

ABSTRACT

The success of a drilling operation is significantly dependent on the quality of the drilling fluid used, thus it is important to use drilling fluids that will operate optimally in a given exploration environment in order to maximise recovery. As current Oil and Gas fields are approaching their maturity, there is a need to explore further offshore in deeper waters. Drilling technologists are thus faced with a challenge of sourcing improved methods and technologies for exploration operations, often in very harsh environments. Drilling fluid constitutes about 15% of the drilling cost, and the common challenges experienced during drilling are fluid loss and rheological properties necessary to withstand extreme operating temperature and pressure conditions. This study evaluates the impact of different concentrations of Nano-crystalline cellulose (NCC) as additive for bentonite-water based drilling fluid, to improve the rheological properties and fluid circulation control.

TEMPO Oxidation synthesis of NCC yielded spherical NCC of sizes ranging between 40 and 90 nm, supported by strong hydrogen bonding within the NCC structure. Fluid loss measurements were carried out at varying temperatures of 30, 40, 50, 60, 70 °C and pressures of 100, 200, 300, 400 kPa. The increase in NCC concentration in drilling fluid samples from 0.2% to 1.2 wt% NCC resulted in fluid loss reduction ranging from 10.6 to 52.5%. More fluid loss was observed at higher temperatures due to reduced interaction between water absorbed and NCC. Viscosity measurements indicated that higher NCC concentrations improve the thermal stability of the fluid, as observed through increased viscosity of the fluid samples with increasing temperature ranging from 30 to 70°C. Furthermore, the yield stress was improved at increased NCC concentrations (0.0 to 1.2 wt%) indicating the enhanced ability to suspend and facilitate the removal of drill cuttings and other solids to the surface. There was also better thixotropic behaviour and improved percentage regeneration with increasing NCC concentration from 0.0 – 1.2 w%, allowing NCC based fluid samples to have better flow properties. This confirms that NCC can be used as a potential additive for improvement of drilling fluid properties.