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Mini Review Article

Effects of Multi-Wall Carbon Nanotubes (MWCNT) on Performance of Water Base Mud (WBM)

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ABSTRACT

Due to the importance and unique properties of nanoparticles, in the present review article effectiveness of different types of Multi-Wall Carbon Nanotube(s) (MWCNT) in improving the rheological properties of Water Based Mud (WBM) drilling fluid are expressed. The experimental results have demonstrated that multi wall carbon nanotube improves rheological properties of the WBM, such as increases the quantity of plastic viscosity, yield point, and water loss of the sample and increases the shale recovery. In the presence of Polyethylene Glycol (PEG), Acidic surface modified carbon nanotube increases the plastic viscosity and yield point of the sample more than not modified carbon nanotube in different sizes and hybrid multiwall carbon nanotube. According to the results multi-wall carbon nanotubes (MWCNT) improve the rheological properties of the drilling fluid and improve shale integrity and shale recovery.

Key words: Water base mud (WBM); Rheological properties; Nanoparticles; Multi-Wall Carbon Nanotube; Shale stability

INTRODUCTION

The well-bore stability is the most important aspect of drilling a gas or oil well in upstream petroleum industry. Shale according to its water sensitivity characteristic that relates to its ionic composition and clay content leads to weakening of the well-bore of the well and many other problems. Shales are also troublesome, since they have a very low Nano-Darcy permeability with very small nanometer-sized pore throats that are not effectively sealed by the solids in conventional drilling fluids. As shown in figure 1, when the shale formation is in contact with water, according to its components, it will brittle or swell [1].

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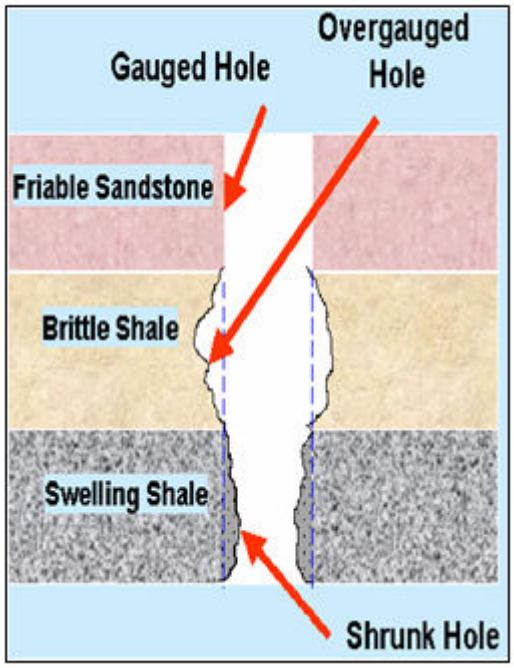

Figure1: brittle and swelling shale

The present invention reduces shale permeability by using multi-wall carbon nanotubes (MWCNT) to plug pore throats, build an internal and external filter cake and reduce the fluid invasion into the shale.

In the past, the balanced activity oil base muds (OBM) were used for drilling troublesome shale formations. OBM subject to its superior shale stabilization characteristic can solve such problems of wellbore instability. OBM is a key solution for maintaining the stability of the shale. However, the use of OBM is limited largely due to its environmental restriction (particularly in offshore drilling), costliness and safety.[2]

WBM is rather more in contact with the clay than OBM. This contact may cause instability. In order to reduce the invasion of drilling fluids, the drilling fluids should form internal or external mud cake [3]. Normal additives cannot form good mud cake, because of small-sized pore throat and low shale permeability. Pore throat plugging may not be achieved in the shale, because of the large size of regularly used solid mud additives, which do not plug pore throat. Normal solid particles are approximately 100 times larger than pore throats. Slow flux of filtrate of WBM into the formation leads to a significant pore pressure zone near the wellbore wall and subsequently wellbore instability. Therefore, the physical plugging of Nanoscale pore throats in the shale formation by nanoparticles can be implemented to reach the several benefits, including pore pressure reduction owing to its feature of preventing the mud filtrate influx toward the shale, while the shale swelling is reduced owing to its feature avoiding the more interaction between the shale and mud filtrate, the high membrane efficiency is generated due to the shale permeability reduction and consequently the shale stability [4].

