina-Christi fruit and adansonia fruit crust) in powder form for filtration control and in coarse size for (Hyphaene thebaica kernel , Zizyphus ,spina-Christi fruit) as loss circulation material , In this project laboratory tests conducted to evaluate the performance and efficient of the local material in filtration control and loss circulation ,From result we figure out the powder of adansonia fruit crust can be used as fluid filtration control additive for low concentration, and Hyphaene thebaica fruit and Zizyphus spina-Christi fruit can stopped the partial losses of the mud specially for small size of LCM .

التجريد

يحدث ترشيح السوائل في الرمل غير المتماسك والطبقات ذات النفاذية العالية مثل الصخر الزيتي وهذا يؤدي الى مشاكل اثناء عملية الحفر مثل إلتصاق الأنابيب وزيادة الكثافة اللازمة لموازنة ضغط الطبقه

يتم إستخدام مواد وإضافات مختلفه لمنع إرتفاع الترشيح للطبقه مثل بوليانيونيك السليلوز منخفض اللزوجه, في المشروع إستخدم الدوم والنبق والغنوغليز وطبقت كمواد تحكم للراشح والفقدان

الهدف من المشروع التحقق من اداء المواد المحليه (الدوم ,النبق,الغنوغليز) في شكل مسحوق للتحكم في الراشح وفي حجم خشن لل (نواة الدوم ,النبق) كمواد فقدان دوره السائل

في المشروع اجريت الإختبارات لتقييم إداء وكفاءة المواد المحليه للتحكم في الراشح وفقدان دورة السائل, من النتائج وجد ان مسحوق قشرة ثمرة الغنوغليز يصلح للتحكم في الراشح للتراكيز المنخفضه ,و وجد ان ثمرة الدوم والنبق توقف الفقدان الجزئي لسائل الحفر خصوصا للحجوم الصغيره

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Abbreviations

ECD≡ Equivalent Circulation Density
DSP≡ Date Seed Powder

LCM≡ Loss Circulation Materials
IEFs≡ Invert Emulsion Fluids

LPLT≡ Low Pressure Low Temperature
MPP≡ Mandarin Peels Powder

BSP≡ Basil Seed Powder
PPT≡ Permeability Plugging Tester

CMC≡ Carboxy Methyl Cellulose
OWR≡ Oil Water Ratio

PAC LV≡ Polyanionic Cellulose Low Viscosity
LTOBM≡ Low Toxic Oil-Based Mud

PV≡ Plastic Viscosity
PHPA≡ Partially Hydrolyzed Polyacrylamide

YP≡ Yield Point
TD≡ Total Depth

GP≡ Grass Powder
LAO≡ Linear Alpha Olefins

IO≡ Isomerized Olefins
ADF≡ African drilling fluid

SOB≡ Pseudo Oil Based Mud
ML≡ milli litter

GR≡ gram

Chapter 1

Introduction

Chapter 1

Introduction

1.1 General :

Drilling fluids are also called drilling mud is a mixture of water, oil, clay and various chemicals, the use of drilling fluids is an essential part of a rotary drilling process. Different types of chemicals and polymers are used in designing a drilling fluid to meet functional requirements such as appropriate mud rheology, density, mud activity, fluid loss control property, etc.

In the course of drilling a well, water or oil-based drilling fluids are pumped from the surface to the bottom of the hole and then brought back to the surface for removing the drill cuttings and excessive solids from the mud and then recirculation of the cleaned mud again to fulfil a suite of functional tasks.

As the subsurface rock formations of a wellbore is porous and permeable, there is a high possibility of loss of a huge volume of the fluid phase of the mud while drilling or making a trip if no fluid loss control additive is incorporate into the mud for sealing and blocking the pores by creating a low permeable mud cake on the borehole wall.

Deposition of excessively thick filter cakes on the borehole wall, significant increase in torque and drag problem, dramatic rise of equivalent circulation density (ECD), surge and swabbing pressures, increase in casing running load, problem in primary cementing, and differential sticking problems in the presence of high permeable formations.

Also, Excessive loss of the fluid of the mud into the porous formation may lead to a dramatic change in mud properties, High fluid loss can lead to increased mud cost. In formulating drilling mud Fluid loss additives are used in the formulation of drilling and completion fluids to control the loss of fluid to the surrounding formations within the acceptable range i.e. less than 15ml /30 min.

One of the important considerations in fluid design is the minimization or Elimination of any detrimental effect to the surrounding environment, using environmental material such as adansonia fruit outer cover, Hyphaene thebaica fruit, Zizyphus spina-Christi fruit instead of chemicals Contributes in decreasing the chemical damage of the additives that used in drilling formulation. . Also using local materials in drilling mud is contribution in minimizing the total mud budget, by localization of the drilling mud additives instead of importation and transportation of these materials from foreign countries which need huge cost . .

1.2 Problem Statement:

High filtration into formation due high permeability or loose sand lead to accumulating of the solid particle of the mud in the wellbore this lead to many problem during drilling operation such as stuck of drilling string into the wellbore, dramatic rise of equivalent circulation density (ECD),etc..., In the project the powder of adansonia fruit crust , Zizyphus spina-Christi fruit powder and Hyphaene thebaica fruit powder are applied for predicting filtration volume of the mud and possibility to applied as LCM .

1.3 Objective:

1. applied adansonia(gongoles) fruit crust , Zizyphus spina-Christi(nabg) fruit and Hyphaene thebaica(dum) fruit material as local fluid loss control material.
2. Evaluate the performance of local fluid loss control material.
3. Efficient of local fluid loss control.
4. simulate the role of local LCM in controlling loss circulation.
5. Efficient of lost circulation control.

1.4 Methodology:

Firstly, the local materials were collected from local market, dried and then grinded into fine size in local market by using seeds mill device, then the material was sieved in civil engineering lab, the filtration test was conducted for the three material by using filter press device, then filtration volume was determined in different time for each one when the mud cake obtained and after thirty minutes. The simulation of rule of local material were applied for determine the efficient of using these materials as LC material.

1.5 Thesis Outline:

This research consists of five chapters, an introduction, literature review and history background, materials and methods, results and discussion and conclusion & recommendation.

Chapter One: The introduction includes a simple definition of drilling fluids and the research orientation towards local material as drilling mud additives, problem statement, objectives of the project, Methodology as general and thesis outline.

Chapter Two: literature review of previous study of friendly drilling fluid additives as generally and fluid loss control additives specially, background of materials that used in research.

Chapter Three: is conducted to materials collection and preparation, drilling fluid test and devices.

Chapter Four: provide the results and discussion of work. The results of this research is based on chapter three.

Chapter Five: presents a general conclusion of the whole work in this research. Recommendations are included for further studies and probabilities.

