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RESEARCH ARTICLE

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EVALUATION OF PHYSICAL AND CHEMICAL PROPERTIES OF CLAY IN THE MUNICIPALITY OF BOA VISTA – PB

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ABSTRACT

In the face of the increasing advance of the oil sector, it is necessary to develop fluids that have ideal properties for drilling oil wells. Due to their properties, bentonite clays have been standing out in this area. More than 79% of these clays are found in deposits in the State of Paraíba, mainly in the municipality of Boa Vista.This work aims at the use of bentonite clay in the municipality of Boa Vista - PB, called Chocolate. Clay was characterized by particle size analysis by laser diffraction (GA), chemical analysis by X-ray fluorescence (EDX), X-ray diffraction (XRD). The results showed that the studied clay presented rheological and filtration properties for use in water-based drilling fluids, according to the standards required by Petrobras.

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INTRODUCTION

Clays are materials characterized by fine granulation and are chemically constituted by aluminum, iron and magnesium silicates. They are formed by minerals, known as clay minerals.These clay minerals are generally crystalline, consisting of various types of elements, such as magnesium, iron, calcium, sodium, potassium, lithium, among others; after grinding they form a plastic paste, if mixed with water and may present in its composition organic matter, soluble salts, quartz particles, calcite, among other residual minerals (SANTOS, 1989). Clays have a number of properties that make them highly advantageous materials. Among these properties we can mention: being easily dispersible in water, wide range of rheological properties, plasticity, external surface area of particles very large, low granulometry, among others, which makes clays raw materials with wide possibilities of applications.As well as the low cost, they are easy to handle and because they are found in abundance. Clays can be divided into several groups, such as smectites, ilites, chlorites, vermicurites, among others (SANTOS et al., 2002).

Bentonite is a type of clay formed by the devitrification and chemical alteration ofvolcanic ash. They were named because of the location of their first warehouse in Fort Benton, USA. Bentonite can also be defined as any clay composed of montmorillonite clay mineral, which are part of the smectite group (DARLEY, 1988; GRIM, 1978). Bentonite has an interesting characteristic that is the capacity to exchange cations, resulting from isomorphic substitutions, so it becomes ideal for industrial use (FERREIRA, 2009; SILVA, 2015). In Brazil, bentonite clays are mostly found in the Northeast Region, state of Paraíba, mainly in the municipality of Boa Vista, which has 96% of the national production (AMORIM et al; 2006). Bentonite clays can be used in several areas, especially in the industrial area, such as waterproofing in dams, discoloration of oils, in the pharmaceutical industry, cosmetics, drilling fluids, among other applications (GOMES, 1988). Given the growing dependence on the use of fossil fuels, methods for oil removal are needed efficiently, viablely and economically. The use of clays in the preparation of drilling fluids becomes an excellent alternative. The functions of bentonite clays in drilling fluids are to increase the stability of wells, decrease friction with the drill, decrease infiltrations of the formed permeate, etc. Fluids can be classified into three types: oil base, water base and gas base (SANTOS, 2012). Drilling fluids can be defined as liquids that aim to facilitate the process of drilling oil wells. The success of the drilling operation depends on the performance of the fluids. The ideal properties of the fluid are gel consistency, viscosity, filtrate control, plastering, inhibition of hydratable clays and lubricity coefficient (AMORIM, 2003). This work aimed to characterize bentonite clay called Chocolate, originating from the municipality of Boa Vista, in the state of Paraíba, aiming to develop water-based drilling fluids, through the determination of plastic viscosity, apparent and the volume of filtrate in order to compare with the Petrobras standard.

MATERIALS AND METHODS

This work was developed at the Materials Technology Laboratory, LTM, at the Federal University of Campina Grande. For this work to be developed, samples of natural bentonite clays from the municipality of Boa Vista, in the State of Paraíba, were used.The clay used is called chocolate, provided by BentonitaUniãoNordeste S.A., located in the municipality of Boa Vista/PB. The additive used to transform polytonic clays into sodium was sodium carbonate (Na2CO3) anhydrous PA, manufactured by Vetec. All characterization tests were carried out in the Materials Technology Laboratory and in the Materials Characterization Laboratory of the Academic Materials Engineering Unit of the Federal University of Campina Grande.The natural samples were dried in an oven at 60°C, then benefited, through a Marconi jaw crusher and subsequently cominated in Marconi disc mill, after grinding, the samples were passed in abnt sieve Nº200 (0.074mm). Laser diffraction uses the liquid phase particle dispersion method associated with an optical measurement process. In this method, the proportional relationship between laser diffraction and particle concentration and size is combined.To perform this characterization, the natural bentonite clay was dispersed with sodium hexametaphosphate and stirred for 20 minutes in Hamilton Beach N5000 agitator at a speed of 17,000 rpm, then rested for 24 h, after 24 h at rest the clay was shaken again for about 5 minutes at the same speed,after agitation, the measurement was performed in a humid mode, until reaching the ideal concentration of 170 diffraction units/area of incidence. Bentonite clay was passed in abnt sieve N° 200 (0.074mm) and submitted to chemical analysis by X-ray fluorescence. X-ray fluorescence spectrometer determines semi quantitatively the elements present in a given sample, through the application of X-rays on the sample surface and the subsequent analysis of fluorescents emitted in Shimadzu's EDX 720 equipment. X-ray generation is done by means of a tube with rh target. Natural bentonite clay and additive with ethylene glycol was passed in ABNT sieve no. 200 (0.074mm) and packed in an Aluminum sample port for X-ray diffraction analysis in Shimadzu's XRD 6000 equipment. The radiation used was Cu Kα (40kV/30mA); the speed of the goniometer was 2º/min and step 0.02º; in the range of 2° to 60°.

