بسم الله الرحمن الرحيم

Sudan University of Science and Technology

College of Petroleum Engineering & Technology

Petroleum Engineering Department

Laboratory Evaluation of suspension of Local Lost Circulation Materials (LCM) in a Drilling fluid

Project submitted in partial fulfillment of requirement of the degree of B.sc In petroleum engineering

Prepared by:

1- Ahmed Abdulaziz Abdelgader Adam
2- Mohammed Hassan Hashim Ebied.
3- Osman Abdullah Mustafa Mohammdain
4- Zahir Elneel Mohammed Ahmed

Supervisor:

Dr.Eng.Ahmed Abdelaziz Ibrahim.

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الآيــــة

بسم الله الرحمن الرحـيم

قال تعالـى:

﴿ وقل رب زدني علـــــــــماً ﴾

ســورة طـه الآية (114)

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

Acknowledgment

After thanks Allah

We would like to send best wishes to supervisor,

Dr.Eng.Ahmed Abdelaziz Ibrahim.

For his gaudiness and support to help us in generating

Perfect work, that by the will of **Allah** become

A beneficial study.

We would like to thank **Eng.Ali Mamoon**, who tirelessly listened to our ideas and offered encouragement when it was most be needed and also for being so supportive by information.

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May Allah bless them all .

Abstract

Loss of drilling fluids into formations (i.e., lost circulation [LC] through natural/induced fractures) is a recurring and costly issue within the industry.

Numerous solutions/practices are applied to prevent or resolve LC. Among these, the addition of lost circulation materials into drilling fluids to plug the fractures has been a widely accepted practice. Well-known local lost circulation materials include ground marble, graphitic carbon, cellulosic particulates, and fibers. In this project used combination of local material (lalob, neem and mica) to plug loss zone

For an LC control operation to be effective and successful, it is necessary to avoid or minimize settling of local lost circulation materials in the treatment or drilling fluid. Uniform suspension of LCM is required during pill preparation and wellbore applications such as during a hesitation squeeze operation.

The objective of this project is to investigate the performance of three natural materials (mica, Azadirachta indica (neem) and balanites aegypytiaca (lalob)) as powder to a void Minimize the settling of local local lost circulation materials . In this project laboratory test take place to evaluate the performance of mixture of local LCM and relative this performance with suspend ability characteristics of LCM. Found that Determination and control of the suspension characteristics of LCM-carrying drilling fluids can help ensure efficient use of LCMs for LC control. This method is especially important in severe loss zones where large-size LCMs are used as well as in high-pressure/high-temperature (HP/HT) or inclined wells where the fluid’s ability to suspend the local lost circulation materials is most critical.

تجـريد

مشكلة فقدان دورة سائل الحفر تحدث خلال عملية الحفر داخل الشقوق الطبيعة او المستحثة وهذا الفقدان مكلف في الصناعة النفطية وهنالك العديد من الحلول طبقت لحل هذه المشكلة ومن ضمن هذه الحلول اضافة مواد فقدان سائل الحفر لسائل الحفر لسد الشقوق كمعالجة لفقدان دورة سائل وهي طريقة وجدت قبول عملي واسع ومن ضمن مواد فقدان دورة سائل الحفر (ground marble, graphitic carbon, cellulosic particulates, and fibers) في هذا المشروع استخدمت ثلاثة مواد محلية كخليط لمنع فقدان دورة سائل الحفر.

ولتكون عمليات التحكم الفقدان فعالة وناجحة من الضروري تجنب او تقليل استقرار مواد فقدان سائل الحفر في عمليات معالجة مشكلة فقدان سائل الحفر.ولتكون فعالة يتطلب تعلق مواد فقدان سائل الحفر تعلقا منتظما خلال عمليات التحضير وايضا خلال ضخه داخل البئر.

يهدف هذا المشروع لحل مشكلة استقرار مواد فقدان دوره سائل الحفر وتقييمها معمليا ليكون التحكم بعمليات فقدان دورة سائل الحفر أكثر فعالية وأكثر نجاحا عن طريق التجارب المعملية

وبعد التجارب المعملية وجد أن تعلق مواد فقدان سائل الحفر يمكن ان يساعد في عمليات التحكم بفقدان سائل الحفر. وهذه الطريقة مهمة جدا وخاصة في الفقدان العالي او الحاد ، عندما تستخدم احجام كبيرة من مواد فقدان سائل الحفر وايضا في ابار (HPHT) ، والآبار المائلة عندما يكون مقدرة سائل الحفر على تعلق مواد LCMS ضعيفة .

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Introduction

Chapter 1

Introduction

1.1 General introduction:

Drilling operation is one of the most important stages in petroleum industry. It consists of many parts like rotation system, hoist system and mud (drilling fluid) circulation system, figure (1-1).

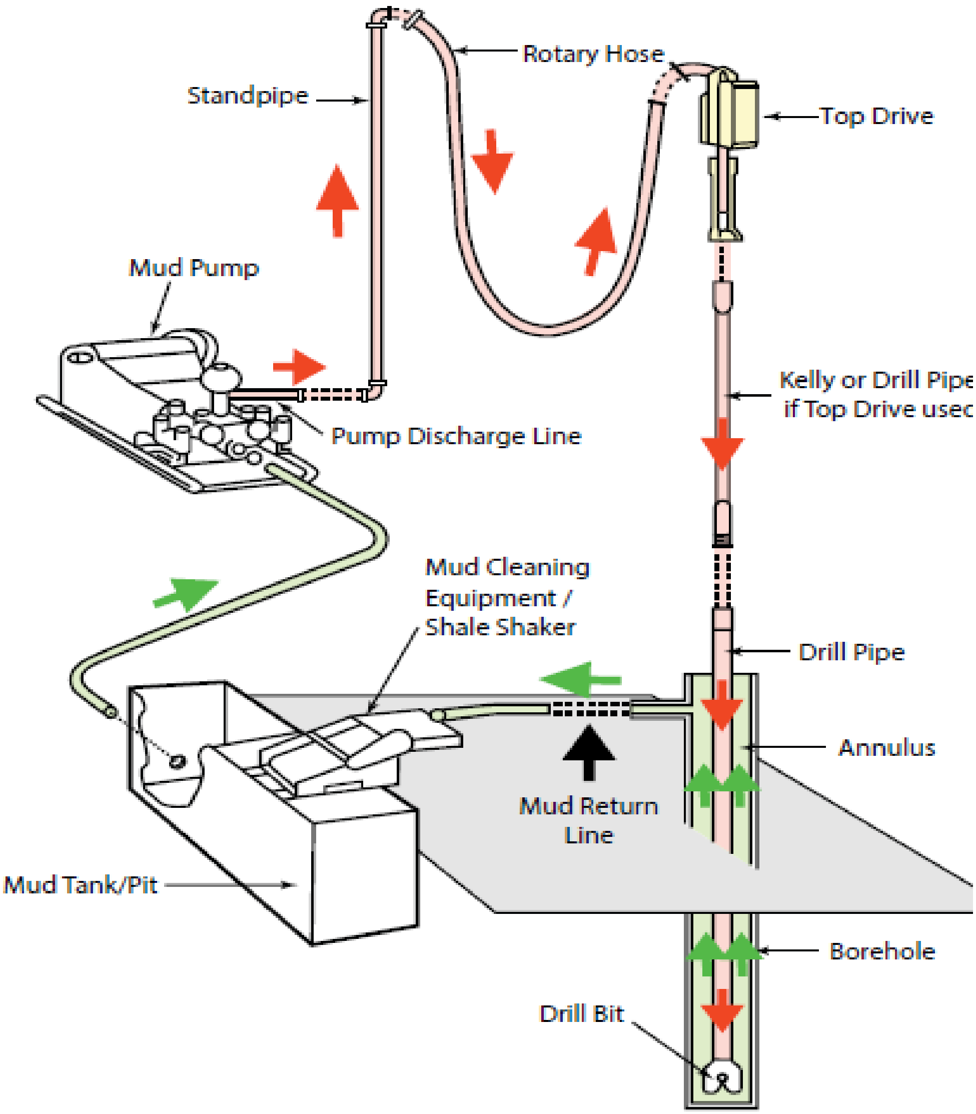


Figure (1-1): circulation system

1.2 Drilling Fluid Classifications:

- Pneumatic (Dry Gas, Mist, Foam)
- Oil-Based (Diesel, Mineral, Non-Petroleum Hydrocarbon)
- Water-Based (Non-Inhibitive Inhibitive Polymer)

1.3 Functions of Drilling Fluids:

The most common drilling fluid functions are:

1. Remove cuttings from the well.
2. Control formation pressures.
3. Suspend and release cuttings.
4. Seal permeable formations.
5. Maintain wellbore stability.
6. Minimize reservoir damage.
7. Cool, lubricate, and support the bit and drilling assembly.
8. Transmit hydraulic energy to tools and bit.
9. Ensure adequate formation evaluation.
10. Control corrosion.

