Comparison of Nigerian Barite Production with some Top Barite Producing Countries

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Abstract- Barite is a very important industrial minerals used as weighting material in the petroleum industry. The nature of barite ores, geochemistry of barite ores based on location were discussed. This paper presents top barite producing countries in the world, their production and consumption of barite, as well as their reserve. Despite all the barite deposits in Nigeria, which is approximately 15 million tonnes, it still imports barite from other countries for use in the drilling of oil and gas in Nigeria. This has led to unnecessary expenses been incurred by the government of Nigeria. Some of the challenges faced with the mining and processing of the Nigerian Barite were discussed. Proposed solutions to the mentioned challenges were also stated. The main challenge of the Nigerian barite is not with the American Petroleum Institute (API) standard, but the policies which do not favour investors. Investment by private companies into the mineral sector of Nigeria will bring about a lot of revenue to the government, if the right things are set in place.

Keywords- Barite, producing countries, low-grade

1 INTRODUCTION

1.1 MINERALOGY

Barite is an industrial mineral which is very useful as drilling mud for oil and gas production, and can also be used in the manufacturing of paints and glass, etc. Barite is known as Barium sulfate with a chemical formula of BaSO4 which has an orthorhombic crystal system. Pure barite has a specific gravity (SG) of 4.5g/cm³ and a hardness value between 3.0 to 3.5 Mohs. It is also chemically inert and is insoluble in water. Barite can also be identified by its white streaks and vitreous to pearly luster. Perfect cleavage for barite mineral is on the {001} plane, while imperfect cleavage is on the {010} plane. Normally, it has a thick to thin tabular crystal. Barite can be found in variety of colors depending on geology or structure, such as yellow, white, brown, gray and blue or can also be colorless. The mineralogical name for the carbonate barium mineral is witherite, which has a chemical formula of BaCO3. Witherite is chemically active and dissolves in water which, can also cause environmental hazard (Kogel et al., 2006).

1.2 ORIGIN AND MODE OF OCCURRENCE

Formation of barite occurs in many geologic environments and can be found in association with both metallic and non-metallic minerals. Barite can be the main mineral in the ore at times and can be recovered as concentrate, while sometimes it can be gangue minerals in the ore and can be recovered from the tailings. Most at times barite has to be the main mineral for the ore to be of economic value.

Fig. 1: A typical flowsheet for barite processing (Clark et al., 1991)

Four main categories of barite deposit exist in relation to their occurrence; (1) stratiform deposits is the largest and most of the barite used in the world today are produced from them (Clark et al., 2014; Galley et al., 2007; Jamieson et al., 2016; Kolawole et al., 2019); (2) Vein-type deposits which have the highest grade and the most widely distributed, however, the deposit are usually small (Clark et al., 2014; Galley et al., 2007; Jamieson et al., 2016; Kolawole et al., 2019); (3) Residual deposits are low-grade consisting of a blend of barite and clays that is not soluble due to this they are no longer exploited (Clark et al., 2014; Galley et al., 2007; Jamieson et al., 2016; Kolawole et al., 2019); (4) hydrothermal deposits contain impurities which are finely disseminated with barite ore (Clark et al., 2014; Galley et al., 2007; Jamieson et al., 2016; Kolawole et al., 2019). In time past, the morphology (bedded, residual, vein and cavity fill), origin or tectonic setting has been used to classify barite by Brobst (1958, 1970), Clark et al. (1991), SMaynard and okita (1991), Jewell (2000) and Hanor (2000). The sediment-hosted stratiform deposits are widely used for drilling fluids (Clark et al., 1991).
Table 1. Physical properties of drilling grade barite (API, 2010)

| Property          | Value          |
|-------------------|----------------|
| Density (g/cm$^3$) | 4.22           |
| Hardness (Mohrs)  | 3.0 - 3.5      |
| Moisture          | 0.1 %          |
| pH                | 8 - 9          |
| Particle size     | > 44 µm - Maximum 15 %  |
|                   | > 74 µm - Maximum 3 %  |
|                   | < 6 Mic (%) - Maximum 25 %  |

Table 2. Chemical composition of drilling grade barite (API, 2010)

| Compound   | %     |
|------------|-------|
| SiO$_2$    | 0.5 - 1.5 |
| BaSO$_4$   | Min 93  |
| Al$_2$O$_3$| 0.35   |
| Fe$_2$O$_3$| 0.05 - 0.1 |
| MgO        | 0.3    |
| SiO        | 1.22   |
| K$_2$O     | 0.02   |
| TiO$_2$    | 0      |
| MnO        | 0.12   |
| P$_2$O$_5$ | 0      |
| CaO        | 0.12   |

2 METHODOLOGY

In this study the production, reserve and consumption of some top barite producing countries in the world (China, USA, India, Morocco, Iran, Kazakhstan, Turkey, Thailand, Mexico and Pakistan) was discussed, as well as that of Nigeria, so as to view the difficulties associated with the processing of barite from Nigeria. Proposed solutions to the current challenges facing Nigerian barite were also discussed.

2.1 BARITE PRODUCTION AND CONSUMPTION

Few countries in the world possess Barite deposits, a number of these countries process barite for both local use and trade internationally (as shown in Figure 2). Some other countries produce only for their own local consumption, while, others produce below their consumption, hence depend on importation, Nigeria is one of such countries, even though it has an estimated 20 million metric tonnes, however, has its production is lower than its consumption thus, has to rely on imported barite from overseas (Kolawole et al., 2019).