Conventional macro and micro base fluids (chemicals and polymers) have limited thermal stability. Moreover, they would get thermal degradation above 125-130 °C. Due to degradation, these chemicals cannot perform their desired function effectively in the drilling mud systems. Therefore, in order to reach the desired viscous and gelling properties under high pressures and high temperatures, the drilling mud must comprise of the specific components, e.g. Nanoparticles, which have stability under extreme conditions. Excellent thermal conductivity of Nanobase fluids associated with temperature and pressure tolerances, it can be a better choice. Nanoparticles have the potential to become a permanent constituent of all drilling mud systems, as they can be an efficient solution of many down-hole problems. NPs as a great alternative replace the traditional strategies and allow current drilling industry to go beyond the limits in order to reach those particular hydrocarbons regularly known as inaccessible [0].

Recently, Nanobase drilling fluids have been formulated and resulted in the improvement of rheological properties, i.e. the stability and the gelling property, and the ultrathin mud cake. Nanobase fluids reduce any damage during the formation by the elimination of spurt loss. Ultrathin mud cake dramatically decreases the differential pipe sticking and, as a result, Nanobase fluid is applied in the formation with the high permeability [6].

Due to the following facts, the Nano (Nanos) additives have the potential to be used in drilling operations; firstly, the huge surface area of NPs increases the interactions between Nanos and reactive shale and resolve borehole problems. Secondly, the less kinetic energy of NPs reduces the abrasive effect of Nanos on down-hole equipment, which leads to damage. In conclusion, Nanos are very effective at low concentrations, as it is an advantage for the ecosystem and industry [7].

CONCLUSION

According to the specific properties of multi wall carbon nanotubes and test results, it is obvious that multi wall carbon nanotubes (MWCNT) can improve shale stability and rheological properties of water based mud. Unmodified carbon nanotube decreases the water loss and increases the cake thickness of the Mud (WBM). Acidic surface modified carbon nanotube increases yield point. Greater Not Modified Carbon Nanotube increases viscosity and yield point of the sample due to its greater diameter and length. By increasing the size (diameter and length) of MWCNT more viscosity, pH and yield point of the WBM is achieved. The presence of Multi-Wall Carbon Nanotubes increases the efficiency of polymers and improves the rheological properties and performance of the water base mud.

REFERENCES

1. Koorosh Tookalloo, Javad Heydaria, Mohammad Soleymani, Alimorad Rashidi, Mahdi Nazarisaram. "Analyzing Effects of Multi-Wall Carbon Nanotubes (MWCNT) & Polyethylene Glycol (PEG) on Performance of Water Base Mud (WBM) in Shale Formation." Pet Eng J. 2018.
2. JOEL OF., UJ DURUEKE, CU NWOKOYE. "EFFECT OF KCL ON RHEOLOGICAL PROPERTIES OF SHALE CONTAMINATED

WATER-BASED MUD (WBM)." GLOBAL J INC. (USA), 2012; 12: (1).

3. SENSOY, TANER, MARTIN E. CHENEVERT, AND MUKUL MANI SHARMA. "MINIMIZING WATER INVASION IN SHALES USING NANOPARTICLES." SPE ANNUAL TECHNICAL CONFERENCE AND EXHIBITION. S PET ENG, 2009.
4. Koorosh Tookallo , Javad Heidarian. "Drilling Fluid, Nano Drilling Fluid" Scholar's Press, 2018.
5. Zhixin Yu, et al. The Potential of Nanotechnology in Petroleum Industry with Focus on Drilling Fluids. Pet Petro Chem Eng J, 2017.
6. Koorosh Tookallo "Analyzing Effects of Various Kinds of Multi-Wall Carbon Nanotubes (MWCNT) on Performance of Water Base Mud (WBM)" COJ Reviews & Research, Crismon Publishers, 2018.
7. Ji L., Guo Q., Friedheim J., Zhang R., Chenevert M, Sharma M. "Drilling unconventional shales whit innovative water based mud – Part 1: Evaluation ofnanoparticlesas physical shale inhibitor." AADE-12-FTCE-50, AADE Fluids Technical Conference, Houston, 2012.