Chapter 2

Literature Review & History Background

Chapter 2

Literature Review & History Background

2.1 literature review:

(I. A. Norizzatul Akmal, 2021) discuss and study of banana peels and sugarcane bagasse as environmentally friendly LCM additive for drilling mud application and investigated thermal stability of the formulated banana peels and sugarcane bagasse-based LCM. The performance of banana peel and sugarcane bagasse with different particle size were tested using Fan Viscometer and Low Pressure, Low Temperature (LPLT) filter press, he performance of the banana peels in rheological properties and filtration properties studies exhibited higher efficiency compared to the sugarcane bagasse and mud without LCM. The thermal stability test conducted on water-based mud with banana peels as LCM indicates that temperature significantly affects the stability and resistant rheology of the water-based mud, founded that better performance of loss circulation material are particle size distribution, concentration of additives and type of materials used.[1]

(Xin Gao, 2021) applied basil seed powder (BSP) as a multifunctional additive for water-based drilling fluids. The chemical composition, water absorbency, rheological properties of aqueous suspension of BSP were tested. The effect of BSP on the rheological and filtration of bentonite- based drilling fluid before and after thermal aging was investigated. The inhibition characteristics were evaluated by linear swelling, shale cuttings dispersion and shale immersion test. Lubricity improvement by BSP was measured with extreme pressure lubricity test. The results revealed that incorporation of BSP into bentonite suspension improved rheological and filtration properties effectively after thermal aging of 120 C.[2]

(Novia Rita et al 2020) discuss the Rheological Properties of Drilling Mud Consist of CMC Which is Made by Carton Waste and Chemical Additive of Na_2CO_3 for Reducing Lost Circulation, the study was conducted for testing the drilling mud rheology by using CMC from carton waste with the addition of Na_2CO_3, this research was conducted with several scenarios, which in each scenario have different levels of CMC and Na_2CO_3, from each result scenario can be seen in the value of density, viscosity, mud cake, pH, and filtrate volume of each mud, the addition of CMC waste carton and Na_2CO_3 in the dominant drilling mud to rheology and additive function of CMC in increasing the viscosity were in 5 gr sample with 4.5 gr of Na2CO3 addition, with density value: 8.75 ppg, viscosity: 26 cp, mud cake : 0.54 cm, pH: 1, and filtrate volume : 4.42 ml.[3]

(Raheel, Fawad, Muhammad,2020) study the performance of starch extracted from wheat flour as filtration control agent in drilling fluid. Thus, to safe the well from many problems during drilling and in order to make safe and effective drilling operation. The purpose of this research is to investigate the potential of utilizing this additive to form environmentally safe, non-toxic, high biodegradability and low-cost water-based drilling fluid samples with varying the amount of starch. results showed that Efficiency of starch obtained from wheat-flour is showing increment in rheological properties as compare to starch present in market by using same and varying quantity of both and observed that wheat-flour starch is more efficient as compare to starch in market. On the other hand, the efficiency of starch is good but it has been also improved by the extraction of starch from wheat flour by the centrifugation process.[4]

(Abo Taleb T, 2019) discuss and investigates the potential of using mandarin peels powder (MPP), a food waste product, as a new environmentally friendly drilling fluid additive. A complete set of tests were conducted to recognize the impact of MPP on the drilling fluid properties. The results of MPP were compared to low viscosity polyanionic cellulose (PAC-LV), commonly used chemical additive for the drilling fluid. The results showed that MPP reduced the alkalinity by 20–32% and modified the rheological properties (plastic viscosity, yield point, and gel strength) of the drilling fluid. The fluid loss decreased by 44–68% at concentrations of MPP as less as 1–4%, and filter cake was enhanced as well when comparing to the reference mud. In addition, MPP had a negligible to minor impact on mud weight, and this effect was resulted due to foaming issues. Other properties such as salinity, calcium content, and resistivity were negligibly affected by MPP, the results showed that MPP significantly increased PV and YP of the drilling mud, especially at 3% and 4% concentrations. Hence, MPP showed the capability to be used as viscosity modifier at 1% and 2% concentrations.[5]

(Abo Taleb T,2019) the researcher study develop an eco-friendly drilling fluid additive to regulate filtrate and mud cake thickness as well as to assess other drilling fluid properties, he used The biodegradable Grass Powder (GP) as a fibrous fluid-loss agent to be compared with the conventional chemical additive (starch), The effects of introducing different concentrations of GP and starch on the physical and chemical properties of the drilling fluid were evaluated, he found that Starch was less effective than GP in improving filtration specifications. In low temperature and low pressure (LTLP) filtration test, the fluid loss was decreased by 42% and 28% using 0.5% of GP and starch additives, respectively. Researcher found that GP can reduce the amount of non-biodegradable waste, and it will be utilized as a supportive biodegradable drilling fluid additive.[6]

(Mazlin Idress, 2019) This researcher study aims to develop new LCM from agro-waste materials which are orange peel and sunflower seed. The LCMs were prepared in fine, medium and coarse size, with different concentration. The performance of the drilling fluid with newly developed LCM was tested in terms of rheological and filtration properties. The results showed that drilling fluid with finest size and high concentration yielded good filtration control , Tow best size chosen The chosen sizes were fine and medium , combination of LCM gave even better results compared to the fine-sized and high-concentration LCM , different sizes minimized the pores created in the mud cake hence helping to reduce the potential of loss circulation problem.[7]

(Abo Taleb T. Al-Hameedi, Husam ,2019) the researcher develops a biodegradable waste material from Grass, which is environmentally friendly to be utilized as an alternative material to address filtration problems. The lab procedure consisted of crushing and grinding process to assemble the samples to be ready for preparation. The material was tested to generate results from the experiments conducted at surface conditions to determine the reduction in the volume of filtrate and mud cake. Based on the experiments conducted, Grass Powder (GP) can be applied to treat problems associated with the seepage loss in the drilling operations. The grass availability, being eco-friendly, low cost, and the simple method of Grass Powder preparation by using grinding and crushing can prove to be a suitable replacement for conventional materials used to control filtration. The results of Grass Powder were compared to starch, commonly used conventional additive. The results showed that Grass Powder decreased the fluid loss by 44% at 1% (7 grams) concentration of GP, and the filter cake was enhanced as well when comparing it to the reference fluid. While the starch material showed an improvement in seepage loss by 40% at 1% (7 grams) concentration when comparing it to the reference fluid. In addition, starch was less efficient in improving the filter cake as compared to Grass Powder. The Grass Powder has the efficiency to control volume loss that is repeatedly encountered in drilling operation .[8]

(M. Enamul Hossain , 2016) used grass as an environmentally friendly additive in water-based drilling fluids. A particle size distribution test was conducted to determine the particle size of the grass sample by the sieve analysis method. Experiments were conducted on grass samples of 300, 90, and 35 lm to study the characteristics and behavior of the newly developed drilling fluid at room temperature. The results show that grass samples with varying particle sizes and concentrations may improve the viscosity, gel strength, and filtration of the bentonite drilling fluid. These observations recommend the use of grass as a rheological modifier, filtration control agent, and pH control agent to substitute toxic materials from drilling fluids.[9]

(Md Amanullah, Jothibasu , Mohammed , Saudi Aramco ,2015) study of the preliminary test results of a locally developed date seed powder (DSP) as fluid loss additive, which is an agricultural waste product. Experimental results indicate that the fluid loss additive is equally applicable for fresh and salt water-based drilling muds and thus demonstrate its suitability for current and future exploration and exploitation of oil and gas resources. due to the organic nature of the raw material and the use of an environment friendly thermo-physical preparation method, the incorporation of the additive in fluid will have no detrimental impact on the surrounding environment, ecosystems, habitats.[10]

2.2. Drilling Fluid Background:

2.2.1 Drilling Fluid Functions: [11]

The drilling mud must perform the following basic functions:

1. To control sub-surface pressures by providing hydrostatic pressure greater than the formation pressure.

2. To remove the drilled cuttings from the hole.

3. To cool and lubricate the drill bit and drill pipe.

4. To prevent the walls of the hole from caving

5. To release the drilled cuttings at the surface.

6. To prevent or minimize damage to the formations penetrated by having minimum fluid loss into the formation.

7. To assist in the gathering of the maximum information from the formations being drilled.

8. To suspend the cuttings and weighing material when circulation is stopped (gelation).

9. To minimize the swelling stresses caused by the reaction of the mud with the shale formations.

2.2.2 Drilling Fluids Additives:

There are many drilling fluid additives which are used to develop the key properties of the mud. The variety of fluid additives reflect the complexity of mud systems currently in use. The complexity is also increasing daily as more difficult and challenging drilling conditions are encountered. We shall limit ourselves to the most common types of additives used in water based and oil-based muds. These are:

1.Weighting Materials.

