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Experimental feasibility study of using carbon nano tubes in upstream application as new additives in water base drilling fluids

ali reza nasiri[(1)]- Majid sajjadian[(2)]-ehsan esmailpourmotlagh[(3)]
(1) Department of Petroleum Engineering, Research Institute of Petroleum Industry, Tehran, Iran

sajjadian@ripi.ir

Abstract: Conventional experience reveals that it is often impossible to employ usual fluid additives for some special functions because of suitable physical, mechanical, chemical, thermal and environmental characteristic.
Therefore, the science and research centers are searching for a physically small, chemically and thermally stable, biologically degradable, or natural product to improve water base drilling fluid properties to apply in most parts of oil and gas exploration. Thank to nano technology, carbon nano tubes were proved enhanced physio-chemical, electrical, thermal, hydrodynamic properties and interaction potential in compare with other materials. This paper investigates the effect of different amount of multiwall carbon nano tubes in water base drilling fluid on rheological properties and hole cleaning capacity. Laboratory tests showed that carbon nanotubes play an important role in improving rheological properties and increasing cleaning efficiency of the mud.

Index Terms: carbon nanotube, water base drilling fluid, rheological properties, hole cleaning

I. INTRODUCTION

Suitable hole cleaning during drilling operations has a significant effect in the operation performance. The capacity of a drilling fluid to transfer cuttings from bottom to the surface is called lifting capacity or hole cleaning. Hole cleaning is one of the basic functions of any drilling fluid Cuttings generated by the bit and any caving and/or sloughing must be carried to the surface by drilling fluid. The circulatory fluid rising from the bottom of the well bore carries the cuttings toward the surface. Failure to achieve effective hole cleaning can lead to serious problems, including stuck pipe, thermal properties. Suspension of nano-sized particles may also enhance stability against sedimentation since surface forces easily balance the gravity force. Recent experiments have demonstrated that, nanofluids have attractive properties for application where heat transfer, drag reduction, binding ability or sand consolidation, gel formation, wettability alteration and corrosive control is of interest (Phuoc et al., 2007).

An Abouzar et al. (2008) shows that, carbon black nano particles in drilling mud produced a more continues and integrated mud cake, therefore less filtrate and mud cake thickness will occur. The objective of this research is to study feasibility and effectiveness of a water-base drilling fluid blend containing carbon nano tubes as novel additives in improving rheological properties and also reducing the filtrate losses to formation by forming a thin filter cake and lifting capacity improvement.

II. Mechanism of hole cleaning

In- depth analysis of published data is used to choose the most relevant and technically important parameters in the analysis of a new additive for better forecast of the hole cleaning efficiency of drilling mud. Various forces play an important role in the cleaning efficiency of drilling mud.

Thus, the cutting transportation process is influenced by four forces [2]:

- A downward gravitational force.
- An upward buoyant force due to the mud flowing around the cutting particle.

A drag force parallel to the direction of the mud flow due to the mud flowing around the cuttings particle. excessive torque and drag, annular pack-off, lost circulation; slow drilling rates low rate of penetration (ROP), induced loss of circulation, and difficulties while running and cementing casing. Cuttings transport is affected by several interrelated mud and drilling parameters.

The immoderate loading of the borehole with drill cuttings because of poor hole cleaning while drilling leads to different borehole troubles with a drastic increase in the drilling and mud cost. Most of the nonproductive drilling time is associated with borehole problems that are directly or indirectly triggered by the poor performance of mud in cleaning the borehole. One third of the stuck pipe problems are associated with excessive cuttings loading into the borehole due to poor hole cleaning [1]. The formation of embedded cuttings in the presence of poor quality mud cake while drilling is also a possibility if the hole is not cleaned properly.

To prevent these problems, various range of expensive methods such as wiper trips or pumping out of the hole, washing and back reaming must be carried out. Novel methods for prevention and controlling the formation of this cuttings bed have been proposed over the years such as addition of special

drilling additives (viscosities) that enhance the cutting transport ability of drilling fluid. Investigations and experiments about cutting removal have been performed mainly for vertical wells (zero degree inclination). A specialized petroleum laboratory at China's Shandong University has developed an advanced fluid mixed with nano-sized particles and superfine powder that significantly improve drilling speed (Saeid et al., 2006). The carbon nano tubes improve the fluid rheological, mechanical, optical and). The distance between the atomic graphitic sheets of the wall in the MWNTs is about 0.34 nm, similar to the interplanar spacing in graphite (Dojin, 2004). The diameter of MWNTs is in the range of a few to ten nanometers and its length can be from micrometer to millimeters with the density of 2.6 g/cu.cm. Nanofluids are the fluids containing at least, a very small quantity of nanoparticles with size of 1 to 100 nanometer (Amanullah and Al-Tahnini, 2009) that are uniformly and stabily suspended in a liquid.

