Available online at http://ijcpe.uobaghdad.edu.iq and www.iasj.net
Iraqi Journal of Chemical and Petroleum Engineering
Vol.23 No.4 (December 2022) 25 – 32
EISSN: 2618-0707, PISSN: 1997-4884

Enhance the Properties of Lignosulfonate Mud by Adding Nanoparticles of Aluminum Oxide and Iron Oxide

Hasan Ali Abbood and Ibtehal Kareem Shakir

Chemical Engineering Department/College of Engineering/University of Baghdad/Baghdad, Iraq

Abstract

Oil well drilling fluid rheology, lubricity, swelling, and fluid loss control are all critical factors to take into account before beginning the hole's construction. Drilling fluids can be made smoother, more cost-effective, and more efficient by investigating and evaluating the effects of various nanoparticles including aluminum oxide (Al_2O_3) and iron oxide (Fe_2O_3) on their performance. A drilling fluid's performance can be assessed by comparing its baseline characteristics to those of nanoparticle (NPs) enhanced fluids. It was found that the drilling mud contained NPs in concentrations of 0,0.25, 0. 5, 0.75 and 1 g. According to the results, when drilling fluid was used without NPs, the coefficient of fraction (CoF) was 44%, when added Al_2O_3 NP and Fe_2O_3 NP at 0.75g reduced CoF by 31% and 33% respectively. When Al_2O_3 and Fe_2O_3 NPs were used, particularly at a concentration of 1g, the amount of mud filtration decreased from 13.5ml to 9.3 ml and 8.5 ml respectively. Additional improvements rheological properties as well as swelling when Fe_2O_3NPs and Al_2O_3 NPs were added at 1g. Overall, it was found that adding NPs to the Lignosulfonate-WBM at a concentration of 1g can improve rheological, swelling, and filtration properties as well as lubrication at 0.75g.

Keywords: drilling mud; nanoparticles; lubrication; rheological; swelling.

Received on 20/05/2022, Accepted on 19/07/2022, Published on 30/12/2022

https://doi.org/10.31699/IJCPE.2022.4.4

1- Introduction

Extracting oil and gas from the ground begins with drilling. Developing this operation to its full potential will help boost output. Drilling mud is essential to achieving this goal. Water, oil, synthetic, and pneumatic (air-based) drilling fluids are just a few of the many types of drilling fluids available. The most widely used fluid is water. About 80% of all wells are drilled with them because they are less expensive than oil or synthetic-based fluids [1]. To maximize oil recovery and shorten the time it takes to reach first oil, drilling fluids are an absolute necessity. Drilling fluids can be likened to blood in the human body because they are used in the drilling process to remove rock. Similarly, to how the kidneys and lungs remove waste from the body via the blood, the mud pump removes drilling cuttings from the bottom and transports them through drilling fluid to clean the mud before it is used again [2]. Drilling muds are used to prevent reservoir fluids from entering the wellbore by providing hydrostatic pressure [3], reduce contact forces and torque between the drill string and wellbore [4], reduce the filtration rate [5], and transport drilling waste to the surface for cooling purposes [6].

When it comes to the construction and completion of a well, drilling mud is an essential consideration. Any drilling operation's success is directly related to the quality and efficiency of its fluid mix, as well as its cost and environmental impact. Pipe sticking and mud loss are two problems that can arise as a result of poor drilling fluid design. Poor mud design can lead to other problems, such as bit balling and borehole collapse [7].

In recent years, nanotechnology has been used to improve the properties of NPs. This is because Nanomaterials' ability to improve fluid performance depends on their size and shape, which is determined by their ability to interact with mud components. Some of the functions of drilling fluid, such as preventing drill cuttings and minimizing formation damage and stabilizing the wellbore. Nanomaterials can be added to drilling fluids to perform any of these functions [8]. Drilling fluid problems can be solved by utilizing NPs with unusual characteristics, such as high thermal conductivity and a large surface area. A few of the most important advantages of using nanoparticles in drilling fluids are their reduced fluid loss and mud cake, as well as their ability to remove hazardous materials and enhance heat transfer, lubrication, and rheological properties such as viscosity [9].

The use of Nano sized particles as an additive agent in drilling fluid formulations has been the subject of several experimental studies. Table **1** reports a summary of NP behaviors on drilling fluids.

The goal of this experiment is to examine the performance of water-based Nano muds containing Al_2O_3 NPs and Fe_2O_3 NPs and compare them to Lignosulfonate water-based muds (WBM). A series of lab tests were used to conduct this evaluation.