2.Viscosifiers.

3.Filtration Control Materials.

4.Rheology Control Materials.

5.Alkalinity and pH Control Materials.

6.Lost Circulation Control Materials.

7.Lubricating Materials.

8.Shale Stabilizing Materials.

2.2.2.1Weighting Materials:

Weighting materials or densifiers are solids material which when suspended or dissolved in water will increase the mud weight. Most weighting materials are insoluble and require

viscosifers to enable them to be suspended in a fluid. Example of weighting material are Barite, Iron Minerals, Calcium Carbonates, Lead Sulphides.

2.2.2.2 Viscosifiers:

The ability of drilling mud to suspend drill cuttings and weighting materials depends entirely on its viscosity. Without viscosity, all the weighting material and drill cuttings would settle to the bottom of the hole as soon as circulation is stopped. One can think of viscosity as a structure built within the water or oil phase which suspends solid material. In practice, there are many solids which can be used to increase the viscosity of water or oil. The effects of increased viscosity can be felt by the increased resistance to fluid flow; in drilling this would manifest itself by increased pressure losses in the circulating system. Example for viscosifiers are clay and polymer.

2.2.2.3 Filtration Control Materials:

Filtration control materials are compounds which reduce the amount of fluid that will be lost from the drilling fluid into a subsurface formation caused by the differential pressure between the hydrostatic pressure of the fluid and the formation pressure. Bentonite, polymers, starches and thinners or deflocculates all function as filtration control agents.

Bentonite imparts viscosity and suspension as well as filtration control. The flat, "plate like" structure of bentonite packs tightly together under pressure and forms a firm compressible filter cake, preventing fluid from entering the formation.

Polymers such as Polyanionic cellulose (PAC) and Sodium Carboxymethylcellulose (CMC) reduce filtrate mainly when the hydrated polymer chains absorb onto the clay solids and plug the pore spaces of the filter cake p preventing fluid seeping through the filter cake and Formation. Filtration is also reduced as the polymer viscosifies the mud thereby creating a viscosified structure to the filtrate making it difficult for the filtrate to seep through.

Starches function in a similar way to polymers. The free waters absorbed by the sponge like material which aids in the reduction of fluid loss. Starches form very compressible particles that plug the small openings in the filter cake.

Thinners and deflocculates function as filtrate reducers by separating the clay flock's or groups enabling them to pack tightly to form a thin, flat filter cake.

2.2.2.4 Rheology Control Materials:

When efficient control of viscosity and gel development cannot be achieved by control of viscosifier concentration, materials called "thinners", "dispersants", and/or "deflocculates" are added. These materials cause a change in the physical and chemical interactions between solids and/or dissolved salts such that the viscous and structure forming properties of the drilling fluid are reduced.

Thinners are also used to reduce filtration and cake thickness, to counteract the effects of salts, to minimize the effect of water on the formations drilled, to emulsify oil in water, and to stabilize mud properties at elevated temperatures.

Materials commonly used as thinners in clay- based drilling fluids are classified as: (1) plant tannins, (2) lignitic materials, (3) lignosulfonates, and (4) low molecular weight, synthetic, water soluble polymers.

2.2.2.5 Alkalinity and Ph Control Materials:

The pH affects several mud properties including:

- detection and treatment of contaminants such as cement and soluble carbonates.

- solubility of many thinners and divalent metal ions such as calcium and Magnesium.

Alkalinity and pH control additives include: NaOH, KOH, Ca (OH)2, NaHCO3 and Mg (OH)2. These are compounds used to attain a specific pH and to maintain optimum pH and alkalinity in water base fluids.

2.2.2.6 Lost Circulation Control Materials:

There are numerous types of lost circulation material (LCM) available which can be used according to the type of losses experienced. Typical LCM materials used are:

- Conventional LCM:

  These include:

  - Flakes: includes mica and cellophane.
  - Granular: includes nutshells, calcium carbonate and salt.
  - Fibrous: includes glass fibre, wood fibre and animal fibre.

- Reinforcing Plugs and Cement:

These are specialized plugs and are only used as a last resort if everything else fails. Two types of reinforcing plugs are in common use:

  - Oil bentonite plug (water-based muds).
  - Water organophilic clay plug (oil-based muds).

- Oil/Bentonite Plug:

The use of this plug is based on the fact that bentonite does not hydrate in oil but when spotted downhole it will contact water, hydrate and with oil forms a strong plug. The pill is pumped to the loss zone with spacers ahead and behind to prevent it from contacting the water-based mud in route to the loss zone. When the pill is finally spotted, it will contact water and will hydrate and seal the loss zone.

- Water/Organophilic Clay Plug:

For oil-based mud, the reverse of the above is used. An organophilic clay, which yields (disperse) in oil-based mud but not in water, is mixed with water and is pumped as a pill to the loss zone. On contact with the oil mud downhole it will form a strong solid material. The pill must be pumped with a spacer ahead and behind to prevent it from contacting the oil based

2.2.2.7 Lubricating Materials:

Lubricating materials are used mainly to reduce friction between the wellbore and the Drill string. This will in turn reduce torque and drag which is essential in highly deviated and horizontal wells. Lubricating materials include: oil (diesel, mineral, animal, or vegetable oils), surfactants, graphite, asphalt, gilsonite, polymer and glass beads.

2.2.2.8 Shale Stabilizing Materials:

There are many shale problems which may be encountered while drilling sensitive highly hydratable shale sections. Essentially, shale stabilization is achieved by the prevention of water contacting the open shale section. This can occur when the additive encapsulates the shale or when a specific ion such as potassium actually enters the exposed shale section and neutralizes the charge on it. Shale stabilizers include: high molecular weight polymers, hydrocarbons, potassium and calcium salts (e.g. KCl) and glycols.

2.2.3 Drilling Fluid Types:

A drilling fluid can be classified by the nature of its continuous fluid phase. There are three types of drilling fluids:

1. Water Based Muds

2. Oil Based Muds

3. Gas Based Muds

2.2.3.1 Water Based Mud:

These are fluids where water is the continuous phase. The water may be fresh, brackish or seawater, whichever is most convenient and suitable to the system or is available.

The following designations are normally used to define the classifications of water-based drilling fluids:

1. Non-Dispersed-Non - inhibited

2. Non-dispersed - Inhibited

3. Dispersed - Non-inhibited

4. Dispersed – Inhibited

-Non-Inhibited means that the fluid contains no additives to inhibit hole problems.

-Inhibited means that the fluid contains inhibiting ions such as chloride, potassium or calcium or a polymer which suppresses the breakdown of the clays by charge association and or encapsulation.

-Dispersed means that thinners have been added to scatter chemically the bentonite (clay) and reactive drilled solids to prevent them from building viscosity.

-Non-Dispersed means that the clay particles are free to find their own dispersed equilibrium in the water phase.

-Non-dispersed-non-inhibited fluids do not contain inhibiting ions such as chloride (Cl-), calcium (Ca2+) or potassium (K+) in the continuous phase and do not utilize chemical thinners or dispersants to affect control of rheological properties.

