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Check Drilling Mud Tasks

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GRAPHICAL ABSTRACT

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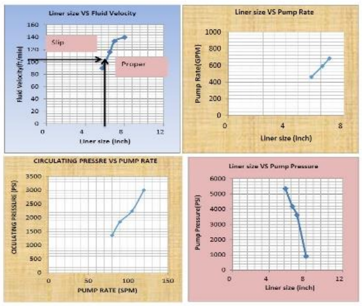

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ABSTRACT

Drilling mud is one of the most important components of rotary drilling, without which drilling is almost impossible. Drilling mud has many functions and applications, including cleaning the bottom of wells and transporting drilled debris to the ground, drying and lubrication of drilling tools such as drills, weight pipes and maintenance drilling pipes. From the wall of the well, it creates an impenetrable layer for the wall to prevent the entry of pressurized floors into the well and to prevent the deposition of particles and weight-increasing materials of the drilling mud, while the drilling mud is stationary. Separation of drilled material after reaching the ground level, weight reduction of weight pipes, drill pipes and wall pipes were done according to Archimedes' law pointed to the hydraulic power of mud pumps to the drill. In this project, the goal was optimal hydraulic design for drilling mud. Due to the fact that in the optimal hydraulic design of drilling mud, the maximum hydraulic power and pump outlet pressure and well geometry are among the limitations, the only parameters that can be used in the design are adjusting the pump outlet rate and size and number of drill nozzles. In this research, attempts were made to design the optimal output rate as well as the number and size of drill nozzles to reduce the pressure drop and increase the hydraulic power of the pump.

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Introduction

Drilling mud is a mixture of several different phases of different materials that has long been used in Iranian drilling to facilitate and continue drilling operations, and over time, different materials with different physical and chemical properties have been added to it [1-5]. The rate of drilling progress and economic studies of drilling reveal the effective role of drilling mud and its proper selection in drilling different formations. The study of problems during drilling and providing appropriate solutions, especially in selecting the type of drilling mud and suitable additives with it, has been considered by botanists in this type of mud. There have been problems with the use of oil-based flowers, which due to the harmful environmental effects of disposers of these flowers have led florists to use water-based flowers. Also, due to the specific problems created by these flowers, the use of polymeric additives to improve the overall properties of different types of flowers in the face of various problems created in different formations are discussed [6-9].

Drilling mud

Drilling mud is a mixture of water and other materials to facilitate and continue drilling operations that have long been used in Iranian drilling and over time, various materials with different physical and chemical properties have been added to it [10-15]. Drilling mud system in operation drilling with its special composition is one of the most important parts of drilling operations and plays a significant role in this operation. Without a drilling mud system, drilling operations are not possible. The mud used to start drilling varies from place to place, so in some cases water can be used, but this is not always the case.

Figure 1. Conventional drilling rig

The surface layers of some areas are composed of low-strength sands and rubble, in which case an almost dense mud is needed to prevent the layers from being washed away and to bring the shards to the surface, creating a stable wall for the well [16-20]. Natural mud is usually used to dig the surface layers, in which consuming a large amount of water will be necessary to keep the weight and concentration of the mud low. At lower depths, where more concentration and gelatinous properties are required for the mud to raise the particles, bentonite is used. This material also creates a crust called cake on the wall, which in addition to increasing the wall's resistance to falling, prevents the penetration of mud water into the floors [21-25]. The concentration of mud that does not contain a mixture of other chemicals can be controlled by a small amount of phosphate. It should be noted that consuming large amounts of phosphate can increase the concentration of flowers. Excessive use of phosphate or change of phosphate type is profitable for consumption [26-30].

Figure 2. Engine Generator Sets

That is why it is necessary to have a flower specialist in such situations. In order to reduce the concentration of this type of flower, chromium lignosulfonate is used more today, which is very effective, but due to its high cost, it must be done consulting a florist [31-35].

History of drilling mud

In general, the history of drilling mud can be summarized in six stages:

Stage One, 1914-1920: There were public perceptions of flowers. In this way, everyone gave a theory and a suggestion about drilling mud based on their findings.

Second stage, 1920-1930: During these years, drilling mud companies started working and each of them introduced new materials to the market, which caused a variety of consumables in drilling mud.

Third stage, 1930-1940: During this period, drilling mud companies were able to supply equipment for testing drilling mud and use new chemicals [35-39].

Phase 4, 1940-1955: During these years, they developed features of the drilling mud system, such as modern mud tanks, mud rifles, and other mud engineering tools that separate solids from mud.

Fifth stage, 1958-1970: The emergence of flower engineering in an academic and modern way, that is, classes were invented for educated people, and formulas were introduced one after another about flowers.