Corresponding Author: Name: Hasan Ali Abbood , Email: hasan.abbood1607m@coeng.uobaghdad.edu.iq

Table 1. Summary of Nanoparticle Behaviors on Drilling Fluids

Nanoparticle types	Outcomes	References
Sio_2	proved the rheological and fluid loss properties. improved the shale inhibition. significant reduction in filtration .	[10] [11] [12]
laponite	Enhancement of thermal stability.	[13]
TiO_2	improves the thermal stability and rheological properties.	[14]
α-MnO_2	minimizing the filtration loss.	[15]
ZnO	improved the rheological behaviors and provided better filtration control.	[16]
Al_2O_3	Improved the effective thermal conductivity. improve the rheological properties.	[17] [18]
Fe_2O_3	Developments rheological and fluid loss properties. improved filter cake and fluid loss.	[19] [20]

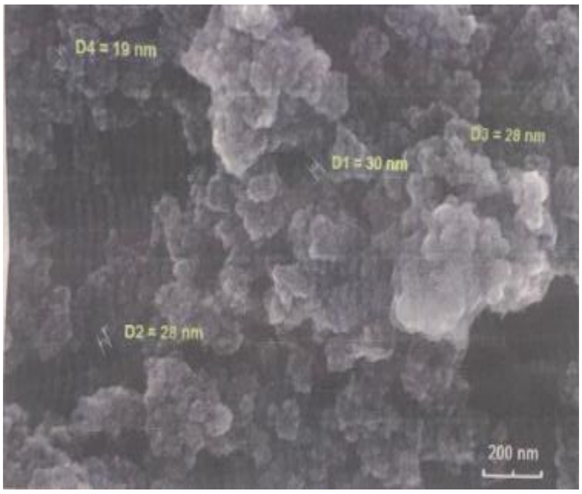

Fig. 2. SEM Images of Fe_2O_3NPs

2- Experimental Work

2.1. Characterization of the materials

Al_2O_3 and Fe_2O_3 are two of the most widely used NPs because of their heat transfer properties and low cost. For this study, Fe_2O_3 and Al_2O_3 NPs were chosen as a result. Nanjing Nano Technology and Sky Spring NPs, respectively, served as the suppliers of Al_2O_3 and Fe_2O_3. Nanoparticle properties are listed in Table **2** and Table **3**. Al_2O_3 and Fe_2O_3 NP morphology is shown in Fig. **1** and Fig. **2** TEM and SEM images, respectively.

Table 2. Physical Properties of Fe_2O_3 NPs

Properties	Typical value
Purity	99.9%
Appearance	black powder
Size	20-30 nm
Ash	<0.2 wt.%

Table 3. Physical Properties of Al_2O_3 NPs

Properties	Typical value
Purity	99.9%
Appearance	White powder
Size	20 nm
Ash	<0.2 wt.%

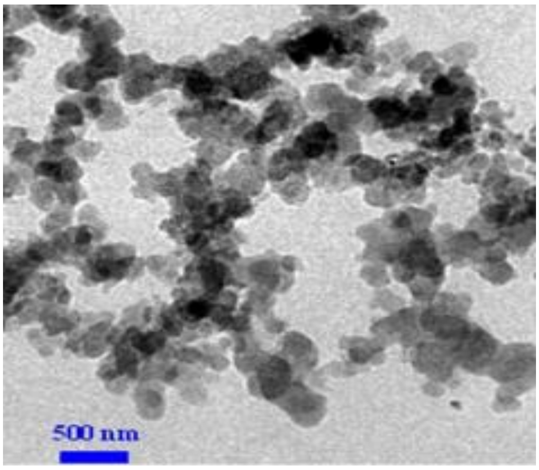

Fig. 1. TEM Images of AL_2O_3NPs

2.2. Methodology

The drilling fluid utilized in this study is Ferro Chrome Lignosulphonate (FCL), which is commonly employed in southern Iraqi oil fields. This mud is simple and quick to prepare. According to API standards, bentonite fluid should be prehydrated by mixing 20 grams of sodium bentonite with 350 milliliters of fresh water for at least 20 minutes using a Hamilton Beach Mixer and letting it sit for 16 hours. Then, add 0.5 g of caustic soda to improve the performance of lignosulphonate and raise the PH values. Also 1g of soda ash is used to remove the calcium ion and improve the properties of calcium bentonite. Lignosulfonate is used to deflocculate and control the rheology of 1g of bentonite. The mixture is then mixed for 20 minutes using a Hamilton Beach Mixer under laboratory conditions, where the concentrations of Al_2O_3 and Fe_2O_3 NPs range from 0 to 1g. The fluid is then placed in an ultrasonic bath for 15 minutes to ensure that the Nano particles are evenly distributed throughout the fluid and experimental work flowchart as showing in Fig. **3**.

