Narrative Review Article: Investigating the Use of Drilling Mud and the Reasons for its Use

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ABSTRACT

The present study investigates the use of drilling mud and the reasons for its use. Drilling mud is defined as the process of adding or injecting special materials into drilling wells. These materials can be of different types, each of which performs specific tasks. For example, drilling mud materials are composed of materials such as clay, siliceous mud, polymers and chemicals. These materials are responsible for the most important function of drilling mud, which is to stabilize the well. In fact, they act as a barrier to natural materials in the underground and prevent the free flow of oil and gas to the surface. Waste of drilling mud means its waste in the drilling process. Drilling mud is a material that simplifies the process of drilling a well and makes it possible to drain waste from it. There are many different types of drilling muds according to their different characteristics, and they are most widely used in the oil and gas industry, for drilling deep wells, and ultimately for the production of mineral bitumen or natural bitumen. Usually, in any drilling mud, this substance penetrates into the empty spaces inside the formation and causes problems. This problem occurs especially in oil and gas industries and in the early stages of well drilling. The deeper the well in question, the more complicated it will be to drill, and as a result, the drilling mud will be a more important issue. In recent years, the use of nanoparticles to control the properties and characteristics of drilling fluids has created many improvements in this field.

Introduction

Drilling fluids are a mixture of chemical and natural compounds that are used to lubricate and cool the drill bit, clean the drilled well, control pressure and improve the performance of the drill string and tools in the well hole [1]. Well mud also means drilling mud used in drilling wells. In the knowledge of geotechnical engineers, drilling mud is a special combination of water and clay, which is used to transport the materials dug in drilling systems to the surface of the earth. It is also used to lubricate and cool the drill bit, clean the drilled wells and remove earth chips, control the pressure and improve the performance of the drilling cement and increase the efficiency of the tool in drilling the well [2].

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Drilling mud is a special type of drilling fluid that is used to drill deep wells. The term flower is used because of the high concentration of the formulation. One of the reasons why drilling mud is used instead of water is that some particles and stones have a special weight and should be removed with the help of this combination [3]. The properties of drilling mud include weight and density, rheological properties, filtration and liquid state of mud and pH volume. Drilling fluids are divided into two main categories. The type of base fluid depends on the drilling requirements. Drilling mud is divided into the following two categories:

- ❖ Water-based drilling mud.
- ❖ Oil-based drilling mud.

1- Water-based drilling mud: Conventional water-based muds include viscosities, fluid flow control agents, weighting agents, lubricants, emulsifiers, anticorrosive, salts, and pH control agents. Potassium muds are most widely used for drilling water-sensitive shales and water-based systems [4]. Their pH is between 7 and 9.5. These flowers include the following categories:

- ✓ Native flower
- ✓ Calcium flower.
- ✓ Natural flowers, such as red flowers, lignite, lignosulfonate.
- ✓ KCl polymer mud with a low percentage of solids including 3 to 6% solids.
- ✓ Barrier muds that prevent the hydration of clays, such as lime muds, salt-saturated muds, chalk muds, seawater muds.
- ✓ Bentonite flowers.
- ✓ Phosphate flowers.
- ✓ Emulsion flowers include oil in water or water in oil [5].

2- Oil-based drilling mud: Oil-based drilling mud consists of petroleum hydrocarbons as the main composition along with other materials such as clays or colloidal asphalts, which can be obtained with the addition of emulsifiers, polymers and other additives including weight factors. created for drilling.

- ✓ Oil drilling mud.
- ✓ Emulsion drilling mud [6].

How to make drilling mud

Drilling mud is produced using mixes called in-line with recirculation method. First, we store some water in a tank and add 120 to 150 pounds of salt to it. To reduce the calcium ion, we add 5.0 to 1 pound of soda and then 12 to 14 pounds of starch and stir well until all the ingredients are completely mixed together. Finally, we add the required amount of weight of barite and ferobar. Heavy drilling mud consists of water and saturated salt, starch, barite, slag and lime (Figure 1) [7].

