

Ultra mud system Optimizes Drilling Efficiency in Sirte basin(Libya)

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ABSTRACT— *Drilling operations continue to get more difficult particularly in the mature fields as the oil company try to get more information about properties of these reservoirs, verify the fluids contact, assist to delineate new development locations, and determine the proven reserves. As wells become more challenging in onshore mature fields areas such as oil field in sirte basin , operators are finding it difficult to drill efficiently to total depth using conventional water-based mud (WBM) systems and often have to rely on oil-based mud (OBM) to reach their drilling objectives. Although there are definite technical benefits associated with OBM, these fluids are often a costly solution with regard to disposal costs, lost circulation issues and regulatory/environmental considerations. As a result, operators are constantly challenged to balance performance requirements with environmental, waste disposal, economic and logistical drivers.*

In response, new high-performance WBM (ultra drilling mud system solutions have been developed to fill the performance gap between conventional water-based and oil-based muds for onshore drilling applications. The newest generation of Ultra Mud weight systems is designed to provide superior performance and environmental compliance while maintaining cost competitiveness compared with conventional WBMs.

Keywords— About four key words or phrases in order of importance, separated by commas

1. INTRODUCTION

Drilling operations continue to get more difficult particularly in the mature fields as the oil company try to get more information about properties of these reservoirs, verify the fluids contact, assist to delineate new development locations, and determine the proven reserves. Not only are oil and gas companies drilling more advanced well designs such as extended-reach and long-lateral horizontal wells, but they also are targeting challenging formations such as deep and high-pressure/high-temperature zones in ever-more complex geology. Because of the technical difficulties associated with these wells, exploratory and developmental drilling has become increasingly risky[1].

A case in point the well is located in a mature hydrocarbon province in the sirte basin with several producing fields in the survey area. The subsurface is complex, with known well bore instability.

In this operational environment, wellbore stability is critical issues to understanding the structural evolution of the formation and trapping mechanisms that are key to delineating prospective exploratory targets and optimizing the locations of development wells. drilling is always a challenge, especially when cutting through depleted zones[4] .

As wells become more challenging in onshore mature fields areas such as oil field in sirte basin , operators are finding it difficult to drill efficiently to total depth using conventional water-based mud (WBM) systems and often have to rely on oil-based mud (OBM) to reach their drilling objectives. Although there are definite technical benefits associated with OBM, these fluids are often a costly solution with regard to disposal costs, lost circulation issues and regulatory/environmental considerations. As a result, operators are constantly challenged to balance performance requirements with environmental, waste disposal, economic and logistical drivers.

In response, new high-performance WBM (ultra drilling mud system solutions have been developed to fill the performance gap between conventional water-based and oil-based muds for onshore drilling applications. The newest generation of Ultra Mud weight systems is designed to provide superior performance and environmental compliance while maintaining cost competitiveness compared with conventional WBMs. In the Introduction section, present clearly

and briefly the problem investigated, with relevant references. The main results should be enunciated. An ultra-drilling mud system was used to successfully drill three wells in a Sirte basin field in Libya where differential sticking, losses, twist offs and catastrophic well bore stability problems were experienced in previous wells drilled with conventional WBM and OBM. ultra drilling mud system set new performance benchmarks for the field area, and saved the operator an average \$500,000 on each of the three wells. The system minimized losses and eliminated stuck pipe events while reducing environmental impact. No formation damage occurred and minimal washouts were experienced during drilling, resulting in good cement bonds and allowing the operator to obtain high-quality image logs.

2. MAJOR FEATURES

The key feature that make OBM effective in difficult wells are improved shale stability by reducing pore pressure transmission, controlling reactive clays, controlling differential sticking tendencies, achieving high rates of penetration, better lubricity to minimize torque and drag, and ease of engineering. However, since not all of these features are necessary for a given well or particular interval, ultra drilling mud system technology is designed to provide any combination of these specific characteristics in a water-based fluid that can be customized to fit a particular application.

