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Investigation of drilling problems in Iraqi oil fields (Review)

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Abstract

The problems that accompany the drilling process of oil wells are often due to the different balance of ground stresses around the borehole and resulting from drilling operations inside the well, as well as because of the interactions between the drilling fluid and the rock formation. Even in very carefully planned wells, problems will almost certainly arise during the drilling of the well. For example, in areas where similar drilling practices are used, bore problems may be reported because formations are heterogeneous even though such problems have not occurred before. In well planning, the key to successfully achieving the objectives is to design the drilling program on the basis of anticipating potential drilling problems rather than being cautious or contained. Drilling problems can be very costly, so the design of drilling program must be carefully studied. The most common drilling problems included: Pipe sticking, drilling mud loss (lost circulation), hole deviation, drill pipe failures, borehole instability, formation damage, hole cleaning, H2S fulcrum areas, shallow gas zones, equipment related drilling problems, and mud contamination. In this review, the most common well problems that are encountered during the drilling of oil and gas wells will be highlighted. The compilation of oil field data and previous studies related to the subject, as well as the field knowledge of the drilling supervisors, were all the information centers for this study. Especially the most important problems that occur in our Iraqi fields and the solutions that have been dealt with are discussed in this review, the study included five fields in southern Iraq. As indicated, these problems lead to a loss of time and effort, in addition to increasing the costs of the drilling process, and workers must avoid such problems as much as possible.

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1. Introduction

Well drilling refers to the complete set of processes required to create circular-section bores in the ground to access oil and gas using drilling techniques. The oil industry is one of the qualitative industries in the world. As this industry has evolved greatly over time and the advancement of technology [1]. Drilling engineering is an essential part of the life of a well. The high complexity of the drilling process of oil wells, its high costs, the need to ensure the full efficiency of the platform, respect for safety and the environment, require continuous improvement of operations, which is achieved by monitoring and processing all available geological data and data collected during drilling [2]. To reach these goals, each drilling rig, especially those that have to drill complex, deep and therefore expensive wells, is equipped with fairly sophisticated mud logging units, this allows for interpretation of a wide range of information of interest to both the geologist and the drilling engineer [3]. The importance of drilling engineering lies in the fact that it is the most effective technique to reach the reservoir layer, as the quality of the completed well bore greatly affects the stages [4]. Later in the life of the well during drilling, many problems can be faced, and their quality ranges from the limits of a slight increase in the cost of drilling to disasters [5]. Sometimes drilling problems are accompanied by losses that are not only material, but sometimes human, which makes these problems an obstacle that must be overcome, and this may require the presence of a person called an expert in increasingly difficult and dangerous drilling problems [6]. Drilling problems are divided into two types:

1- Problems arising from formation conditions and the content and nature of the penetrated formation.

2- Problems resulting from the method used in drilling, as well as the elements that work to complete the well [7]. The ground stresses, in addition to the pore pressures of the rock formations, are trying to restore the previous equilibrium by allowing the rock layers to move towards the borehole. Where the well is usually kept stable by maintaining a balance between the ground stresses and pore pressure on the one hand and the drilling fluid pressure inside the well on the other hand, where problems are expected in the well at any time this balance is disturbed [8]. One most important problem that encounter the drilling process and hinder the progress of the penetration of the layers is groundwater runoff. The porous and permeable excavated layers in particular contain fluids, which consist of water most of the time and have a variable salinity that depends on the solubility of the salts present in each layer, the depth of the layer and its high temperature [9]. Which leads to an increase in the solubility of these salts and the water may contain sulfur materials or gases [10]. As a result of what was mentioned above, this water flows into the bore of the well under the influence of its pressure resulting from its column or resulting from compressive forces due to the weight of the layers to prevent this flow [11]. The drilling process requires the use of mud with an appropriate density and its properties are not affected as a result of contamination with the water of the drilled layers and the length of its column generates a static pressure equal to the formation pressure or slightly more in order to prevent the flow of groundwater to control the groundwater runoff [12 and 13]. Caving of the well at the salt layers and some sedimentary layers at different depths are formed. Excavation of these layers poses technical difficulties, the most important of which is melting of salt when drilling the layer with a water-based mud, fresh or slightly saline [14 and 15]. The dissolution of salt dome causes an expansion in the walls of the well, affecting its verticality, in addition to hampering the processes of dragging and dropping as a result of these expansions or protrusions [16 and 17]. The phenomenon of mud channels behind the casing may occur due to the low annular velocity of the displacement mud [18]. The main objective of this review is to shed light on the most important drilling problems and methods of avoiding and treating them (old and modern methods) in the event of their occurrence. In particular, the most important problems that occur in our Iraqi fields and the solutions that have been dealt with are discussed in this review.

2. Hole Problems Categories:

In good planning, the key to successfully achieving objectives is to design drilling programs based on anticipation of the potential hole problems rather than caution and containment. Indeed, drilling problems are very expensive [19]. The most common drilling problems include:

2.1 Pipe sticking : is defined as the adhesion of part of the drill pipe or heavy pipe to the wall of the well [20]. At that time, the movement of the drilling shaft becomes difficult, as well as the progress of drilling. Intractability can be classified according to the causes leading to it into two types [21]:

2.1.1. Differential Stuck:

This type of sticking occurs due to the differential pressure created when the pressure of the clay column overcomes the pressure of the porous layers [22]. The adhesion of the pipes (drilling pipes, ballast or liner) is carried out by differential pressure when the following factors are present: The drilling thread or liner stops moving (reciprocating or horizontally) [23]. The presence of a porous and highly permeable layer against the thread. The presence of a vertical inclination in the adhesion area [24]. Increased drilling mud column pressure over formation pressure [25]. Increase the percentage of filtrate with water. The presence of thick drilling mud through the adhesion zone [26]. According to the equation 1, differential Stuck can be defined [27]:

$$F = (Hs - Pf) * (h * t)) * f \quad \ldots (1)$$

Where:

F = differential force, N

Hs = differential pressure, psi

Pf = configuration pressure, psi

(h*t) =contact area, inch2

f=friction coefficient, usually varies from 0.05 – 0.25

2.1.2 Mechanical Stuck: It occurs as a result of the inefficiency of lifting the excavated rock crumbs and their falling around the drilling column, or because of the swelling of the shale layers, as well as when the drilling column is lowered very quickly in narrow areas, and it is characterized by the inability to rotate the drilling fluid, as well as the failure to move the drilling column. [28 and 29]