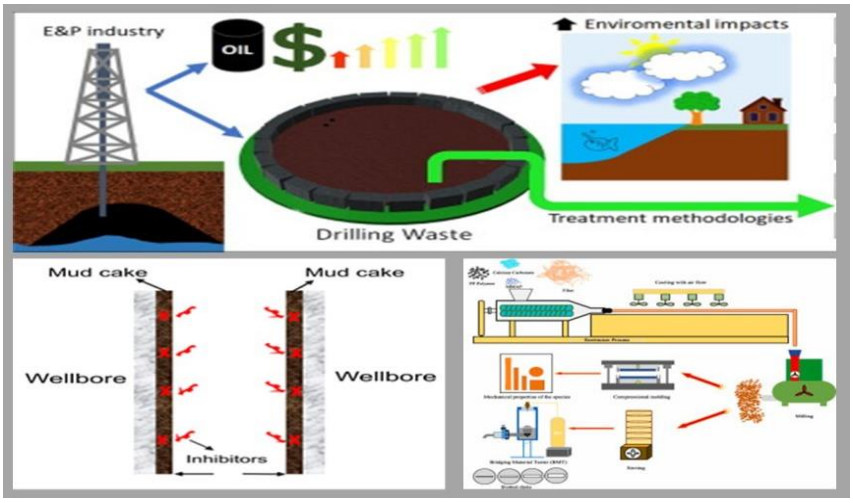

Figure 1. How to make drilling mud

Features of drilling mud

1- Well Stabilization: One of the main features of drilling mud is well stabilization. Drilling mud materials have different compositions that help to stabilize the well and prevent the condensation of petroleum materials towards the surface of the earth [8].

2- Adhesion: Drilling mud materials have the characteristic of adhesion that due to the interaction with the surface of the well wall, they stick and stabilize sedimentary materials to the well wall.

3- Thermal stability: drilling mud materials must have the ability to be stable at different temperatures. This feature is especially important in drilling wells with high or low temperatures [9].

4- Density: The density of the drilling mud material should be suitable to prevent the free flow of oil and gas towards the surface of the earth.

5- Surface tensions: drilling mud materials must have the ability to withstand surface tensions and prevent failure [10].

6- Adjusting the flow of materials: Drilling mud materials should have the ability to adjust the flow of different materials to help drilling productivity.

The mentioned features give great importance to the drilling mud in the drilling of oil wells and have great effects on the efficiency and stability of the wells [11].

Mud drilling and its reasons

Hazroi means: the loss of all or part of the drilling fluid, well completion fluid and cement slurry into permeable formations such as rock masks, porous formations such as limestone, or naturally or induced fractured formations such as dolomites, which during Drilling, well completion and cementing operations take place. Dealing with everything is a costly and time-consuming process. Because there are various consequences and results, among them, an increase in the cost due to the acquisition of drilling mud, an increase in the time of the drilling machine, a fault in the formation due to the entry of mud materials into the producing formations, jamming of the pipes, the need to drive the wall pipe. Additionally, poor cementing due to underfilling behind the pipe wall increases the possibility of blowout and eventual loss of the well. In order to find the causes of spillage, effective factors have been identified and considered, which include the type and lithology of the layers, hydraulic parameters such as pump pressure and flow intensity before spillage, and the characteristics of drilling mud before spillage. From the properties of drilling mud, the parameters of mud weight, solids percentage, plastic viscosity, pour point and gel resistance have been considered [12].

All types of drilling fluids

According to its severity, drilling fluids are divided into four general categories. If it is less than 10 bbl/hr, it is called leakage. If this number is between 10 and 100, it is called a brief randomness. Also, if this number is between 100 and 500, it will be referred to as the perfect term. Finally, the wells of more than 500 bbl/hr are called full mud wells. Harzroi also has different models based on the type, intensity and location of occurrence. For this reason, knowing the type and location of any problem can be very effective in choosing the right method to control it. The information related to the place of occurrence of Harzroi is done by checking the information of nearby wells, the changes that occurred in the formation and different charting methods. Of course, like all other industries, maintenance and repair principles are also used to control everything. This means that there are systematic methods to regularly control the existence of

contamination and prevent its spread, which should be used in the process of drilling deep wells. Bridging material tester (BMT) is one of the devices that is used to measure and optimize it to minimize it. In this device, one model is available for each type of construction. For example, for the sandstone formation, they consider a ball model and measure the number of weeds on the soil from inside this model. Acidification tests are performed in the acidification laboratory. We know that after cement work, acid is applied to the well, so that the remaining cement is removed and washed. Acidizing Instrument is located in this unit, the heart of this device is its pump. In this device, pressure and heat are applied to the stone. In fact, the acid is injected into the core with a certain pressure. In this device, pressure and heat are applied to the stone. In this way, the carbonates inside the brain are dissolved. After acidification, the permeability is measured again, the output of this device is prepared in printed form [13].