1.4 Common Drilling fluid problem:

1. Lost circulation
2. Contamination

1.4.1 Lost circulation:

Losses of whole mud to subsurface formations is called lost circulation or lost returns. Lost circulation is one of the most fundamental problems encountered in drilling. It results in wastage of costly mud and time involved in rig operations. It also requires the use of materials and techniques in order to prevent them and the resultant loss of petroleum reserves. Other hole problems such as wellbore instability, stuck pipe and even blowouts have been the result of lost circulation. Besides the obvious benefits of maintaining circulation, preventing or curing mud losses is important to other drilling objectives such as obtaining good quality formation evaluation and achieving an effective primary cement bond on casing. Lost circulation occurs in one of two basic ways:

1.4.1.1 natural losses:

Natural losses occur in rocks containing porosity and permeability or with natural fractures .Three types of formations can be recognized:

- **Coarse Sands and Gravel Beds**

  Usually occur near the surface where the formation is both porous and highly permeable: permeability in excess of 10 to 25 Darcy.

- **Natural Fissures or Fractures**

  Natural fissures and fractures usually occur in limestone and chalks which have been subjected to tectonic activities or to leaching by acids. Losses in the formations is usually severe.

- **Cavernous Formations**

  Caverns develop in limestone and dolomite formations ranging in size from fraction of an inch to large tunnels. They form as a result of ground water percolating through the formation and subsequent dissolving of the calcium. Total losses are usually experienced when drilling cavernous formations, resulting in the use of a special drilling technique called blind drilling. In blind drilling, drilling is carried out without returns to surface, usually using sea water.

1.4.1.2 INDUCED FRACTURES

Hydraulic fracturing is initiated and lost circulation occurs when some critical fracture pressure is reached or exceeded. Once a fracture is created or opened by an imposed pressure, it may be difficult to repair (heal) and it may never regain the original formation strength, as shown later in Figure (1-2). Lost circulation may persist even though the pressure is later reduced. This is one reason why it is better to pre treat for, and prevent, lost circulation than to permit it to occur. Lost circulation resulting from induced pressure is usually caused by one of two situations:

- Setting intermediate casing in the wrong place. If casing is set above the transition zone crossing from normal to abnormal pressures, the pressures exerted by the heavier mud (required to balance the increasing pressures) will often induce fracturing at the weak casing seat. Losses due to fracturing are most commonly near the previous casing seat, not at bit depth, even if casing is properly set.

- Excessive down hole pressures are the result of many conditions including:
  - ❖ Mechanical forces.

    Improper hydraulics. Excessive pump rates and velocities causing high Equivalent Circulating Density (ECD) pressures.
  - ❖ Drilling practices.
    - Increasing pump rates too rapidly after connections and trips. This can be extremely important when dealing with oil-base fluids Failure to bring the pumps up to speed slowly can put much higher circulating pressures on the formation due to the tendency of oil base mud to thin at higher temperatures generated while circulating and to thicken at lower temperatures during trips. It is common for circulating pressures to decrease 100+ psi (6.9+ bar) as the mud heats to circulating temperature.
    - Raising or lowering the pipe too fast (surge/swab).
    - Spudding bridges.
    - Excessive Rate of Penetration (ROP) for a given flow rate will result in high cuttings concentration in the annular fluid causing a high ECD.
    - Pipe whipping.

  - ❖ Hole conditions.
    - Sloughing shale or increased solids loading in the annulus and high equivalent circulating density.
    - Accumulation of cuttings in a washed-out portion of the hole or in the mud.
    - Cuttings beds or barite sag forming on the low side of a directional well, or possible slumping.

- Bridges.
- Kicks and well-control procedures.

❖ Mud properties.

- Excessive viscosities and gel strengths.
- Buildup of drilled solids.
- Thick filter cakes that reduce the hydraulic diameter of the wellbore.
- Excessive mud density or increasing mud density too fast.
- Unbalanced mud columns.
- Barite sag.

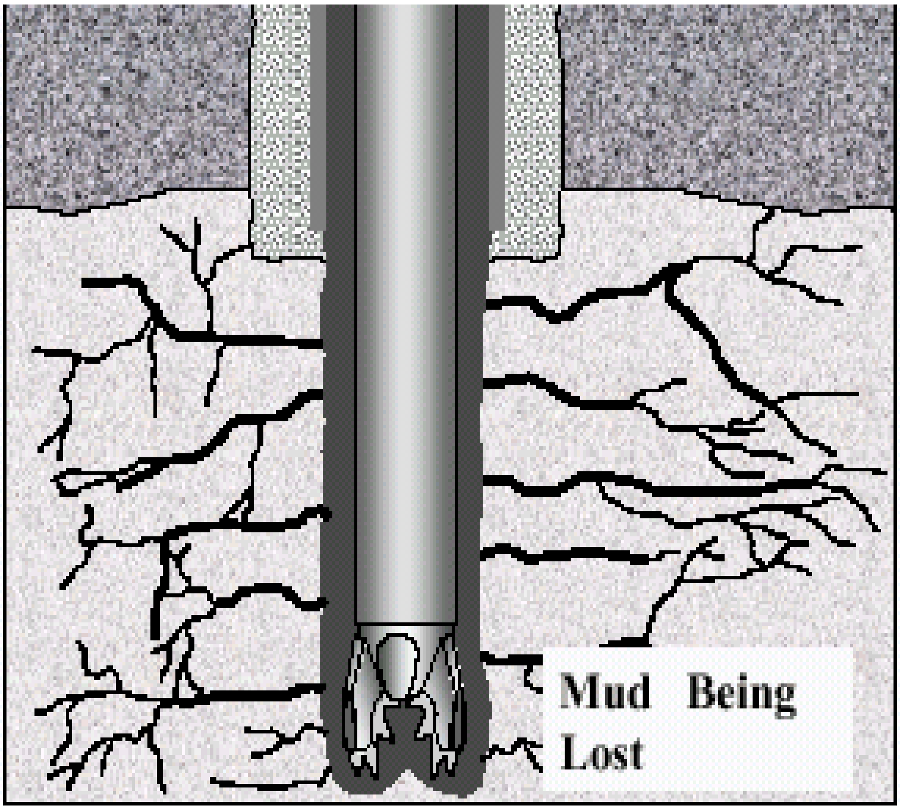


Figure (1-2): show formation lost circulation

1.5 Lost circulation can be grouped into four classes:

1. Seepage losses: From 1-10 bbl/hr and lost while circulating at the normal drilling circulating rate
2. Partial losses: From 10-50 bbl/hr and lost while circulating at the normal drilling circulating rate

3. Severe losses: Greater than 50 bbl/hr and lost while circulating at the normal drilling circulating rate. In some cases, no losses may be seen if pumping stops indicating that the ECD is the cause of lost circulation.
4. Total losses: When the mud level in the annulus can not be seen or the hole can not be filled through the annulus. Total losses usually occur in cavernous formations

1.6 Preventive Measures:

Good planning and proper drilling practices are the keys to preventing lost circulation by minimizing excessive pressures on the formation. Several measures can be taken to prevent or minimize lost circulation:

1. Set the casing in the appropriate zone so the fracture gradient of the formation at the casing shoe will be sufficient to support the hydrostatic head of heavier muds required to balance pressures in the formations below.

2. Minimize down hole pressures.

Pipe movement should not exceed critical speeds when tripping. When the drillstring is run in the hole, there is a surging pressure from the piston effect of the bit and collars increasing the pressure exerted on the bottom of the hole. Good drilling practices will keep these pressure surges within the fracture and formation pressure

1.7 LOCATING THE ZONE:

1. Locate the exact point of lost circulation. Several methods are available for locating the point of lost circulation. These include:

- Spinner survey
- Temperature survey.
- Radioactive tracer survey.
- Hot wire survey.
- Pressure transducer survey.