For example, Amin and Eyad investigate the sticking problem in the Khabbaz oil field, where well drilling operations face many problems, including the sticking of drilling pipes, which is one of the very common problems all over the world in the oil drilling industry, causing an increase in non-productive time, loss of time and effort, and an increase in cost as a result of additional operations of liberation and the extraction of the attached drilling pipes, in addition to the lateral drilling operations in the event that the extraction operations are not successful. Drilling in the Khabbaz oil field faces many challenges and problems, including the loss of the drilling fluid cycle, the flow of salt water during drilling, and the destruction of the wall of the cavity, causing the pipes to stick. It was recommended to determine the appropriate type of drilling fluid and the characteristics of the rheological drilling fluid, and to improve the design of the selection of the casing seating area to reduce the possibility of pipe sticking [30]. Abbas et.al, after studying 385 wells for different fields in southern Iraq, found that the possibility of releasing the stuck pipe depends on the response time and the subsequent surface action performed by the driller during and after sticking. A delayed and inappropriate reaction not only results in a loss of time trying to free the stuck pipe, but also in the loss of an important part of expensive pipe equipment and tools. Therefore, a quick and effective response must be made to free the stuck pipe. Investigation of previous successful responses that resolved problems with blocked tubes makes it possible to predict and adopt appropriate treatments. Abbas et.al have developed new models to predict the solution of stuck pipes for vertical and deviant wells using artificial neural networks (ANNs) and support vector machine (SVM). The results of the analysis revealed that both ANNs and SVM approaches can be of great benefit, with the results of SVM being the most promising [31].

In the field there are special sheets, by answering a set of questions, the cause of the difficulty will be determined. This sheet contains information on how to deal with intractability in addition to some important notes. Al-Hamidi et.al.studied the Tanumah and Zubair formations of the Sinbad field. They found that the stuck pipe was a cause the problem of instability of vertical and deviant wells. WhichCause for the majority of the time unproductive (NPT). They found that the solution was to use oil drilling fluids (use a specific chemical pill to stop the mechanical tube stuck in the tanumma formation,Well 6, Sinbad field) and using a different (unbalanced) "U" tube technique for stopping differential stuck pipes Zubair formations, well 11, Sinbad field[32]. Tables 1and 2 represent a field worksheet in which, by answering a set of questions, the cause of the difficulty will be determined. This sheet contains information on how to deal with intractability in addition to some important notes. It is worth noting that field experience and field practice make the owner of this paper not need to know the type of intractability Figures 1 and 2 show the mechanical and differential stuck, respectively.

Table 1: Stuck pipe mechanism work sheet [29].

Stuck Pipe Mechanism			
Pipe Motion Prior To Sticking	**Pack – Off Bridge**	**Differential**	**Wellbore Geometry**
Moving Up	2	0	2
Rotating Up	0	0	2
Moving Down	1	0	2
Rotating Down	0	0	2
Static	2	2	0
Pipe Motion After Sticking			
Down Free	0	0	2
Down Restricted	1	0	2
Down Impossible	0	0	0
Pipe Rotation After Sticking			
Rotate Free	0	0	2
Rotate Restricted	2	0	2
Rotate Impossible	0	0	0
Cir.Pressure After Sticking			
Circulation Free	0	2	2
Circulation Restricted	2	0	0
Circulation Impossible	2	0	0
Totals			
INSTRUCTIONS: Answer the shaded questions by circling all the numbers in the row with the correct answer. Add the columns, the column with the highest number indicates the sticking mechanism.			

Table 2: Freedom wellbore geometry work sheet [29].

Freedom Wellbore Geometry
Initial Action:

If sticking occurred while moving up, apply torque and jar down with maximum trip load. -١

If sticking occurred while moving down, do not apply torque and jar up with maximum trip load.
top or reduce circulation when cocking the jar and when jarring down. NOTE: Pump pressure will increase -١
the hydraulic jar up-blow, decrease the down-blow.
Continue jarring until the string is free or alternative decision is made. Jarring for 10+ hours may be -٢
necessary.

Secondary Action:
Spot acid if stuck in limestone or chalk. Spot fresh water if stuck in mobile salt.

When The String Comes Free:
4. Increase circulation to maximum rate, rotate and work the string.
5. Ream / back ream the hole section thoroughly.
6. Circulate the hole clean.

7. Under ream hole section or remediate in another way.

FREEDOM PACK-OFF / BRIDGE	
Stuck While Moving Up Or With String Static	**Stuck While Moving Down**
Action To Establish Cirulation:	**Action Establish Circulation:**
١. Apply low pump pressure (200-400) psi. maintain pressure if restricted circulation is passible.	1. Apply low pump pressure (200-400) psi. Maintain pressure if restricted circulation is possible.
٢. DO NOT JAR UP!! APPLY TORQUE !!!Slack – off to MAXIMUM set down weight. Allow sufficient time for a hydraulic jar to trip (4-6 min. for long cycle, see jar manual).	2. Do not jar down!! Apply torque!!! Apply maximum over pull to jar. Allow sufficient time for a hydraulic jar to trip 4-6 min. for long cycle, see jar manual).
٣. If the string does not come free, do not jar up !!! jar down until the string comes free or an alternative decision is made jarring down for 10+ hours may be necessary.	3. if the string does not come free, DO NOT JAR DOWN!!! jar up until the string comes free or an alternative decision is made jarring up for 10+ hours may be necessary.
ONCE CIRCULATION ISEST ABLISHED ٤. Slowly increase pump speed to maximum rate. When possible, work the string and circulate the hole clean from bit depth.	**ONCE CIRCULATION ISEST ABLISHED** 4. Slowly increase pump speed to maximum rate. When possible, work the string and circulate the hole clean from bit depth.
٥. Ream the section until the hole is clean.	5. Ream the section until the hole is clean.
٦. If POOH to log and or run casing return to bottom & circulate hole clean.	6. Continue RIH until excessive set down weight is observed, circulate hole cleaning.