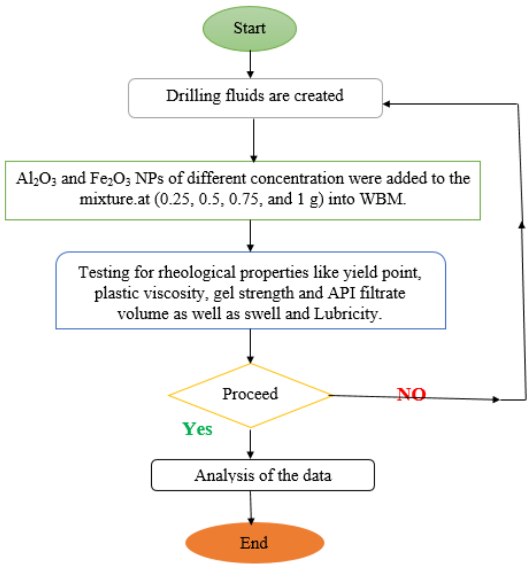

Fig. 3. Experimental Work Flowchart

2.3. Rheological Testing

Plastic viscosity, gel strength, filter cake thickness and filtrate loss were some of the rheological properties studied for the prepared muds. Mud viscosity and gel strength (10 sec and 10 min) were measured using a Van-G meter. The API standard was used to measure the parameters of plastic viscosity (PV) and yield point (YP). The Van-G meter was used to determine the PV and yield point values at both 300RPM and 600RPM motor speeds. The filter cake was evaluated, and the filtration loss was calculated in a filter press with the help of this tool. Filter press pressurized cells contain a pressurized filter medium.

To A nitrogen gas cylinder was connected to the filter press equipment in order to raise the cell pressure to 100 psi. It took about 30 minutes for each of the tests, and there were two of them. afterwards, the cell was disassembled and the mud thrown away. To avoid damaging the mud cake, be sure to take your time and be cautious when removing the components from the cake. The cake was gently scrubbed to remove any remaining mud before serving. As a final step, the filter cake thickness was measured and recorded in 1/32-inch increments. To be clear, all tests were performed at 27 °C. Equations are used to calculate (PV) and (YP) [29]:

$$PV= \theta_{600} - \theta_{300} \quad (1)$$

$$YP=\theta_{300} - PV \quad (2)$$

Whereas Φ600 = Dial reading at 600 RPM, and Φ300 = Dial reading at 300 RPM.

2.4. Lubricity

Extreme pressure/lubricity testers were used to measure CoF for the lubricity test. Drill string and wellbore are analogous in that they are made of metal to metal. It was possible to calculate lubricity with this formula [23]:

$$COF = \frac{\text{Torque reading}}{100} \quad (3)$$

$$100=\frac{150 \text{ inch}-\text{Ibs torque wrench reading}}{1.5 \text{ inch torque shaft lever arm}} \quad (4)$$

$$CF = \frac{\text{Meter reading for water (standerd)}}{\text{meter reading obtained in water calbration}} \quad (5)$$

$$CoF = \frac{\text{(Meter reading for water)(CF)}}{100} \quad (6)$$

Whereas, CoF = Coefficient of fraction, and CF= Coefficient factor.

2.5. Shale Swelling Testing

Drilling mud compatibility with the wellbore should be determined before operations begin. The interaction of the shale with the drilling muds is the method to test the shale's compatibility with the swelling process. In this studies, we used a compactor cell to create shale plugs for a swelling analysis. Swelling test procedure for shale is provided [11].

3- Results and Discussion

3.1. Properties of Rheology

A. Plastic viscosity

Due to the difficulty of pumping drilling fluid with a high PV, drillers avoid using it for drilling operations. Drilling fluid density, on the other hand, is directly related to mud viscosity and should be considered when designing a drilling fluid. For this reason, lower mud viscosity results in less dense water due to a reduction in hydrostatic pressure, which isn't always a good thing [22]. The PV of Lignosulfonate-WBM was found to be only 7 cP. As shown in Fig. **4**, The addition of NPs to Lignosulfonate - WBM generally increased the PV. However, the PV amounts at various concentrations of each NP type vary (from 0 to 1 g) was different. In addition, 1 g of Al_2O_3 NPs was added to increase the amount of PV to 8 cP. The Al_2O_3 NPs are dispersed throughout the fluid uniformly; the mud's viscosity may rise due to an increase in interlayer friction [19]. We were able to achieve 8 cP of PV by mixing in 0. 5 g Fe_2O_3 NPs with the base mud. When the concentration was increased to 0.5 g, the PV remained constant at 8 cP before increasing to 9 cP at the 1 g concentration point.