Mechanical properties of mud

The mechanical properties of mud that must be determined in the laboratory are:

- Plastic Viscosity (PV).
- Yield Point (YP).
- Gel Strength (GS).
- Filtration Lost (FL) [14].

Problems caused by mud spillage

Everything causes different problems. Well blowout, pipe jamming, loss of a large volume of drilling mud, damage to the formation and similar cases are among the problems that occur in wells related to oil and gas industries and cause many losses. Any fluid can form due to the pressure difference between the mud and the formation, and as a result, it causes the pipes to get stuck in the well. A problem that needs to be solved by a costly operation called balance finding. Also, any fluid can cause the transfer of small mud particles into the pores of the formation. This issue also reduces the impermeability of the well wall and increases the possibility of damage. Drilling mud may also cause various chemical reactions and cause various problems for the well by forming sediment [4].

All types of drilling fluids

Drilling fluids are divided into four general categories based on their severity. If it is less than 10 bbl/hr, it is called leakage. If this number is between 10 and 100, it is called a brief randomness. Also, if this number is between 100 and 500, it is referred to as "complete". Finally, the wells of more than 500 bbl/hr are called full mud wells. Harzroi also has different models based on the type, intensity and location of occurrence. For this reason, knowing the type and location of any problem can be very effective in choosing the right method to control it. The information related to the place of occurrence of Harzroi is done by checking the information of nearby wells, the changes that occurred in the formation and different charting methods. Of course, like all other industries, maintenance and repair principles are also used to control everything. This means that there are systematic methods to regularly control the existence of contamination and prevent its spread, which should be used in the process of drilling deep wells [7].

How to control fluid leakage?

There are many reasons why things go wrong. Lithology and type of formation being drilled, variables of drilling process such as pressure, pumping rate and other characteristics of drilling mud are among these things. Of course, regardless of the mentioned cases, in many cases, the causes of the disorder are unknown and it is very difficult to control it. The reduction of mud volume from the total volume due to water reduction and filling of a new well is

completely different from Harzroi issue. Researchers have investigated the effect of adding a DRISPAC brand polymer to bentonite water base mud in different concentrations on any fluid. Also, the causes of drilling fluid spillage have been investigated and the quantity and type of spillage controlling materials have been determined. According to Daccord's classification, spillage in the drilling industry can be classified as leakage (less than 10 barrels per hour), brief (between 10 and 100 barrels per hour), severe (between 100 and 500 barrels per hour) and complete (more than 500 barrels). per hour) is classified. The type, severity, and location of each well occurrence are different, and the systematic method that is known to control it economically and effectively includes two factors: prevention and treatment [12].

The current methods of controlling drilling fluid are:

- Injection of leprosy controlling substances (LCM) for low severity leprosy.
- Installing a cement plug for high-intensity discharges.

Unfortunately, the problems associated with the installation of cement plugs are:

- Creating long breaks in the drilling program.
- Tilting of the well from the main path.
- Low resistance of cavity wall cement and plug breakage, especially in the case of bentonite cement.

Probably, by using mechanical equipment and special tools that can easily be sent to any area, or have an effect on that area, a quick way to overcome this problem can be achieved [6].

