ABSTRACT

The Viability of Slim Hole Drilling Using Salt Water Based Drilling Fluids with respect to Well Bore Hydraulics and Formation Stability

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Slim-hole drilling refers to the drilling of a well with a wellbore typically less than seven inches in diameter. Slim-hole drilling is beneficial to the low budget operator as there are considerable savings on rig time and costs and the rig size is ideal for drilling in remote areas. During slim-hole drilling, drilling fluid hydraulics is of great concern since significant pressure losses can occur in the drill pipe and annulus due to the reduced annular clearances. In addition, the flow regime generated in a slim hole and the compatibility of the drilling fluid with the formation, can have an impact on the stability of the wellbore.

Slim-hole drilling has been successfully conducted onshore Trinidad in the Morne Diablo / Quinam Block for a number of years. The most commonly used drilling fluid is salt water based mud since it is cheaper and easier to dispose of than oil based mud. However, the open literature did not show any studies conducted to determine the impact of drilling fluid hydraulics and drilling fluid compatibility on well-bore stability. In this study, twenty-five water based drilling mud formulations were prepared using different concentrations of sodium chloride, potassium chloride and calcium chloride. The rheological properties of each formulation were determined and the Bingham Plastic and Power Law models were applied. The frictional pressure losses for three commonly drilled slim-hole

configurations were then computed and compared. Outcrop shale samples from the area were then treated with each formulation and the percentage loss in mass due to hydration and disintegration was measured for each sample.

The results from these two tests showed that of the mud formulations tested, overall, those with KCl (2.9 %) and $CaCl_2$ (0.7 %), KCl (3.6 %), KCl (0.7 %) and NaCl (2.9 %), NaCl (0.7 %), and $CaCl_2$ (2.9%) can be deemed the most suitable for slim hole drilling for the well configurations used. For these mud formulations, frictional pressure losses using both rheological models were the lowest and provided the best hydraulics properties. The outcrop samples also showed the lowest percentage loss by mass when treated with these formulations indicating the best wellbore inhibition properties. Taking into account all factors of lowest frictional pressure loss, highest shale stabilizing ability and lowest cost, overall, the best performing formulation was 0.7 % by weight sodium chloride. If cost is not a factor, the best performing formulation was 2.9 % KCl, 0.7% $CaCl_2$.

Keywords: Sheva Curvis Serrattan, Slim Hole Drilling, Formation Stability, Drilling Fluids, Brine, Water Based Mud, Hydraulics, Trinidad