2. Determine the severity of loss (normal partial severe and total losses)

3. Determine the type of loss.

- Shallow, unconsolidated formations where rock permeability can exceed 14 darcies

- o Formations that have natural fractures such as limestone and some hard shale formations
- o Fractures that are induced through mechanical or hydraulic forces exerted on the formation
- o Cavernous zones normally confined to limestone

4. Classification of loss by determining the pressure within the zone

1.8 Lost circulation procedure and treatment in field:

USE OF PLUGGING OR BRIDGING AGENTS. This technique should be used against seeping and partial losses and the less severe complete losses. A plug of bridging agents in the mud is mixed and applied as follows:

1. Establish the approximate point of the loss, type of formation taking the mud height the mud stands in the hole and the rate of loss. The most probable point of the loss is just below the casing shoe if a fracture of the formation due to a pressure surge is suspected.
2. Use open-ended drill pipe for placement of the plug if practical. Otherwise use open watercourse bits or jet bits with the nozzles removed. If materials must be placed through a :
   - o jet bit or MWD/LWD tools, medium or fine, sized bridging agents should be used to prevent plugging the bit.
   - o Mix a 100- to 250-bbl LCM slurry. Blends of (coarse, medium and fine) granular, fiber and flake bridging agents are commercially available and could be substituted for those added separately. Use mud from the circulating system or mix LCM in a freshly prepared, viscous, bentonite slurry. Add 15 lb/bbl of coarse NUT PLUG. Add 5 lb/bbl coarse-to-medium fibers. Add 5 lb/bbl of medium-to-fine fibers. Add 5 lb/bbl of 1⁄2-in. (13-mm) cellophane flake.
   - o Pump the LCM slurry through the open-ended drill pipe opposite the loss zone.
   - o Suspension of Lost Circulation Materials
   - o There for in severe loss zones where large-size LCMs are used as well as in high-pressure/high-temperature (HP/HT) or inclined wells.

Determination and control of the suspension characteristics of LCM-carrying drilling fluids can help ensure efficient use of LCMs for LC control. For an LC control operation to be effective and successful, it is necessary to avoid or minimize settling of LCM in the treatment or drilling fluid. Uniform suspension of LCM is required during pill preparation and wellbore applications such as during a hesitation squeeze operation.

Suspend ability represents ability of the particles to resist settling in a fluid. The suspend-ability of a LCM in the carrier drilling fluid is important to help ensure the following:

1. Uniform suspension of LCM in the pill-preparation tank
2. Proper suspension of LCM in a wellbore annulus during a lost circulation control operation.

Handy prediction and management of LCM suspension properties and the resulting effective lost circulation control can provide a significant improvement in LCM technology. The model could serve as a tool mud engineers use to evaluate the suspend-ability of a LCM in a given fluid, allowing them to make speedy decisions at the rig site to optimize the LCM and fluid combinations. This can help minimize the corresponding down-time and prevent wellbore stability related issues. This work may also be a part of a drilling fluid design and reduce costly, time consuming trial and error attempts to design LCM treatments.

1.9 Problem statement:

Settling of lost circulation material (LCM) in the treatment or drilling fluid Make LC control operation to be ineffective and failed. In this project a mixture of LCM using particle of Mica Azadirachta indica and balanites aegypytiaca (local Materials) as powder was applied for predicting the suspend ability

1.10 Objectives:

- To identify optimum size of local LCM
- Evaluate the performance of local LCM in field condition

- Evaluate the suspend-ability and minimize settling of local LCM.
- Efficient lost circulation control.

1.11 Methodology:

First National material collected from forest (soba) and mica collected from (ministry of mineral) followed by milled step in local market and then in soil lab in civil engineering department three type of material of different sizes were obtain by sieving process as shown in table (4-1) drilling fluid was prepared in CEPT,SUST. Measured density, ryheology properties, by mud balance and 6 speed viscometer respectively and added different sizes of LCMs with optimum percentage obtained by sabeel et al graduate project and tested in lost circulation device to evaluate the different sizes performance with different type of losses (total , partial and seepage) another amount of mixture was prepared and poured in glass linear which was kept 4 hour in room condition after aging the glass linear was Divided to two equal section (top and bottom) each section were separated from mixture by filtering it through 75 micro meter sieve and washing it with water to remove any adhered mud and repeated this processes for different LCM sizes

Chapter 2

Literature review

Chapter 2

Literature review

2.1Background of materials

2.1.1 General description of Mica:

Mica is a group name for sheet-like silicate minerals of which muscovite biotite and phologopite are the most important minerals, chemically mica is a complex silicate of sodium potassium and aluminum, however the chemical composition is not of important of any industry except of some uses of ground mica where the content of iron oxide present as an impurity should be very low. Muscovite occurs in a range of colors from the so called "ruby" to light and dark green with numerous other intermediate shades ruby color is usually preferred for some industries. Muscovite mica is not affected by heat till temperature of 1050 F, where it is starts' loosing it is water of crystallization ti is completely loose water at (1500-1800) F. Mica is widely distributed through the world, but commercially valuable book and block mica concentrated are scarce. The most important mica deposits in sudan occurred in the rubatab area, nile province. They extend along the western bank of the nile between berber and Abu Hamed, but the most interesting mica outcrops concentrate in the region between zuma and zuaira villages and up to jebel Rahaba and Jebel Razam to the west of the Nile. The area is composed of metasediments of the basement complex intruded by different types of igneous rocks. It is believed that the mica bearing pegmatitic is associated with the young granitic intrusions in the area. An experimental project for mica production was started in march,1974. The project started with two leased areas Rahaba I and Rahab II, (Geological& Mineral Resources Department. "Mica Deposits in the sudan").

Rahaba II mine opened as underground .The calculated ore reserves down to depth of thirty five meters are 90,000 tons of mica books. The development of the mine now reached 22 meters in depth and gave very good results ,since march 1978 Rahaba II is considered as commercial body the other mine Rahaba I is under development and the 14 result till now are very encouragement its expected that in six month time Rahaba I will be another commercial unit. The topography of the rubatab area is characterized by amonotony of low relief. Several features namely gebel Bafd1 in the extreme north, G. Razzam , G. umm Sheriba, G. Absol, G. Qarn Dam ,El Tor, G.Danab ELkelb, G.Nakharu and G. Umm Arafibia in the extreme south; G.Barga to the south – east of the shereik, rise through this low- flying undulating monotonous country.

These comprise Elkoro, Abusalam, Abusaiyal, Abusol ,Elrahaba (EL I th- nein) ELHad,Dam EL Tor,Umm Sarih and a few Khors. The process that the company used for cutting mica was, after began of mica project it was trained the local labors on knife cut, they did this to avoid air inclusion and they were trained and can beconsidered skills labors. Bates Company was prepared mica after mining, it was Transported to the cutting centers, they used knife cut to avoid air inclusion. Then they putted the standard bellow to define the criteria that they used to determine it is size, area and minimum diameters of one side, (Geological& Mineral Resources Department. "Mica Deposits in the sudan"),

Figure (2-1):show mica sharps

2.1.1.1 Chemical properties:

In the chemical composition muscovite is a silicate of aluminum and potassium, but usually small amount of magnesium and iron are present. Also for most industrial purposes the physical properties of mica are more important than chemical composition for some uses the latter is an important concentration, (M.L. KABESH, 1960)

Table: (2-1) results of chemical analysis "Indian and Sudanese, Mica", (M.L. KABESH, 1960)

COMPONENT	SUDANESE Rubatab muscovite %	INDIAN %
AL2O3	35.1	36.72
F2O3	2.3	0.95
TIO2	0.4	-
CAO,BAO	-	0.21
SIO2	45	45.57
K2O	9.8	8.81
NA2O	1	0.62
Mature H2O	4.6	5.05

Muscovite is chemically stable and is not easily affected by oil, water or acid and can be heated to dual redness with little ill effect, (M.L. KABESH, 1960).

2.1.1.2 Physical properties:

The physical properties of muscovite however are those which determine it is value cleavage flexibility with which it can be cut, color, staining, size, resistant to heat and electrical current. It is the last factor that the muscovite is superior to most other mica.

The de-electrical properties, unfortunately, the de electrical strength, the de electrical constant, the power factor and the volume resistant of the rahaba II muscovite have not been studied in detail.

The flexibility of the Rahaba mica should be described as moderate to good and the thermal properties are good .Some pinholes, commercially known as "pin pits", were recognized in a few samples. The Rahaba muscovite is hard and it is possess good splitting properties. To describe mica diaphaneity the company was take the samples from depths 2-3 meters were with very mineral stains, vegetable stains or cross graining, Some silver stains were present due to air bubbles and patches gave them a silvery appearance by reflected lights.

They divided the diaphaneity to two classes according to defect due impurities and structural defect due to impurities , these are further divided in to two sub-classes stains and spots ,the most common impurities films of clay staining takes place in the zone of surface weathering by the penetration of muddy water between the laminae . The solution penetrate large areas of crystals and work between many of the laminae is generally obtained at some distance from the surface and is abcent where mining reaches hard and un altered pegmatite body.