Description of the problem

Spillage is the loss of drilling fluid, well completion fluid, and cement slurry into permeable formations such as sandstone, limestone, dolomite, etc. during drilling, well completion, and cementing operations. Leakage of drilling fluid is one of the big and unavoidable problems in the drilling industry, which imposes heavy costs due to interruptions in the drilling program. Dealing with everything is a costly and time-consuming process. Because it causes an increase in cost due to the loss of drilling mud, an increase in the rental time of the drilling rig, damage to the formation due to mud material entering the producing formations, pipes getting stuck, the need to drive an additional wall pipe, poor cementing due to not filling the back of the pipe. wall, the possibility of eruption and finally loss of the well. Accurate knowledge of the type and location of pests is very effective in choosing the correct materials to control pests. For this reason, determining the exact location of any reservoir is as important as determining its controlling materials, and this issue is determined using previous excavation records, structural changes, and various mapping techniques. In dolomite formations, the width of the cracks plays a very important role in the drilling fluid flow. Twisted cracks have different widths and are a function of the degree and type of recent tectonic activities. According to this criterion, the width of the cracks in the active areas is from 0.11 to 20.00, in the middle areas from 0.03 to 0.15, and in the inactive areas from 0.01 to 0.1 mm and often has a length in the range of 3 They are 0.5 to 7.5 meters. The substance or substances that control any flow of drilling fluid into permeable formations can act through different mechanisms and prevent any flow of fluid in different ways, or control its intensity (Figure 2) [9].

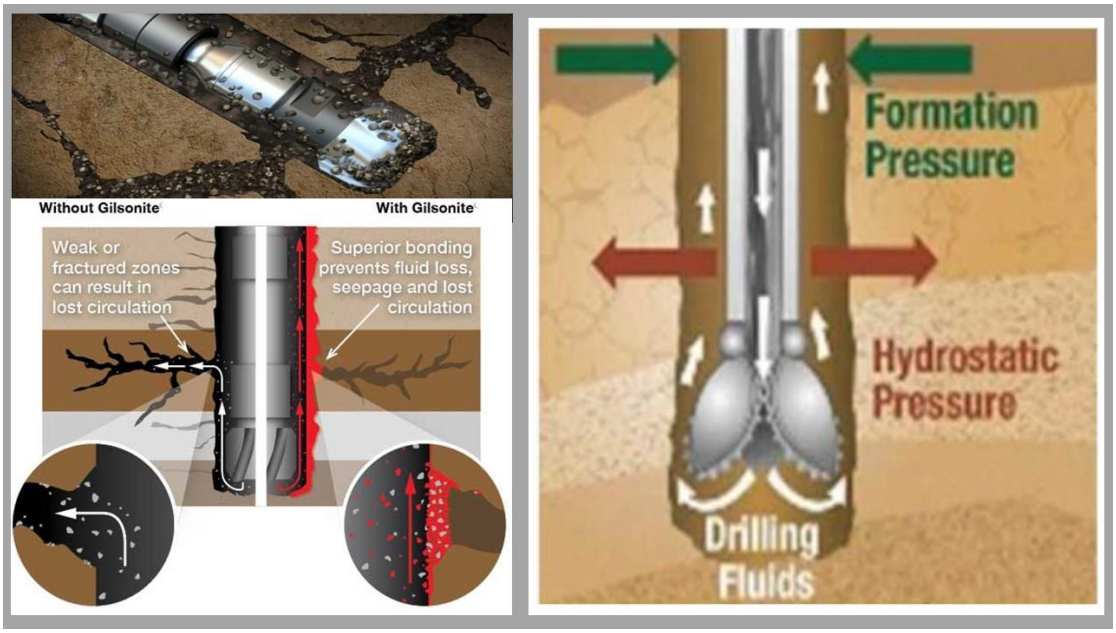

Figure 2. Description of the problem

Solutions and suggestions

- ✓ The recommended material is its temperature stability up to about 200 degrees Fahrenheit.
- ✓ The proposed material should be resistant to salt water with a concentration of 250 grams per liter of sodium chloride.
- ✓ The proposed material should be resistant to high calcium concentration of about 1% in water [5].
- ✓ The proposed material should have good flowability for injection in the well.
- ✓ The closing time of the proposed material should be controllable, so that it does not block the route during transportation to any place.
- ✓ The volume of the proposed material should be designed according to the intensity and dimensions of the area.
- ✓ The proposed material does not produce toxic fumes.
- ✓ Corrosion properties of the proposed material should be controllable and not cause severe corrosion of wall pipes and downhole tools.
- ✓ The proposed material should be compatible with all types of drilling fluids (water base and oil base).
- ✓ It is possible to prepare the desired mixture in operational conditions [11].