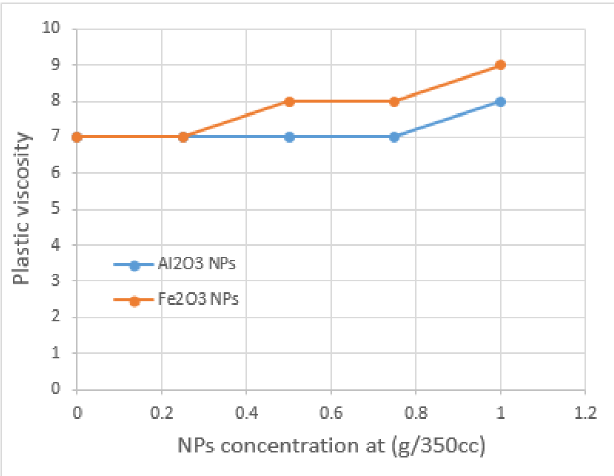

Fig. 4. NPs Concentration Affects by Plastic Viscosity (cp)

B. Yield Point

Mud-cutting capacity can be determined by taking into account the YP value, which is an important factor make it easier to transport heavier cutting [8]. We found that based Lignosulfonate -WBM had a yield point of 9 lb/100ft^2. It is shown in that NPs affect the yield point of linosulfonate -WBMs in Fig. **5**, At different NP concentrations, the YP of WBM with linosulfonate -WBM shows different results. The YP of Al_2O_3 NP Lignosulfonate -WBM increases at all concentrations. At a concentration of 1 g of Al_2O_3 NP Lignosulfonate-WBM, the maximum YP was 55 lb/100 ft^2. Yield point values risen sharply for Fe_2O_3 NPs, reaching 38 lb/100 ft^2 at 1g. Since Al_2O_3 NPs have a higher surface-to-volume ratio at 1 g, they will interact more strongly with the base fluid around them, leading to a higher YP [25].

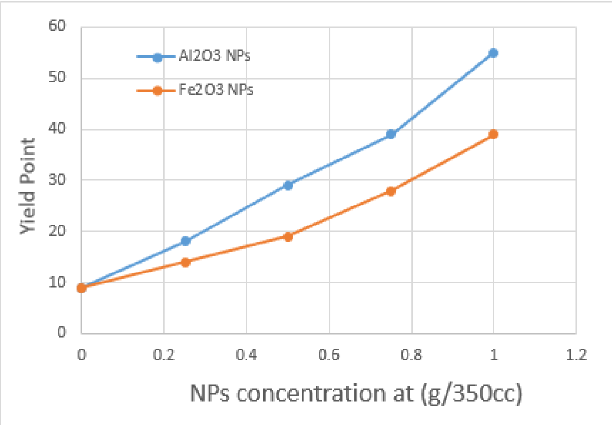

Fig. 5. NPs Concentration Affects the Yield Point

C. Gel Strength

The gel strength of the drilling fluids must be maintained at a relatively high level in order to suspend and transport cuttings in horizontal wells. Reduced WBM circulation circulating pressure loss also contributes to improved drilling efficiency [26]. It is a standard. Under static conditions, the electrochemical forces in the fluid determine the gel strength. Fig. **6** and Fig. **7**, the influence of NPs at various concentrations on GS is demonstrated at 10 s and 10 min, respectively. Base mud gel strength was determined to be 7 and 12 lb/100 ft^2 for 10 sec and 10 min, respectively, in the initial test. The addition of Al_2O_3 NPs ranging from 0.25 to 1 g increased the Lignosulfonate - WBM gel strength values in both tests (10 sec and 10 min). A concentration of 1 g Al_2O_3 NPs produced a Lignosulfonate-WBM 10 sec gel strength of 53 lb/100 ft^2 and a 10 min gel strength of 58 lb/100 ft^2. In the presence of Fe_2O_3 NPs, the 10 sec and 10-min gel strength values increased by addition NPs from 0.25 to 1g. Fe_2O_3 NPs, on the other hand, increased the 10 sec and 10 min gel strength values to 40 and 50 lb/100 ft^2 respectively. The high gelling characteristics of the fluid may necessitate a high starting torque, which must be justified by investigating the fluid's shear thinning behavior. The absence of numerous and serious drilling issues can only be ensured by using a high-strength gel [27]. Finally, the gelling properties of Al_2O_3 NPs at 1g concentration are superior to those of Fe_2O_3 NPs, due to the electrostatic force between Al_2O_3NPs, which links their cases with base fluids to create a rigid structure, this happens [18].