Inclusion plates of of brittle silica are sometimes found lying between the lamination of mica and forcing them apart this inclusion of silica as muchas one cm thick. Thickness examination of mica was checked by standard thickness seven mills and more (mill=1/1000 in). Bellow 7 mills rejected to be opened to consider films and book form splitting, (M.L. KABESH, 1960).

2.1.2 Neem chemical and physical properties” azadirachta indica”:

In African savanna there are several types of forest tree species used for food, wood or Traditional medicinal purpose also there is a large variety of oil-bearing plants used for Food, lighting and for industrial purposes.Meliaceae families are well known in Africa because it has many suitable uses and cover Size range from forest trees to small shrubs.Theneemtree (Azadirachta indica) is native to tropical South East Asia and belongs to Meliaceae family. It is fast growing ,can survive drought , poor soil and very hot temperature up to 44°C and as low as 4°C . It is a tall tree,up to 30 21 meters high with leafy spreading branches. The seed of neem (figure 2-5)is about 1.5 cm long.Neem (azadirachtaindica) is an ever green tree and used for medicinal purpose and pest control.The neem seeds contain about (30-50)% of oil and other many active components,Neem fatty acids (FAs) comrise oleic,stearic,palmitic and linoleic acids, mainly used for pharmaceutical industries. The fatty acid composition of the oil may vary from tree to tree because of genetic make-up (Faye, 2010; singh et al., 1999).Neem cake has been used as animal feed for a long time we report here on the chemical composition of A. indica oils (AISO and CPSO) and cakes (AIC and CPC): FA composition, acidity, iodine values, amino acids, and carbohydrates, (Mulholland et al, 2000).

Figure (2-2): show Neem seeds before grinding

2.1.2.1 Composition of neem seed oil and cake obtained after oil extraction:

Fresh A.indica was collected and the seeds were separated manually, cleaned and dried. The dried seeds were ground in a mill and screened through a mesh Tindo Se'bastien Djenontin, et al, 2012).

2.1.3 Chemical and physical properties of Lalob" Balanites aegyptiaca":

Lalob which known as balanites aegyptiaca is one of the desert tree and has many uses as edible seed (figure 2-6), wood of fuel, charcoal, timber and fodder. It has high medicine value (Sheded; Pulford and Hamed; 2006).the outer part of the seed used to cure skin diseases, hypoglycemic agent, root bark as anti malaria and promising for HIV (Alashaal et al,2010; Cook et al,1998)

Figure (2-3):show Lalob seed

2.1.3.1 Physical properties:-

Color: was described by using the color nomenclature namely, red, orange (mixture of red and orange), yellow, green (mixture of green and yellow) in the addition of bright or dull, (C.A.OKIA et al, 2013) Refractive index: was defined by using Bellingham Stanly refract meter, (model number A86006), (C.A.OKIA et al, 2013) Viscosity: was defined by using viscometer standardized using viscosity standard fluid from Brookfield, (C.A.OKIA et al, 2013)

2.1.3.2 Chemical contracture:

- **Polymers:**
    - Cellulose: It is cracked in the presence of high acidic media, and then it is swelledwhen it is absorbed water, has no effect on sandstone and does not ferment during time.
    - Lignin: Is a complex polymer of aromatics alcohol. It is an organic compound commonly found in the cell wall of plant cell making them hard and protective. It is affected by basicity of the media.
    - Hemi cellulose: Has a random amorphous structure with little strength. It is easily hydrolyzed by dilute acid or base as well as myriad enzymes.

- **Acid value:** this test was done by to find the acid value of lalob seed, (C.A.OKIA et al, 2013).

- **Saponification value:**

  the saponification value measure the number of milligrams of KOH required to saponificate 1 gram of fat under certain condition. This test was done to find the saponification value of lalob seed. (C.A.OKIA et al, 2013), table (2-10).

- **Iodine value (Hanus method):**

  the iodine number measure the quantity of lode in 1 gram of subtends. This test was done to find the iodine value of lalob seed by Hanus meyhod, (C.A.OKIA et al, 2013)

2.2 Literature review

Lost circulation is a broad subject and several studies and measures have been introduced in the industry to combat it.

Firstly Moore (1986) noted that in shallow, unconsolidated formations where the drilling fluid may flow easily into the formation, the most common method used to combat lost circulation is to thicken the mud. This may be done in fresh water muds by adding flocculating agents such as lime or cement. He also stated that in areas such as below surface casing in normal-pressure formations where natural fractures are common, the most common method used to combat lost circulation is to drill without fluid returns to the surface. The purpose is to remove the generated cuttings from the hole and deposit them at the lost circulation zone

Also Natalia Collins et al (2010) study Wellbore Stress Management Engineered Process Drilling depleted zones with a high overbalance significantly increases the risk of borehole tensile failure, with subsequent lost circulation. To minimize these risks, appropriate engineered treatments should already be present in the drilling fluid as new formations are exposed. What is required is properly sized particulate material that can use both “near size” pore throat plugging as well as aggregating in the pores. In order for these materials to be applied in the drilling fluid they should not adversely affect the rheology or increase the ECD. An engineered approach for sizing the material to the application should be taken to achieve full benefit and The application strategy has two components: prevention (pre-treatment) and correction (remediation).

Pre-Treatment. Pre-treat with optimally sized LCM (a combination of the finer grinds of sized resilient graphitic carbon and sized calcium carbonate) before drilling high risk lost circulation zones, such as depleted sands Subsequent Treatment. Add subsequent treatments in the form of sweeps , This addition treatment will help ensure the wellbore sees a higher concentration of particulate materials in general, and the larger particles in particular.

Natalia Collins et al (2010) discuss the Bridging Particle Size Distribution and Fracture Modeling .this modeling can be applied to more accurately predict and optimize LCM selection, concentration and target particle size distribution. Based on pore size

Metcalf et al. (2011) in which they investigated the successful application of a new environmentally-friendly natural polymer to control lost returns during drilling and primary cementing operations in the Permian Basin of West Texas is also worth noting. This polymer consists of 30 pounds per barrel of conventional LCMs, a natural polymer, and silicate particles. They presented instances where this material was used to cure partial to total losses in more than 100 wells during drilling and primary cementing operations after other loss return control materials/methods have failed

Donald L.et al (2008) discuss Developing and Testing Lost Circulation Materials By combining a particle size design modeling capability with standardized lab screening tests and this test result a unique blend containing optimized types of lost circulation materials, including a resilient graphitic carbon, formulated with an optimized particle size distribution(OPSD) has been developed

Conventional LCMs at (December, 2011) by HARRISON the research discuss The effectiveness of granular LCMs depends on their particle size distribution, with larger particles first forming a bridge across or within the void and smaller particles bridging the openings between larger ones. Fibrous materials are best suited for controlling losses in porous and highly permeable formations because they form a mat-like bridge over the pore openings and Flake LCMs are also designed to form a mat on the formation face, which also provides the best results as fibrous materials when used to treat losses in porous and highly permeable formations. Blends of granular, flakes, and fibrous materials are used in solving actual field problems

Fred Growcock et al (2012) studies Shear Degradability of Granular Lost Circulation Materials and The results indicate that, while the carbon-based products are more resistant than the marble-based products to shear degradation neither one is particularly long-lasting, especially compared to the fibers and nut shells, which exhibited little or no change in their PSDs An exception is a high-resiliency carbon-based LCM Neither the fiber nor the nut shell demonstrated a clear size dependence of shear resistance based on particle size. And found the Continuous wellbore strengthening treatments generally require maintenance of a specific size distribution of the lost circulation material (LCM) in the whole mud and although show some studies of LCM degradability have been carried out in the past, these looked at only a few LCM and then only at total recovery of material after brief shearing of LCM suspended in a drilling fluid and result show size of the LCM is a key property that controls its ability to seal and strengthen fractures, it is critical to measure the effect of shear on the full PSD of the material.

Anton Gerner (2012) analyzed experimentally LCM in OBM These materials are added to the drilling fluid to seal the fractures and to increase fracture initiation or fracture propagation pressure. The lost circulation materials may be used in the form of pills, when the lost circulation zone is identified. In some cases, solutions to lost circulation may be obtained by the pretreatment of the drilling mud with the particles of the proper material and with the proper particle size distribution. Subsequent treatment is also important, as a form of lost circulation prevention, when the particles are efficiently added to the mud system in the correct size, shape and type.