Freedom Differential Sticking

Initial action:

1-Circulate at maximum an allowable rate.

2-Work maximum limit torque down to the stuck depth and hold the tor que in the string.

3-Stop or reduce pump speed to minimum.

4-Slack-off maximum set down limit.

5-Allow sufficient time for a hydraulic jar to trip (4-6 min for long cycle, see jar manual).

6-If the string does not come free, hold torque in the string and continue jarring down with maximum trip load.

Secondary Action: If the string does not come free after 5to10 jar blows, continue jarring while preparing a pipe releasing pill.
When The String Is Free: 7-Rotate & work the string. 8-Circ at max. rate to clean the hole. 9-Check the proper mud specifications.

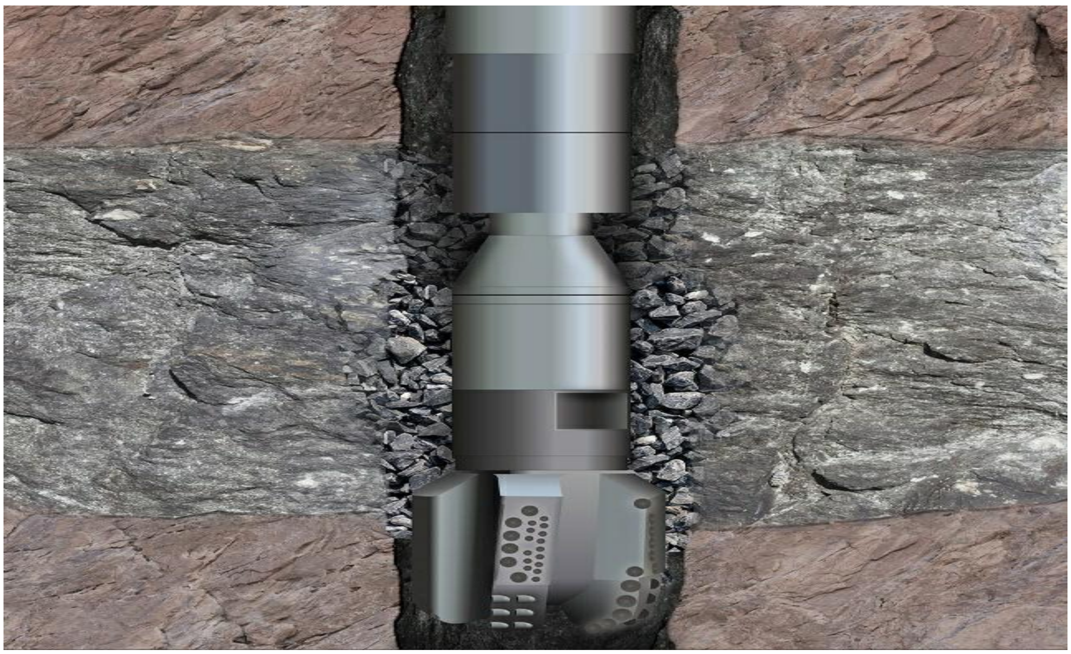

Figure1: Mechanical pipe sticking [31].

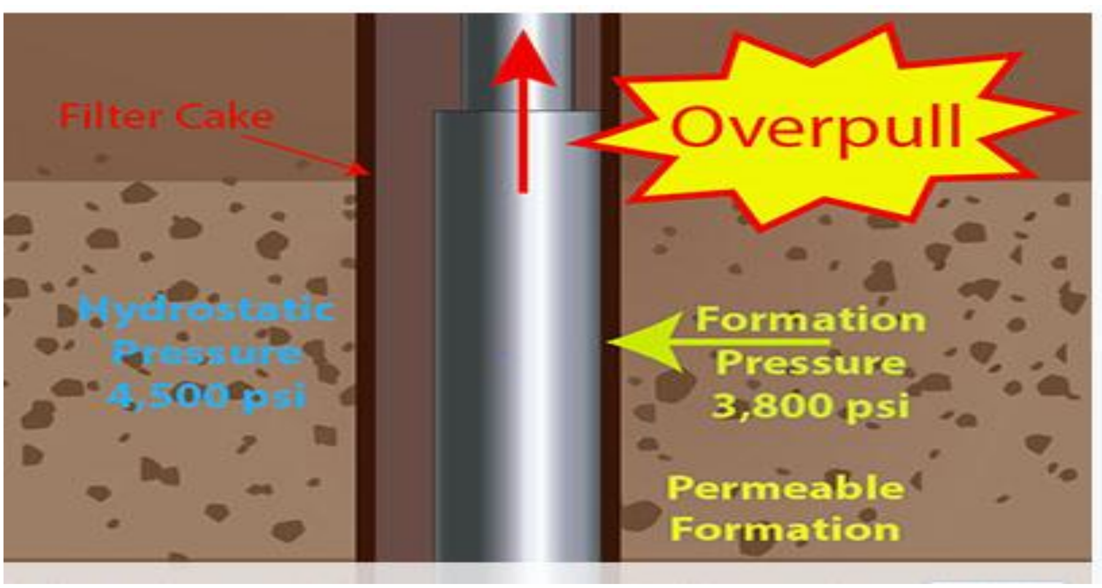

Figure ٢: Differential pipe sticking [32].

Assi found that most of the NPT in a study of two wells in southern Iraq was due to a stuck pipe. Figure 3 shows that most of the non-productive time (NPT) was due to a pipe blocking problem for the X-51 well (vertical well). Similar to the X-51 well, the non-productive timeline as in Figure 4, which is also shows that most of the non-productive time was due to pipe sticking. On the other hand, the next biggest reason for the unproductive time in this well was the continuous expansion because it is a directional well [33].

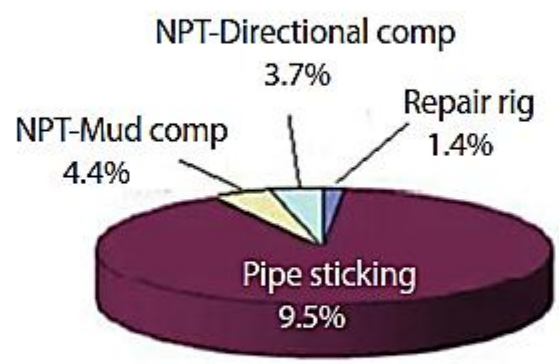

Figure ٣: Non-productive time for the well R-51 [33].

