https://doi.org/10.33261/jaaru.2020.27.1.010 *Association of Arab Universities Journal of Engineering Sciences (2020) 27(1): 83–93*

Association of Arab Universities Journal of Engineering Sciences
مجلة اتحاد الجامعات العربية للدراسات والبحوث الهندسية

The Performance of Iraqi Bentonite Using Soda Ash and Caustic Soda Additives

Ghofran F. Al-Ghanimi [1] and Nada S. Al-Zubaidi [2]*

[1]*Department of Petroleum Engineering, University of Baghdad, Baghdad, Iraq, ghofran_f94@yahoo.com*

[2]*Department of Petroleum Engineering, University of Baghdad, Baghdad, Iraq, nadaszubaidi@yahoo.com*

**Ghofran F. Al-Ghanimi, ghofran_f94@yahoo.com*

Published online: 31 March 2020

Abstract— Choosing an adequate drilling fluid is of paramount importance in drilling operations. Thus, controlling the drilling fluid properties is by means of the appropriate selection of drilling fluid components of base fluids, solids, and additives to preserve drilling fluid properties. The aim of this study is to use the available and low cost Iraq's mineral resources. One of these minerals is presented by the Iraqi calcium montmorillonite clay (Ca-bentonite) was obtained from Wadi Bashera / Western Desert /Anbar Governorate to be used as an alternative active solid instead of spending hard currency on importing commercial clay. This study was grouped into two workflows. In the first workflow, XRF and XRD analyzes were performed after grinding the Iraqi raw bentonite rocks and screening it to separate the impurities in order to find out the chemical composition (oxides) and mineral composition (clay and non-clay minerals). The XRF analysis showed that Iraqi bentonite has Al2O3 to SiO2 ratio of 0.3623 which is approximately similar to 0.3455 that obtained by Wyoming bentonite. The XRD analysis detected that Iraqi bentonite is mainly composed of montmorillonite and palygorskite which form the predominant constituents of clay minerals, whereas quartz and gypsum are presented as non-clay minerals. The experimental work is the second work flow of this study in which the rheological and filtration properties, in addition pH value and stability of 3wt. % of Iraqi bentonite fresh water based fluid were tested. Two types of additives with different concentrations were used, soda ash and caustic soda. The results of the experimental work showed that, adding different concentrations of soda ash resulted in an increase in the rheological properties of 3wt. % Iraqi bentonite fresh water based drilling fluid. Soda ash within the range of 0.35 to 0.57g /350 cc water (0.35 to 0.57 lb/bbl) can be used to upgrade Iraqi bentonite. Caustic soda addition within range 0.2 to 0.4 g/350 cc water (0.2- 0.4 lb/bbl) caused an increase in the rheological properties of fresh water based drilling fluid prepared with 3 wt. % of Iraqi bentonite. Combination of soda ash and caustic soda with different concentrations revealed better results than that obtained from each additive alone. An improvement in the filtration properties has been also achieved by adding soda ash and caustic soda into the drilling fluid. Also, an enhancement was achieved in stability from 65 % to 98 % with soda ash and caustic soda additions. This study presents an efficient and cost-effective local bentonite for meeting the required drilling fluid rheological properties.

Keywords— Calcium montmorillonite, Iraqi bentonite, Soda ash and caustic soda, Rheological and filtration properties.

1. Introduction

The solids in drilling fluid can be divided into two types, inert (heavy minerals) and active (clay). The inert solids are non-swelling solids which are essentially electrically uncharged and have very little proclivity to react with each other or to a change in environment. The active solids are those that have electrically charged surfaces and can interact with one another to form a gel structure within a fluid and are reactive with their environment. Also, most of the active solids have the ability to be hydrated in water [3]. Clays are the primary source of active solids in a drilling fluid. In most drilling fluids there are two primary sources of clay solids, montmorillonite (bentonite) or palygorskite (attapulgite), which is added intentionally, and native clays, which enter the drilling fluid through the dispersion of drilled solids. In this study, Iraqi calcium montmorillonite (Iraqi bentonite) was used as active solids in fresh water based drilling fluid. The montmorillonite claystone of Late Cretaceous age is presented in the Western Desert within the Digma Formation. Montmorillonite claystone is originally black shales, rich in the carbonaceous matter and was oxidized to yellow and green claystone in surface and near-surface sections [13, 2]. In this study Iraqi montmorillonite was obtained from Wadi Bashera in Western Desert (Anbar Governorate) (Figure 1) [15, 14]