Understanding the mechanisms of fracture sealing and the performance of the lost circulation materials is critical if the problem of lost circulation is to be mitigated effectively. The objective of this thesis was to investigate the performance of the chosen lost circulation materials (i.e LC-Lube) in 60/40 and 80/20 oil/water ratio OBM mud systems. The bridging performance of LC-Lube was studied with the help of the bridging tests in the laboratory. The D50 of the particle size distribution was 310 µm. The slot openings used in the bridging tests were 100 µm, 250µm, 300 µm, 400 µm and 500 µm. The concentration of LC-lube additive were 16,85 lb/bbl and 8,49 lb/bbl. The results of the tests were compared and the performance of the bridging materials discussed and analyzed. The results have shown that the LCM performance in two different mud systems when it comes to bridging, was better with 60/40 OBM in the case of 250 µm and 300 µm slot openings and a concentration of 16,85 lb/bbl. In the case of a lower concentration of the LC-lube, the performance with the 60/40 was as well better with the slot openings of 250 µm and 300 µm, although the difference was less pronounced.

Sandeep D.et al (2013)Investigating lost circulation in has shown that it is difficult to arrest losses while drilling with non-aqueous drilling fluids (NAF) as compared to aqueous drilling fluids (AF). In an This paper discusses the modification of drilling fluids (particularly non-aqueous fluids) to combat lost circulation. N1 measured at low and moderate shear stresses for different aqueous and non-aqueous drilling fluids shows that the magnitude of N1 for AF was significantly higher than that for NAF; although, the FANN® 35 viscometer shear rheology of both was similar. Another important finding was that adding certain polar-organic compounds to the NAF improves its N1 magnitude remarkably, which in turn was found to improve the drilling fluid’s performance in lost circulation applications. For representative AF and NAFs, with the same FANN 35 viscometer rheology properties and lost circulation materials, fracture plugging efficiency was probed on a Permeability Plugging Apparatus (PPA) using a tapered slot. The plugging performance of the LCM in the AF was significantly better than in the NAF for the same combination of LCM. This difference in plugging performance was attributed to the noticeable difference in N1 observed for these two drilling fluids. The relation between N1 and plugging efficiency became evident when the addition of polar-organic compounds to the NAF increased its N1 and improved its plugging efficiency .this work reach to fact that FANN 35 viscometer (or shear stress rheology) data for the drilling fluids did not clarify the difference between the PPA plugging behavior in the AF and NAF .These findings could be used to tailor the NAF for LCM treatment during the mud design phase and help alleviate trial-and-error in the LCM design .

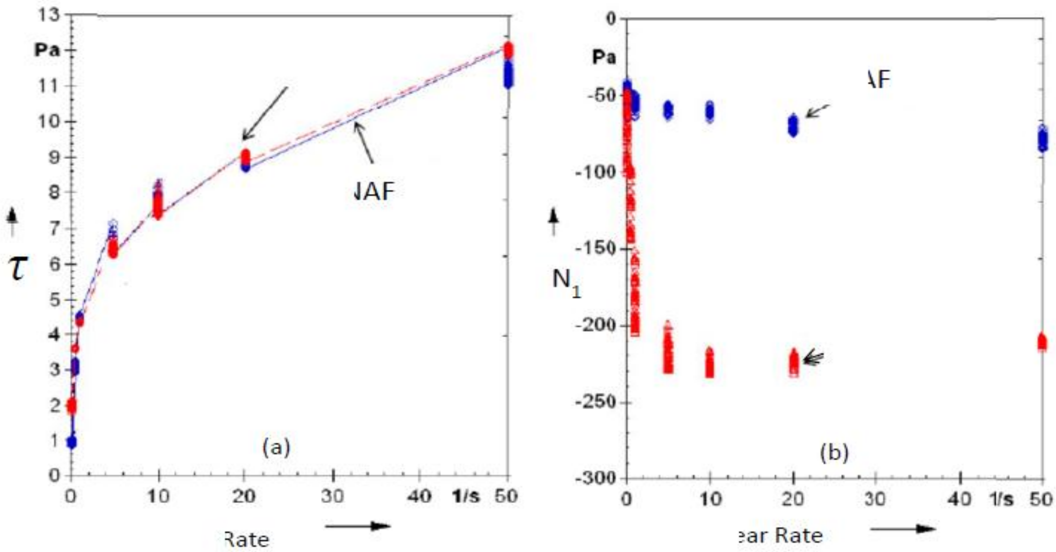


Figure (2-4) (a) Shear stress (τ) and (b) Normal stress response N_1 plotted for AF and NAF

Arunesh Kumar et al (2010) Studied Properties of Lost-Circulation Materials and found that the appropriate sized particulate materials, referred to as lost circulation materials (LCM) have been used to arrest or mitigate the lost circulation. Depending on the estimated width of the fractures, natural or induced, the LCMs are selected and mixed with drilling fluids in the form of a pill or run continuously with the fluid to treat the target zone. And the result of Laboratory data and field experience indicate limited success may occur if a single material such as sized calcium carbonate is used alone for wellbore strengthening. This is possibly due to size reduction that may occur while drilling or due to fracture closure stresses (FCS) acting on the particles.

However, using calcium carbonate in conjunction with resilient graphitic carbon (RGC) material has shown to be effective in increasing the formation integrity.

The effect of mechanical properties of LCMs on wellbore strengthening has been investigated using compression/crush tests at different confining pressures simulating a wide range of FCS. Crush test demonstrated compaction and significant crushing of the ground marble and ground nut shells at high confining pressure (~ 5000 Psi). Considerable improvement in the crushing resistance and resiliency of these materials was observed with small additions of RGC. Knowledge of deformation and failure behavior of different LCM materials may result in better design. In this paper recommendations are made on different combinations of LCM that may be used more effectively to provide wellbore strengthening Experiments to Determine the Less-Studied LCM Properties Determination of Shape Factors Crushing Resistance Determination Constant volume of LCM (or mixture) was taken for the experiments. then weighing, LCM, sieving was done using Rho Tap sieve shaker Pressure was applied using the Tinius Olsen Hydraulic Tester at a loading rate of 1500 lbf/min After crushing, LCM was again sieved to estimate the D (90), D (50) and D (10) Percentage change in D (90) is reported as

$$\frac{\text{D(90)before crushing} - \text{D(90)after crushing}}{\text{D(90)before crushing}} * 100$$

Similarly the percentage change in D (50) was calculated Resiliency Determination From discussion of results obtained from previous tests Conclude that For wellbore strengthening, the mechanical strength of the LCM will play an important role. The LCM combination needs to have sufficient crush resistance to withstand the various types of stresses (mainly FCS) in the wellbore without undergoing significant change in the particle size. Two different LCM may perform better when used together. From experimental results and several reported instances of combined use of ground marble and resilient graphite, that mixture of LCM may provide better results.

Sandeep D et al (2014) demonstrated LC control operation to be effective and successful, it is necessary to avoid or minimize settling of LCM in the treatment or drilling fluid. Uniform suspension of LCM is required during pill preparation and wellbore applications such as during a hesitation squeeze operation. And presents semi-empirical models useful for predicting the suspend-ability (resistance to settling) of a LCM in a treatment or drilling fluid. The design parameters used in these models which can significantly influence the LCM suspend-ability response consist of density, shape, and particle size distribution of the LCM, in addition to density, rheology, and composition of the carrier fluid. The modelling work in this paper also provides methods for tailoring LCM and/or drilling fluid properties to achieve effective LCM suspension.

Determination and control of the suspension characteristics of LCM-carrying drilling fluids can help ensure efficient use of LCMs for LC control. This method is especially important in severe loss zones where large-size LCMs are used as well as in high-pressure/high-temperature (HP/HT) or inclined wells where the fluid’s ability to suspend the LCM is most critical

The LCM particles of specific size ranges were obtained by sieving the ground walnut shells. Three samples of different sizes were obtained by the sieving process using VWR USA mesh standard test sieves and four different clay-free water-based drilling fluids were formulated to exhibit variations in yield stress (τ) and mud weights.after the LCM has added to the drilling fluids the rheology and mud weight has measured using FANN® 35 viscometer and mud balance resepectily.

