

Characterization and Beneficiation of Some Nigeria Bentonitic Clays for Formulation of Drilling Mud in Oil and Gas Industry

Benedict O. Edenseting^{1*}, Bassey, E.N²., Babalola, R³., Gumus, R⁴

^{1,2} Department of Chemical and Petroleum Engineering, University of Uyo, Nigeria

^{1,3} Department of Chemical/Petrochemical Engineering, Akwa Ibom State University, Nigeria

⁴Department of Chemical Engineering, Niger Delta University, Bayelsa State, Nigeria

*Corresponding author: Benedict O. Edenseting; Email: edenseting77@gmail.com

Received 1 July 2022; revised 21 July 2022; accepted 25 August 2022

Abstract

In the quest to develop sustainable materials locally for the drilling industry, the bentonitic potentials of two indigenous clays from Edikor and Ukukudung deposits were studied. The x-ray fluorescence (XRF), Fourier Transform Infrared (FTIR) and Scanning Electron Microscope (SEM) techniques were used to characterize the beneficiated bentonitic clay samples. This was done to ascertain the chemical composition and structural morphology of the samples. The minerals identified in FTIR results of the clay samples show that they are montmorillonite of the smectite group. The AlAlOH stretching band occurs at 2512 and 2504 cm^{-1} whereas the bending occurs at 1766 & 1796 cm^{-1} for Edikor and Ukukudung clays, respectively. The SEM microstructure images show that the bentonite samples are generally moderately dispersive with some large flows which were separated and dispersed from one another. For the drilling mud formulation, the two local clays were beneficiated with 1.5 g Na_2CO_3 / 350 ml of water.

Keywords: XRF, FTIR, SEM, Bentonite, Beneficiation, Characterization.

1.0 INTRODUCTION

Nigeria is among the top oil producers in sub-Saharan Africa, and her economy is largely based on this mineral. Hence, the continuous search for local materials in processing this mineral. Falode *et al.*, (2007), and Emofurieta (2010) reported at the international conference on “Modern Mining Processing” that Nigerian bentonite proven reserves have risen above four billion metric tons. However, research over the past years has shown that drilling activities in the petroleum and ground-water development industries in Nigeria are still consuming large amounts of clay for drilling mud formulations, of which a greater percentage is imported despite these large reserves of clay in Nigeria. (Omole *et al.*, 1989). The bentonitic clays require some level of beneficiation to upgrade the quality before application in drilling fluid preparation making.

2.0. MATERIALS AND METHODS

2.1 Materials and Equipment

The Edikor and Ukukudung Bentonitic clays were sourced from UdungUko Local Government Area of Akwa Ibom State. All reagents used were of analytical grade.

All materials used are: Edikor bentonitic clay, Ukukudung bentonitic clay, Sodium carbonate (Analytical grade), Sulphuric acid (Analytical grade), pH paper, Distilled water, Tap water, and Masking tape

The equipment used for the work include: Fourier Transform Infrared (FTIR) spectrometer (8400S model), Scanning Electron Microscope (Machine PHenom Pro – X model), Electric Oven (Haracus model),

4.0 CONCLUSION AND RECOMMENDATION

This study beneficiated and characterized some Nigerian bentonitic clay from Edikor and Ukukudung formation. The samples revealed low grade calcium montmorillonite making it unsuitable for utilization in drilling fluid formulation, but upon beneficiation the rheological properties improved significantly in comparison with imported standard Wyoming bentonite. The characterization was done with the application of XRF, SEM, and FTIR. FTIR shows Bentonitic characteristics but with a lower inner surface OH stretching band of 2504cm⁻¹ and 2512 cm⁻¹ for Edikor and Ukukudung, respectively the literature value 3627-1cm⁻¹. However, the sample shows a bentonitic clay behavior rich in silica and Alumina and can be deduced to be montmorillonite or smectite. Scanning electron microscopy (SEM) carried out reveal that both samples possessed morphology which is a confirmation of its bentonitic clay nature.

The X-ray fluorescence conducted on the non-beneficiated and beneficiated samples again gives result within the API bentonite standard.

To reduce wasteful capital flight, it is imperative to develop a drastic policy intervention with the aim of developing the 'National strategy for competitiveness in raw materials (local clay) and other products in Nigeria'.

REFERENCES

- Akinade, A. (2015). *Beneficiation of Nigeria Local Clay to meet API Standard Specification for Drilling Fluid Formulation. International Journal of Engineering Sciences and Management.*
- American Petroleum Institute (1990). *Specifications for drilling fluids.* Spec. 13A, 1 July, pp1-3.
- Bourgouyne, A.T., Millhiem, K.K., Chenevert, M.E., Young, F.S. (1991). *Applied Drilling Engineering*, 2nd edition, Society of Petroleum Engineers, Richardson, Texas.
- Dewu, B.B. M, Oladipo, M. O. A. Funtua, I. I, Arabi, S. A, Mohammed-Dabo, I. A. and Muhammad, A.A. (2012). *Evaluation of Rheological and other Physical Properties of Bentonitic Clays from Fika Formation in parts of North-Eastern Nigeria.* Petroleum Technology Development Journal, Vol. 1.
- Emofurieta W.O. (2010) 'International Conference on Modern Mining Processing', Abuja, Nigeria. www.nigerianewsdirect.com.
- Emofurieta, W.O. (2001). *The Characteristics of the Nigerian Bentonite.* Geocicaia, Rev. U niv. Aveiro., Vol.115, pp. 39-41.
- Farmer V.C (2000). *Traverse and longitudinal crystal modes associated with OH stretching vibrations in single crystals of koalinite and dickite spectrochimica Acta A*, 56, 927.
- Madejova, J. and Komadel P., (2001). *Baseline studies of clay Minerals: infrared methods.* Clay and Clay Minerals Vol. 49. 410-411
- Obaje, S. O. (2013). *Suitability of Borno Bentonites as Drilling Mud.* International Journal of Science and Technology, Vol. 3 No. 2, pp 152.
- Okorie E. Agwu, A. N. Okon, O. I. Akpanika (2016). *Activation of Local Bentonite Clays for Use as Viscosifiers in Water-Based Drilling Fluids,* Journal of Scientific Research and Reports.
- Okorie, O.M. (2009). *Modification of Drilling Fluid pH with Local Nigerian Additives.* Petroleum Technology Development Journal, Vol. 1, pp. 2-9.
- Omole O, Malomo S, Akande S (1989). *The suitability of Nigerian black soil clays as drilling mud clays.* J. Appl. Clay Sci 4:357-372
- Omole, O., Malomo, S. and Akande, S (1989). *The Suitability of Nigerian Black Soil Clays as Drilling Mud Clays, I. Nature and Technical Properties.* Applied Clay Science, Vol 4, pp. 357-360.
- Omole, O., Adeleye, J.O., Falode, O., Malomo, S. and Oyedeji, O.A. (2013). *Investigation into the Rheological and Filtration Properties of Drilling Mud Formulated with Clays from Northern Nigeria.* Journal of Petroleum and Gas Engineering Vol. 4, No. 1, pp. 1-8