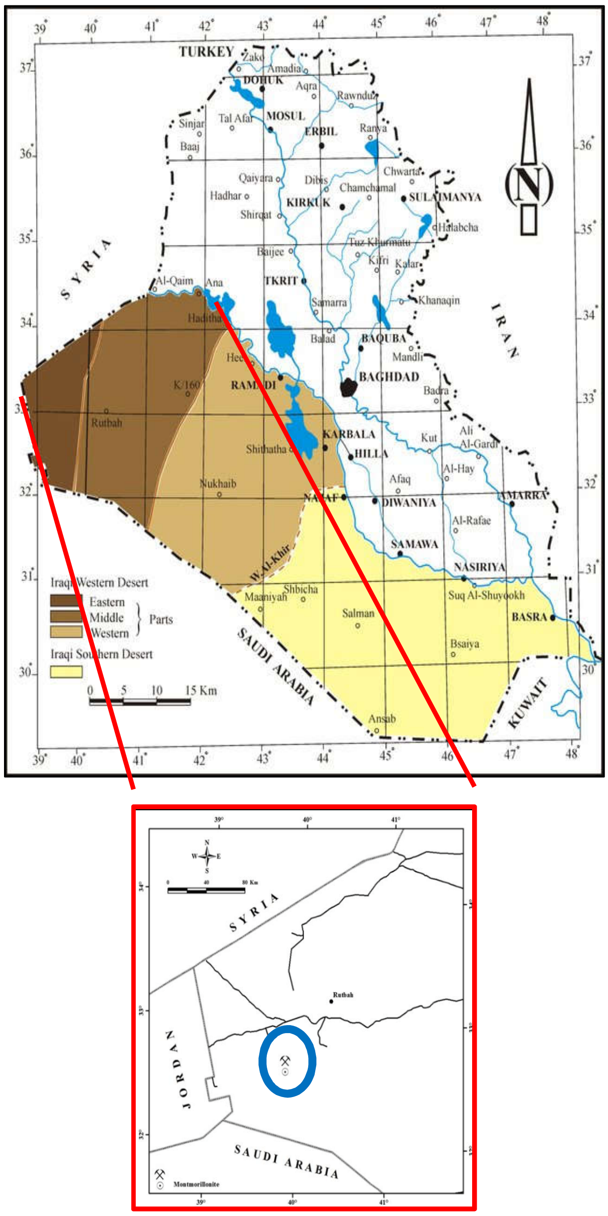

Figure 1: Montmorillonite claystone in the Western Desert of Iraq [15, 14]

The major industrial clays are kaolins, smectites, palygorskite, and sepiolite [10]. The paramount smectite minerals are sodium montmorillonite, calcium montmorillonite, magnesium montmorillonite (saponite), iron montmorillonite (nontronite), lithium montmorillonite (hectorite), and aluminum montmorillonite (beidellite). The most common smectite mineral is calcium montmorillonite (Ca- bentonite), which means that the layer charge deficiency is balanced by the interlayer cation calcium and water. Sodium montmorillonite is relatively rare in occurrence in comparison with calcium montmorillonite which is found in many areas of the world [9].

Several studies have been done to figure out on the performance of Ca-bentonite in drilling fluid, or to upgrad it using different additives. Al-Ajeel and Abdulla [1] studied the upgrading of Ca- montmorillonite claystone (Digma formation) from Wadi Bashira in the Western Desert of Iraq using tetrasodium pyrophosphate as dispersant agent. They investigated the effect of different parameters such as slurry solid concentration, dispersant amount and dispersant/ slurry mixing times on the efficiency of the beneficiation process. Karagüzel, et al in [6] studied an alternative to sodium bentonite (Na-bentonite), the possibility of (Na, Ca)-bentonites to meet the required drilling mud properties by activation of the bentonites. The activation was performed using soda ash and magnesium oxide. Rasin and Hamad [12] investigated the activation of Qara Tappah Ca-bentonite in Iraq with different concentrations of soda ash. The results showed that the original Qara Tappah bentonite was converted to Na-bentonite and maximum rheological properties were observed. Mahdi, et al. in [8] activated calcium montmorillonite claystone (Ca- bentonite) from Wadi Bashir in the Western Desert in Iraq with soda ash by a dry grinding procedure and subsequently evaluated for use as drilling fluids to conform API specifications. Magazoub, et al. [7] investigated the effects of soda ash additives with various concentrations and the subsequent simultaneous heating and stirring for variable periods on the rheological behavior of Ca-bentonite colloidal dispersions. It was found that the swelling and the viscosity of the treated bentonite samples increased with increasing soda ash additions. Ibrahim and Al-Bidry [5] activated Iraqi Ca- bentonite / western desert in Iraq with two methods, direct and indirect activation after grinding the raw Ca-bentonite to powder, sieved and dried in oven at 180ºC for 12 hrs. The direct activation included the addition of various concentrations of NaOH directly to 22.5 g of Iraqi bentonite and 350 ml of distilled water. Indirect activation included, alkali activation, alkali activation with thermal activation, and alkali activation with acid activation were studied. The experimental works showed that, an enhancement in the rheological properties was observed with direct activation Iraqi bentonite, while resulted in poor filtration control. Indirectactivation failed to enhance the performance of Iraqi bentonite.

In this study, experimental work had been conducted to upgrade Iraqi calcium montmorillonite (Iraqi bentonite), using different concentrations of soda ash and caustic soda (NaOH).

