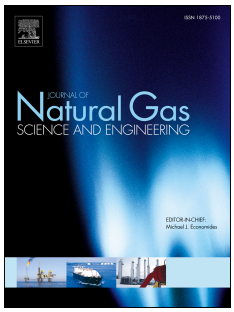
Accepted Manuscript



Experimental and statistical investigation of drilling fluids loss in porous media–part 1

Chinedum Peter Ezeakacha, Saeed Salehi

PII: S1875-5100(17)30494-8

DOI: 10.1016/j.jngse.2017.12.024

Reference: JNGSE 2399

To appear in: *Journal of Natural Gas Science and Engineering*

Received Date: 19 September 2017

Revised Date: 9 November 2017

Accepted Date: 28 December 2017

Please cite this article as: Ezeakacha, C.P., Salehi, S., Experimental and statistical investigation of drilling fluids loss in porous media–part 1, *Journal of Natural Gas Science & Engineering* (2018), doi: 10.1016/j.jngse.2017.12.024.

Experimental and Statistical Investigation of Drilling Fluids Loss in Porous Media–Part 1

Chinedum Peter Ezeakacha, Saeed Salehi, University of Oklahoma

Abstract

Drilling fluids Invasion and mud filtration is a complex process that is influenced by several variables, and has NPT (Non-Productive Time) implications. Most of these variables are either within operational control limits (mud type, LCM type/concentration, and rotary speed) or pre-existing limits (temperature, fracture width, and rock type/permeability/porosity. It is unclear which of these variable(s) have significant positive or negative impact on dynamic fluid loss, filtration patterns, invasion rates, and plastering effect.

The primary objective of the study presented in this paper is to quantify the contributing effects of temperature change, lost circulation material (LCM) type, concentration, size (particle size distribution), and variation in porous media on dynamic drilling fluids invasion. Statistical methods were used to determine the magnitude and significance of these independent variables. The fluid loss experiments reported herein were performed with dynamic-radial system that accounts for rotary speed, eccentricity, torque, pressure, and temperature. The effects of the three variables mentioned above were studied using cylindrical wellbore-shaped ceramic filter tubes, Limestones, Sandstones, and Chalk formations.

The results from the experiments showed that change in temperature significantly affects fluid loss. The importance of rock mineralogy, porosity, and permeability in dictating dynamic fluid loss profiles, mud invasion rates, and plastering effects were also revealed by the fluid loss results. The results from the ceramic filter tubes, often undermines the effect of rock type which can be misleading. Statistical analyses showed no significant impact on the two treatment levels (low and high) pore throat sizes that were investigated. These results cannot represent the actual porous media complexities. In the cases where vertical fractures were created and sealed, the combined effects of LCM and low permeability were defined in the reduced dynamic mud filtration results and filter cake plastering effects.

Keywords: Dynamic Fluid Loss, Statistical Methods, Lithology, Rock Permeability, Temperature, Lost Circulation Material.

1. Introduction

The effects of drilling fluids loss and mud plastering have been studied in recent years, especially with the increase in wellbore stability issues and lost circulation challenges in complex reservoirs. During drilling fluids invasion, bottomhole pressure forces fluid particles to penetrate the near wellbore fractures and pore throats, and these particles can accumulate to form a rigid filter cake (Farahani, et al. 2014; Civan, 2007). This is often referred to as mud cake wellbore strengthening or wellbore stabilization. In simple terms, wellbore strengthening can be described as a variety of approach that gives room for drilling a wellbore, or an interval of interest, with an increased fracturing pressure. Recent studies have revealed that wellbore strengthening can be achieved through mechanisms such as fracture opening and closure, as well as, mud cake plastering (Dorman et al. 2015; Contreras et al. 2014; Guo et al. 2014; Nwaoji et al. 2013; Salehi and Nygaard, 2011). Irrespective of the mechanism, the primary goal is to increase