

Drilling Fluid Solutions for Improving Wellbore Integrity in Shales

Abstract

Shale-related wellbore failures are well-known and often dominate drilling problems. The failure events are mainly due to wellbore shear failure or tensile failure. Wellbore tightening and reaming problems from borehole breakouts to stuck pipe and losing the well because of borehole collapses are all consequences of wellbore shear failure. Drilling events related to tensile failure are partial loss of drilling fluid into formation or complete fluid loss due to formation breakdown, which increases risk of well control issues. Prevention of borehole shear failure could be achieved by geomechanical analysis. However, the time-dependent wellbore instability problem due to fluid invasion into shale formations should be controlled by means of an additive to water-based drilling fluid systems. The fracture gradient of a borehole, its breakdown and fracture re-opening pressure, could be enhanced by including lost circulation material (LCM) into drilling fluid. The fracture sealing efficiency of this treatment would be affected by the particle properties of LCMs, including particle size and particle size distribution. The main objective of this study is to investigate ways of improving wellbore integrity in shales by drilling fluid solutions. To reach this objective, two goals were investigated: a) how Nano additives affect water-based drilling fluid systems to prevent fluid invasion into shales; b) what effect particle sizes and size distribution have in enhancing the fracture gradient for impermeable formation-like shales. This study will contribute toward methods to control wellbore shear failure and to enhance the fracture gradient, which is believed to have a significant impact on improving wellbore integrity in shales.