2. Processing Raw Bentonite

Iraqi raw needs to be grinded and the impurities, minerals, and compounds that adversely effect on the bentonite grade to be decanted. Thus the following steps show the processing procedure that adopted in this study (**Figure 2**):

1. Raw bentonite is sun-dried.
2. Using grinder to mill the dry raw bentonite (to be powdered) for 80 seconds. The grinder should be run for 40 second and relaxed for 20 second.
3. Weight 100 g milled raw bentonite (specimen) and let it passes through 200 mesh screen.
4. Weight the retained by 200 mesh screen and weight the receiving in pan (passing through the screen).
5. The receiving in pan is the bentonite that will be used to prepare drilling fluid.

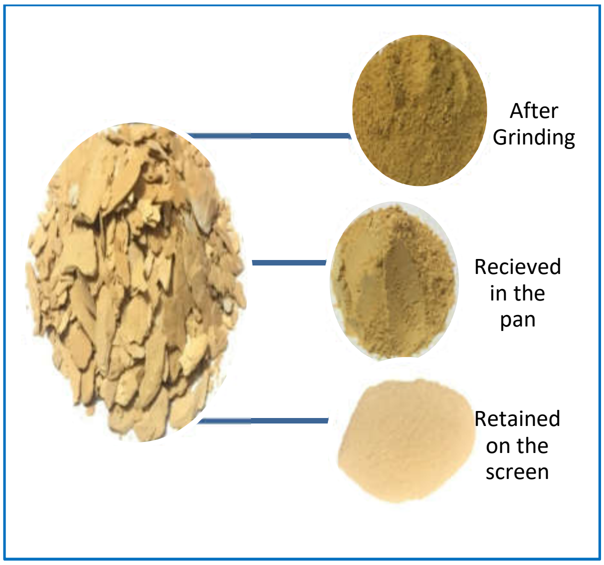

Figure 2: Iraqi raw bentonite processing

3. Experimental Work

3.1 Materials

3.1.1 Iraqi bentonite

Iraqi bentonite that was received in the pan was used.

3.1.2 Chemical Additives

Two types of chemical additives, soda ash and caustic soda were used to improve the performance of Iraqi bentonite in water based drilling fluid. The specifications, concentrations, solubility, and functions of these two chemical additives are shown in **Table 1** and **Table 2** [4, 9].

Table 1: Specifications of soda ash and caustic soda

Name	Formula	Appear-ance	Concentr-ation lb/bbl (g/350cc)	Solubility g/100g water
Sodium Carbonate (Soda Ash)	Na_2CO_3	White Powder	0.2-4	21.5
Sodium Hydroxide (Caustic Soda)	NaOH	White Powder	0.2-4	119

Table 2: Functions of soda ash and caustic soda

Name	**Functions**
Sodium Carbonate (Soda Ash)	Principile use is for removal of soluble calcium salts from makeup waters and muds; some use in clay benefication
Sodium Hydroxide (Caustic Soda)	Used in water muds to raise pH: to solubilize lignite, lignosulfonate and tannin substances; to counteract corrosion, and to neutralize hydrogen sulfide

3.2 Preparing drilling fluids

Drilling fluid preparation was grouped into two work flows. The first was the reference drilling fluid that formulated from 3 wt. % Iraqi bentonite and fresh water. The second was prepared by adding chemical additives Na_2CO_3 and NaOH to the reference drilling fluid with various concentrations.

Preparing reference drilling fluid is demonstrated as follows:

1. Add the required quantity of Iraqi bentonite to tap water as required and mix for 20 minutes.
2. The mixture is aged for 24 hours to allow the colloids time to hydrate, then the fresh water based drilling fluid is ready to be tested.

To prepare drilling fluid with chemical additives, the following procedure has been followed

1. Add the required quantity of Iraqi bentonite to tap water as required and mix for 10 minutes. Then add the required quantity of chemical material and mix for 20 minutes.
2. The mixture is aged for 24 hours to allow the colloids time to hydrate. After that the fresh water based drilling fluid is ready to be tested.

4. Results and Discussion

4.1 Clay Characterization

4.1.1 X-Ray Fluorescence (XRF) Analysis

The chemical analysis (XRF analysis) of Iraqi bentonite (after processing) is illustrated in **Table 3**, where it shows

a comparison between Iraqi bentonite and Wyoming bentonite. The Al_2O_3 to SiO_2 ratio of Iraqi bentonite clay is 0.3623. Thus, this ratio is approximately similar to 0.345 that obtained by Wyoming bentonite.

4.1.2 X-Ray Diffraction (XRD) Analysis

Bentonite is rarely used in its raw form, both drying and processing are usually essential to modify its properties. The mineral components of Iraqi raw bentonite, received bentonite in the pan, and the retained on the screen are illustrated in **Table 4** and shown in **Figure 3** and **Figure 4**. Iraqi bentonite consists mainly of montmorillonite and palygorskite forming the major constituents of clay minerals, whereas quartz and gypsum are presented as impurities (non-clay minerals). Processing technique resulted in removing gypsum and reducing quartz in the received bentonite in the pan.