Roughly eighty percent of formations drilled Libya onshore basin contains reactive shale, and more than 90 percent of well bore stability problems are related to the drilling fluid's inability to control reactive shales. The most important variable in maintaining shale stability is preventing pore pressure invasion into the shale formation. Pressure invasion alters the near-well bore stress state and can induce failure. Shale stability is achieved when pressure invasion is reduced and differential pressure support is maintained. Incorporating a micronized deformable sealing polymer in the ultra-drilling mud system allows shale micro pores, micro fractures and bedding planes to be mechanically bridged to create an effective barrier that prevents destabilizing pressure transmission into the shale.

The inability to suppress hydration in reactive clays leads to complications such as bit balling, accretion, poor solids removal efficiency, high dilution rates, filtration control and the control of rheological properties. Reactive clay swelling, along with pore pressure transmission, is a leading cause of shale instability. Clay hydration occurs from surface hydration, bonding of water molecules to oxygen on the surface of the clay, and ionic hydration, which is the hydration of interlayer cations with surrounding shells of water molecules. Surface and osmotic absorption leads to two distinctly different problems: swelling (clay expansion after water uptake) and dispersion (the disintegration of the clay fabric after hydration). Picture 3 and 4 shows no bit balling and stable balling.

Clay inhibition is more difficult to achieve with water-based systems because of the similarity of the wetting characteristics between the drilling fluid and formation. HPWBM uses an environmentally acceptable water-soluble clay hydration suppressant to stabilize highly reactive clays through a cation exchange mechanism. The suppressant effectively inhibits reactive clays from hydrating to control problems associated with reactive shales. Figure 1 & 2 & 3 shows superior clay inhibition and cutting encapsulation that promote well bore stability. The stabilizers & bit wear clean after used ultra-mud.

3. STABILITIES OF WELLBORE

Common drilling operations problems such as stuck pipe caused by differential pressures in low pressure/depleted zones are still challenge with both WBM and OBM. When used with the proper lost circulation material, the micronized deformable sealing polymer developed for ultra-drilling mud system reduces differential sticking tendencies in low pressure/depleted zones. The micronized deformable sealing polymer will bridge at the bore hole interface of low-permeability formations, such as tight gas sands. This bridging creates an external as well as an internal filter cake that effectively controls differential sticking. Moreover, the internal filter cake enhances the effective rock strength for increased formation fracture resistance. This increase in rock strength allows depleted sands to be drilled with the appropriate mud weight required to control pressured shales and/or pressured production sands while reducing mud losses to the depleted formation [3].

Oil Based Mud often exhibit high penetration rates compared with conventional water base mud. Drilling soft, reactive formations can present issues in regard to bit balling and reduced penetration rates. Bit balling is caused by reactive clay accretion on a water-wet bit and bottom-hole-assembly, which effectively prevents the bit from contacting the formation. A penetration rate enhancer can be added to ultra-mud system that is reducing the tendency of reactive clays to adhere to the bit and BHA surfaces.

The newest-generation HPWBM system is designed to provide well bore stability in a freshwater or low-salinity environment. This presents a considerable advantage for waste treatment in land environments, particularly where chloride discharge is restricted. Infill drilling/multi wells campaign, the system can be recycled and reused to save the

operator valuable mixing and rig time. In addition, mud reclamation reduces the total amount of fluid required, ultimately lowering the overall environmental impact of drilling operations.

Other positive features associated with ultra-mud system technology include enhanced image log quality, efficient cementing operations, reduced logistical and HS&E concerns, reduced barite sag, early gas kick detection, full-gauge well bore, and inherent flexibility in meeting specific performance objectives.

