Drilling and completion fluids

SPE/IADC 52813

"New Open-Hole displacement Procedure Dramatically Reduces Loss of synthetic fluid in Deepwater GOM"

Synthetic drilling fluids have evolved into the system of choice for deepwater drilling, particularly in the Gulf of Mexico. As these systems are proportionally mom expensive than their traditional counterparts, the loss of even a few barrels can impact well economics significantly. Historically, it has been commonplace to leave hundreds of barrels of synthetic drilling fluid in the wellbore during open-hole displacements. Attempts to retrieve synthetic muds with water-base systems have proved counterproductive. When exposed to water-base muds in open hole, the formation becomes extremely unstable and will literally cave in, resulting in a number of operational problems.

This paper describes the development and application of a new displacement procedure and a modified water-base mud that successfully recovered 961 bbl of synthetic mud on the Manatee project in the deepwater Gulf of Mexico. When compared directly with conventional open-hole completions in she deepwater GOM, the new procedure resulted in a savings of $l75,000. Furthermore, no additional rig time was required to condition the water-base system used in the successful open-hole displacement: More importantly, the wellbore remain stable and no problems were encountered while tripping through the 4,462-ft of open hole exposed to the reengineered water-base fluid system.

The authors will describe both the new procedure. which included a casing shoe with an extremely high lead-off test and realigned pumps, and the new 15 lb./gal water-base displacement fluid. The modified system was both inhibitive to reactive shades and could also withstand the contamination effects of thc calcium employed in synthetic muds.

—G Courtney, K Elliott, Shell Deepwater Development Inc
–N Smothers, et al, M-I LLC

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"Novel Lime-Free HTHP Drilling fluid system Applied Successfully in Gulf of Thailand"

A lime-free, high-temperature invert emulsion drilling fluid that has been developed and applied successfully on several wells in the Gulf of Thailand. The subject drilling program was in a field with downhole temperatures of 430°F. the fluid is run with a pH of less than 7.0, which is accomplished with the introduction of 1 ppb of citric acid and the elimination of the alkaline source (lime).

The fluid was developed to allow the op-

erator to log CO2 formation gas at the surface by utilizing a conventional "mud logging" unit. The ability to log CO2 gas with surface equipment eliminates the wireline RFT logging runs. This would provide significant savings during the course of an extensive drilling program.

This paper discusses the development of the lime-free emulsifier package and its application in more than 55 wells in the Gulf of Thailand. Extensive laboratory tests, the introduction of a completely new ??????? fluid loss reducer (stable in excess of 450°F) and a low end rheology modifier will be examined in detail.

Further, the paper discusses the drilling of more than 400 wells using the various invert systems preceding the lime-free system. Several problems with the earlier generation systems prompted the development of the cost-effective lime-free system.

—J Harrison, Unocal Thailand
–M Stansbury, et al, M-I LLC

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"New Permeability Plugging Apparatus Procedure Addresses Safety and Technology Issues"

For the past 9 years, the drilling industry has used the Permeability Plugging Apparatus (PPA) to assist in evaluating and resolving differential sticking and lost circulation problems which may arise while drilling depleted, weak or fractured zones. The increasing use of open-hole completions in horizontal wells also means that more attention has to be paid to the cake-forming properties of drilling fluids. The PPA is a high pressure, high temperature filtration device able to evaluate fluid loss and "spurt loss" of drilling fluids under filtration conditions that more closely approximate those encountered downhole than the filter paper normally used. Although filtration occurs under static rather than dynamic conditions, pressures as high as 5,000 psi and temperatures of up to 500°F (260°C) may be investigated. The main feature of the PPA is the use of ceramic disks as the filtration medium. These are available in a wide range of porosities and permeabilities to match those properties of the formation much better than filter paper ever will. There are currently 5 types of cells with different pressure ratings in use, both in the laboratory and in the field. In response to concern about the safety of these devices, and the reproducibility of the data generated with them, the **American Petroleum Institute** initiated a program to investigate these issues. and to produce a standardized test procedure.