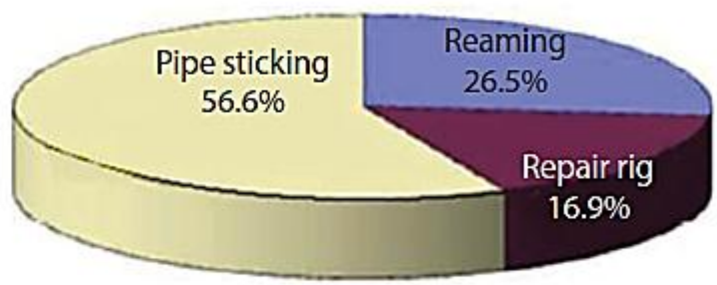

Fig. 4 Non-productive time for the well R-53 [33].

2.2. Borehole instability: Shales or oil shale constitute most of the problems of instability of the well cavity, starting from drifting to the complete collapse of the cavity. Oil shale is fine-grained sedimentary rock consisting of clay, silt, and in some cases fine sand. The types of oil shale range from clay highly cemented mudstone. That over 75% of the excavated formations worldwide are shale formations, and the reason for the instability of the shale is either mechanical (stress change versus the strength environment of oil shale) or chemical (rock interaction and drilling fluid invasion of oil shale) [34] and as shown in Figure 5. Maitham studied the well instability problem in the Halfaya field, where he found that the well bore instability is one of the main problems that slow down drilling in the Halfaya oil field. When drilling in oil shale formations, wellbore instability is seen as the primary problem, resulting in unproductive time and high well drilling costs. In most cases, drilling costs may be reduced by planning to build an integrated geomechanical model. According to Maitham's study, the unsuitable mud weight is the main reason for the instability of the wellbore (10.49) pounds/gallon during drilling Nahr Omar unit A in well N002H and (10) pounds/gallon during drilling Nahr Omar unit B in well N107D [35]. Walaa and Eyad have studied the problem of wellbore instability for the Rumaila oil field through basic laboratory tests (three-axle test), well testing (Mini-frac. test), and repeated formation testing. Mohr-Coulomb, Mogi-Coulomb, and Modified Lade are the three failure criteria that are used to analyze well fractures and to determine the minimum mud weight required for a stable well wall. The results of the analysis showed that the Coulomb wave criteria are closer to the failure of the really well compared to the other two criteria and are considered the best criteria for predicting rock collapse in the Rumaila oil field. Wellbore instability analysis revealed that vertical wells with low deviation (less than 40 degree) had better safety and stability [36].

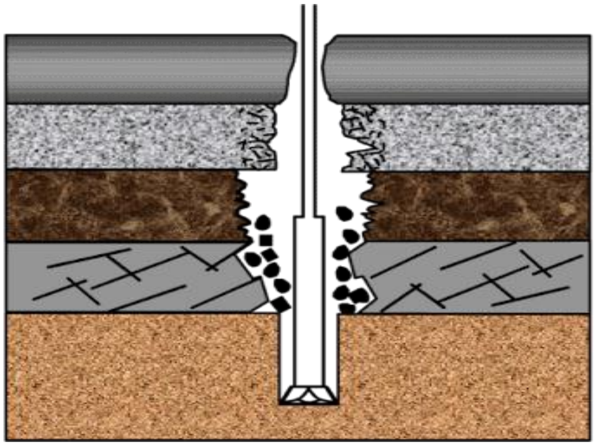

Figure 5: Bore hole instability [34]

2.3. Pipe failures: Drill pipe failure is one of the common drilling problems. Pipe failure can be placed into one of the following categories: Twist off caused by excessive torque. Separation due to excessive stress. Burst or collapse due to excessive internal pressure or external pressure respectively. Fatigue is the result of cyclical mechanical loads, with or without wear. Drill thread stress failure is the most common and costly type of failure in oil/gas and geothermal well drilling operations. The combined action of cyclic stresses and corrosion can shorten the life expectancy of a drill pipe by a thousand times. Cyclic stresses occur due to dynamic loads resulting from drill string vibrations, bending load reflections in the curved sections of the bore, and doglegs caused by rotation. Pipe corrosion occurs while O2, CO2, chlorides and/or H2S are present. H2S is the most corrosive component of steel pipes, and is deadly to humans. Regardless of what may have caused the pipe failure, the cost of fishing operations and sometimes failed attempts to recover equipment from the bore can result in millions of dollars lost in rig downtime, expensive downhole tools lost, or a section abandoned. Already dug down the missing equipment as shown in Figure 6. Many theses discussed the issue of the failure of the drilling and lining pipes, including the thesis that discussed the failure of the lining pipes for the Halfaya and Abu Gharib fields in Maysan, for example the thesis submitted by Almohammedawi. Where the thesis discussed "Risk Management of Oil Well Drilling Operations and Economic Evaluation of Missan Oil Fields", where two field case studies were chosen in the two oil fields in southern Iraq, namely the Abu Gharb field and the Halfaya field. Four wells were selected, three wells in the Abu Gharb oil field, and one well in the Halfaya oil field. The study of the two cases includes problems that occurred in the four wells. The first case is the occurrence of a cavity in the liner measuring (9⅝) knots in the four wells in both fields. As for the second case, it involved the loss of two radioactive sources from the oil well evaluation equipment in a well in the Halfaya field. The research dealt with the risk management of oil well drilling operations and the economic evaluation of the Maysan oil fields (Halfaya and Abu Gharib), the aim of the thesis is to assess the risks of oil well drilling operations and manage them is to increase the probability of success of the project through risk analysis, mitigation, control and monitoring. The thesis concluded that improving well design, ideal drilling practices, selecting reliable plants for producing the liner, and improving well appraisal practices would reduce or prevent the occurrence of these problems in oil fields in the future. Thus, it will reduce the drilling cost and time and lead to achieving the desired objectives of the drilling companies and improving the key performance indicators. The problems that occur during the drilling of exploratory and developmental oil wells at the global level, and the problems that occur during the drilling of wells in the Iraqi fields in the companies of southern, central and northern Iraq. The material losses caused by these problems through the consumption of materials, equipment and time, in addition to the biggest danger, which is the risks to workers from engineers, diggers, and the rest of the basic and support staff [37]. Al-hlaichi and Al-Mahdawi concluded through the study of the Rumaila oil field that improving the well-drilling design reduces the total expenditure by reducing the well construction time and expenses. The design of the drilling and liner pipes should be improved by means of:approving the actual field conditions and the problems associated with them. Also, they have proposed processes to improve the design of wells, such as slim well comparative with the traditional design, in addition to optimizing the selection of installation depth, liner loads, and drill pipe quality in order to avoid pipe failure [38].