Step 6, from 1970 onwards: Today we see that changes and improvements have been made in drilling mud systems and their properties, and more complete and newer materials are being introduced to the market every day.

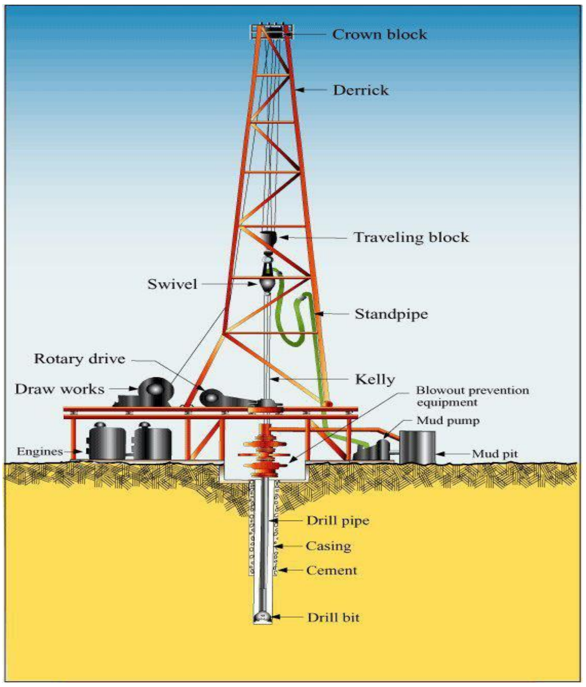

Figure 3. Overview of a drilling rig and its components

Important tasks of drilling mud

1) Cleaning the bottom of the well and transporting the excavated debris to the ground,

2) Drying and lubrication of drilling equipment such as drills, weight pipes and drilling pipes,
3) Maintaining the well wall and creating an impenetrable layer for the wall,
4) Preventing pressurized floors from entering the well,
5) Discovering oil, gas or water inside the floors,
6) Preventing the deposition of gravel and weight gain materials of drilling mud, when the drilling mud is stationary,
7) Separation of excavated materials after reaching the ground,
8) Reducing the weight of weight pipes, drilling pipes and wall pipes according to Archimedes' law,
9) Directing the hydraulic power of mud pumps to the drill,
10) Minimizing any disturbance in the condition adjacent to the well,
11) Providing information to the geologist.

Cleaning the bottom of the well and carrying the excavated debris to the ground

One of the important tasks of drilling mud is to remove crushed stones from under the drill. This increases the life of the drill and the efficiency of the drilling mud. The drilling mud that moves upwards from the bottom of the well carries the debris to the surface [40-45]. Particles under their weight tend to settle inside the mud. Concentration, high pumping and fast movement of mud inside the well overcome this tendency and bring the particles to the ground. Several factors are more effective in the efficiency of mud to raise particles, which are:

A) **Speed in the annular space:** Speed in the annular space is an important factor in raising gravel and the purpose is the speed of movement of mud behind the drilling pipe. In general, to carry particles and stumps by the flower, the speed of ascent of the flower in the annular space should be faster than the speed of falling stumps and solid particles of the flower. The rate of fall of stumps and solid particles of mud on the one hand depends on their specific gravity and geometric shape and on the other hand on the viscosity, weight and speed of mud in the annular space. Flower speed depends on four factors: pumping speed, pump speed, well diameter and diameter of the exterior of the drill pipe which depends on these variables and should be adjusted so the velocity of the mud in the annular space is 100 to 200 feet per minute [46-50].

B) **Specific gravity**: Specific gravity is the unit weight of flower volume and reduces the weight of particles. The higher the specific gravity of the flower, the greater the effect of its buoyancy force, and the greater the power of its material.

C) **Viscosity:** it depends on the type and dispersion of suspended particles in the mud and is an important factor in the carrying capacity of drilled material. Viscosity is measured in terms of the time it takes for a quart of mud to pass through a special funnel called a marsh funnel [51].

D) **Pipe rotation:** Pipe rotation also disperses solid particles around the tubes due to centrifugal force and pushes it towards the center of the annular space which has the maximum speed and directs it to the ground faster [52-55].

Cooling and lubrication of drilling equipment: Considerable heat is generated by the friction of the drill and pipes with the well wall and a very small amount of this heat is absorbed by the floors, so this heat must be removed from the operating environment by the drilling mud. The heat absorbed by the drilling mud comes out of the mud in the middle of the road and on the ground. If the heat from friction is not dissipated by this device, the drill will burn and the drill pipes will soon wear out and puncture at the point of contact with the formations. The drilling mud will also cause some lubrication. The clay and bentonite present in the drilling mud are themselves a type of lubricant, in addition to other lubricants such as diesel which can also be used in the drilling mud [56].

