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Parametric Evaluation of Novel, Basic and Effective Parameters on Performance of Nano Drilling Fluid

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Abstract

The objective of designing drilling fluid for extreme and deep environment (HPHT wells) is to develop high performance drilling fluid system in well bore to achieve zonal isolation. The primary objective of drilling fluid is to improve thermo electrical and rheological properties and displacement efficiency of drilling fluid system. The experimental results show the filtration number is decreased from 0.2 to 0.1, approximately when the thickness is changed from 1 to 2 centi meters. In addition according to the standard the thermal penetration is investigated in the different thickness of drilling fluid. The obtained results show, the increasing in the amount of nano particle increases the amount of viscosity of slurry. Also, it seems each extra 0.2% nano oxide increases the viscosity about 0.2 Pa.s from 0.2% to 0.6%. The basic parameters which are effective in determination of drilling fluid performance are evaluated in this study, finally.

Keywords

Electrical Conductivity, Thermal Conductivity, Thermal Penetration, Drilling Fluid Additives,
High Performance Drilling Fluid System, Rheology, Ferric Oxide Nano Particle

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1. Introduction

The thermo electric and also, the rheological properties of drilling fluid play important role to determine the workability of slurry, fineness (Shahriar and Nehdi, 2012). The mixing process is very important parameters for thermal and rheological behavior of drilling slurry, the criteria of designing slurry depends on formulation, thermal conductivity, density, plastic viscosity, shears tress, yield point and gel strength for enhance durability and toughness for drilling slurry (Shahriar and Nehdi, 2011) Cement grout is used for sealing geothermal wells for is olatezones drilling fluid operation. The electrical and rheological behaviors of drilling slurry are important for the drilling process; it will be optimum to predict correctly about slurry placement (Bannister, 1980). Drilling slurry is concentrated suspensions of small and heavy particles so thermal and rheological measurements are suffering to the disruption of drilling operation (Miranda *et al.*, 2010). The thermo electrical properties and the rheology of Oil Well drilling fluid (OWDF) should be considered when it applied on the originally and primarily casing drilling. Therefore, fundamental knowledge of OWDF slurry rheology is necessary to evaluate the ability to mix and pump grout, remove mud and slurry placement optimization and to predict the effect of temperature on the slurry pit (Shahriar and Nehd, 2011). Incomplete mud removal can result in poor drilling fluid bonding, zone communication and ineffective stimulation treatment (Bannister, 1980). A rheology is study related to the flow of fluids and deformation of solids under stress and strain. In

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shear flows, fictitious parallel layers of liquid past each other in response to a shear stress to produce a velocity gradient, in term of to shear rate, which is equivalent to the rate of increase of shear strain (Guillot, 2006). The property of drilling slurry is complex which has the appearance and interactions between the additives (Banfill and Kitching, 1991). The chemical composition of drilling fluid, particle distribution, test in g methods, size shape, W/DF ratio, mixing time and temperature (Frittella *et al*., 2009). The drilling slurry is viscous plastic materials that exhibit yield stress and tension below the yield stress ultimately slurry behaves as a rigid and solid (Mirza *et al*., 2002). The Bingham plastic and power-law model is widely used to describe the rheological properties of drilling slurry measurements. Frittella *et al*. (2009) that can be determined the properties of drilling fluid flow i.e., plastic is cosity, yield point, friction characteristics and gel strength (Harris and Service, 1991). The concentration and form of so lid particles has a significant impact on the thermo electrical rheological properties of the OWDF slurry to yield stress and plastic viscosity of drilling paste usually increase as the cement becomes finer and increases the stability ofs slurry (Boukhelifa *et al*., 2004). Equivalent Circulating Density (ECD) is important factor to understand the flow behavior, flow rate, annular velocity and differential pressure; for that purpose number of computer simulation software is available to predict the ECD (Guillot, 2006). The displacement efficiency is achieving the maximum mud displacement. A standoff value of the percentage of casing centralization in the wellbore, job operation time for proper thickening and Reynolds numbers base on laboratory methods is measuring rheological properties to understand flow behaviour's (Labibzadeh *et al*., 2010).

2. Materials and Method

The ferric oxide nanoparticles, a common ingredient has a huge variety of applications. This topic is proven that, the application of Fe_2O_3 nano particles in low dosage is not toxic. So, this type of metal oxide is chosen as additive. The nano fluids that are used in this experimental work are prepared in two steps. The Rotational Viscometer (RV) is used to determine the viscosity of samples in the high temperature range of manufacturing and construction. The RV test can be conducted at various temperatures, but since manufacturing and construction temperatures are fairly similar regardless of the environment. The RV test helps ensure that the drilling fluid binder is sufficiently fluid for pumping and mixing. The basic RV test measures the torque required to maintain a constant rotational speed (20 RPM) of a cylindrical spindle while submerged in drilling fluid binder at a constant temperature. This torque is then converted to a viscosity and displayed automatically by the RV. The standard Rotational Viscometer procedure is according to AASHTO T 316 and ASTM D 4402: Viscosity Determination of Asphalt Binder Using Rotational Viscometer.