-Non-dispersed- inhibited fluids contain inhibiting ions in the continuous phase, however they do not utilize chemical thinners or dispersants.

-Dispersed-non-inhibited fluids do not contain inhibiting ions in the continuous phase, but they do rely on thinners or dispersants such as phosphates, lignosulfonate or lignite to achieve control of the fluids' rheological properties.

-Inhibited dispersed contain inhibiting ions such as calcium (Ca2+) or potassium (K+) in the continuous phase and rely on chemical thinners or dispersants to control the fluids rheological properties.

2.2.3.1.1 Non-Dispersed, Non-Inhibited Mud Systems:

Spud Gel Mud: Used for top hole drilling, usually in40 to 50 bbl. pills on each connection, and hole volume sweeps and displacement at hole TD. The muds prepared by pre-hydrating bentonite at 30 ppb (pounds per barrel) for 4-6 hrs. prior to use to allow time for the clay to yield.

CMC Gel Mud: Used as an alternative to the spud mud when the mud system is closed in. The CMC added at 1 to 3 ppb, offers some fluid loss control, however, this mud system should only be used in areas of unreactive formations and will be subjected to high levels of dilution.

2.2.3.1.2dispersed, Non-Inhibited Systems:

Lignite, Lignosulphonate or Phosphate Muds: This is a clay- based fresh water mud which requires high treatment dilution levels while drilling reactive clays. Extra caustic soda needs to be added because of acidic tendencies of system. This is a cheap and easy mud system to maintain, however, it is not common in the oil industry today.

2.2.3.1.3dispersed Inhibited Systems:

Lime /Gypsum Muds: These muds are built from fresh water but can also be built using seawater. Lime/gypsum muds are often used in areas where shale hydration and swelling result in significant borehole instability. The presence of calcium ions in mud help to stabilize the open shales and prevent sloughing and heaving.

2.2.3.1.4 Non-Dispersed, Inhibited Systems:

These mud systems are the most common in drilling problematic formations like reactive clays, sloughing heaving shales and halite salt sections. The mechanisms of inhibition vary according to the type of inhibitive product being used. It is common to utilize two or more products in the same mud system. These mud systems also minimize the reaction with the drilled cuttings and therefore help to avoid the high dilution rates exhibited by other fluid groups.

Salt Saturated Mud: In this system, the continuous phase, water, is saturated with salt (sodium chloride) usually at 180 mg/L, and mud viscosity is developed with PAC (for filtration) and XC Polymer (for viscosity) and starch is used to control fluid loss. Attapulgite clay can be used for viscosity particle distribution. This system is used for drilling salt sections to balance the formations and avoid wash-outs. This system has a minimum mud weight of 10 ppg.

It should be noted that the solubility of salt increases with temperature, so the system should be mixed with slightly extra salt to compensate for the increased temperature at downhole conditions. If the drill string becomes stuck whilst drilling a salt section, spot a fresh water pill across the zone and allow the salt to dissolve.

KCl Polymer Mud: This mud consists of Potassium Chloride (KCl) dissolved in fresh or salt water. Both the potassium and the polymer are used to reduce shale hydration by ion substitution using the potassium ions and encapsulation of the shale by the polymer. Potassium is a smaller and more highly charged ion than the sodium ion but has a low charge density and is less hydrated than the sodium ion. Hence, the substitution of sodium ions on the shale surface by the potassium ions enable the shale platelets to be closer together and, in addition to this, the potassium ion fits inside the volume of the ion spacing on the clay surface, thereby neutralizing the negative charge on the clay surface with a greater strength. This results in shale drill cuttings being easier to remove and less contamination in the system. Wellbore stability is also increased by the addition of potassium to mud as a result of creating a non-reactive wellbore. During drilling, the potassium ion is being readily used up on the wellbore and cuttings and further additions of potassium is required to to maintain the potassium concentration in the mud system.

PHPA Muds: PHPA (Partially Hydrolyzed Polyacrylamide) is a high molecular weight polymer and is used as a cuttings and wellbore stabilizer. The PHPA molecules bond on clay sites and inhibit the dispersion of solids into the mud system by encapsulating the clay particles. This aide the solids removal process on surface. The PHPA concentration should be held in excess in the system by 2 to 4 ppb at all times. This system can be used in conjunction with KCl for added inhibition. Clay inhibition can also be obtained from products like Glycols, Cations and Mixed Metal Hydroxides.

WBM ingredients can be divided into 16 functional categories [12] Table (2.1) Each functional category of additives may contain several alternative materials with slightly different properties

Table (2.1) : Functional Categories of Materials Used In WBM:

Functional Category	Function	Typical Chemicals
1/ Weighting Materials	Increase density (weight) of mud, balancing formation pressure, preventing a blowout	Barite, hematite, calcite, Limonite
2/ Viscosifiers	increase viscosity of mud to suspend cuttings and weighting agent in mud	Bentonite or attapulgite clay, carboxymethyl cellulose, partially hydrogenated polyacrylamide (PHPA) & other polymers
3/ Thinners, dispersants, temperature stability agents	Deflocculated clays to optimize viscosity and gel strength of mud	Tannins, polyphosphates, lignite, lignosulfonates
4/ Flocculants	Increase viscosity and gel strength of clays or clarify or de-water low-solids muds	Inorganic salts, hydrated lime, gypsum, sodium carbonate and bicarbonate, sodium tetraphosphate, acrylamide-based polymers
5/ Filtrate reducers	Decrease fluid loss to the Formation through the filter	Bentonite clay, lignite, Na-carboxymethylcellulose, polyacrylate, pregelatinized starch

	cake on the wellbore wall	
6/ Alkalinity, pH control Additives	Optimize pH and alkalinity of mud, controlling mud properties	Lime (Ca (OH2)), caustic soda (NaOH), soda ash (Na2CO3), sodium bicarbonate (NaHCO3), & other acids and bases
7/ Lost circulation materials	Plug leaks in the wellbore wall, preventing loss of whole drilling mud to the formation	Nut shells, natural fibrous materials, inorganic solids, and other inert insoluble solids
8/ Lubricants	Reduce torque and drag on the drill string	Silicate beads, water-based lubricants, synthetic liquids, graphite, surfactants, glycols, glycerin
9/ Shale control materials	Control hydration of shales that causes swelling and dispersion of shale, collapsing the wellbore wall	Soluble calcium and potassium salts, other inorganic salts, and glycols
10/ Emulsifiers & surfactants	Facilitate formation of stable dispersion of insoluble liquids in water phase of mud	Anionic, cationic, or nonionic detergents, soaps, organic acids, and water-based detergents
11/ Bactericides	Prevent biodegradation of organic additives	Glutaraldehyde, triazine Disinfectants
12/ Defoamers	Reduce mud foaming	Alcohols, silicones, aluminum stearate, alkyl phosphates
13/ Pipe-freeing agents	Prevent pipe from sticking to wellbore wall or free stuck pipe	Silicate beads, detergents, soaps, surfactants, water-based lubricants
14/ Calcium reducers	Counteract effects of calcium from seawater, cement, formation anhydrites, and gypsum on mud properties	Sodium carbonate and bicarbonate (Na2CO3 & NaHCO3), sodium hydroxide (NaOH), polyphosphates
15/ Corrosion inhibitors	Prevent corrosion of drill string by formation acids and acid gases	Amines, phosphates, specialty mixtures
16/ Temperature stability agents	Increase stability of mud dispersions, emulsions and rheological properties at high temperatures	Acrylic or sulfonated polymers or copolymers, lignite, lignosulfonate, tannins