Coating and maintaining the well wall: A good drilling mud creates a thin, impermeable layer on the well wall. This thin cake both prevents wastage of mud and its smoothness and helps strengthen the stones of the well wall and also prevents them from falling into the well. The ingredients that make up flower cake particles are mostly bentonite or starch. By increasing colloids in mud such as bentonite and adding chemicals to improve particle dispersion, this property can be enhanced in drilling mud and in many cases, it may be necessary to add liquid starch or other materials to pass the liquid through. This crust was reduced.

Preventing pressurized floors from entering the well

Resistance to stratified pressure depends on the weight of the mud in the well. The normal pressure of the floors is 465 pounds per thousand feet, which is the pressure of a column of water that contains some minerals; usually the weight of water containing some solid particles in the floors is enough to balance this pressure. In parallel with the abnormal pressures of the floors, it is necessary to adjust the hydrostatic pressure of the mud equal to or even greater than the pressure of the ground floors with the help of weight-bearing materials such as barite, so that they do not break and mud or well eruption does not occur [57-59].

(1)

$$P_{Hyd} = \frac{MudWeight\,(pcf\ ) \times Depth\,(ft\,)}{144}$$

Considering that three liners have been proposed for the pump, first we have calculated the pump flow for three liners so that we can have an estimate of the pump capacity [60].

Table 1. Pump outlet pressure in terms of stroke rate

PUMP RATE (SPM)	CIRCULATING PRESSURE (PSI)

120	**3005**
105	**2242**
90	**1852**
80	**1363**

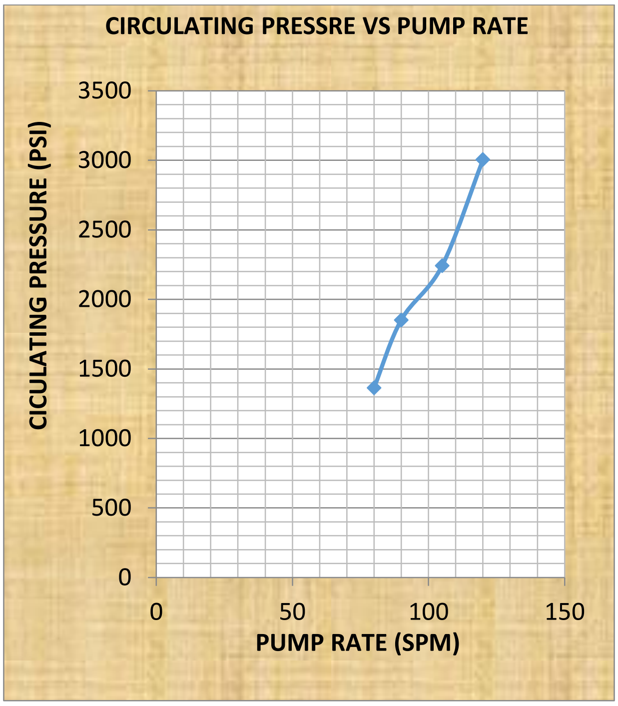

Figure 4. Pressure diagram against pump discharge

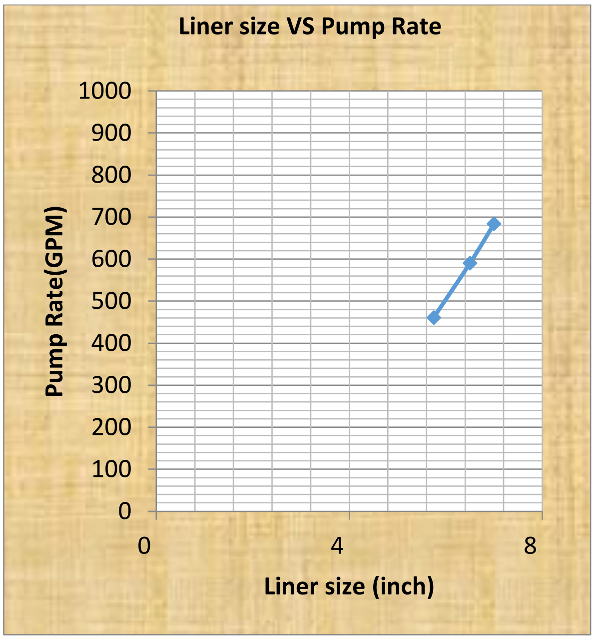

Figure 5. Pump liner size diagram versus pump discharge

Then the pump pressure diagram is drawn according to the size of the pump liner to have an estimate of the pressure against the size of the liner [61-63].