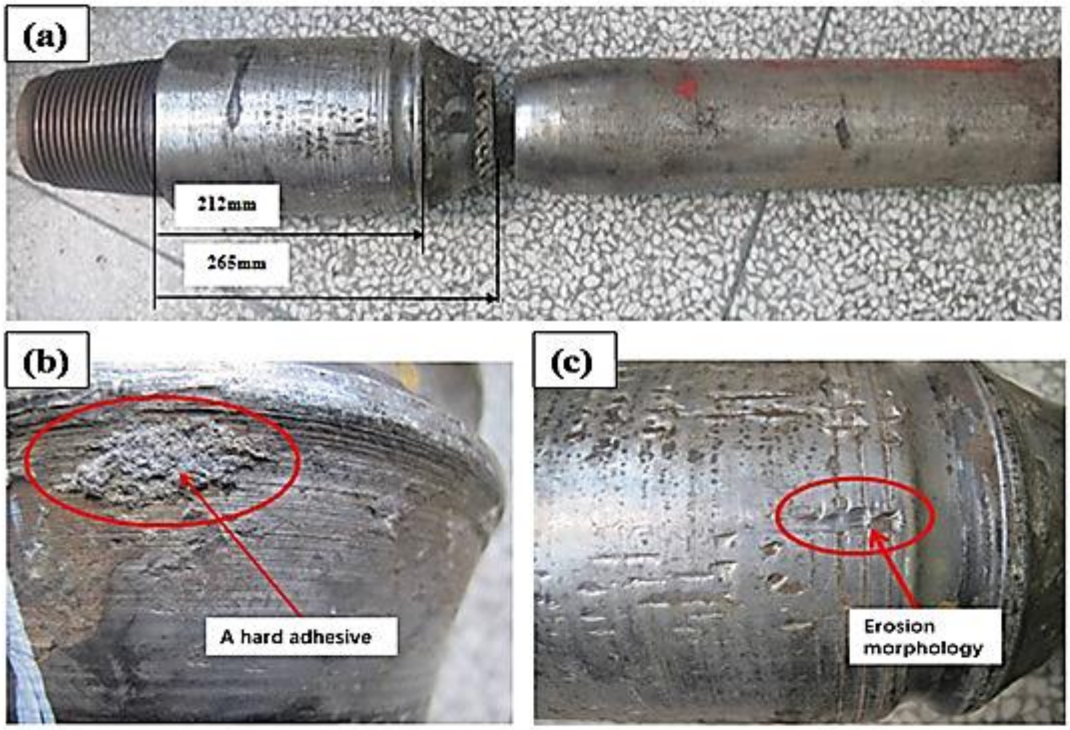

Figure 6: Pipe failure [37].

Also in the oil industry, other equipment fails, not just the drilling pipes, such as the erosion of the bit teeth. Assi has studied the most important factors leading to this, in addition to analyzing the data of a group of rigs used to drill wells in the Rumaila field, southern Iraq. From table 3i t's clear that the Smith bit (MSi616) has been give good performance rather than other bit types because this has good bit dull grade also this bit was used to drill RU-417 well, it has been Re-run from R-541 (592 m, 63.7 hours, 1-1-BT-A-X-IN-CT-TD) [39].

Table 3: Effect of bit manufacturing and model on ROP [39].

well	Manufacturing	Bit Size"	Bit model	SN#	IADC	ROP(m/hr.)
R-529	Smith	8.5	MD616LEPX	JE5702	M222	21.19
R-532	Haliburton	12.25	FX65D-PDC	1E+07	M323	9.63
R-538	Haliburton	12.25	SFD75H	1E+07	S322	24.24
R-541	Smith	12.25	MSi616	JF4377	M223	9.29
RU-417	Smith	12.25	MSi616	JF4377	M223	2.89
RU-431	Smith	8.5	MD616LEPX	JF5701	M224	6.75

2.4 Drilling Fluid Contamination and Treatment:

The drilling fluid, and during its journey during drilling, passes through many layers that affect the composition of the drilling fluid and pollute it, and as in table 4. The composition of Al-Dibdibba consists of mud and gravel with layers of mud gypsum, which causes the drilling mud to coagulate, raise its viscosity, and increase the proportion of sand in the drilling mud. The treatments are carried out using Shale shaker, desander devices. It is preferable to use drilling mud consisting of a polymer. It is also preferable to add sodium carbonate to precipitate magnesium and calcium ions. The formation of the Ghar is composed of sand and gravel, and digging this formation increases the proportion of sand in the drilling mud. The treatment is done by adding bentonite polymer (PAC) in order to obtain a good cleaning and to form a mud cake that prevents sand from entering the formation. The Dammam formation is permeable, containing in its lower part salt water and sulfur water, and the loss of drilling fluid may occur. The treatment requires maintaining a drilling density of 1.16 gm/cc in order not to increase the hydrostatic pressure. The formation of Rus is composed of anhydrite and a few layers of dolomite, and this formation causes problems of increasing calcium ions and increasing the proportion of calcium ions, and then increasing the viscosity and leaching of water, and the treatment is done by adding sodium carbonate to precipitate calcium ions. As for the formation of Umm Al-Rudhuma and Tayarrat, they contain sulfur water, and also, its formation is considered a soft formation, as drilling is rapid, which leads to an increase in cuttings. To treat the above problems, we use a drilling fluid that is able to give a good gel and suspend the rock pieces. And also, to maintain the density of the mud up to 1.16 gm/cc to avoid the occurrence of run-off in the sulfur water present in the layer of the Tayarrat. The shirransh layer consists of plastic marl, where its composition leads to sturdiness as well as balling, increasing viscosity and slowing down the drilling speed. Reducing viscosity is one of the most important treatments and it is possible to add or use an emulsion as a drilling fluid. Hartha has upper dolomite and lower marl. The most important problems with this stratum are partial total loss of drilling fluid and treatments lie in the addition of Lost Circulation Materials (LCM). The Saadi layer consists of limestone, which contains a small amount of gas and oil. It is preferable to add chromium to lignite, because it is resistant to heat and reduces filtration. As for the tanumma layer, it consists of shale, and its most important problem is the occurrence of demolition of the shale, but fortunately, its thickness does not exceed 50 meters. The treatment is done by adding lignosulfonate and chromium to lignite. The khasib layer is a strong layer consisting of limestone that slows down the drilling speed, and the treatment is carried out by increasing the viscosity and gelatinization to obtain a more efficient cleaning. As for the Mushrif, Rumaila, Ahmadi and Mawdud layers, their composition is mostly limestone with a percentage of shale, the treatment is by adding a control to the shale and adding a substance that reduces filtration (PAC). As for the Nahur Omar layer, its upper part is shale and the lower part is sandstone. It is preferable to convert the mud to LIME MUD to support the well wall and not to destroy the shale. The Shaiba layer is composed of shale limestone and it is possible for mud loss to occur. Here we need to reduce the recycling density and use LCM. The Zubair layer is composed of compressed shale in its upper and middle part, sandstone, while the lower part is shale, adding an inhibitor to the shale is the treatment such as Nano silica.