3. Results and Discussions

Experimental results are shown in this section of article. Yield stress, plastic and also slurry viscosity are investigated in this paper.

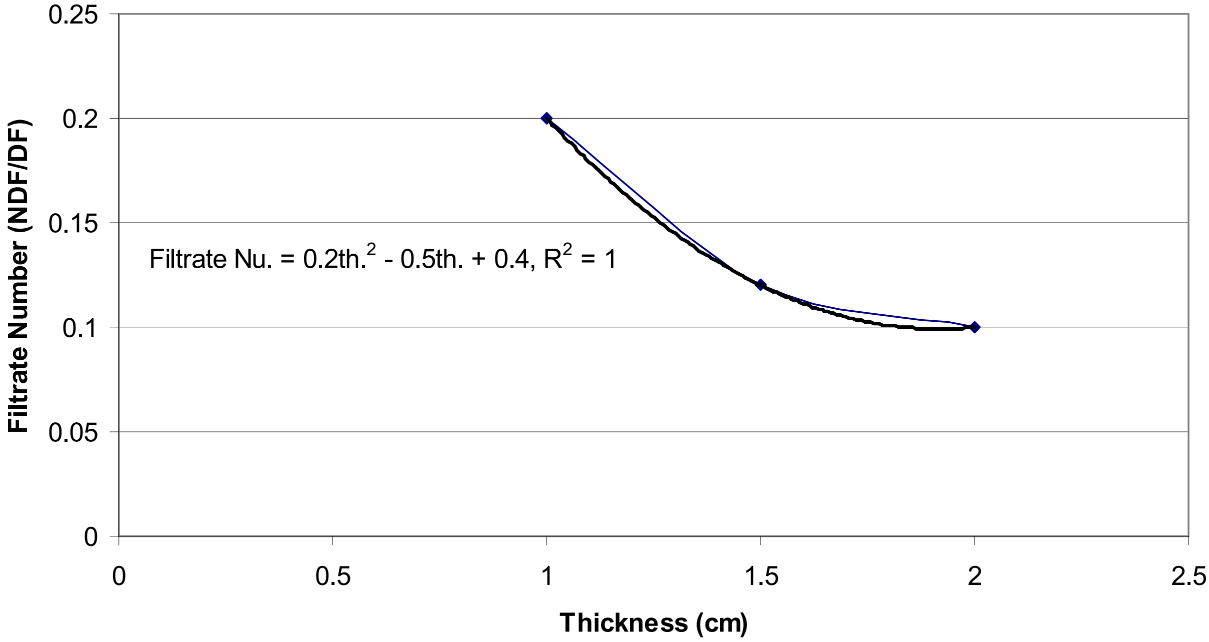

Figure 1. The effect of thickness on filtration number.

The effect of thickness on the filtration number is evaluated in the Figure 1. As shown, the filtration number decreasing with increasing in the thickness number. The filtration number is decreased from 0.2 to 0.1, approximately when the thickness is changed from 1 to 2 centi meter.