Table 3: Chemical composition of Iraqi bentonite

Bentonite	**Oxides, %**								★ LOI
	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	Na_2O	K_2O	TiO_2	
Iraqi Bentonite	56.94	20.63	3.32	2.95	2.8	0.55	0.3	0.68	9.86
★ **Wyoming Bentonite (USA)**	66.11	22.84	6.51	1.92	1.32	ND	0.56	0.55	----

★ LOI: Loss of Ignition ★ [11]

Table 4: XRD Analysis of Iraqi bentonite (received in the pan) and the retained on the screen

Constituent	XRD Description
Iraqi bentonite (received in the pan)	Montmorillonite, Palygorskite, Quartz
The retained on the screen	Montmorillonite, Palygorskite , Quartz, Gypsum
Commercial Bentonite	Montmorillonite, Quartz

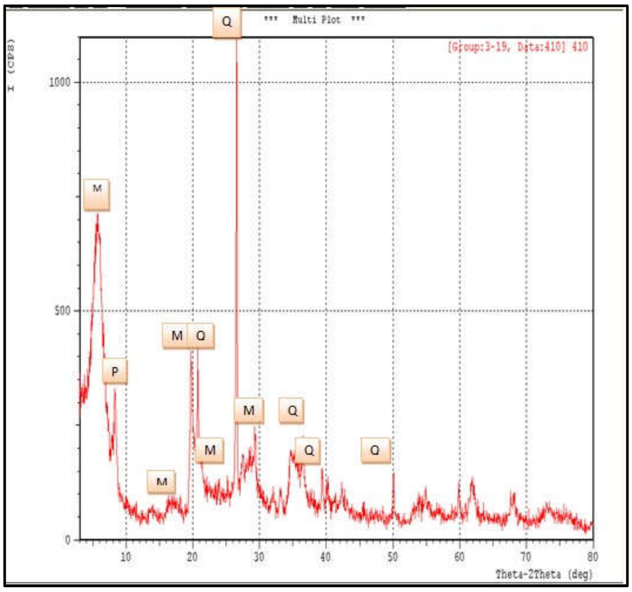

Figure 3: XRD pattern of Iraqi bentonite (received bentonite in the pan)

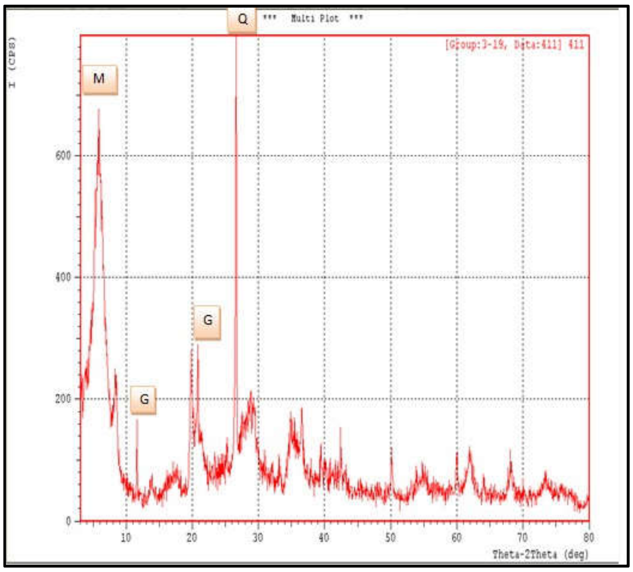

Figure 4: XRD pattern of the retained on the screen

4.2 Effect of Soda Ash (Na_2CO_3)

4.2.1 Effect of soda ash on the rheological properties

Adding soda ash (Na_2CO_3) to 3 wt. % Iraqi bentonite fresh water drilling fluid resulted in significant increase in the rheological properties as illustrated in **Table 5** and shown in **Figure 5**. Adding 0.57g Na_2CO_3 resulted in an increase in the apparent viscosity from 2 to 22.33cP and a significant increase in yield point from 2 to 37.672 $lb_f/100ft^2$. This increment in the rheological properties can be attributed to the flocculation of bentonite platelets. In contrast, the results showed that the plastic viscosity have constant values at concentrations less than o.57 g of Na_2CO_3 while it reaches to 3.949 cP with 0.57 g of Na_2CO_3. A reduction in PV and YP of 23.51% and 26.94%, respectively, has been obsereved when a 0.62g of Na_2CO_3 was added to the drilling fluid which can be attributed to the aggregation phenomena. Instable drilling fluid rheological properties were observed with more Na_2CO_3 addition.

4.2.2 Effect of Soda ash on the filtration properties

The filtration properties were greatly improved by the addition of Na_2CO_3 to 3 wt. % Iraqi bentonites fresh water based drilling fluid. Filtrate volume reduction of 68.75 % with 0.57 g soda ash was obtained. This reductioncan be attributed to the drilling fluid thickening, while the mud cake thickness remained unchanged (**Table 6**).