Table 4: The geological formation for south field in Iraq.

Formation	Composition	Remark
Dibddiba	loose sand and gravel	An increase in the percentage of sand in the drilling fluid
Lower faris	maril and anhydrite	High plastic viscosity and spherical hoof
Ghar	loose sand and gravel	An increase in the percentage of sand in the drilling fluid
Dammam	limestone and dolomite and porous and vuggy	The upper part is solid and the lower part contains sulfuric water, and the possibility of losing drilling fluid occurs in it
Rus	Anhydrite	High percentage of positive calcium ions and drilling speed, which causes an increase in the weight of the drilling fluid
Umradhuma	dolomite(vuggy and porous)	Container on sulfuric water and drilling speed goes up
Tayarat	dolomite(vuggy and porous)	There is a high probability of sulfur water runoff and there is a possibility of losing the drilling fluid cycle
Shiranish	Marl (plastic)	High viscosity, slow drilling, sticking may occur, auger balling
Hartha	dolomite(vuggy and porous),Marl	Total fluid loss
Sadi	limestone (chalky)	It contains gas and a little bit of oil

Tanuma	shale	Low thickness and slow drilling
khasib	limestone (shaly)	Solid layer with potential for oil and gas
Mishrif	limestone (chert)	blow out, gas cut, cap rock
Rumaila	limestone (shaly)	slow drilling
Ahmedi	shale ,limestone	Shale is thin
Maudud	limestone (porous)	Possible liquid loss in some fields
Nhr Umr	shale ,limestone and sand	Destruction of shales, corrosion of auger (high-temperature sand), damage to the productive layer, blockage of pipes
Shuaiba	limestone, dolomite(vuggy and porous)	slow drilling, Total fluid loss
Zubair	shale ,limestone and w.sand	Shale collapse, eruption, intractable pipe

2.5. Loss of circulation :

It is a very common problem, as most fields in the world mud losses occur during drilling operations. And then lost circulation is a difficult problem to prevent while drilling, and as shown in figure 10. There are many treatments for blood loss applied to reduce losses. using corrective approach or to prevent a lot of losses by using preventive methods, also called as "Borehole Strength". The leakage has types related to the aforementioned pressure differences, the specifications of the bit and the characteristics of the layer, and it has different rates of which:

1- Partial smuggling during the rotation of the child.

2- Total leakage when the rotation is stopped, but without a drop in the liquid level in the well.

3 - Total smuggling with a drop in the liquid level in the well.

The Dammam Formation is the first formation in the Basra oil fields to be exposed to mud loss. It is found at the top of this area between 435 and 490 m and all wells in the field should be dig through this area. The interval consists of Interleaved limestone and dolomite, which generally range from 200 to 260 m. It is certified in depth. It is believed that mud features lead to mud losses seen during drilling during this interval. Understanding and anticipating drilling problems, understanding their causes, and planning solutions are necessary for overall-well-cost control and for successfully reaching the target zone. Hussam et.al. (2018) mentioned that blind drilling can be used to combat mud losses in Dammam formation. However, this technique should be evaded in deeper formations for instance the Hartha and Shuaiba formations as it will have a very low possibility of accomplishment in deeper formations [40]. Ameen used artificial neural networks to predict the loss of drilling fluids before occuring depending on the data of drilling parameters and drilling fluid properties of the wells that suffered from the problem of losses located in the same area. Where two models of artificial neural networks were developed to predict drilling fluid losses in the formation of Dammam - Rumaila oil field in southern Iraq. The two models have the same structure and installation. The first model used the early stopping technique to stop the training process when the minimum function is gotten without relying on a specific number of iterations, and the second model uses a specific number of iterations to complete the training process. The results were similar in terms of the accuracy of the model and its ability to predict different types of losses [41].

Nasiri et al. (2017) conducted a series of field tests. They evaluated the different LCM yields in the most commonly used clay bentonite. The results show that in order to control heavy losses, mixtures of Quick Seal, RIPI-LQC, and mixtures of RIPI-LQC and RIPI-LQF must be used. The results of the experiments showed that the lowest amount of loss Occurred when using mixtures of RIPI-LQC and RIPI-LQF with a concentration of 18 and 7 ppb as shown in Figure 7. [42]. Kazzar and Ayad studied the treatment and evaluation the losses problem of drilling fluid in the Nasiriyah oil field. Laboratory experiments have shown that adding (2) pounds/barrel of sunflower husks to (20) pounds/barrel of SMP-1 gave a decrease in the loss ratios, as the loss reached zero in the case of rock samples with a permeability of less than 900 millidarcy. And from 99.8% to 6.72% for models with a permeability higher than one, that is, the improvement rate was from 97.53% to 100%, noting that this loss stopped completely after only a few seconds. The study concluded that the size of the materials, especially the vegetable ones, is an important factor for closing the cracks completely. Finally, when the fluid has a high malleable point and a low plastic viscosity, it helps to stop or reduce the loss of drilling fluid, even if relatively [43]. Figure 8 shows the types of drilling mud loss, its positive causes, and some treatments.