RESULTS AND DISCUSSION

Particle Leach Analysis by Laser Diffraction (AG): Figure 1 shows the particle size distribution curves of the samples studied.The sample presented bimodal behavior. It is possible to observe that there is a higher concentration of particles with diameter between 2 and 5µm. Observing the values in Table 1, it is verified that the fraction of 43% of the clay has a diameter below 2µm and an average particle diameter of 4.63µm. These values are similar to those found in studies on bentonite clays SILVA et al. (2015) and PEREIRA et al. (2015).

Chemical X-Ray Fluorescence Analysis (EDX): Table 2 shows that the chemical composition analyzed presents a high silicon oxide content. This content refers to silicon present in the tetrahedral layer of clay minerals, as well as accessory minerals, free silica, mica and feldspar. The value of Al2O3, of 18.1%, defines the alumina present in the octahedral layer and accessory minerals.

It was also observed that the sample under study presented high iron oxide content / 8.7%. This high content in the sample comes from the octahedral leaf of smecitic clay minerals and accessory minerals present with hematite, goethite and ilmenite. These contents are similar to studies of bentonitic clays from the State of Paraíba (PEREIRA et al., 2015; SILVA et al., 2015).

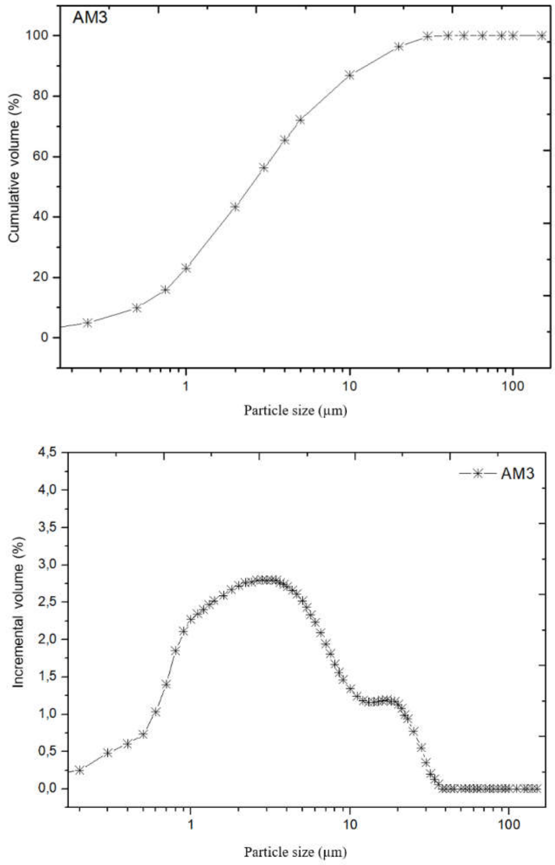


Figure 1. Particle size distribution curves of the sample studied

Table 1. Shows the values of the granulometric distribution of the sample studied

Sample	x<2µm	2µm<x<20µm	x>20µm	Average Diameter(µm)
AM	43,30	53,06	3,64	4,63

Table 2. Chemical composition of the studied clay

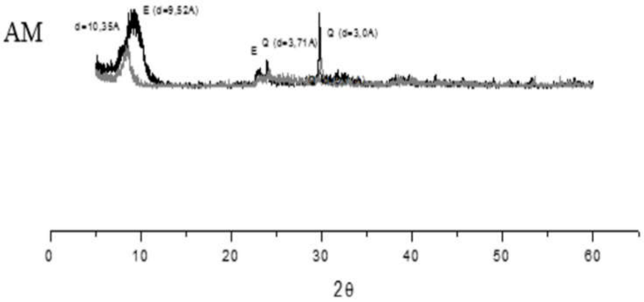
Samples	Oxides						
	SiO_2 (%)	Al_2O_3 (%)	MgO (%)	Fe_2O_3 (%)	CaO (%)	TiO_2 (%)	Other Oxides (%)	PR (%)
AM	55,4	18,1	3,2	8,7	2,4	1,0	2,2	9,0

PR - Loss to the rubro.

The MgO content of 3.2% comes from the octahedral layer of smectite or dolomite or magnesium carbonate. The CaO content, 2.4%, comes from the accessory mineral calcite. The loss to the red corresponds to the sum of the loss of the following components: free and adsorbed water, coordinated water, interspersed between the layers and hydroxyls present in clay minerals, organic matter and carbonates existing in clay. The sample studied showed a red loss of 9.0%.

X-ray diffraction (DRX)

Figure 2 shows the diphratogram of the sample studied in the natural form and added with ethylene glycol.



E- Smectite, Q - Quartz, F – Feldspar

Figure 2. Diphratogram of the sample compositions of the studied clay. Source: Authors

In the analysis of the diphratogram in Figure 2, the studied sample shows the presence of smecitic clay (JCPDS 29-1497) characterized by basal interplanar distances of 10.11Å, 10.51Å, 5.73Å and 3.87Å; presence of accessory minerals such as quartz (JCPDS 46-1045), characterized by basal interplanar distances of 3.0Å, 2.99Å and 3.71Å; and feldspar (JCPDS 13-0294) characterized by basal interplanar distances of 2.74Å, 2.63Å and 3.58Å. The expansion of the basal interplanar layers, after the addition of ethylene glycol, shows that the studied clay belongs to the group of smectites. It is observed that the sample studied in this study is similar to other samples from the State of Paraíba (MENEZES et al., 2001; PEREIRA et al., 2011; SILVA et al., 2015).

CONCLUSION

The characterizations of the sample confirmed that it presents the characteristics of bentonite clays typical of the state of Paraíba. Chocolate de Boa Vista clay, in Paraíba, has rheological and filtration properties that meets Petrobras specifications and is suitable for use in water-based oil drilling fluids.

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