Table 5: Effect of Na_2CO_3 on 3 wt. % Iraqi bentonite fresh water based drilling fluid

Na_2CO_3 Weight g /350cc Fresh Water	**AV (cP)**	**PV (cP)**	**YP (lb_f/100 ft²)**	**YP/PV (lb_f/100 ft²/cP)**	**10 sec gel (lb_f/100 ft²)**	**10min gel (lb_f/100 ft²)**	**Density (ppg)**	**pH (pH-paper)**	**Stability %**
0.0	2	1	2	2	1	1.5	8.50	8	65
0.35	12	2	20	10	9	15	8.49	8.5	98
0.44	14.16	2	24.33	12.16	17	18	8.49	8.5	98
0.53	19	2	34	17	32	40.5	8.49	8.5	98
0.54	19	2	34	17	24	26.5	8.49	9	98
0.57	22.33	3.949	37.672	9.539	37	52	8.49	9	98
0.62	17.08	3.327	27.506	8.26	28.5	37	8.49	9	98
0.7	20.83	2	37.66	18.83	38	43	8.49	9	98
0.8	17.15	3.3	27.7	8.39	29	44	8.49	9	98
0.88	16.33	1.83	29	15.84	26	29	8.49	10	98

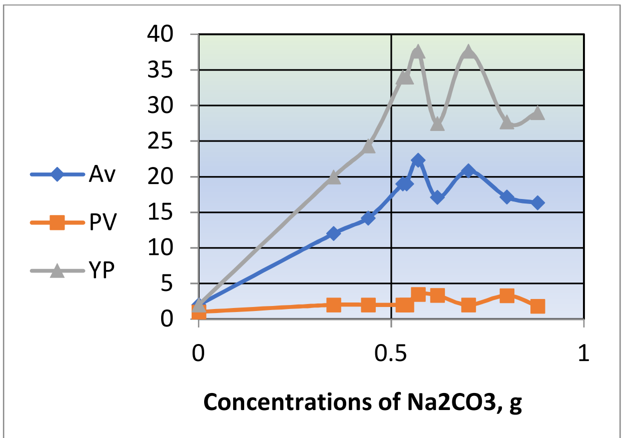

Figure 5: Effect of soda ash on the apparent viscosity, the plastic viscosity, and yield point on 3 wt. % Iraqi bentonite water based drilling fluid

Table 6: Filtration properties of 3 wt. % Iraqi bentonite fresh water based drilling fluid with Na_2CO_3

Addition States	$V_{7.5}$, ml	V_{30} , ml	t_{mc} , mm
Reference (3 wt.% Iraqi Bentonite + Fresh Water)	48	96	2
Reference+ 0.35 g Na_2CO_3	18	36	4
Reference + 0.57 g Na_2CO_3	15	30	2

4.3 Effect of Caustic Soda (NaOH)

4.3.1 Effect of Caustic Soda on the rheological properties

The effect of caustic soda on 3 wt. % Iraqi bentonite fresh water based drilling fluid is illustrated in Table 7 and shown in Figure 6. A significant improvement in the the rheological properties were observed with 0.4 g NaOH addition, where the yield point increased to 44.33 lbf/100ft2 due to the flocculation of bentonite platelets. However, the ratio YP/PV has reached to a significant value above the permitted specifications by API. Reduction in the rheological properties was observed with 0.6 g NaOH concentration due to the aggregation (face to face linking) of the bentonite platelets. Using more than 0.6 g NaOH resulted in instable drilling fluids rheological properties.

4.3.2 Effect of Caustic Soda on the filtration properties

As mentioned earlier, an enhancement in the rheological properties were obtained with NaOH addition to the fresh water based drilling fluids prepared with 3 wt. % Iraqi bentonite.This enhancement reflected their impact on the filtration properties where significant decrease in filtrate volume was observed with 0.2 g NaOH addition to 3 wt. % fresh water based drilling fluid (**Table 8**).

Table 7: Effect of NaOH on 3 wt. % Iraqi bentonite fresh water based drilling fluid

NaOH Weight g\350cc Fresh Water	AV (cP)	PV (cP)	YP ($lb_f/100\ ft^2$)	YP/PV ($lb_f/100\ ft^2/cP$)	10 sec gel ($lb_f/100\ ft^2$)	10min gel ($lb_f/100\ ft^2$)	Density (ppg)	pH (pH-paper)	Stability %
0.0	2	1	2	2	1	1.5	8.50	8	65
0.2	12.166	3.67	16.99	4.629	15.5	27	8.50	12	98
0.3	20.165	2.33	35.67	15.309	27.5	32	8.51	12	98
0.4	23.165	1	44.33	44.33	32	50	8.51	12	98
0.5	24	3	42	14	25	38	8.52	12	98
0.6	18.166	3.33	29.67	8.909	12	14	8.52	12	98
1	22.665	6.33	32.67	5.16	13.66	16	8.52	12	98
2	20	2	36	18	13	14	8.52	12	98
3	18.5	5	27	5.4	8	9	8.52	12	98
4	16.33	3.827	25.01	6.53	7	8	8.53	12	98