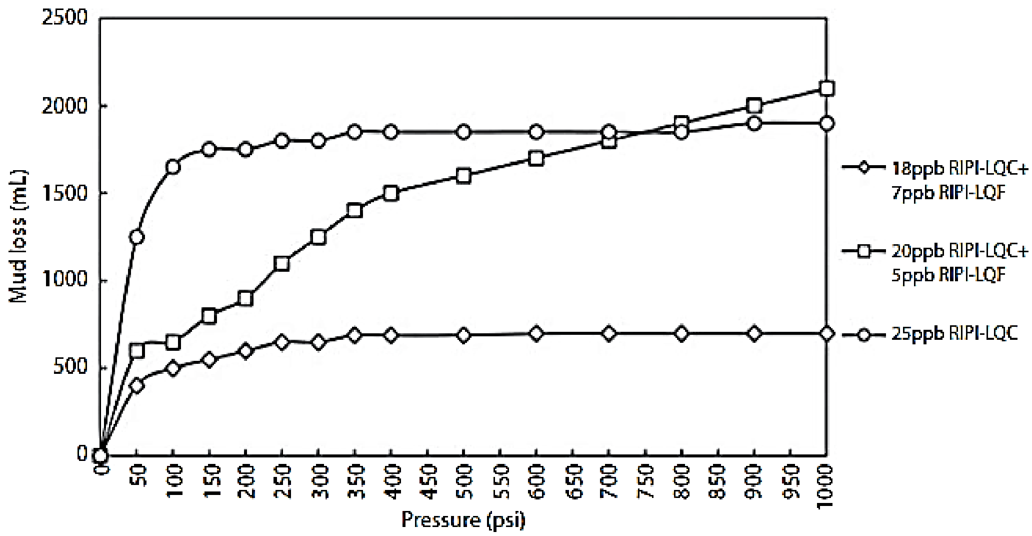

Figure 7: Mud loss for different LCM (RIPI-LQC) [42].

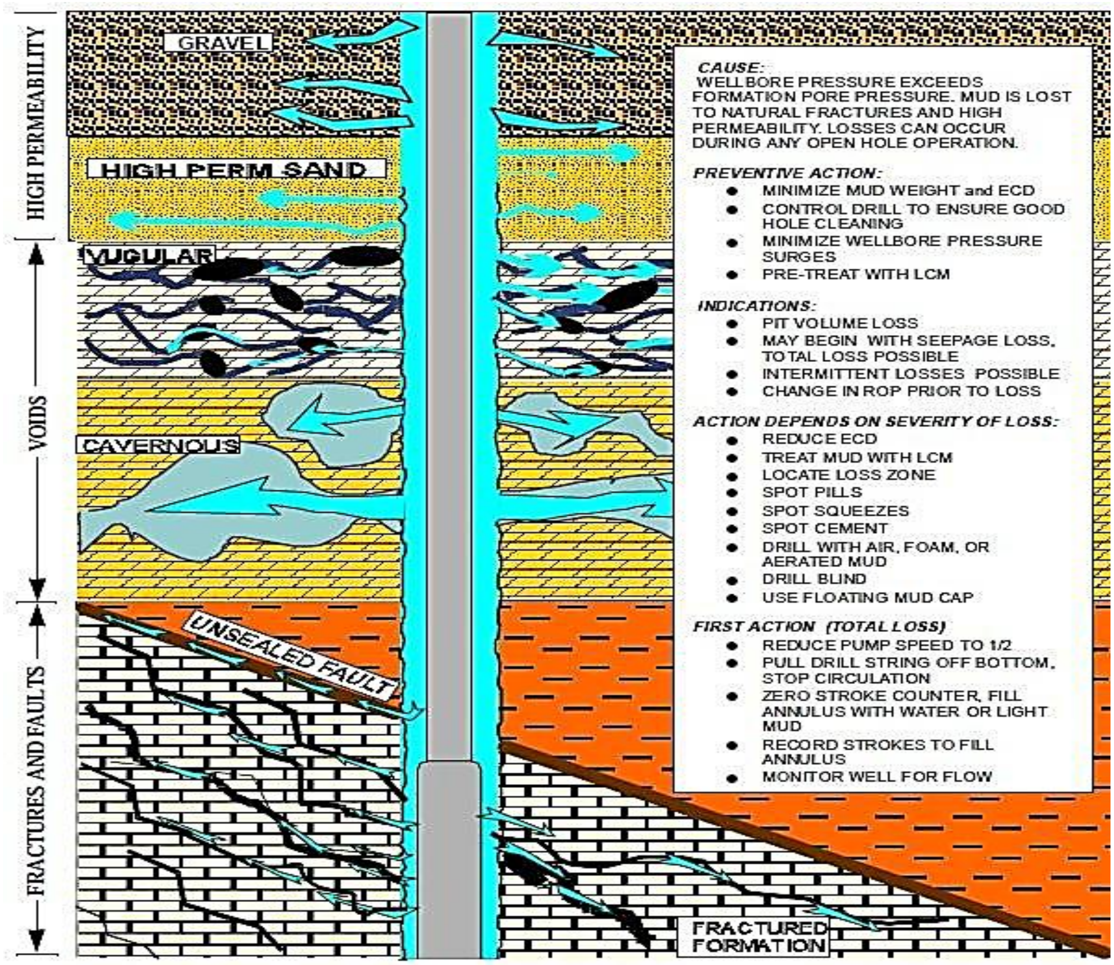

Figure 8: Mud losses, types reasons and treatment [44].