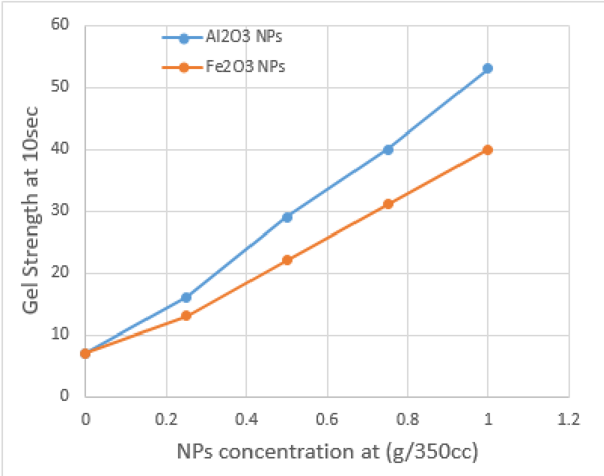

Fig. 6. NPs Concentration Effects on Gel Strength over a 10-sec

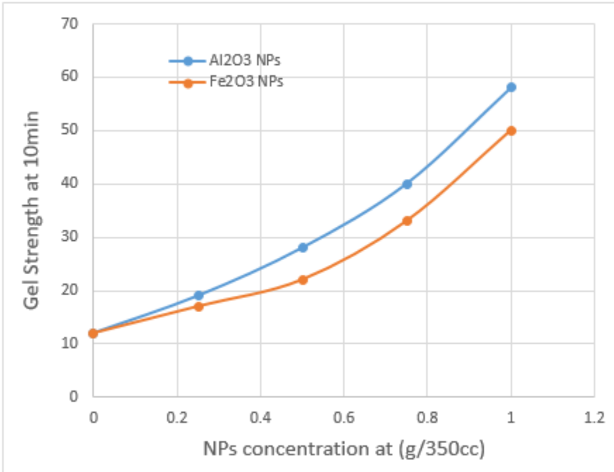

Fig. 7. NPs Concentration Effects on Gel Strength over a 10-min

3.2. Loss of filtering

Wellbore plugging, formation expansion, and wellbore instability and collapse can all be caused by fluid outflow into the formation. Differential pressure adhesion, caused by cake buildup on the wellbore wall, increases the risk of drilling tool damage [28]. In order to prevent drilling fluid from escaping and entering a formation, NPs can be used to obstruct the pore space [7]. Fig. **8**, shows the fluid loss behavior of Lignosulfonete-WBM with varying NP concentrations. The Lignosulfonete-WBM lost 13.5 mL of fluid after 30 minutes. The fluid loss volume was reduced to 9.3 mL after incorporating Al_2O_3 NPs into the WBM at a concentration of 1 g. In general, Al_2O_3 NPs are a good additive for lowering the filter loss of Lignosulfonete-WBM. The addition of 1g of Fe_2O_3 NPs reduced the lignosulfonete-WBM filter losses to 8.6 mL. Base mud fluid loss can be reduced by using 1g of Fe_2O_3NPs. However, Fe_2O_3 NPs are a better choice for reducing fluid loss, this finding concur well with [9].

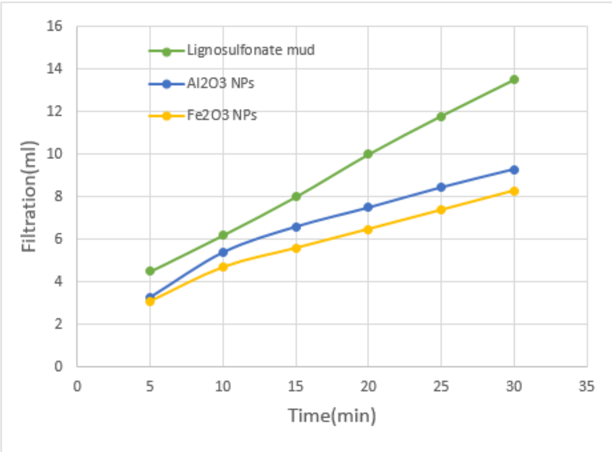

Fig. 8. NPs Concentration Affects the Filtrate (ml)

3.3. Lubricity and NPs concentration

A lot of heat and friction is generated during drilling operations at the bit and the drill string/wellbore interface. In addition, when the drill string is rotating, the friction that occurs between the wellbore and the drill string can generate a significant amount of torque and drag [29]. It is one of the primary functions of drilling fluid to lubricate the drill string as it progresses through the well. To determine a surface's coefficient of friction, you must first determine how much traction there is between the two objects [23]. Fig. **9**, a small amount of nanoparticles in the drilling fluid reduced CoF slightly, according to the results of this study. Using base mud, we were able to increase torque by about 44%. In contrast, the addition of Fe_2O_3 and Al_2O_3 NPs led to a Torque reduction of 33% and 31%, respectively, at a concentration of 0.75 g. Similar to Fe_2O_3 NPs, Al_2O_3 NPs above 0.75 g caused 35% and 37% increase in COF, respectively. WBM lignosulfonete crushes under rotation and forms angulated forms, resulting in higher CoF values than Fe_2O_3 and Al_2O_3 NPs. NPs reduce the CoF by creating a slippery layer between the drill string and the borehole.