In this paper, the Multiwall Carbon Nanotubes (MWNTs) is produced using custom built Vapor Deposition (CCVD) in research institute of petroleum industry (RIPI). Figure-1 shows a schematic diagram of the experimental set-up used for CNT growth by CVD method. The process involves passing a hydrocarbon vapor (typically 15–60 min) through a tubular reactor in which a catalyst material is present at sufficiently high temperature (600–1200 °C) to decompose the hydrocarbon. CNTs grow on the catalyst in the reactor, to be collected after cooling the system to room temperature. In the case of a liquid hydrocarbon (benzene, alcohol, etc.), the liquid is heated in a flask and an inert gas is purged through it, which in turn carries the hydrocarbon vapor into the reaction zone[7]. MWNTs have the diameter of 5 to 30 nm and length greater than 100 μm. When nanoparticles are dispersed in a base drilling fluid, they will change fluid's thermal conductivity and viscosity conditions.

III. Preparation procedure

The fluid preparation involved various stages and each had to be carried out in particular order for achieving consistent fluid blends for the results to be reliable.

The first step was to prepare water-based mud. The additives were added in reference to sample sizes of 350 mL. After that, appropriate amount of 5 %w/w polymer are added and blended for about 5 min to prepare the sample of required concentration of polymer and surfactant. Various amounts of MWNTs are added to samples in a slow manner without causing aggregation. All polymeric fluids are prepared at their maximum hydration potential as listed in Table 1.

IV. Experimental performed

The following experiments were performed in this study:

- Mixing and dispersion test

Dispersion of the MWNTs in the base fluid was achieved by ultrasonic mixer. Tests were performed to determine the optimum conditions (temperature, mixing time). At the completion of each test, the composite was aged over a day to get sufficient stability.

- Rheological Tests

A Fann 35 Viscometer was used to find the viscosities of the samples and 350 mL of the prepared blend is taken and poured into a viscometer cup. The readings are taken at 600, 300, 6 and 3 rpm. The 10 sec gel strength is measured at the lowest speed of the rotor. After allowing the sample to settle down for 10min, the reading at lowest rotor speed gives us 10 min gel strength. The same readings are taken for all samples.

- Other required experiments.

Varieties of systems were adopted to effectively evaluate the success of this fluid system in terms of well cleaning-up. The analytical method employed is the use of VG Rheometer, sharing at rate 300rpm to simulate the turbulent flow during cleanup fluids evaluation. The procedure is as outlined below.

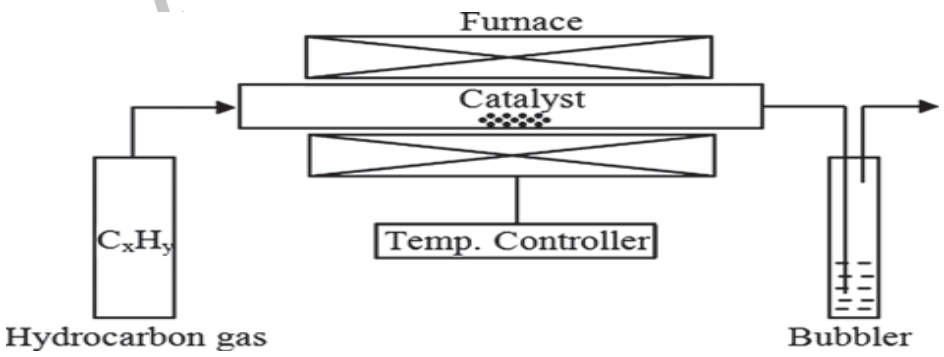

Fig. 1. Schematic diagram of a CVD setup

1. The VG bob was soaked in fluid for 20 minutes and the bob inspected. The bob and VG sleeve system were levered into treatment fluid.
2. The treatment fluid shared at 300rpm for 60, 120, 180, 240, 300 seconds.
3. The sleeve was removed at each stage to physically evaluate the amount of film removal on the bob.
4. Steps 1 to 4 were repeated for various mud sample.[8]

V. RESULTS AND DISCUSSION

Table-1 shows the results of the rheology measurements for Water-based muds with different percent of multiwall carbon nanotubes additives. Adding MWNTs into the water based mud will affect mud viscosity and gel strengths. These unique nanoparticles can function as fluids viscosity stabilizer to significantly improve Rheological properties for water base drilling fluid. Results in Table 2 record that by increasing percentage of MWNTs used in each mud sample, lifting capacity has improved as shown in Fig 2.

