



# Lucas Whatley

## Final Thesis Defense

### Masters of Science in Petroleum Engineering



#### *Water-Based Drill-In Fluid Optimization Using Polyelectrolyte Complex Nanoparticles as a Fluid Loss Additive*

##### Abstract

It is well known within industry that conventional drilling fluids can damage the well's producing zone. Damage mechanisms occur due to leakage of drilling fluid into the formation even after the formation of a filter cake. This filtrate contains entrained particulates that can enter the pore spaces of the rock and restrict flow through the pore throats resulting in reduced permeability during production. Cleaner drill-in fluids with low solids content have been developed for use when drilling through a producing zone in an attempt to mitigate the extent of damage caused by leak-off. These fluids should not only provide excellent fluid loss prevention, but also exhibit the rheological characteristics needed to perform the traditional functions of conventional fluids. Even though these fluids reduce the amount of particulates entering the formation by containing less solids, the filtrate that is still able to flow through the filter cake can be equally as damaging. Reduction of filtrate volumes can be further achieved by introducing nanoparticles to bridge across the nano-sized gaps within the filter cake. This research focuses on the application of polyelectrolyte complex nanoparticles (PECNP) as a fluid loss additive to further enhance the filter cake filtration properties of a general drill-in fluid. A baseline fluid is formulated consisting of a sodium chloride brine, biopolymers for rheology and fluid loss purposes, and calcium carbonate as a density and bridging agent. The ratio and pH of polyelectrolytes were optimized in order to create stable PECNPs for this system. Different dilutions of PECNPs were added and tested in a static fluid loss setup, where filtrate volumes were compared to determine the best system of 1/8th diluted nanoparticles. The chosen system was then taken to be tested in the dynamic fluid loss setup "Quasimodo" where fluid loss volumes were successfully reduced and wall building coefficients lowered. Analysis of cleanup curves after testing revealed that the PECNP drill-in fluid was less damaging to the core permeability than when the baseline fluid was used.



**Committee Chair:**  
**Prof. Reza Barati**

**Monday, January 29<sup>th</sup>**  
**1:00 – 2:30PM**  
**4161 Learned Hall**