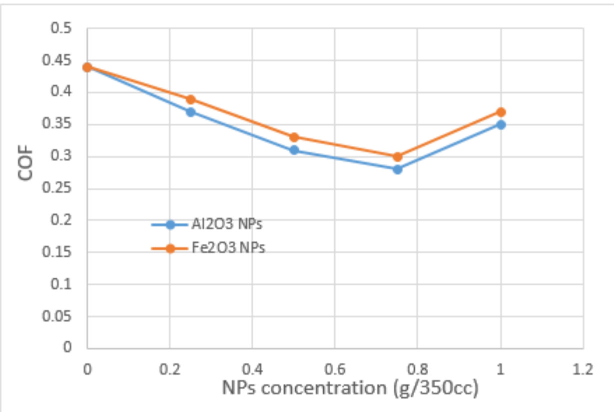

Fig. 9. Friction of Coefficient (COF) Depends on the Concentration of NPs in the Fluid

3.4. Swelling Behavior and Nanoparticle Effects

By far and away the most common result of freshwater intrusion is the alteration of clay minerals. When clays in the rock matrix are hydrated and swelled by water, they can become dispersed and cause particle plugging. The clay mineral smectite or montmorillonite is the most important one for swelling. Interlayer adsorption of water has the capability of expanding this clay up to a 10-fold range. This depends on the cation in the interlayer [30]. WBM with the NPs. Because of the synergetic properties of NPs, to expand, it means that the bentonite in the NPs system absorbed less water, resulting in less clay swelling and increased shale strength [24]. Fig. **10**, show the expansion quantity meter results for the sodium bentonite shale, using four different drilling fluids, including fresh water, Al_2O_3 NPs, Fe_2O_3 NPs, and Lignosulfonete-WBM. After 15 hours in fresh water, the bentonite had grown by 15% and the Lignosulfonete-WBM had grown by 13%. Al_2O_3-NP-treated Lignosulfonete-WBM grew by less than 7% after 16 hours of exposure to these systems. Finally, the addition of Fe_2O_3 NPs reduces swelling to 8% due to NPs' ability to plug Nano pores in clay, preventing shale swelling. As a result, Al_2O_3 NPs are the most effective additive for reducing Lignosulfonete-WBM swelling [11].

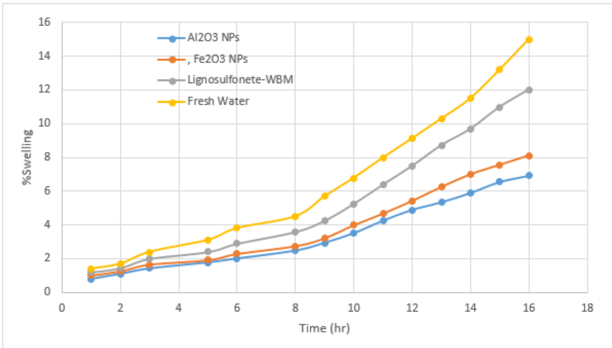

Fig. 10. Shale Interacted with Liginosulfonate-WBM /Al_2O_3, Fe_2O_3 NPs and Compared with Basic Muds

4- Conclusion

Shale plug immersed in Al_2O_3 NPs mud shows less erosion and cracking along the boundary and at the center of the shale plug compared to basic mud, However, Al_2O_3 NPs mud system shows good shale inhibition compared to Fe_2O_3 NPs mud system. Overall, the results showed that the addition of $Al_2O_3$and Fe_2O_3 NPs to the basic mud system improved shale inhibition and rheological properties. API and LPLT filtrate volumes were minimized by using $Al_2O_3$and Fe_2O_3 NPs. Minimizing CoF with $Al_2O_3$and Fe_2O_3 NPs. However, further studies are required to investigate the effect of $Al_2O_3$and Fe_2O_3 NPs at higher concentrations over shale swelling and rheological behavior of the muds.

References

[1] M. S Al Ruqeishi, Y. Al Salmi and T. Mohiuddi, (2018). "Nanoparticles as Drilling Fluids Rheological Properties Modifiers", Progress Petrochem Science, Vol.1 - Issue – 5.

[2] M. S.Al-Yasiri and W.T. Al-Sallami, (2015). "How the Drilling Fluids Can be Made More Efficient by Using Nanomaterials", American Journal of Nano Research and Applications, Vol. 3, No. 3, pp. 41-45.