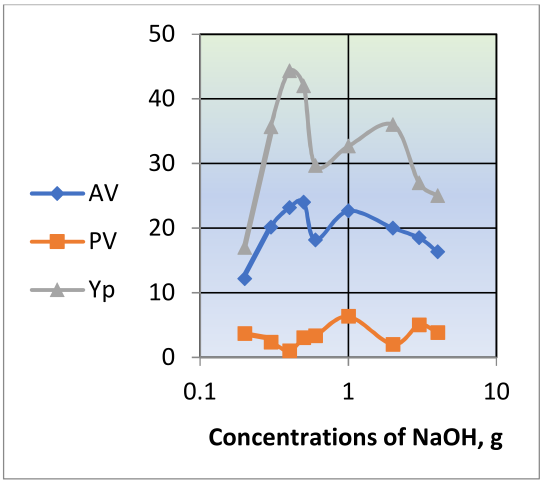

Figure 6: Effect of caustic soda on the apparent viscosity, the plastic viscosity, and yield point on 3 wt. % Iraqi bentonite water based drilling fluid

Table 8: Filtration properties of 3 wt. % Iraqi bentonite fresh water based drilling fluid with NaOH

Addition States	, ml$V_{7.5}$	, V_{30} ml	, mmt_{mc}
Reference (3 wt.% Iraqi Bentonite + Fresh Water)	48	96	2
Reference + 0.2 g NaOH	18	36	2
Reference + 0.3 g NaOH	18	36	1
Reference + 0.4 g NaOH	15.5	31	2

4.4 Effect of soda ash and caustic soda combination

4.4.1 Effect of soda ash and caustic soda combination on the rheological properties

Four Types of soda ash -caustic soda combination (B, C, D, and E) with their effects on the properties of drilling fluid is illustrated in **Table 9** and shown in **Figure 7,** where A represents the reference drilling fluid. An enhancement was resulted in with all types of soda ash - caustic soda combination especially B, D, and E types.

4.4.2 Effect of soda ash and caustic soda combination on the filtration properties

As shown in **Table 10**, the combination of NaOH and Na_2CO_3 resulted in 64.58 % and 75 % reduction in filtrate volume with (0.23 g Na2CO3 + 0.07 g NaOH) and (0.27 g Na2CO3 + 0.15 g NaOH) additions respectively.

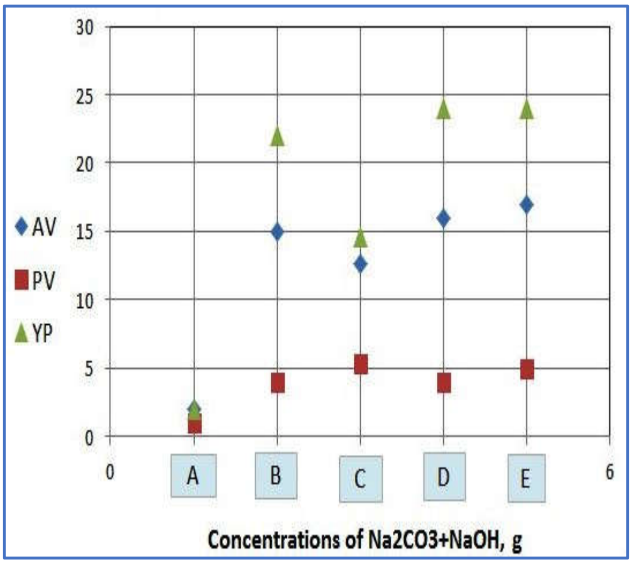

Figure 7: Effect of Na_2CO_3 and NaOH combination on 3 wt. % of Iraqi bentonite fresh water based drilling fluid, A- 0g Na_2CO_3+0g NaOH, B- 0.15g Na_2CO_3+0.15g NaOH, C- 0.07g Na_2CO_3+0.23g NaOH, D - 0.23g Na_2CO_3+0.07g NaOH, E- 0.27g Na_2CO_3+0.15g NaOH

Table 9: Effect of Na_2CO_3 and NaOH combination on 3 wt. % of Iraqi bentonite fresh water based drilling fluid

Na_2CO_3+ NaOH Weight g\350cc Fresh Water	AV (cP)	PV (cP)	YP (lb_f/100 ft^2)	YP/PV (lb_f/100 ft^2/cP)	10 sec gel (lb_f/100 ft^2)	10min gel (lb_f/100 ft^2)	Density (ppg)	pH (pH-paper)	Stability %
0 (A)	2	1	2	2	1	1.5	8.41	8	65
0.15+0.15 (B)	15	4	22	5.5	20	24	8.40	9.2	98
0.07+0.23 (C)	12.66	5.33	14.67	2.75	10	12	8.42	9.8	98
0.23+0.07 (D)	16	4	24	6	25	26	8.40	9	98
0.27+0.15 (E)	17	5	24	4.8	15	19	8.35	10	98