2.2.3.2 Completion and Workover Fluids: [11]

These are fluids are designed to be non-damaging to the reservoir during the completion of and workover a well. They are usually brines (salty water) which can be made up with up to three different salts depending on the required density. Commonly seawater or sodium chloride is used. Below is a list of salt types and their density ranges:

- Sodium Chloride 8.4 to 10.0 ppg
- Calcium Chloride 8.4 to 11.63 ppg
- Sodium Chloride /Calcium Chloride 9.0 to 11.23 ppg
- Calcium Chloride / Calcium Bromide 10.83 to 13.33 ppg
- Calcium Bromide / Zinc Bromide 13.33 to 18.33 ppg

2.2.3.3 Oil Based Muds:

An oil-based mud system is one in which the continuous phase of a drilling fluid is oil. When water is added as the discontinuous phase then it is called an invert emulsion. These fluids are particularly useful in drilling production zones, shales and other water sensitive formations, as clays do not hydrate or swell in oil. They are also useful in drilling high angle/horizontal wells because of their superior lubricating properties and low friction values between the steel and formation which result in reduced torque and drag. Invert emulsion fluids (IEFs) are more cost effective than water muds in the following situations:

- Shale stability
- Temperature stability
- Lubricity
- Corrosion resistance
- Stuck pipe prevention
- Contamination
- Production protection

Oil based muds are subject to strict Government Legislations and so serious thought should be given to alternative systems.

There are two types of oil-based muds:

- Invert Emulsion Oil Muds
- Pseudo Oil Based Mud

2.2.3.3.1 Invert Emulsion Oil Mud:

The basic components of a typical low toxicity invert emulsion fluid are:

-Base Oil: Only low toxic base oil should be used as approved by the authorities (such as the DTI in the UK). This is the external emulsion phase.

-Water: Internal emulsion phase. This gives the Oil/Water Ratio (OWR), the% of each part as a total of the liquid phase. Generally, a higher OWR is used for drilling troublesome formations. The salinity of the water phase can be controlled by the use of dissolved salts, usually calcium chloride. Control of salinity in invert oil muds is necessary to "tie-up" free water molecules and prevent any water migration between the mud and the open formation such as shales.

- Emulsifier: Often divided into primary and secondary emulsifiers. These act at the interface between the oil and the water droplets. Emulsifier levels are held in excess to act against possible water and solid contamination.

-Wetting Agent: This is a high concentration emulsifier used especially in high density fluids to oil wet all the solids. If solids become water wet they will not be suspended in the fluid, and would settle out of the system.

-Organophilic Clay: These are clays treated to react and hydrate in the presence of oil. They react with oil to give both suspension and viscosity characteristics**.**

-Lime: Lime is the primary ingredient necessary for reaction with the emulsifiers to develop the oil water interface. It is also useful in combating acidic gases such as CO_2 and H_2S. The concentration of lime is usually held in excess of 2 to 6 ppb, depending on conditions.

2.2.3.3.2 Pseudo Oil Based Mud:

To help in the battle against the environmental problem of low toxicity oil-based muds and their low biodegradability, developments have been made in producing a biodegradable synthetic base oil. A system which uses synthetic base oil is called a Pseudo Oil Based Mud

(SOB) and is designed to behave as close as possible to low toxic oil-based mud (LTOBM). It is built in a fashion akin to normal oil-based fluids, utilizing modified emulsifiers.

SOB muds are an expensive system and should only be considered in drilling hole sections that cannot be drilled using water-based muds without the risk of compromising the well objectives.

The base oil that is being changed out can be one of the following:

Detergent Alkylates, Synthetic Hydrocarbon, Ether and Ester. These have been listed in increasing order of cost, biodegradability and instability.

Synthetic base fluids include Linear Alpha Olefins (LAO), Isomerized Olefins (IO), and normal alkanes. Other synthetic base fluids have been developed and discarded such as ethers and benzene-based formulations.

Esters are non-petroleum oils and are derived from vegetable oils. They contain no aromatics or petroleum-derived hydrocarbons. The primary advantage of an ester-based fluid is that it biodegrades readily, either aerobically or, more importantly, from a mud cuttings disposal viewpoint, anaerobically.

2.2.3.4 Gas Based Fluids:

There are four main types of gas-based fluids:

1. Air

2. Mist

3. Foam

4. Aerated Drilling Fluid

These are not common systems as they have limited applications such as the drilling of depleted reservoirs or aquifers where normal mud weights would cause severe loss circulation. In the case of air, the maximum depth drillable is currently about 6-8,000 ft. because of the capabilities of the available compressors. Water if present in the formation is very detrimental to the use of gas-based muds as their properties tends to break down in the

2.3 Background of Material:

2.3.1 Hyphaene Thebaica: [13]

Hyphaene thebaica is commonly referred to as doum, and it is a type of palm tree with edible oval fruit which belongs to the mint family (Arecaceae). They have several vernacular names like doum palm, doom palm, gingerbread palm, zembaba, mkoma, arkobkobai and kambash [1, 2]. The doum palm is native to the northern half of Africa. It grows in the west from Mauritania and Senegal, and east to Egypt, Kenya and Tanzania. It tends to grow along the Nile River in Egypt and Sudan in the areas which contain groundwater. It is also native to the Levant and the Arabian Peninsula (Israel, Sinai, Yemen and Saudi Arabia). It grows in wadis and at oases, but it is considered as drought-tolerant and sometimes grows on rocky hillsides. Also, it is very resistant to destruction by fire in scrub or a forest.

2.3.1.1 Botanical Description:

The doum palm is a dioecious palm and grows up to 17 m (56 ft) high. The trunk, which can have a girth of up to 90 cm (35 in), the trunk divided into two branches, each branch divided again into two branches, and the ends of the branches contain tufts of large leaves. The bark is smooth, dark gray and contains the scars of fallen leaves. The petioles are about 1 m long, sheathing the branch at the base and contain curved claws. The leaves are fan-shaped and measure about 120 by 180 cm (47 by 71 in) Figure (2.1) Male and female flowers are produced on separate trees. The inflorescences are similar in general appearance, up to about 1.2 m (3 ft. 11 in) long, irregular in the branching and have two or three spikes in each branch. Male flowers have a short-stalk, solitary in pits of the spadix, spathe-bracts encircling the spadix, pointed. Branches of female spadices become thicker in the fruiting stage. Woody fruits are produced in the female palm that continues on the tree for a long time. They are 6–10 × 6–8 cm, smooth, rectangular to cubical with rounded edges, shiny brown when ripe. Its fresh weight is about 120 g and dry weight is about 60 g and each one containing a single seed. The size of seeds about 2–3.5 × 3 cm, the color is ivory, truncate at the base and the apex is obtuse [4].

2.3.1.2Chemical Composition of Doum Fruit:

Doum fruit has a high-quality protein varied between 2.86 and 5.01%, high proportion of lysine and cysteine of crude protein varied between 4.09–4.16% and 0.2–1.62%, respectively, the limited amino acid threonine, crude fat varied between 1.2 and 8.4%, crude fiber varied between 52.26 and 66.5%, the most important carbohydrates component was mannose varied between 13 and 75.9%, also the presence of calcium, magnesium, potassium, iron sodium and negligible amount of nickel, cobalt and molybdenum. Phytochemical compounds of doum fruit such as tannins, saponin, steroids, glycosides, flavonoid, terpenes and terpinoids were found at low and moderate concentrations [14].