[3] S. Livescu, (2012)." Mathematical modeling of thixotropic drilling mud and crude oil flow in wells and pipelines—A review", Journal of Petroleum Science and Engineering, Vol.98-99, PP.174-184.

[4] Ayad A.Alhaleem A.Alrazzaq, H. A. Neamah,(2018). "Torque and Drag Forces Problems in Highly Deviated Oil Well", Iraqi Journal of Chemical and Petroleum Engineering, Vol.19 No.3, 19 – 31.

[5] Amel Habeeb Assi, (2018). "Potato Starch for Enhancing the Properties of the Drilling Fluids", Iraqi Journal of Chemical and Petroleum Engineering, Vol.19 No.3, 33 –40.

[6] F. H. M. Almahdawi, A. Zarzor Al-Yaseri and N. Jasi, (2014)." Apparent Viscosity Direct from Marsh Funnel Test", Iraqi Journal of Chemical and Petroleum Engineering, Vol.15 No.1, PP.51- 57.

[7] Ahmed R. AlBajalan and Hunar K. Haias, (2021). "Evaluation of the Performance of Conventional Water-Based Mud Characteristics by Applying Zinc Oxide and Silica Dioxide Nanoparticle Materials for a Selected Well in the Kurdistan/Iraq Oil Field", Advances in Materials Science and Engineering, ID 4376366, PP. 10.

[8] V. Srivastava, (2021). "Application of manganese oxide nanoparticles synthesized via green route for improved performance of water based drilling fluids", Applied Nanoscience, Vol. 11, PP.2247–2260.

[9] G. Cheraghian, (2021). "Nanoparticles in drilling fluid: A review of the state-of-the-art", Journal of materials research and technology, vol.13, 737-753.

[10] G. Cheraghian, Q. Wu, M. Mostofi, M. C. Li, M. Afrand, and J. S. Sangwai, "Effect of a novel clay/silica nanocomposite on water-based drilling fluids: Improvements in rheological and filtration properties," Colloids Surfaces A Physicochem. Eng. Asp., vol. 555, pp. 339–350, Oct. 2018.

[11] A. Aftab, A. R. Ismail, and Z. H. Ibupoto, "Enhancing the rheological properties and shale inhibition behavior of water-based mud using nanosilica, multi-walled carbon nanotube, and graphene nanoplatelet," Egypt. J. Pet., vol. 26, no. 2, pp. 291–299, Jun. 2017, doi: 10.1016/j.ejpe.2016.05.004.

[12] A. V. Minakov, E. I. Mikhienkova, Y. O. Voronenkova, A. L. Neverov, G. M. Zeer, and S. M. Zharkov, "Systematic experimental investigation of filtration losses of drilling fluids containing silicon oxide nanoparticles," J. Nat. Gas Sci. Eng., vol. 71, Nov. 2019, doi: 10.1016/j.jngse.2019.102984.

[13] X. Huang et al., "Enhancement of thermal stability of drilling fluid using laponite nanoparticles under extreme temperature conditions," Mater. Lett., vol. 248, pp. 146–149, Aug. 2019.

[14] M. Beg, P. Kumar, P. Choudhary, and S. Sharma, "Effect of high temperature ageing on TiO2 nanoparticles enhanced drilling fluids: A rheological and filtration study," Upstream Oil Gas Technol., vol. 5, Oct. 2020, doi: 10.1016/j.upstre.2020.100019.

[15] V. Srivastava, M. Beg, S. Sharma, and A. K. Choubey, "Application of manganese oxide nanoparticles synthesized via green route for improved performance of water-based drilling fluids," Appl. Nanosci., vol. 11, no. 8, pp. 2247–2260, Aug. 2021, doi: 10.1007/s13204-021-01956-8.

[16] A. R. Albajalan and H. K. Haias, "Evaluation of the Performance of Conventional Water-Based Mud Characteristics by Applying Zinc Oxide and Silica Dioxide Nanoparticle Materials for a Selected Well in the Kurdistan/Iraq Oil Field," Adv. Mater. Sci. Eng., vol. 2021, 2021, doi: 10.1155/2021/4376366.

[17] M. Al-Yasiri and D. Wen, "Gr-Al2O3 Nanoparticles-Based Multifunctional Drilling Fluid," Ind. Eng. Chem. Res., vol. 58, no. 23, pp. 10084–10091, Jun. 2019, doi: 10.1021/acs.iecr.9b00896.

[18] M. T. Al-Saba, ; A Al Fadhli, ; A Marafi, ; A Hussain, ; F Bander, and ; M F Al Dushaishi, "Application of Nanoparticles in Improving Rheological Properties of Water Based Drilling Fluids," 2018.