The new procedure addresses the safety issues of the PPA cell designs. Further, the procedure outlines a new method of calculating parameters based on the test data, intended to provide consistency between users. The new procedure has been used, both in the laboratory and the field, to evaluate seepage loss additives as well as traditional lost circulation additives. Case histories are provided which demonstrate successful use of the device in the prevention of differential sticking problems in drilling depleted zones.

—N Davis, Chevron petroleum Technology, et al

SPE/IADC 52816

"Down-Hole Simulation Cell for Measurement of Lubricity and Differential Pressure Sticking"

Extended reach and horizontal wells through depleted reservoirs represent major challenges to the well design engineers. Realistic design limits imposed by lubricity and differential pressure sticking must be established to ensure well success. Drilling fluid type and composition are Important design variables for purpose of reducing lubricity (torque and drag) end to establish allowable pressure differentials. Better understanding of the mechanism of differential pressure sticking and proper evaluation of the lubricating characteristics of different drilling fluid systems, under simulated down-hole conditions, are needed to determine optimum design and operational parameters. A specially designed fully automated downhole, simulation call permits accurate and reproducible measurements of the coefficient of friction between drillstring and mud fitter coke and differential pressure sticking pull-out force. Filter cake pore pressure and permeability together with axial and radial forces as a function of time are also measured. Testing principles are based on cylindrical captors (drillstring) equipped with sensors (rotational for lubricity and non-rotational with axial motion for differential pressure sticking). Displacement into ft cylindrical filter cake (wellbore wall) Is made automatically through lateral motion of the measurement cell, The main advantage of this apparatus to that ell pressure and force sensors are located Inside the cell, allowing for direct measurements. Both welter and 90 based fluids can be tested at dynamic pressure differentials of up to 100 bar. A soda of lubricity and differential pressure sticking tests have been conducted. Test data are used to evaluate the differential pressure sticking potential and lubricity of different drilling fluids. Date generated have assisted in understanding the fundamental physics of differential pressure sticking and form the basis for validation of a differential pressure sticking model. This paper describes specifications and measurement principles of the purpose built down-hole simulation cell. Examples of test date are also presented.

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"OneStep Enzyme Treatment Greatly Enhances Production Capacity on Horizontal and High Angle Completions"

Horizontal, high angle, multilateral and open hole well completions are becoming more and more common in the oil industry. Drilling mud systems, known as drill-in fluids, are utilized during the drilling of many of these wells. The fluids are designed to build a durable filter cake along the formation face, effectively controlling fluid losses to the zone during drilling. The drill-in fluids are typically comprised of starch, xanthan and/or cellulose polymers (or a combination of several of these) along with particulates such as sized calcium carbonate or salt. This filter cake impairment must be eliminated to fully realize the maximum production potential of the completion. Past approaches to remove the filter cake include the application of acids and/or oxidizer breaker systems, however the results indicate lower than anticipated well productivities.

Previous laboratory and field work has demonstrated that drill-in filter cake damage can be effectively removed through the application of a newly developed technique incorporating an enzyme based polymer degradation system. The enzyme treatment is carefully designed to degrade the starch, xanthan or cellulose based drill-in fluid. Follow-up acid work can then be performed to remove salt and/or carbonate particulates. This "two step" process of a separate enzyme and acid treatment, although effective, may be unnecessary in some cases. A "one step" method is presented.

The wells evaluated in this study were drilled or completed using a starch and xanthan polymer fluid and calcium carbonate particles. Lab testing and experience with these fluids have shown that insufficient polymer degradation can significantly reduce flow capacity in the near wellbore area, leading to reduced well productivity or injectivity. Acid and/or oxidizer breaker treatments alone have shown to be marginally successful.

This paper will focus on a "one step" enzyme treatment to both remove the filter cake polymer damage and calcium carbonate material in one effective treatment. Laboratory data and case histories are presented to show that this "one step" process is less costly than previous methods used in other areas of the world and has been used to treat long completion intervals, effectively improving well performances.

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