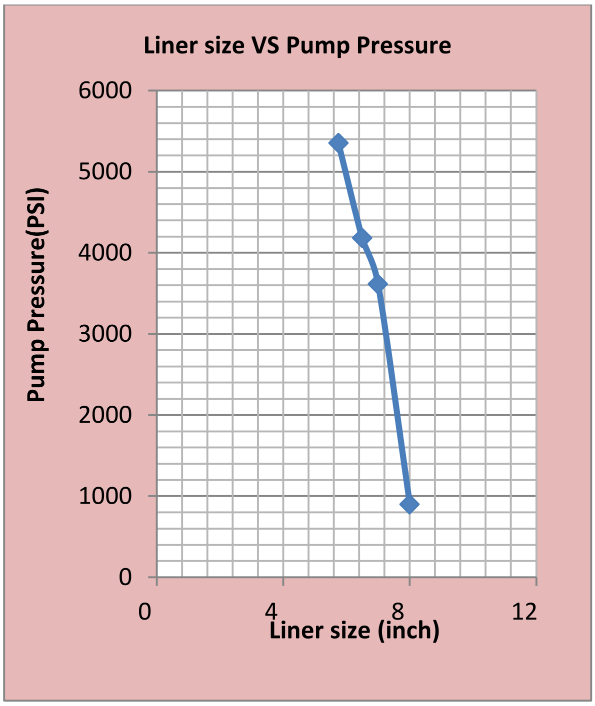

Figure 6. Pump liner size diagram against pump pressure

As it is clear in Figure 6, the size diagram of the pump liner is completely downward in terms of pressure, i.e. the output pressure decreases as the size of the pump liner increases. Due to the fact that in the optimal hydraulic design of drilling mud, the maximum hydraulic power and well geometry are among the limitations, so the only parameters that can be used in the design are adjusting the pump output rate, size and number of drill nozzles [64].

In the next step, the slip speed should be calculated according to the flow and outlet pressure considering the size of the pump liner. The slip velocity is the velocity that if the velocity of the fluid is less than this velocity, the logs and drill bits will not be able to move up and up the surface. According to what was said in the previous sections, the minimum slip speed for transporting particles to the surface for this type of fluid and this well geometry is about 110 ft / min [65].

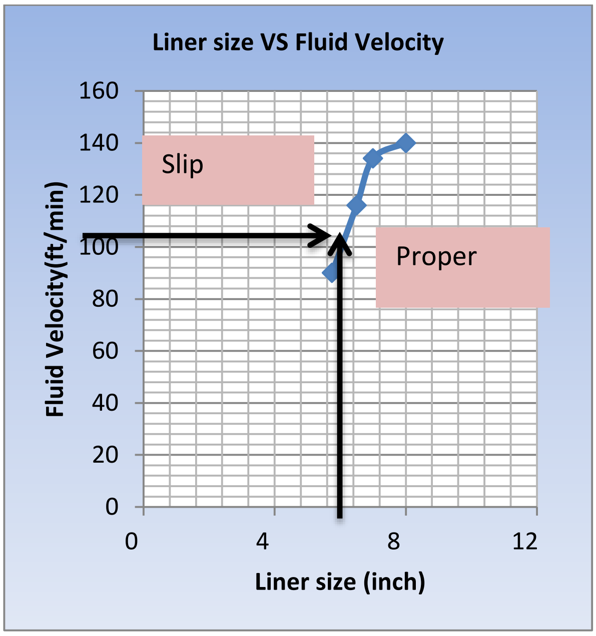

Figure 7. Pump liner size diagram against fluid velocity

According to Figure 7, a pump with a liner size of 5 7.8" is not suitable because the speed produced by this pump to transfer particles is less than 110 feet per minute. The 6 1.2 "liner produces a velocity of about 110 ft/min for the fluid, which provides the minimum speed required to transport the particles.

Conclusion

The drilling mud also has the ability to direct the hydraulic power of the pumps to the drill bit. Of course, not all of the pump power reaches the drill bit, but it loses part of it in its flow and movement path (non-useful power) and only a part of it, called the useful power, reaches the drill tip. The hydraulic force of the mud must be taken into account when planning the drilling mud. This means that while the minimum volume of mud is decreasing, the drilled material should also be brought to the surface as quickly and efficiently as possible. It has hydraulic power and must be constantly monitored. Also, the amount of mud solids should be carefully controlled and kept at an acceptable level for better drilling efficiency. Proper drilling mud should not disturb the natural condition of the floors and provide the necessary information about the type of floors.

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