[19] Z. Vryzas, "A Comprehensive Approach for the Development of New Magnetite Nanoparticles Giving Smart Drilling Fluids with Superior Properties for HP/ HT Applications," 2016.

[20] Z. Wang, Y. Wu, P. Luo, Y. Tian, Y. Lin, and Q. Guo, "Poly (sodium p-styrene sulfonate) modified Fe3O4 nanoparticles as effective additives in water-based drilling fluids," J. Pet. Sci. Eng., vol. 165, pp. 786–797, Jun. 2018, doi: 10.1016/j.petrol.2018.03.001.

[21] Z.vryzas, et al.(2015). "Development and testing of novel drilling fluids using Fe2O3 and SiO2 nanoparticles for enhanced drilling operations", SPE International Oilfield Nanotechnology Conference, Vol. 13, pp. 737-753.

[22] A. E. Bayat, et al. (2018). "Experimental investigation of rheological and filtration properties of water-based drilling fluids in presence of various nanoparticles", Colloids and Surfaces A 555, 256–263.

[23] A. R. Ismail, et al. (2016). "The novel approach for the enhancement of rheological properties of water-based drilling fluids by using multi-walled carbon nanotube, Nano silica and glass beads", Journal of Petroleum Science and Engineering, Vol.139, PP.264–275.

[24] Al-Yasiri, M., Awad, A., Pervaiz, S., Wen, D., Influence of silica nanoparticles on the functionality of water-based drilling fluids, Journal of Petroleum Science and Engineering (2019).

[25] F. H. M. Al-Mahdawi and K. Saad, (2018). "Enhancement of Drilling Fluid Properties Using Nanoparticles", Iraqi Journal of Chemical and Petroleum Engineering, Vol.19 No.2, 21 – 26.
[26] K. Wang et al. (2018). "Magnesium aluminum silicate nanoparticles as a high-performance rheological modifier in water-based drilling fluids", Applied Clay Science, Vol.161, NO.1, PP. 427-435.
[27] R.Ghosn, et al. (2017). "Silica Nanoparticles for the Stabilization of W/O Emulsions at HTHP Conditions for Unconventional Reserves Drilling Operations", Oil Gas Sci. Technol , Vol. 72, NO.4 ,PP.13-21.
[28] J. Sun, et al. (2020). "Salt-Responsive Zwitterm ionic Polymer Brush Based on Modified Silica Nanoparticles as a Fluid-Loss Additive in Water-Based Drilling Fluids", Energy & Fuels, Vol.34, NO.2, PP.1669-1679.
[29] "Drilling Fluids Manual", Amoco Production Company.
[30] "Drilling Fluids Reference Manual", Buker Hughes.

تحسين خواص طين الحفر (Lignosulfonete Mud) بإضافة نانو أوكسيد الالمنيوم واوكسيد الحديد

حسن علي عبود و ابتهال كريم شاكر

قسم الهندسة الكيمياوية/كلية الهندسة/جامعة بغداد

الخلاصة

ان الخواص الانسيابية، والتزييت، والانتفاخ لجدار البئر، والتحكم في الترشيح لسائل حفر الابار النفطية كلها خواص مهمة يجب مراعاتها قبل البدء بعملية حفر البئر النفطي. حيث يمكن جعل تلك السوائل أكثر سلاسة، فعالية واقل كلفة من خلال إضافات مواد نانوية والتي تعرف بأوكسيد الالمنيوم واوكسيد الحديد. وكذلك يمكن تقييم أداء تلك السائل من خلال مقارنة خصائصه الأساسية مع تلك الخصائص المحسنة بالإضافات النانوية، حيث تكون تلك الإضافات بتراكيز مختلفة (٠,٢٥,٠,٥,٠,٧٥,و١غم). وفقاً للنتائج، وجد ان سائل الحفر بدون النانو يمتلك معامل احتكاك بنسبة ٤٤%، بينما مع النانو (اوكسيد الالمنيوم واوكسيد الحديد) وبتركيز ٠,٧٥ غم قل معامل الاحتكاك بنسبة ٣١% و٣٣% على التوالي. وكذلك استطاع النانو (اوكسيد الالمنيوم واوكسيد الحديد) تقليل الراشح بنسبة ٣٠% و٣٧% على التوالي. وكذلك تم تحسين الخواص الانسيابية وتقليل الانتفاخ وخاصة عند تركيز ١غم من تلك النانو. الخلاصة، ان استخدام النانو وخاصة عن تركيز ١غم استطاع تحسين الخواص الانسيابية والترشيح والانتفاخ بالإضافة الى التزييت عند تركيز ٠,٧٥ غم.

الكلمات الدالة: طين الحفر، حبيبات نانوية، التزييت، الترشيح، الانتفاخ.