Suspend-ability test: The stainless steel aging cell containing the LCM fluid mixture in a glass liner was placed in the static oven at 150°F and aged for 4 hours .after aging The distribution of the LCM in the static-aged mixture was investigated by separating the mixture in the glass liner in two equal sections: the top half section and bottom half section. The LCM quantities in each section were separated from mixture by filtering it through a 50-mesh USA standard test sieve and washing the LCM on the sieve with water to remove any adhered mud. The same tests were repeated for different LCM and drilling fluid combinations. The degree of LCM suspend-ability is quantified in the below equation in terms of percentage of LCM retention in top half section of glass liner (% LCMT) obtained after the aging of the sample as:

$$\%LCM^T = \frac{\%LCM^T}{\%LCM^T + \%LCM^B} * 100$$

Methods used to determine the LCM size

1. Abrams' Median Particle-Size Rule (Abram 1977): According to this rule the median particle size of the bridging material should be equal to or slightly greater than 1/3 the median pore size of the formation.where λ is pore throat size. Abrams' rule only addresses the size of particle required to initiate a bridge. The rule does not give optimum size or address an ideal packing sequence for minimizing fluid invasion and optimizing sealing.

$$\mathbf{D = \frac{\lambda}{3}}$$

2. IPT (Ideal packing theory) (Dick 2000): The IPT uses either pore sizing from thin section analyses or permeability information, combined with particle-size distributions of the bridging material, to determine the Ideal Packing Sequence
3. The Vickers Method (Vickers 2006): In this method, to exceed the bridging efficiency gained by using the IPT method, it was decided to match target fractions. The following criteria (Vickers criteria) for the bridging blend should meet the following standards to achieve minimal fluid loss into a reservoir

   D (90) = largest pore throat

   D (75) < 2/3 of largest pore throat

   D (50) +/- 1/3 of the mean pore throat

   D (25) 1/7 of the mean pore throat

   D (10) > smallest pore throat
4. Halliburton Method (Whitfill 2008): The d50 of the particle size distribution is set equal to the estimated fracture width to offset uncertainty in the estimation. In this manner, sufficient particles both larger and smaller than the estimated fracture width are present to plug a smaller or larger fracture width. There is still a lot of scope to investigate the other physical properties of the particles which would help in fully characterizing the particles and then lead to a better treatment design.

Sabeel et al.(2015) Investigate the performance of three natural materials (mica, Azadirachta indica (neem) and balanites aegypytiaca (lalob)) as powder to solve the problem. After resultant daily mud report from two different wells in order to determine the Properties of drilling mud, the drilling mud prepared in the lab and simulated its properties and tested by API filtration. The three materials were grinded in powder form and screened to chemical one of Neem and Lalob. Then they tested by XRD to know the crystalline construction of Mica and chemical one of Neem and Lalob. After that they added to the mud and tested by API filtration, firstly each one alone to get minimum filtrate, secondly mixture of them to determine their percentages of any one in the last form of LCM and test the ability of them to use as LPM, all these tests without changing in the rheological properties of the drilling mud. After that poured the LCM in the loss circulation device to get the optimum weight that can be used to solve the problem. API filtration device to measure the mud filtrate and found that the optimum percentage of materials in mixture is 44.64% for lalob and 35.71% for neem and 19.64% for mica .then the loss circulation device was used to evaluate the performance of the LCM starting with 50gm of LCM and 4000ml of water Experiment 1 was done and the result was total loss. Then weight of LCM was increased and minimize the volume of water untill reached that 200gm of LCM which has 750ml of losses after 21sec it is optimum weight

Chapter 3

Methodology

Chapter 3

Methodology

Loss of drilling fluids into formations (i.e., lost circulation [LC] through natural/induced fractures) is a recurring and costly issue within the industry. Numerous solutions/practices are applied to prevent or resolve LC. Among these, the addition of lost circulation materials (LCMs) into drilling fluids to plug the fractures has been a widely accepted practice. Well-known LCMs include ground marble, graphitic carbon, cellulosic particulates, and fibres.

For an LC control operation to be effective and successful, it is necessary to avoid or minimize settling of LCM in the treatment or drilling fluid. Uniform suspension of LCM is required during pill preparation and wellbore applications such as during a hesitation squeeze operation.

3.1Preparation of loss circulation materials:

National material collected from forest (soba) and mica collected from (ministry of mineral) after this material are available ,used as powder of this material by grinding with different size in those material , and combinated them in different size The LCM particles of specific size ranges were obtained by sieving the ground walnut shells. Three samples of different sizes were obtained by the sieving process.

3.1.1Neem and Lalob grinding:

The grinding mechanism of these materials began after cleaning them carefully and removes the upper cover and other undesirable substances from them. In grinding process used conventional classic mill (figure (3-1))

Figure (3-1): seeds mill device (local market)

that used to grind varies substances in common markets. Seeds are placed in the orifice of the mill and the process of grinding spent about a quarter hour (15 min) for each material alone. The next step is to sizing the powder particle of those materials using sieve shakers. Neem and lalob powder are putted indifferent size of micron mesh screen and shaked carefully in order to collect the suitable size of powder which pass through the mesh screen. Also Mica was screened with that sieve but, with different size of mica in micron meter.

Figure (3-2): mica powder

Figure (3-3): Neem powder

Figure (3-4): Lalob seed and powder

Then prepared drilling fluid by mixture device to mix the certain quantity of materials (bentonite , PAC-LV, mica neem and lalob) with water after weighting using sensitive balance, and then the properties are detected as the details Properties tests The materials were prepared in powder form that to be satisfying the laboratory tests. Then they weighted to add to mud,

Figure (3-5): all materials that used (drilling fluid lab)

3.2 Lost circulation Materials Test Device (DL):

The calculation of the lost circulation material is based on it is characters. For this testing with special pressure provide the lost circulation material (mud), test the effect of jam-up o every mud to select the correctly lost circulation material.

3.2.1 Purpose:

This device can be used to simulate lost value of lost circulation material under the different stratum, rift and pressure, and measure the value and depth of osmosis of the lost circulation material. It will be used to test the effect off jam-up of every material.

3.2.2 Main technical parameters:

Feed cylinder capacity: 4000ml

Working pressure: 0-7MPa

Depth: 0-80mm

Overall size: 4000*520*1060

3.2.3 Characters & Working Principles:

Feed the testing material into cylinder of the device, and then test the effect of jam-up of every material with the different pressure. This device has the characters of small size, simple structure, and easy operation. It can be used to test all kinds of lost values with different situation.

Figure (3-6): loss circulation device

3.3 Suspend-ability test:

Suspend-ability test: The stainless steel aging cell containing the LCM fluid mixture in a glass liner was placed in the static aged for 4 hours.

The distribution of the LCM in the static-aged mixture was investigated by separating the mixture in the glass liner in two equal sections: the top half section and bottom half section. The LCM quantities in each section were separated from mixture by filtering it through a 75-mesh USA standard test sieve and washing the LCM on the sieve with water to remove any adhered mud. The same tests were repeated for different LCM and drilling fluid combinations

.

Figure (3-7): Suspension of LCM particles

As shown in Table (3-1), the suspend-ability obtained based on material properties of given LCM and the fluid could be used as indicative of LCM suspend-ability. The LCM or fluid properties may be adjusted to obtain the desired suspend-ability to assure effective suspend-ability of LCM.

Table (3-1):experimental suspend-ability (LCMT)

LCM %	Degree of suspension
LCM%<10%	NO suspension
LCM%(10-40)%	Weak suspension
(40-50)%	Good suspension

3.4Drilling Fluid properties tests:

3.4.1Density measure:

Measure density of drill fluid (mud weight) The density (commonly referred to mud weight) is measured with a mud balance of sufficient accuracy to measure within 0.1 lb/gal (0.5 lb/ft^3 or 5 psi/1000 ft of depth.). For practical purpose density means weight per unit volume of mud may been expressed in hydrostatic pressure gradient in psi per 1000 of vertical depth.

3.4.1.1 Description:

The mud balance Figure (3-8) consists principally of a base on which rests a graduated arm with cup, lid, knife edge, level vial, rider and counterweight. The constant volume cup is affixed to one end of the graduated arm, which has a counterweight at the other end. The cup and arm oscillate in a plane perpendicular to the horizontal knife edge, which rests on the support, and are balanced by moving the rider along the arm.

Mud balance:-

Figure (3-8): mud balance

3.4.1.2 Procedure:

1. Remove the lid from the cup, and completely fill the cup with the mud to be tested.
2. Replace the lid and rotate until firmly seated, making sure some mud is expelled through the hole in the lid.
3. Wash the mud from the outside of the cup, and dry it.
4. Place the balance arm on the base, with the knife edge resting on the fulcrum.
5. Move the rider until the graduated arm is level, as indicated by the level vial on the beam.
6. At the edge of the rider closest to the cup, read the density or weight of the mud.
7. Report the result to the nearest scale division, either in lb/gal, lb/ft3, psi/1,000 ft of depth or Specific Gravity (SG).