Figure (2.1) : hyphaene thebaica

2.3.2 Ziziphus Spina-Christi: [14]

Ziziphus spina-Christi commonly known as Christ's Thorn Jujube, is a deciduous tree and native to the warm- temperate and subtropical regions, including North Africa, South Europe, Mediterranean, Australia, tropical America, South and East of Asia and Middle East (Yossef et al., 2011). It belongs to the Rhamnaceae family in the order of Rosales that contains about 60 genera and more than 850 species. The genus Ziziphus consists of about 100 species of deciduous or evergreen trees and shrubs throughout the world (Abalaka et al., 2010). Z. spina- Christi has been among the key plants of the Iranian traditional medicine since ancient times and is indigenous and naturalized throughout Iran (Solati and Soleimani, 2010). It has been known as “Sedr” in Iran and wildly distributed in East, South, North-East and central parts of.

2.3.2.1 Descriptions:

Z. spina-Christi is a shrub, sometimes a tall tree, reaching a height of 20 m and a diameter of 60 cm; its bark is light-grey, very cracked, scaly; trunk twisted; very branched, crown thick; shoots whitish, flexible, drooping; thorns in pairs, one straight, the other curved. Its leaves are glabrous on upper surface, finely pubescent below, ovate-lanceolate or ellipsoid, apex acute or obtuse, margins almost entire, lateral veins conspicuous. Flowers in cymes, subsessile, peduncle 1 to 3 mm. Fruit about 1 cm in diameter (Zargari, 1988).

Figure (2.2) : Ziziphus spina-Christi

2.3.2.2 chemical composition:

A survey of the literature revealed that a number of cyclopeptide and isoquinoline alkaloids, flavonoids, terpenoids and their glycosides have been found to occur in various amounts in most Ziziphus species. The leaves of these plants contain betulinic and ceanothic acids, various flavonoids, saponins, erols, tannins and triterpenes (Ali and Hamed, 2006; Glombitza et al., 1994). The extract of Z. spina-christi was shown to contain butic acid and ceanothic acid (a ring-A homologue of betulinic acid), cyclopeptides, as well as saponin glycoside and flavonoids, lipids, protein, free sugar and mucilage (Adzu et al., 2003). Cardiac glycosides and polyphenols (such as tannins) are also reported from the leaves (Abalaka et al., 2010). Geranyl acetate (14.0%), methyl hexadecanoate (10.0%), methyl octadecanoate (9.9%), farnesyl acetone C (9.9%), hexadecanol (9.7%) and ethyl octadecanoate (8.0%) were characterized as the main components of Z. spina-christi leaves essential oil (Ghannadi et al., 2002).

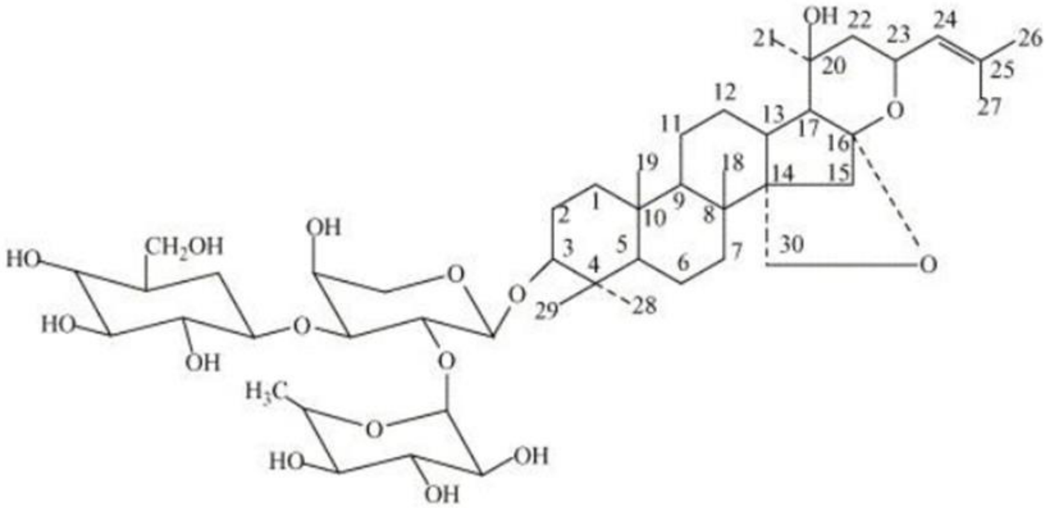

Figure (2.3) : Molecular structure of christinin-A, the major components of Z. spina-christi leaves.

2.3.3 Baobab Tree (Adansonia Digitata L):

Baobab or Adansonia digitata L. belongs to the Malvaceae family (Bremer et al., 2003) and is a deciduous tree native to arid Central Africa (Yazzie et al., 1994). Its distribution area is large and this species can be found in most of Sub-Sahara Africa's semi-arid and sub-humid regions as well as in western Madagascar (Diop et al., 2005). It has been intro- duced to areas outside Africa and grown successfully (Sidibe & Williams, 2002). Baobab is a very long-lived tree with multipurpose uses. The different plant parts are widely used as foods, medicines and the bark fibres are also used (Sidibe & Williams, 2002). The tree provides food, shelter, clothing and medicine as well as material for hunting and fishing (Venter & Venter (1996) cited in Gebauer et al., 2002). Every part of the baobab tree is re- ported to be useful (Owen (1970) cited in Igboeli et al., 1997 and Gebauer et al., 2002). [15]

2.3.3.1 Description: [16]

The baobab has an extensive root system and high-water holding capacity. Its mean annual temperature range is 20–30°C, but it can tolerate well high temperatures up to 40–42°C (in West Africa), it's resistant to fire, and survive low temperature as long as there is no frost. It is drought tolerant and frost sensitive. This adaptation allows it to grow in zones with 100–1000 mm annual rainfall, but trees are often stunted in the lower rainfall areas [12]. The tender root, tubers, twigs, fruit, seeds, leaves and flowers are all edible and they are common ingredients in traditional dishes in rural areas in Africa.

2.3.3.2 Chemical Composition:

The leaves contain 13-15% protein, 60-70% carbohydrate, 4-10% fat and around 11% fibre and 16% ash [17]. Energy value varies from 1180-1900kJ/100g of which 80% is metabolized energy. The leaves are rich in pro-vitamins A and C. In terms of protein content and WHO standards, leaves of baobab can be rated 'good' in that they score well for 5 of the 8 essential amino acids as shown in Table (2.2)

Table (2.2) : amino acid composition of baobab parts (mg/g dry weight) :

Amino acid composition	Fruit pulp (mg/g dry weight)	leaves (mg/g dry weight)		Seed (mg/g dry weight)	% of total protein WHO ideal
		A*	B**		
Aspartic acid	2.96	10.3	12.9	21.1	-
Glutamic acid	3.94	13.4	11.4	48.9	-
Serine	1.18	4.7	4.6	11.4	-
Glycine	1.21	6.0	5.6	10.4	-
Histidine	0.42	2.1	2.2	5.05	-
Arginine	2.28	8.5	7.1	2.21	-
Leucine	-	8.7	8.7	14.0	7.0
Threonine	0.65	4.1	3.6	6.98	4.0
Proline	2.35	5.6	6.8	9.55	-
Tyrosine	1.06	4.5	4.1	5.59	-
Valine	1.62	6.3	6.5	11.6	5.0
Methionine	0.14	2.4	1.0	2.29	-
Isoleucine	1.37	6.7	5.5	8.27	4.0
Phenylalanine	2.06	5.7	6.0	10.3	-
Cysteic acid	1.09	2.7	2.1	3.60	-
Lysine	1.63	6.1	6.1	11.2	5.5
Tryptophan	0.18	1.6	2.0	2.81	4.0
Alanine	2.21	6.2	6.7	10.6	-
Phenylalanine + tyrosine	-	-	-	-	16.0
Methionine + cystine	-	-	-	-	3.5