Suggested solutions (suggested solutions are not necessarily limited to the following suggestions)

- ✓ The use of polymer materials with medium molecular weight (gel state) to seal the site.
- ✓ Using optimized LCM materials.
- ✓ Use of portable solid materials with drilling fluid.
- ✓ Using methods of increasing viscosity and reducing fluid flowability in formation cracks.
- ✓ Reducing the weight of the drilling fluid column in order to reduce the intensifying force.
- ✓ The use of polymer materials should be compatible with the drilling process, in such a way that it prevents the waste of fluid in any place or reduces the flowability of the fluid outside the wall pipe (formation environment).

- ✓ The use of methods to quickly identify the leaky area at the beginning of drilling to prevent the spread of this problem by providing quick and appropriate solutions immediately after registering the first signs of fluid leaky and before continuing drilling in that area [9].
- ✓ The use of solid leak-proof materials such as clays or reinforced carbon materials should be pumped to the contaminated area along with the drilling fluid. Of course, special care must be taken in this case, so that the reasons for the ineffectiveness of the common materials for controlling severe fluid leakage are identified and fixed.

Providing calculation methods and dimensional analysis to control any item for classification, formulation and more effective control of any item

Unacceptable solutions:

- ✓ Materials and methods that do not have control over the exact location of anything.
- ✓ Materials and methods that the cost of providing them is more than the cost equivalent to the interruption of the drilling rig.
- ✓ Materials that cannot be pumped or injected into the well.
- ✓ Materials and methods that cause destruction of oil or gas formation [10].

Conclusion

Leakage is caused by the introduction of a significant volume of drilling fluid into the formation that is being drilled. Mud overflow occurs when the permeability of the formation is high enough, or the holes and fractures in the formation are so large that they are not blocked by solid materials in the mud. Anything can vary from very little to very much. In addition to incurring additional costs for the preparation and replacement of mud during drilling operations, contamination causes serious damage to a reservoir. Since most of Iran's reservoirs are of carbonate type with abundant fractures, loss of mud or any flow means loss of mud or cement during drilling operations. Excavations can be done according to the natural shape of the formation or by injecting mud into the formation. For a significant porosity in porous formations, the pore size should be about three times larger than the mud particle size. Therefore, this type of permeability of the formation should be 10-15 Darcy. Therefore, this type of debris is almost limited to sand and coarse stones near the surface. Natural cracks and fissures can be very permeable under normal conditions and can be the source of production in some fields. Based on the operational experience, the main reason for erosion all over the world is these natural cracks and fissures. If the flower column pressure is higher than the balanced limit, anything can happen. Limestone and dolomite are usually found in these types of formations. Due to their size, drilling these types of formations may lead to serious damage. Too much mud weight may cause formation failure and eventually lead to destruction. In formations with high porosity, the high weight of mud can lead to an increase in porosity inside the pores of the formation. In the formations where the pore pressure difference of the fracture pressure is low, the ruptures may occur due to the fracture of the formation by ECD drilling or suction and thrust pressure. During the entire drilling operation, the instruction to prevent spillage should be considered. Drilling mud is one of the most undesirable factors in the drilling operations of oil and gas wells, which has a direct effect on the well completion and production operations. For this reason, it doubles the importance of studying Harzroi and investigating the factors affecting it. Based on this, in the present article, the presence of drilling mud and the factors affecting it have been studied in the Asmari reservoir. For this

purpose, by analyzing excavation data and preparing maps of soil, the weight of soil and the condition of soil in the field were comprehensively investigated. In this way, in addition to a better and more accurate understanding of the deposits in the reservoir, their relationship with drilling problems was also investigated. By studying the drilling history of these wells and using equal value maps, the mud weight required for drilling in the Asmari Formation in different parts of the field and its influence on the amount of waste has been determined. The problems that occurred in the wells were analyzed and finally, by determining the distribution of problematic sectors in different areas of the field, the density of these wells in each area was determined and the prone areas in terms of the occurrence of any problem were identified and introduced. The results of this study show that the most disturbance in the Asmari reservoir occurred in the area of the main ridge of the structure and the southeast area and the area near the northwest tip of the field structure, and the largest mud weight was also used in the main ridge and the southeast ridge of the reservoir. Most of the problematic wells are located in the central ridge of the field, and the wells that are further away from this area have been drilled without any problems.

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