3.4.2 Hydrogen ion concentration PH

Measured the value of acidity and alkalinity in the drilling fluid mud by used sunflower (pH) paper its standard paper as green color, submersed in the mud and compared the paper color to standard color contributed to standard number Then matches and read directly

Figure (3-9): PH paper

3.4.2.1 Procedure:

1. Place an indicator stick in the mud and allow it to remain until the color has stabilized, usually less than a minute. Rinse the stick off with deionized water but do not wipe.
2. Compare the colors of the stick with the color standard provided and estimate the pH of the mud.
3. Report the pH of the mud to the nearest 0.5 pH units.

3.4.3 6-Speed viscometers:

Measured (viscosity, plastic viscosity, and yield point).

3.4.3.1 Description:

Direct-indicating viscometers are rotational types of instruments powered by an electric motor or a hand crank. Drilling fluid is contained in the annular space between two concentric cylinders. The outer cylinder or rotor sleeve is driven at a constant RPM (rotational velocity). The rotation of the rotor sleeve in the fluid produces a torque on the bob or inner cylinder. A torsion spring restrains the movement of the bob, and a dial attached to the bob indicates displacement of the bob. Instrument constants have been adjusted so that plastic viscosity and yield point are obtained by using readings from rotor sleeve speeds of 600 and 300 RPM.

Figure (3-10): 6 speed viscometer device

The following are types of viscometers used to test drilling fluids:

1. Hand-cranked instrument has speeds of 600 and 300 RPM. A knob on the hub of the speed-change lever is used to determine gel strength.

2. The 12-volt, motor driven instrument also has speeds of 600 and 300 RPM. A governor-release switch permits high shearing before measurement, and a knurled hand-wheel is used to determine gel strength.

3. The 115-volt instrument is powered by a two-speed synchronous motor to obtain speeds of 600, 300, 200, 100, 6 and 3 RPM. The
3-RPM speed is used to determine gel strength.

4. The variable speed 115- or 240-volt instrument is powered to obtain all speeds between 625 and 1 RPM. The 3-RPM speed is used to determine gel strength.

3.4.3.2 Procedure for apparent viscosity, plastic viscosity and yield point determination:

The mud is placed in a thermo cup and surface of mud is adjusted to scribed line on the rotor sleeve. .the motor is started by placing the switch in the high-speed position with the gear shift all the way down. Then waiting for a steady indicator dial value, and record the 600 rpm, the switch is changed to the 300-RPM speed, then waiting for a steady value and record 300-RPM reading. Plastic viscosity in centipoises = 600 reading minus 300 reading. Yield Point in lb/100 ft2 = 300 reading minus plastic viscosity in centipoises. Apparent viscosity in centipoises = 600 reading divided by 2.

Chapter 4

Result and discussion

Chapter 4

Result and discussion

According to the data from literature review some results (from laboratory experiments that mentioned in previous chapter) concluded in this chapter, after that these results discussed.

We use different size of LCM and different of drilling fluids LCM materials

Table (4-1) show sizes of LCM

Size	LCM size (microns)
Size 1	650-800
Size 2	800-1180
Size 3	1180-2000

4.1 Drilling fluid preparation:

Table (4-2) show drilling Fluid Formulations

Component	Weight (gm)
Bentonite	103
PAC-LV	12.8
Neem	28.8
Lalob	35.2
Mica	15.4
PH control	0.01

Water volume ml=1600 ml

And drilling fluid with PAC-LV and without PAC-LV to study viscosity effect Size :

4.2 Rheology properties:

Table (4-3) show FANN viscometer Data

RPM	6-Speed Viscometer measured data
600	64
300	45
200	37
100	27
6	8
3	6
PV(CP)	19
LSYP(lb/100 ft2)	4
10 Sec/10 Min Gel Strength (lb/100 ft2)	8/9

4.3 Lost Circulation Materials Test Device Experiments:

Table (4-4) show quantity of lose with size 650-800 mic

Type of lose	Volume of loses per time
Total	Total lose
Partial	At7 min 1250 ,At 30 min 1300
Seepage	At 1.5 min 950 , At 30min 1100

Table (4-5) show quantity of lose with size 800-1180 mic

Type of lose	Volume of loses per time
Total	At 1.5 850 , At 7 min 900
Partial	At 7 min 721
Seepage	At 7 min 620

Table (4-6) show quantity of lose with size 1180-2000 mic

Type of lose	**Volume of loses per time**
Total	At 1.5 min 150
Partial	No lose less than 50
Seepage	No lose less than 20

4.4 Suspend ability test:

4.4.1 Suspend ability test with PAC-LV

Table (4-7) show drilling Fluid Formulations

Component	**Weight**
Bentonite	25.8
PAC-LV	3.2
Neem	7.2
Lalob	8.8
Mica	3.9
PH control	0.01