*Data from Burkina Faso.
**Data from Maiduguri, Nigeria.

the Seeds are used as a thickening agent in soups; they are also fermented and used as a flavoring agent, or roasted and eaten as snacks [31,42]. When they are roasted, they are sometimes used as a substitute for coffee. In some cases, seeds are de-hulled by boiling, rubbing by hand, and then sun drying the kernels before grinding. Fermentation of powdered de-hulled seeds is known to increase protein digestibility. It also reduces the trypsin inhibition activity but increases tannin content [43]. The baobab seeds are ground with peanuts and water and sugar added to make a sauce used with porridge [44]. Seed pulp is sometimes known as monkey bread and is eaten and traded in the different regions [15]. The seeds have an energy value of 1803 kJ/100g approximately 50% higher than leaves, moisture 8.1%, protein 33.7%, and fat 30.6%, carbohydrates 4.8%, fibre 16.9% and ash 5.9% [32]. The vitamin C content of the baobab seeds has not been researched extensively but they are known to contain high levels of lysine, thiamine, Ca and Fe [45]. Nkafamiyaet al. [46] reported that the phosphorous, calcium and magnesium are the major mineral elements present in baobab seeds table (2.3)

table (2.3) : Mineral contents of baobab fruit pulp and seed (μg/g dry weight) :

Mineral	Seeds μg/g dry weight	Fruit pulp μg/g dry weight
Iron	18.3	17
Calcium	3950	3410
Magnesium	3520	2090
Manganese	10.6	-
Zinc	25.7	10.4
Sodium	19.6	54.6
Phosphorus	6140	733

Figure (2.4) : Baobab Tree (Adansonia digitata L)

Chapter 3

Methodology

Chapter 3

Methodology

3.1Preparation Fluid Loss Control Materials:

The local material adansonia fruit haversack and Zizyphus spina-Christi fruit were brought from local market in Khartoum, Hyphaene thebaica fruit brought form north Kordofan, after material become available it is crushed into coarse size particle then it is grinded into powder by using conventional classic mill **figure (3.1),** the powder of the material was sieved in civil engineering lab **figure (3.2)**.

3.1.1 Adansonia Fruit Haversack Grinding:

Before grinding the adansonia fruit haversack soaked in the water, then dried followed by grinding process by using conventional classic mill.

3.1.2 Zizyphus Spina-Christi Fruit Grinding:

Before grinding the waste of Zizyphus spina-Christi fruit was washed by water, then dried, the seed inside the fruit was taking out

3.1.3 Hyphaene Thebaica Fruit Grinding:

All Hyphaene thebaica fruit grinding except kernel fruit.

Figure (3.2): sieve(civil E L)

Figure (3.3): Powder of Adansonia Fruit crust (ADF lab)

Figure (3.1): Conventional Classic Mill (Common Market)

Figure (3-5): Hyphaene Thebaica Fruit Powder(ADF lab)

Figure (3.4): Zizyphus Spina-Christi Fruit (ADF lab)

Figure (3.6): Coarse Size of Material (ADF lab)

Then prepared drilling fluid by mixture device **figure (3.7)** to mix the certain quantity of materials (soda ash, caustics soda, xanthan polymer, Starch, KCL) with water after weighting them using sensitive balance **figure (3.8)**, The materials were prepared in powder form that to be suitable for the laboratory tests. Then they weighted to add to mud.

Figure (3.7): mixer (ADF lab)

Figure (3.9): materials that used (ADF lab)

Figure (3.8): sensitive balance (ADF lab)

Fluid loss control and LC control efficiency were determined over multiple experiments according to standard procedures through the laboratory work. This test including:

3.2.1 Filtration Volume:

Unit: ml / 30 minutes at100 psi

The filter press instrument used to investigate of filtrate volume of drilling fluids. filtrate volume of studied sample was determined according to the following procedure:

1- first the drilling mud prepared by mixing water with materials ((soda ash, caustics soda, xanthan polymer, Starch, KCL) with local fluid loss control material after weighted with sensitive balance.

2- Pour the drilling mud with local fluid loss material into the filter press cell. Before adding the mud with local fluid loss material, be sure each part of the filter cell is dry and that all gaskets are not distorted or worn. Place filter cell in frame and close relief valve. Place a container under the drain tube.

3- Set one timer for 7,5 min ± 0,1 min and the second timer for 30 min ± 0,1 min. Start both timers and adjust pressure on cell to 100psi. Pressure shall be supplied by compressed co2 gas in small cell.

4- At 7,5 min ± 0,1 min on the first timer, read the filtration volume in ml per minute, read filtrate until the end of the second timer set at 30 min.

3.2.1.1 Filter Press Device:

The calculation of the filtration volume of the drilling mud based on the character of the device. With pressure provided test the filtration volume for each mud

3.2.1.1.1 Purpose:

This device used to simulate the filtration process and formation of the mud cake, and used to determine the filtration volume of the mud.

3.2.1.1.2 Main Technical Parameter:

Working pressure: 100 psi

Laboratory condition

3.2.1.1.3 Characters & Working Principles:

Feed the drilling fluid with the testing material into cylinder of the device. and then test the effect of filtration volume of every material with the constant pressure. This device has the characters of small size, simple structure, and easy operation. It can be used to test filtration volume of drilling mud with testing material.

Figure (3.10): Filter Press Device (ADF lab)

3.2.2 Simulation of LCM Application:

3.2.2.1 Procedure:

1. both LCM materials of the coarse size for Hyphaene thebaica fruit kernel and Zizyphus spina-Christi fruit were weighted with sensitive balance.

2.drilling fluid prepared by mix the soda ash, caustics soda, xanthan polymer, Starch, KCL and packer after weighted with water.

3. LCM were added to drilling fluid with mixing by mixer.

4.beach sand put in the filter press cylinder over the filter paper inside the cylinder.

5.The drilling fluid with the LCM pour in the cylinder over the beach sand.

6. Place filter cell in frame and close relief valve. Place a container under the drain tube.

7.montoring the losses occurring after applied constant pressure.

8. vent the filter press pressure after the loses almost stopped.