4. CASE DISCUSSION

The first three exploratory wells drilled in the year of 2014 by Sirte Oil Company(SOC) in Sirte basin that used ultra-mud system to overcome the hole stability problems are related to the drilling fluid's inability to control reactive shale's . First well A4-LPD3 it is located in the area close to Zaqqut station. Where those concessions were discovered during seventies. ALPD3 well was drilled by using ultra mud system +/- 10ppg without problem since the shale section was not thick as found in the other wells. The second A4-NC 107 is located about 50 km north A40-LPD3. Regarding to the wells had been drilled in the past with conventional mud weight and problem associated with drilling operations, therefore those wells drilled recently using ultra mud with +/- 10.9 ppg when sidetrack technique was decided to be performed due to the fact that the shale section collapsed when conventional mud weight (L.s. polymer weight) was used even though mud weight was raised in order to prevent caving and sloughing with no success . the target was the reached and tested and found to be productive

Well A4-NC107: Drilled 1429 ft. side track hole in Hagafa shale section, cored and drilled to target depth formation, logged and completed well without problem. Bu using this mud shale remain more than 25 days without collapse the hole, see graph (). The third well A4-NC 126 is located east to th 40 km east of waha filed and it was successfully drilled with ultra-mud with 10.9 without any shale problem. Moreover, utilized same mud in A4-NC 107 that carried by truck to A4 well at concession 126. The well A4- NC 126 is used to drilled 8.5” section through Hagfa shale to TD, and hole opened for 40 days[2]. No hole problem occurred where differential sticking, losses, twist offs and catastrophic well bore stability problems were experienced in previous wells drilled with conventional WBM and OBM. HPWBM set new performance benchmarks for the field area, and saved the operator an average \$350,000 on each of the three wells. The system minimized losses and eliminated stuck pipe events while reducing environmental impact. No formation damage occurred and minimal washouts were experienced during drilling, resulting in good cement[2].

4. CONCLUSION

Drilling performance on those wells that used Ultra- mud system are more better than the drilled wells with conventional mud system in term of drilling performance and wellbore stability problems like collapse shale pipe sticking and , bit balling , see figure (1). In Conventional WBM was again used to drill the 171/2-inch hole section to 2,030 feet and the 121/4-inch hole to target depth but always accompanied with hole instabilities in result side track and extra time to reach target. Ultra mud system was then used to drill the 81/2-inch interval to 11400 feet with ending mud weight with no losses, seepage or stuck pipe, again eliminating the need for a contingency liner.

The operator considers the three-well campaign using ultra mud system highly successful, with all two wells completed ahead of schedule and the last well achieving record performance. The reduced final mud weights helped eliminate losses and reduce chemical consumption. The faster drilling rates, reduced mud weights and ability to recycle the mud from well to well saved the operator a combined \$1.5 million on the wells.

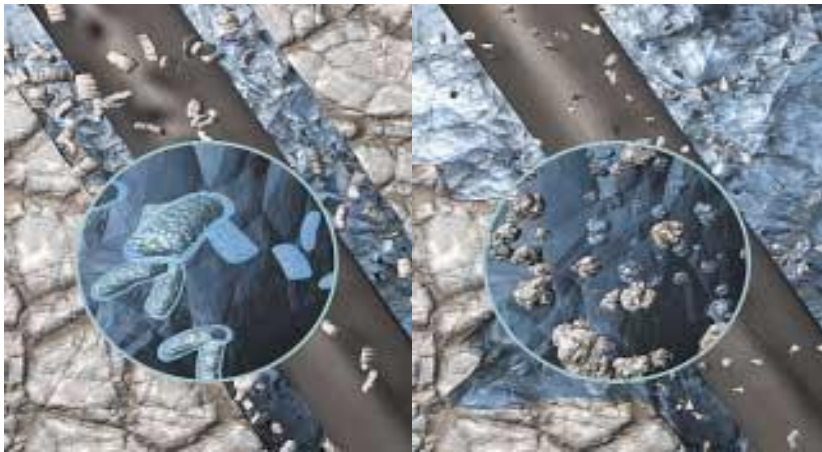
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Figure (1) pictures show no bit balling or stab's balling resulting no drag on trips



Inhibition action #2: Cuttings encapsulation



inhibition action #3: Superior Clay inhibition