Table(4-8) show suspend ability data size (650-800)mic

Weight	
Top	8.73 gm
Bottom	9.27 gm
LCM%	48.5 %

Table(4-9) show suspend ability data size (800-1180) mic

Weight	
Top	6.9 gm
Bottom	11.1 gm
LCM %	38.3 %

Table(4-10) show suspend ability data size (1180-200) mic

Weight	
Top	2.7 gm
Bottom	15.9 gm
LCM %	14.5 %

4.4.2 Suspend ability test without PAC-LV

Table(4-11) show suspend ability data size (650-800) mic

Weight	
Top	7.4 gm
Bottom	10.6 gm
LCM %	41.1 %

Table(4-12) show suspend ability data size (800-1180) mic

Weight	
Top	5.6 gm
Bottom	12.2 gm
LCM %	31.4 %

Table(4-13) show suspend ability data size (1180-2000) mic

Weight	
Top	1. 5 gm
Bottom	17 gm
LCM %	8.1 %

4.5 Discussion:

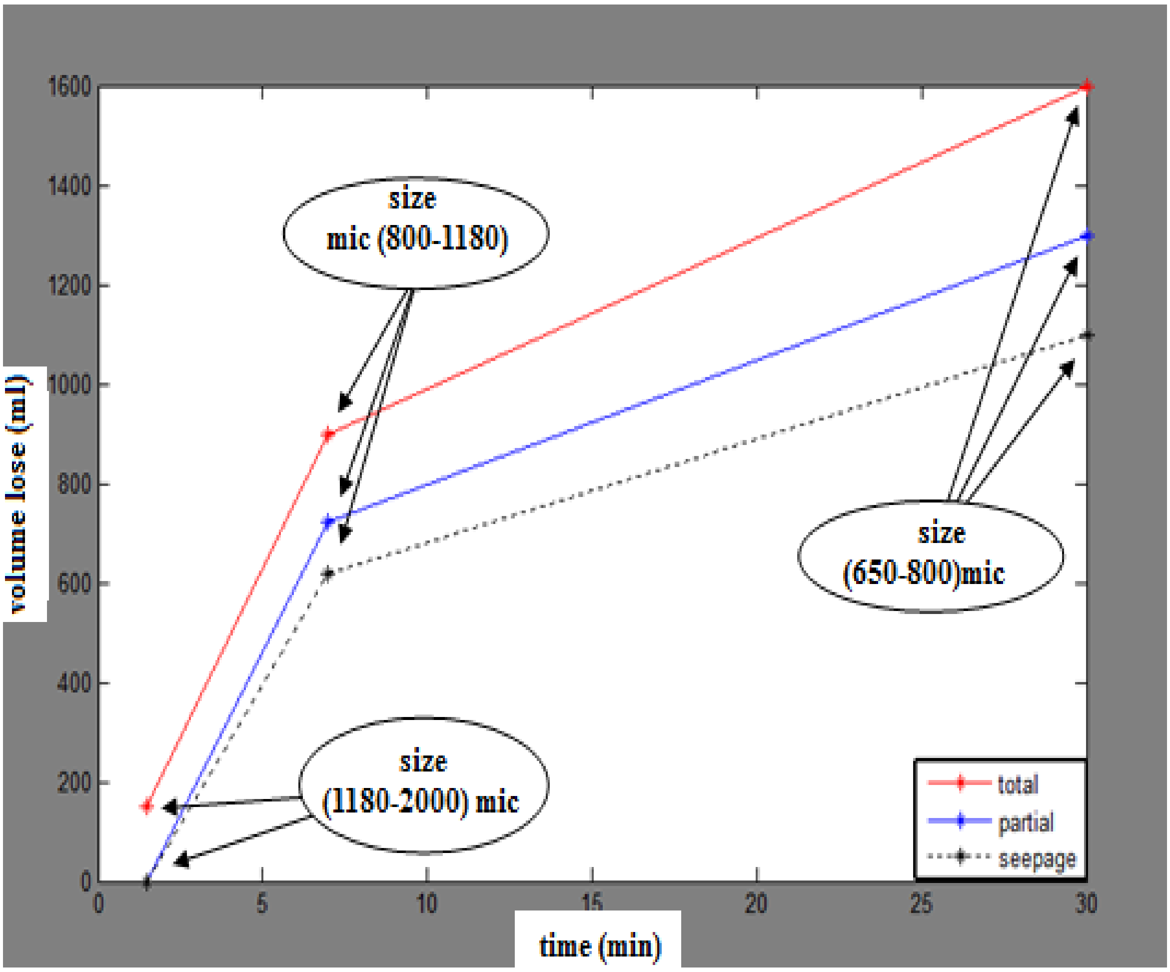
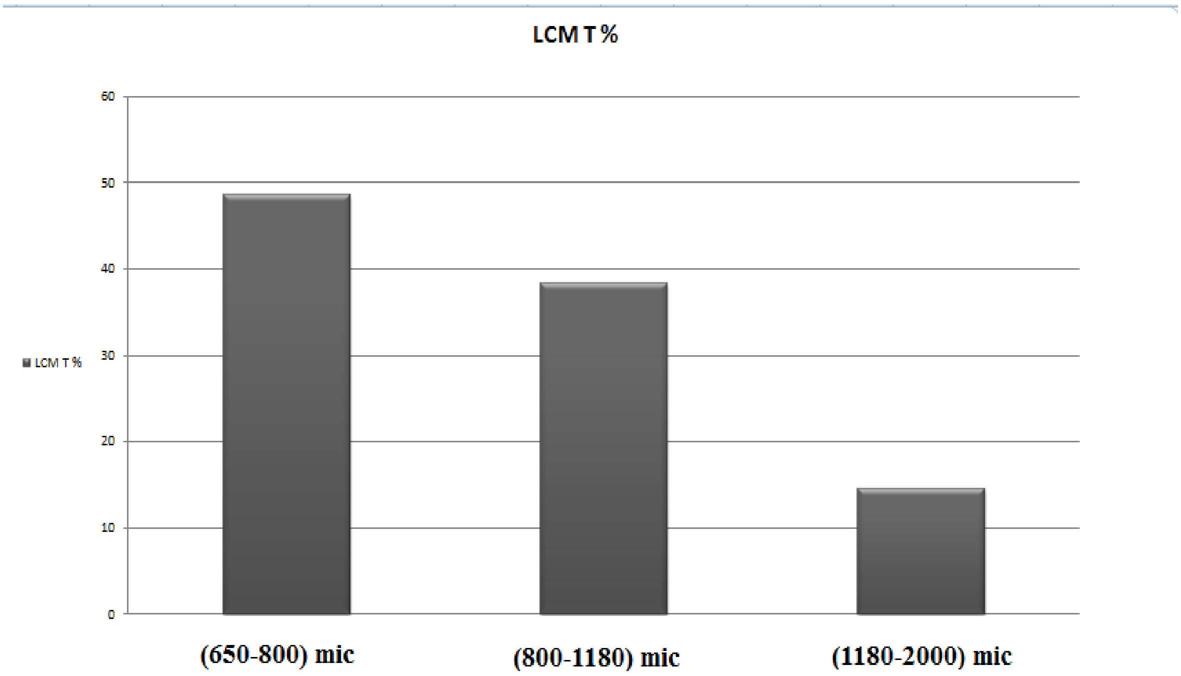


Figure (4-1): The relation between time, volume lost and LCM size

From the above experimental studies and from tables (4-4) , (4-5) and (4-6) in chapter 4 that shown in above figure (4-1). the amount of lose (in three of losses) reduce when the we use a large size of LCM particular and we found that the (1180-2000) is effective in lost circulation operation



Figure(4-2): Suspend ability test with PAC-LV

4.6 Effect of LCM particle size on suspend-ability:

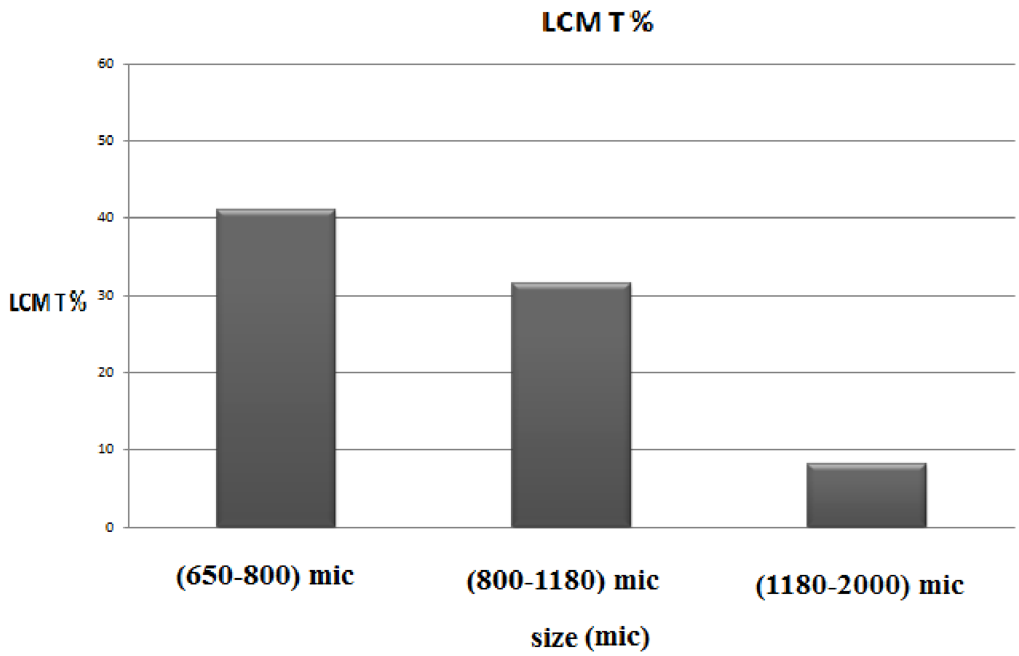
The suspend-ability of the LCM particles (local LCM) of the three selected sizes was measured in the drilling fluid (mud weight = 8.89.ppg and LSYP =4lb/100ft).the large size 1180-2000µm particles have settled almost completely towards the bottom section of the liner, whereas the medium size 800-1180µm particles showed some degree of suspension in the fluid while the small size 650-800µm particles appeared to stay suspended uniformly in the fluid. Thus, the suspend-ability decreases with increase in particle size.

Table (4-14) also shows values of the suspend-ability based on the properties of the local LCM and the drilling fluid (yield stress and mud weight) used for above experiments. It was evident that the suspend-ability of LCM (indicated by % LCM) increases with increase in the respective suspend-ability parameter .

Table (4-14)show the percentage of LCM with specific size

(local LCM size) gm	LCM %
1180 – 2000	14.5 %
800 – 1180	38.3 %
650 – 1180	48.5 %

And also suspend ability depend on drilling fluid properties like density and rheology properties



Figure(4-3): Suspend ability test without PAC-LV

Chapter 5

Conclusion and recommendations:

Chapter 5

Conclusion and recommendations

5.1 Conclusion:

In this research a mixture of neem powder, lalob powder and mica used as LCM material.

First step we obtain three size from those material by using sieve analysis followed by drilling fluid preparation and measured rheology properties of drilling fluid and mixture them with LCM in LCM device to evaluate performance of local lost circulation material and wait 4 hours according (Kulkarni et al. 2014) to with different type of lose (total, partial ,and seepage).

The next step was using suspending glass linear and divided into two section one in top and other in bottom half –half and measured LCM % to identify optimum size of local LCM. The LCM suspend-ability increases with increase in the fluid's rheology; in addition, it increases with decrease in LCM particle size as well as decrease in density difference between LCM particles and the fluid .from this study to obtain effective LCM mixture suspend ability may be 14.5% .

5.3 Recommendations:

- gain more applicable results that require to use Particle plugging apparatus (PPA) and HPHT fluid loss apparatus in conjunction with slotted/tapered discs to Evaluate LCM performance for corrective treatments.
- Using different of drilling fluid with different rheology properties using fluid lose additive and shale stabilizer and Viscosifier and barite
- Using other base drilling fluid
- Study how the usage of these materials can reduce the nonproductive time (NPT).
- Calculate the cost of using these materials.

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