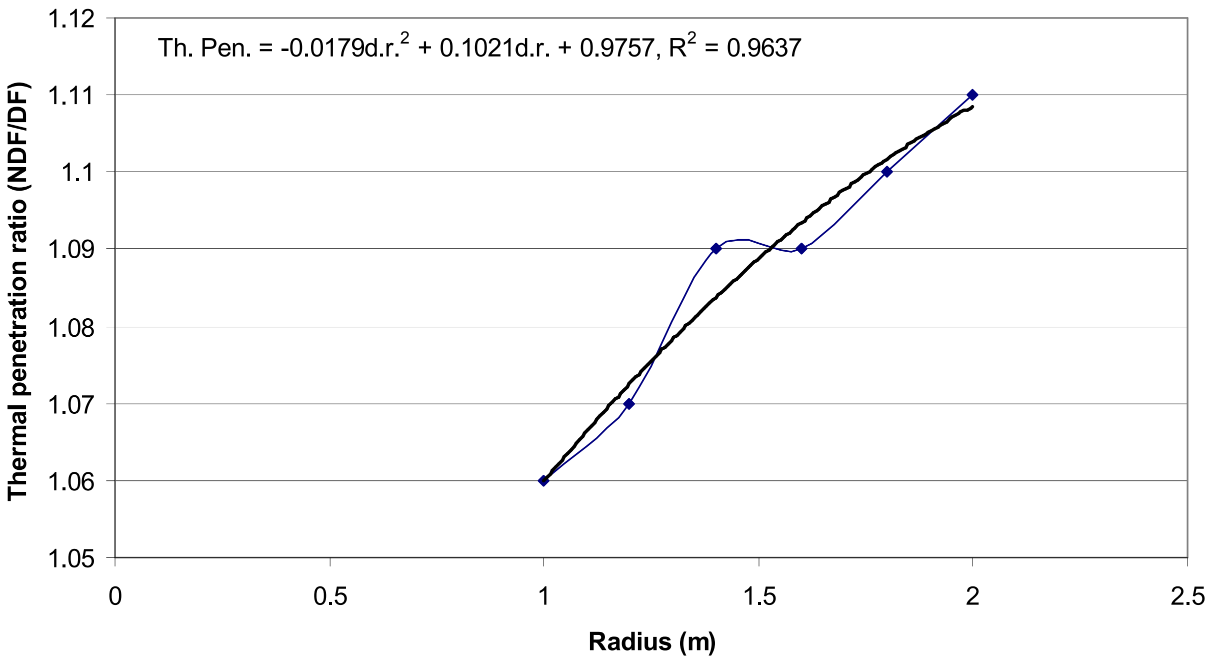

Figure 2. The thermal penetration versus radius.

The thermal penetration is measured in the different radius. Experimental data shows the thermal penetration ratio will be increased with increasing the radius of drilling fluid. The thermal penetration is as a basic parameter in testing the nano and simple drilling fluid. The correlation with second order can estimate this manner. The Figure 2 shows this relation.

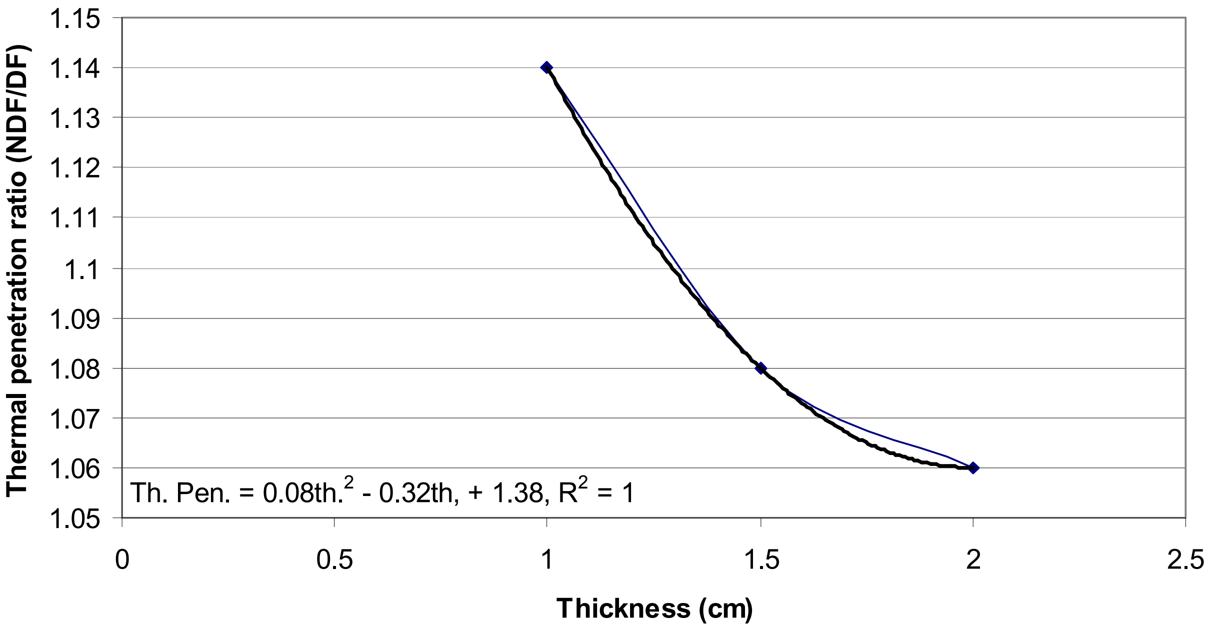

Figure 3. The effect of thickness on the thermal penetration.