Table 10: Filtration properties of 3 wt. % Iraqi bentonite fresh water based drilling fluid with NaOH and Na_2CO_3 combination

Addition States	$V_{7.5}$, ml	V_{30} , ml	t_{mc} , mm
Reference (3 wt.% Iraqi Bentonite + Fresh Water)	48	96	2
Reference + 0.23 g Na2CO3 + 0.07 g NaOH	17	34	2
Reference + 0.27 g Na2CO3 + 0.15 g NaOH	12	24	1

5. Stability of the drilling fluid

As shown in Table 5, 7, and 9 an enhancement was observed in the stability from 65 % to 98 % for all types of drilling fluids with soda ash and caustic soda additions.

6. Conclusion

Based on the results of the experimental tests of the effect of soda ash and caustic soda additions on the rheological and filtration properties of drilling fluids prepared with Iraqi bentonite, the following conclusions are presented:

1. XRD analysis revealed that montmorillonite and palygorskite forming the major constituents of clay minerals in Iraqi bentonite. Whereas non-clay minerals, gypsum and quartz are existed as impurities.

2. Low concentrations of soda ash resulted in a significant increase in the rheological properties of 3wt. % Iraqi bentonite. Based on the results, soda ash can be used within range of 0.35 to 0.57g /350 cc water (0.35 to 0.57 lb/bbl) to upgrade Iraqi bentonite.

3. A significant effect of caustic soda addition within range of 0.2 to 0.4 g/350 cc water (0.2-0.4 lb/bbl) were observed on the rheological properties of drilling fluid prepared with 3 wt. % of Iraqi bentonite.

4. Combination of soda ash and caustic soda with different concentrations were added to 3 wt. % Iraqi bentonite water based drilling fluid and obtained drilling fluid with properties (the rheological properties) that may not be provided by one material alone.

5. An enhancement in filtration properties were observed with caustic soda and soda ash additions to fresh water drilling fluids prepared with Iraqi bentonite.

6. The stability of all drilling fluids prepared with Iraqi bentonite was enhanced from 65 % to 98 % with all concentrations of caustic soda and soda ash.

Nomenclature

API	American Petroleum Institute
AV	Apparent viscosity (cP)
PV	Plastic viscosity (cP)
t_{mc}	Thickness of mud cake (mm)
$V_{7.5}$	Filtrate volume after 7.5 minute (ml)
V_{30}	Filtrate volume after 30 minute (ml)
XRD	X-Ray Diffraction
XRF	X-Ray Fluorescence
YP	Yield Point ($Ib_f/100ft^2$)

References

[1] Abdullah, S. N., & Al-Ajeel, A. W. A. (2010). Upgrading of montmorillonite claystone (Digma Formation) from Wadi Bashira, Western Desert, Iraq. Iraqi Bulletin of Geology and Mining, 6(2), 149-157.

[2] Al-Bassam, Kh.S. 2007 A. Mineral Deposits and Occurrences of the Iraqi Western Desert. Iraqi Bulletin of Geology and Mining, Special Issue No. 1, p. 145 – 168.

[3] Annis, M. R., & Smith, M. V. (1996). drilling fluids technology. (August).

[4] Darley, H. & Gray, G. R., 1988. Composition and Properties of Drilling and Completion Fluids fifth edition. USA: Gulf Professional Publishing.

[5] Ibrahim, A. S., & Al-Bidry, M. A. (2019, July). Activation Iraqi bentonite for using as drilling mud. In IOP Conference Series: Materials Science and Engineering (Vol. 579, No. 1, p. 012006). IOP Publishing

[6] Karagüzel, C., Çetinel, T., Boylu, F., Çinku, K., & Çelik, M. S. (2010). Activation of (Na, Ca)-bentonites with soda and MgO and their utilization as drilling mud. Applied Clay Science, 48(3), 398-404.

[7] Magzoub, M. I., Nasser, M. S., Hussein, I. A., Benamor, A., Onaizi, S. A., Sultan, A. S., & Mahmoud, M. A. (2017). Effects of sodium carbonate addition, heat and agitation on swelling and rheological behavior of Ca-bentonite colloidal dispersions. Applied Clay Science, 147, 176-183.

[8] Mahdi, S. N., Kshash, J. M., & Al-Ajeel, A. W. A. (2013). Sodium activation of Iraqi high grade montmorillonite claystone by dry method. Iraqi Bulletin of Geology and Mining, 9(1), 65-73.

[9] MI, 1996.Drilling fluid manual.UAS: s.n.

[10] Murray, H. H., 2007. Applied Clay Mineralogy. 2nd ed. UK: Elsevier.

[11] Nawasreh, M., & Al Omari, Y. (2015). Bentonite. Edited by Sahawneh, J., and Madanat, M., Ministry of Energy and Mineral Resources, Amman. Mineral status and future opportunity, 31p.