Chapter 4

Result and Discussion

Chapter 4

Result and Discussion

Table (4.1) : sizes of local fluid filtration control materials :

Material	Fluid loss control size
adansonia fruit powder	Less than 710 mc
Zizyphus spina-Christi fruit powder	Less than 710 mc
Hyphaene thebaica fruit powder	Less than 710 mc

4.1 Drilling fluid preparation:

Table (4.2) : weight of drilling fluid additives for fluid filtration control experiments :

Water volume =350 ml

Additive	**Weight(gr)**		
	Adansonia Fruit	Zizyphus Spina-Christi Fruit	Hyphaene Thebaica Fruit
filtration control materials	2	2	2
Soda ash	0.5	0.5	0.5
Caustics soda	0.5	0.5	0.5
Xanthan polymer	1.5	1.5	1.5
Starch	4	4	4
Kcl	15	15	15

Table (4.3) : weight of drilling fluid additives with different weight of Adansonia Fruit :

Water volume 350ml

Additive	**Weight(gr)**		
	Test1	Test2	Test3
Adansonia Fruit	2	4	7
Soda ash	0.5	0.5	0.5
Caustics soda	0.5	0.5	0.5
Xanthan polymer	1.5	1.5	1.5
Starch	4	4	4
Kcl	15	15	15

4.2 Filtration Materials Test Device Experiments:

Table (4.4) : filtration volume for fluid filtration control materials :

Time	Fluid loss control	Volume(ml)
7.5	Adansonia Fruit	**5**
	Zizyphus Spina-Christi Fruit	**8.2**
	Hyphaene Thebaica Fruit	**8.6**
30	Adansonia Fruit	**10**
	Zizyphus spina-Christi Fruit	**More than 10**
	Hyphaene Thebaica Fruit	**More than 10**

Table (4.5) : filtration volume of Adansonia Fruit:

Time	Weight(gr)	Volume(ml)
7.5	**2**	**5**
	4	**8.2**
	7	**8.6**
30	**2**	**10**
	4	**More than 10**
	7	**More than 10**

Figure (4.1) : filter cake for the local fluid filtration control materials

4.3 Simulation of LCM experiment:

4.3.1 Drilling Fluid Preparation for LCM Simulation:

Table (4.6) : drilling fluid formulation for local LCM experiment :

Water volume =350 ml

Additive	Weight (gr)
Soda ash	**0.5**
Caustic soda	**0.5**
xanthan polymer	**1.5**
Starch	**4**
Pac lv	**2**
Packer	**1**
Kcl	**15**
LCM (Hyphaene thebaica fruit kernel and Zizyphus spina-Christi fruit)	**25.5**

4.3.2 Result:

The local LCM material give good result for controlling the loss of the drilling mud , after 10 minute the losses almost stopped.

4.4Discussion:

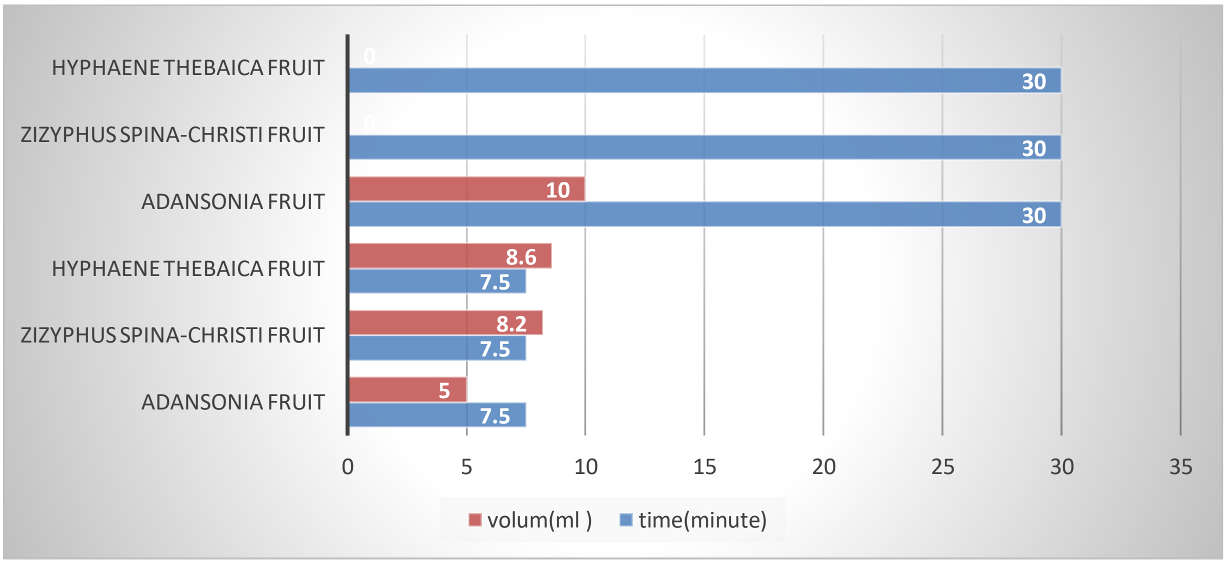

Figure (4.2) : Filtration volume vs time for filtration control materials

The figure shows the filtration volume for local fluid filtration materials at the same condition and weight, the adansonia give the best result compared with the other materials.

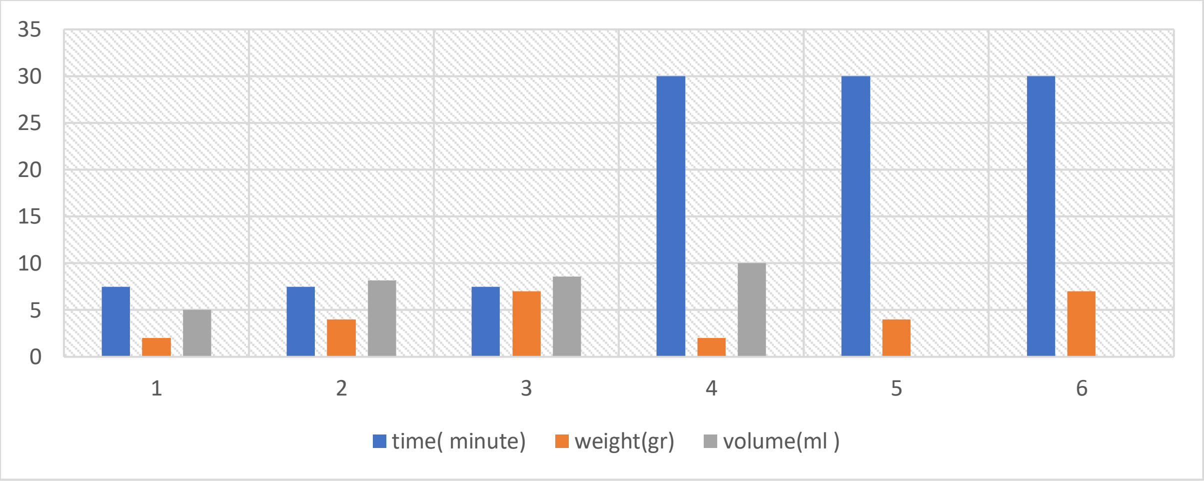

Figure (3.4) : Filtration volume vs time for Adansonia Fruit

Depending on the previous tests the adansonia tested for different concentrations and noted that for lower concentrations give best result.

Chapter 5

Conclusions and Recommendations

Chapter 5

Conclusions and Recommendations

5.1 Conclusions:

Based on the results of the tests performed, the following conclusions were obtained:

1/ Using low concentration of adansonia as fluid filtration control reduce filtration volume

2/ Hyphaene thebaica fruit and Zizyphus spina-Christi fruit cannot be use as a filtration agent because of their high filtration volume. Zizyphus spina-Christi fruit

3/ It cannot be use at pay zone, because of low solubility of fluid filtration materials

4/ Hyphaene thebaica fruit and Zizyphus spina-Christi fruit can be use as LCM.

5/ From simulation result obtained that Hyphaene thebaica fruit and Zizyphus spina-Christi fruit for coarse size the loss is almost stopped.

5.2 Recommendations:

1/ To study the effect of adansonia fruit on other drilling fluid properties.

2/ Applied the Hyphaene thebaica fruit and Zizyphus spina-Christi fruit as LCM in small sizes.

3/ Experiment the Hyphaene thebaica fruit and Zizyphus spina-Christi fruit as LCM by PPT (permeability plugging tester) test.

4/ To test each of Hyphaene thebaica fruit and Zizyphus spina-Christi fruit individually as LCM.

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