The thermal penetration as a one of the quality indexes in the testing of drilling fluid is measured with changes in the thickness. This relation is illustrated in the Figure 3. According to the standard the thermal penetration is investigated in the different thickness of drilling fluid. The thermal penetration ration is decreased from 1.14 to 1.06 with the increasing the thickness from 1 to 2 centi meter.

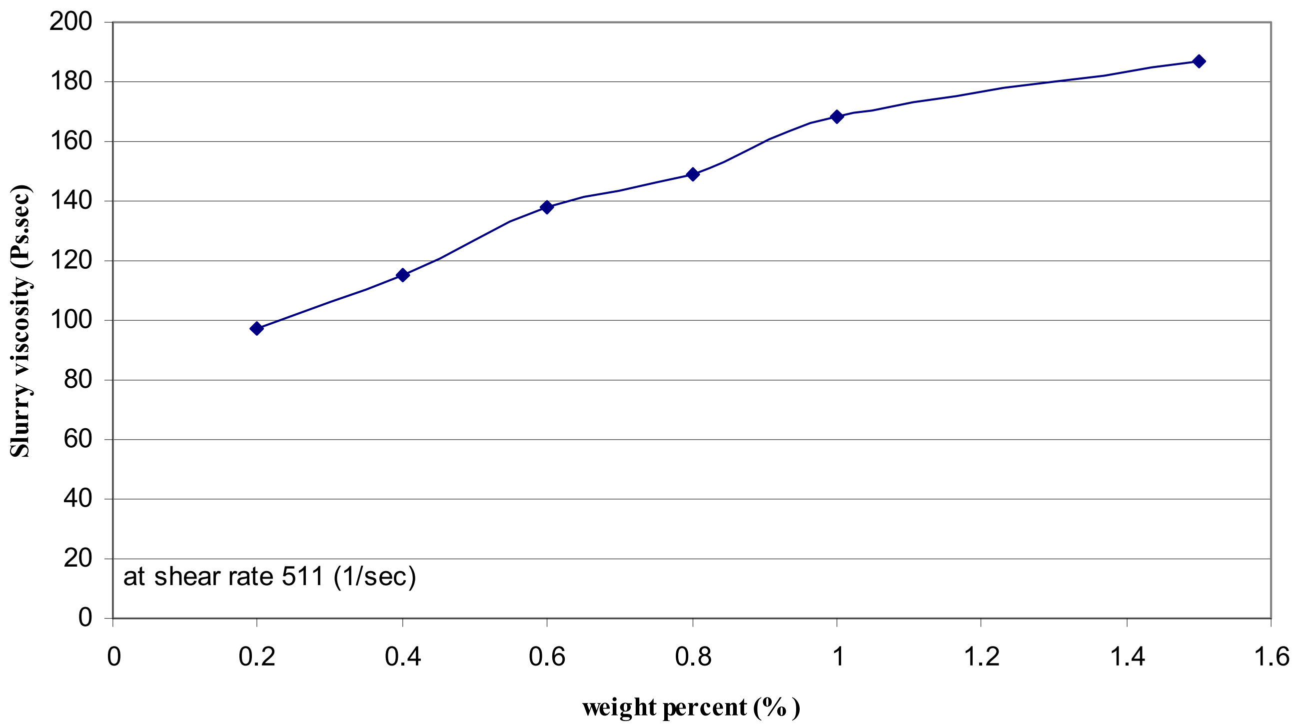

Figure 4. The effect of amount of ferric oxide on the values of viscosity.

The effect of amounts of nano ferric oxide on the amount of viscosity of slurry at the constant amount of shear rate (150 1/sec) is shown in the Figure 4. The increase in the amount of nano particle increases the amount of viscosity of slurry. It seems each extra 0.2% nano oxide increases the viscosity about 0.2 Pa.s from 0.2% to 0.6%. The slope of the curve in the Figure 4 decreases with the increase in the amount of nano ferric oxide (0.6% to 1.5%). So, a value of nano ferric oxide seems to be which at higher than that value, the amounts of viscosity will be constant.

4. Conclusions

Experimental results are shown in this section of article. Yield stress, plastic and also slurry viscosity are investigated in this paper. Experimental results show, the filtration number decreasing with increasing in the thickness number. The filtration number is decreased from 0.2 to 0.1, approximately when the thickness is changed from 1 to 2 centi meter. In addition according to the standard the thermal penetration is investigated in the different thickness of drilling fluid. The thermal penetration ration is decreased from 1.14 to 1.06 with the increasing the thickness from 1 to 2 centi meter. The experimental results show, the increasing in the amount of nano particle increases the amount of viscosity of slurry. It seems each extra 0.2% nano oxide increases the viscosity about 0.2 Pa.s from 0.2% to 0.6%.

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