Table 1. Properties of mud used with various amount of MWNTs

Mud sample	Composition, weight percent	Viscosity at 600 rpm (cP)	Apparent viscosity (cP)	Gel strength (10 sec/ 10 min)
base	1.5 lb/bbl Xanthan gum	40	20	7/18
1	Base + 0.006% MWNTS	46	23	8/14
2	Base + 0.012% MWNTS	46	23	9/17
3	Base + 0.024% MWNTS	49	24.5	11/19

Fig.2. Fann-35 Viscometer

Table2- Laboratory test results for various fluids

MUD SAMPLE	PERCENTAGE CLEAN OUT WITH TIME (SECONDS)				
	60 sec	120 sec	180 sec	240 sec	300 sec
Base	0	0	0	0	0
1	5	13	19	26	31
2	5	14	20	29	41
3	12	19	30	42	53

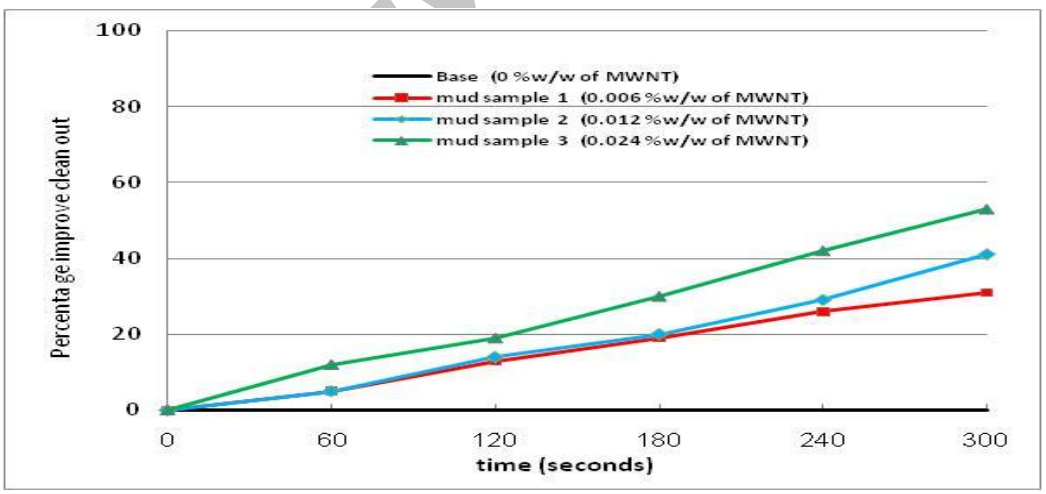

Fig.3. Effect of different value of nanoparticles (MWNTs) on hole cleaning

VI. CONCLUSIONS

1. Ultrasonic mixer is shown to be suitable for characterizing the state of nanotube dispersion as addition to water base drilling fluid.
2. MWNTs in the water based mud, can improve lifting capacity of drilled cuttings depending on the cuttings sizes, annular velocity and flow rate. Therefore, the drilled cutting is easily raised to the surface for disposal.
3. The apparent viscosity of water base mud increases as percentage of MWNTs in the base drilling fluid increases. Thus, the lifting capacity also increases. The MWNTs are dispersed in water based mud since water absorbs into it and becomes agglomerated. This phenomenon will increase mud viscosity.

REFERENCE

[1] Machado JCV, Aragao AFL (1990). Gel Strength as Related to Carrying Capacity of Drilling Fluids. SPE Latin American Petroleum Engineering Conference. October 14-19. Rio d Jeneiro: SPE Paper, 21106.
[2] Yu, m, Melcher, d., Takach, n., Miska, S.Z. and Ahmed, R.: " A New Approach to improve cutting Transport in Horizontal and Inclined Wells," SPE paper 90529, presented at the SPE annual Technical Conference and Exhibition, Houston, Texas, September 26-29, 2004.
[3] Hett, A., Nanotechnology - Small matter, many unknown, 2004, accessed on 13 November 2008.
[4] Hervé-Bazin, B., Les nanoparticules – un enjeu majeure pour la santé au travail?, Les Ulis, EDP Sciences, 2007.
[5] Lauterwasser, C., Small sizes that matter: opportunities and risks of nanotechnologies, report in co-operation with the OECD International Futures Programme, 2008, accessed on 13 November 2008. http://www.oecd.org/dataoecd/37/19/37770473.pdf
[6] Amanullah Md, Al-Tahini AM (2009). Nano-Technology-Its Significance in Smart Fluid Development for Oil & Gas Field Application. SPE 126102 paper presented at the 2009 SPE Symposium and Exhibition, Alkhobar, Saudi Arabia, 11 May.
[7] Mukul Kumar and Yoshinori Ando," Chemical Vapor Deposition of Carbon nanotubes: A Review on Growth Mechanism and Mass Production", Journal of Nanoscience and Nanotechnology.Vol. 10, 3739–3758, 2010.
[8] Rodriguez, F.: Principles of Polymer Systems, McGraw-Hill, New York City (1970) 60-66.

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