3. Discussion:

There are numerous problems that accompany the process of drilling oil and gas wells, many problems occur while drilling wells in the oil fields in southern Iraq. Dealing with these problems poorly and ineffectively, which leads to loss of time and cost. This study aims to identify these oil problems, in addition to diagnosing some potential problems, and then provide the best treatment for each problem. Field data collection and previous researchers' studies of drilling problems, as well as the field and practical experience of drilling supervisors, are the basis for this review. First, the southern fields were carefully and extensively analyzed and studied, starting with the geological structure, and then an integrated discussion of each formation was carried out to present its characteristics. Some of the most important potential drilling problems that occur during the drilling process were raised, and then a treatment was provided for each problem in order to ensure the most appropriate solution. The oil field formations in southern Iraq have been studied clearly as a complete characterization process has been performed including all formations (from Dibdaba to Zubair formations). For each formation, the geological composition of the formation was clarified, as well as presenting all the problems that may occur during the excavation of the formation, or that may occur due to possible causes (mechanical or chemical). The results of many previous studies were discussed and put forward about the reason for the existence of drilling problems in these formations and their seriousness, and the evidence for these theories was presented in this study. For each problem, a remedy is reached to ensure the safest practices, minimum time loss, as well as minimizing costs. Although pipe failure cannot be completely eliminated, there are some measures that can be taken to reduce it. Fatigue failures can be mitigated by reducing induced cyclic stresses and by ensuring a non-corrosive environment during drilling operations. Rotating stresses can be minimized by controlling dogleg intensity and drill string vibrations. Erosion can be mitigated by corrosion scavengers and by controlling the pH of the slurry in the presence of H_2S. Proper handling and inspection of the drill string on a routine basis are the best measures to prevent failure. It can be seen that the geological structure has its share in the drilling problems, as some problems are attributed to a chemical cause, which is related to the drilling mud, and the other is mechanical, which is related to the effect of stresses on the rock. Also, one of the solutions to the problems mentioned is to follow the optimal drilling methods, which will reduce costs and increase profits, by controlling the drilling variables. One of the most common problems that occur during the drilling of oil wells is the stuck pipe, which is the inability to pull the pipes out of the well, and it may occur for many different reasons. And knowing the cause of intractability is very important, because through it, the method of treatment is determined. For the pipe failure, studies have shown that the most important reasons leading to it are: Chemical composition of the drilling, pH of the mud, increase in the temperature, pressure and rotational speed, the type of material the pipe is made of and its durability. The use of suitable drilling mud with a suitable pH to prevent corrosion, as well as the use of excellent quality pipes that are able to withstand the conditions of the well from heat, pressure and speed of rotation. For stuck pipe, studies have shown that the most important reasons leading to it are: the hydrostatic pressure of the drilling fluid on the formation is much greater than the stratum, adhesion due to the differential stuck, stuck due to bit balling, stuck due to caving or tight hole, stuck due to geological faults, bad mud properties and excess mud cake lead to differential stuck. Avoidance and treatment stuck pipe lie in: it is recommended to use threaded drilling columns when excavating such layers, and if columns are not available threaded, the stabilizer should be added to the assortment. Also, the elements of the bottom drilling formation must be free of protrusions that could scratch the cake. It is preferable, during excavation, in areas where collapse or high permeability occurs, to be careful of changes angle of inclination. Table 5 shows a summary of the drilling problems studied and the solutions proposed and implemented by the researchers.

Table 5: Drilling problems that were studied and the solutions used by the researchers.

Problem	**Researchers**	**Field**	**Solution ,technique, or model**
Stuck pipe	Amin and Eyad	Khabbaz	The appropriate type of drilling fluid
Stuck pipe	Abbas et.al	385 wells for different fields in southern Iraq	Using artificial neural networks
Stuck pipe	Al-Hamidi et.al.	Tanumma and Zubair formations of the Sinbad field	"U" tube technique for stopping differential stuck
Borehole instability	Maitham	Halfaya field	The appropriate type of drilling fluid
Borehole instability	Walaa and Eyad	Rumaila	Predicting rock collapse (Coulomb wave criteria)
Pipe failures	Almohammedawi .	Halfaya and Abu Gharib	Improving well design
Pipe failures	Al-hlaichi and Al-Mahdawi	Rumaila	Slim well and improving well design
Erosion of the bit teeth.	Assi	Rumaila	Good bit selection (bit record)
Lost circulation	Hussam et.al	Rumaila	Blind drilling
Lost circulation	Ameen	Rumaila	Used artificial neural networks to predict the loss before occurring
Lost circulation	Nasiri et al	30 wells for different	Using chemical mixtures to control

		fields in southern Iraq	loss
Lost circulation	Kazzar and Ayad	Nasiriya oil field	Using sunflower husks and chemical mixtures to control loss

4. Conclusions:

1-Excavation problems are many, and their causes are due to the failure to use appropriate tools and drilling fluids on the one hand, and on the other hand, the causes of excavation problems are also due to the nature of the geological structure of some of the excavated layers.

2. During drilling, many problems are encountered, and their severity ranges from minor to catastrophic. Therefore, each site must have an expert for difficult problems in order to avoid material and human losses. And that the problems of excavation result from the method used in excavation or from the stratigraphic conditions and the nature of the excavated layers.

3-Mud loss problem is very common, as most fields in the world have mud losses during drilling operations. Loss of mud circulation is a difficult problem that must be prevented or mitigated. There are many treatments for loss of mud circulation, which are applied to reduce losses, using preventive methods. It is necessary to research and finding alternative ways to mitigate this problem, as this will lead positively during drilling operations in terms of costs and the time. Blind excavation technique can be used to prevent mud losses in the Dammam structure. However, this method should be avoided in deep formations such as the Hartha formation and the Shuaiba formations due to very low probability of success for deeper configurations.

4-The excavated layers are multiple and have different geological composition, so appropriate drilling fluids must be chosen for these layers, as follows: WBM clay and polymer clay in addition to the polymer gel and Kcl polymer, as these clays have proven their effectiveness during drilling.

5-As for the intractability of the pipes, through the review, it was found that there are many solutions, such as the use of oil-based mud, the use of the U-technique, or the use of artificial intelligence ANN.

6- The most important output of this review is that those in charge of well drilling operations must constantly review the drilling records and the final well report in order to benefit from them while drilling other wells in order to avoid falling into the same previous problems**.**

Nomenclatures:

PAC: Polyayonic celellous
μp: Plastic viscosity
Yp: Yield point
Lost Circulation Materials. LCM:
Cp: Centipoise.
pH: the concentration of hydrogen ions (H+) in a liquid
WBM: water base mud

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