[12] Rasin, F. A. (2011). Study on the Activation of Qara Tappah Iraqi Bentonite and Its Test as Gelling Agent. Al-Mustansiriyah Journal of Science, 22(6), 123-128.

[13] Sissakian, V. K., Al-Ansari, N., Adamo, N., Knutsson, S., & Laue, J. (2018). Geology of the Euphrates River with Emphasize on the Iraqi

Part. Journal of Earth Sciences and Geotechnical Engineering, 8(3), 167-185.

[14] Sissakian, V. K. (2007). STRATIGRAPHY of the Iraqi Western Desert. (January 2007).

[15] Toama, H. Z., Al-Ajeel, A. W. A., & Abdullah, E. M. (2018). Beneficiation of Low Grade Calcium Bentonite Claystone. Engineering and Technology Journal, 36(5 Part (A) Engineering), 546-554.

ادائية البنتونايت العراقي بأستخدام اضافات كربونات الصوديوم وهيدروكسيد الصوديوم

غفران فالح الغانمي [1]*، ندى صباح الزبيدي [2]

[1]*قسم هندسة النفط، جامعة بغداد، بغداد، العراق، ghofran_f94@yahoo.com*

[2]*قسم هندسة النفط، جامعة بغداد، بغداد، العراق، nadaszubaidi@yahoo.com*

* *غفران فالح الغانمي، ghofran_f94@yahoo.com*

نشر في: 31 آذار 2020

الخلاصة – ان اختيار مائع الحفر المناسب يعتبر من الأمور المهمة في عمليات الحفر. بالتالي السيطرة على خواص مائع الحفر يكون من خلال الأختيار المناسب لمكونات سائل الحفر من قاعدة الموائع، المواد الصلبة، والاضافات للمحافظة على خواصه. ان هدف هذه الدراسة هو استخدام الثروة المعدنية العراقية المتوفرة بكلفة قليلة. حيث تم استخدام الصلصال العراقي نوع المونتموريلونايت الكالسيومي (البنتونايت الكالسيومي) الموجود في وادي بشيرة / الصحراء الغربية / محافظة الانبار لغرض دراسته واستخدامه كبديل للصلصال المستورد التجاري. تم تقسيم العمل الى مجموعتين، المجموعة الأولى تضمنت طحن البنتونايت العراقي الخام وغربلته للتخلص من الشوائب. ثم تم اجراء تحاليل XRD(تحليل حيود الأشعة السينية) و XRF(تحليل الأشعة السينية الفلورية) له لمعرفة التركيب الكيميائي (الاكاسيد)، المعادن الصلصالية وغير الصلصالية. تحليل XRF يبين ان البنتونايت العراقي له نسبة SiO_2 / Al_2O_3 تساوي 0,3623 وهي مقاربة للبنتونايت نوع Wyoming التي تساوي 0,3455. تحليل XRD وجد ان البنتونايت العراقي اساسا يتكون من المونتموريلونايت والبالكورسكايت والتي تكون المعادن الصلصالية السائدة والمهيمنة اما المعادن الغير صلصالية فهي الكوارتز والجبس. المجموعة الثانية تضمنت دراسة الخواص الريولوجية والترشيح بالاضافة الى الاستقرارية وقيمة تركيز ايون الهيدروجين لمائع حفر محضر من (3 نسبة مئوية وزنية). حيث تم استخدام تراكيز مختلفة لاضافات مختلفة وهي رماد الصودا والصودا الكاوية. النتائج المختبرية بينت ان عند تراكيز مختلفة من رماد الصودا يسبب زيادة في الخواص الريولوجية لمائع حفر محضر من (3 نسبة مئوية وزنية). حيث رماد الصودا ضمن مدى 0,35 الى 0,57 غم / سم3 من الماء ممكن استخدامه لرفع ادائية البنتونايت العراقي. اضافة الصودا الكاوية الى مائع حفر محضر من 3 نسبة مئوية وزنية من البنتونايت العراقي ضمن مدى 0,2 الى 0,4 غم / سم3 من الماء ادى الى زيادة في الخواص الريولوجية. تم الجمع بين الصودا الكاوية ورماد الصودا بتراكيز مختلفة واضيفت الى موائع حفر محضرة من 3 نسبة مئوية وزنية واعطت نتائج أفضل مما لو تم استخدام كل مادة لوحدها. تحسنت استقرارية الموائع جميعها المحضرة من البنتونايت العراقي من 65% الى 98% عند اضافة المواد المذكورة اعلاه. مائع الحفر المحضر من البنتونايت العراقي لها حجم راشح كبير واضافة الصودا الكاوية ورماد الصودا ادى الى تحسن في خواص الترشيح.

الكلمات الرئيسية – " المونتموريلونايت الكالسيومي ، البنتونايت العراقي ، الصودا الكاوية و رماد الصودا ، الخواص الريولوجية و خواص الترشيح ".