In 2015, China had the highest barite production estimated at approximately 43 percent of global production (approximately 7.5 million tonnes) and consuming only 19 percent out of its total production (USGS, 2017). China’s total barite reserve stand at an estimate of 35 million tonnes of global barite reserve (Figure 3) (KPMG, 2017; USGS, 2017). Morocco is the next after China in terms of barite production, then India and USA, while Nigeria is the twentieth. According to USGS report of 2017, the largest consumers of barite is USA, which consumes approximately 25 percent of global production (USGS, 2017). Conversely, Nigeria has a huge reserve (~ 20 million tonnes), produces (only 10,000 tonnes) and consumes (17,000 tonnes) leaving the country with a deficit of approximately 7,000 tons (KPMG, 2017; Minerals, 2009; USGS, 2017). In 2009, it was reported that Nigeria imported 13,000 tonnes of barite annually, a tonne costing $230, amounting to an annual total of $29.9 million for barite importation (Minerals, 2009).

Figure 4, presents the map of Nigeria, indicating states having barite deposits. The states which possess barite is popularly known as the Benue troughs, which are; Adamawa, Benue, Cross River, Gombe, Nasarawa, Plateau and Taraba states, including Zamfara state in Nigeria. There is close proximity from the barite reserved states and the oil producing states as shown on the map of Nigeria in Figure 3. This implies low cost of transportation of beneficiated barite to the oil producing states.
2.2 CHINA

It has been observed that marine barite deposit from China is in Yangtze (north), and Jiangnan region (south) during the Late Proterozoic to Early Cambrian (Clark et al., 2004). In China sediment-hosted stratiform barite is most common. Barite deposit from China has Ba occurring as stratiform witherite (BaCO₃) and barytocalcite (BaCa(CO₃)₂). The barite veins are majorly found in black shale chert horizons of the lower Cambrian in Aksu area, northwestern Tarim Basin. In addition, consisting majorly of coarse grain anhedral to euhedral barite crystals and minorly dolomites and pyrites (Zhuy et al., 2015). As at 2016, China has a reserve of 30 million tonnes of barite and produced 2.8 million tonnes of barite (USSG, 2017).

2.3 USA

Majority of the ore-grade barite deposits from the US are located at Nevada belt, and beside the early Paleozoic North American continent, the commercial barite deposits are found in Ordovician and Devonian marine rocks (Clark et al., 2004). The Nevada belt holds approximately hundreds of sediments, stratiform barite deposits is estimated to have a width of 125 km within the Paleozoic marine strata. Comprise of pyritic black shale and siltstone embedded with black chert and few aggregates of dolomitic siltstone, limestone, dolostone, sandstone, and conglomerate.

In 2016, the United States of America produced 316,000 tonnes of barite (USSG, 2017). The current reserves of the USA are estimated as 41 per cent of global reserve (204 million tonnes). Nearly, 14 million tonnes is located at Rocky Mountain and Pacific Coastal regions; another 19 million tonnes are in Missouri, Georgia and Tennessee; nearly 50 million tonnes occur in Nevada and Arkansas. Most of the United States’ study on geology and reserves of barite was carried out by Dean and Brobst (Dean and Brobst, 1955; Brobst, 1958; Brobst, 1965). Recently study report barite located in New Mexico (Williams et al., 1964), Arkansas (Brobst and Ward, 1965), California (Weber, 1966), Nevada (Shawe et al., 1967), and the Appalachian region (Brobst and Hobbs, 1968).

2.4 INDIA

India’s production is from a sedimentary basin which occurs on the Archean basement in Andrah Pradesh, which is from a middle Proterozoic deposit (Clark et al., 2004). Above 98% of India’s barite is from the Mangampeta mine, which is the largest global barite deposits, with preliminary reserves of approximately 37 million tonnes taking into consideration the minimum a specific gravity of 4.2. Source rocks to the Mangampeta deposit comprise portion of the Cuddapah Supergroup, deposited in the Middle Proterozoic Cuddapah basin found near the margin of the Archean craton, south of India. As at 2016 India has a reserve of 32 million tonnes of barite and produced 1 million tonnes of barite (USSG, 2017).

2.5 MOROCCO

In 1962, Huvelin described Morocco’s barite deposits. With huge barite proportion coming from the Jebel Irhoud mine western region of the Paleozoic Jbelit massif. Barite exists in veins and replacement bodies (Paleozoic carbonate rocks). The deposit’s age is reported as telethermal and post-Triassic. In 1960, the barite stockpile was calculated to be approximately 800 thousand tonnes. A solidify district in High Atlas holds veins enclosed in purplish-red sandstone, conglomerate, and shale of Permian age. Veins located at Zelmou, possess 2 million tonnes in reserve in eastern region of Morocco that should be considered for exploitation despite their remote location. Barite veins located at Glib-en-Nam, 32 km southward Oujda with a reserve of 100,000 tonnes has been mined since 1962. Huge deposit of siliceous FeCO₃ and BaSO₄ has to be beneficiated in order to recover approximately 4.5 million tonnes of barite located in Bou Ousel, Central Morocco. As at 2016 Morocco produced 700 thousand tonnes of barite (USSG, 2017).

2.6 IRAN

In 1959, Iran begun to mine barite, due to Suez Canal being closed stopping barite importation (Hooper, 1963). Nearly, twenty-five barite reserves were located in Iran before 1959, however were not exploited for production, despite the need of approximately 40,000 tonnes annually of barite for drilling mud. Iran’s mud requirements are higher than other countries in the world, for each hole drilled. Due to greater reservoir pressures drilling was done having mud weighing nearly 2691.10 Kg/m³. Iron ore that occur in a very thin, controlled structure made some of the barite appear in red, while majority remains white. The usual source rocks were volcanic tuffs (Oligocene and Miocene green beds) (Hooper, 1963). Exploration of Barite deposits were those close to Tehran, Ghazoin, Saveh, and Ghom, approximately 400 thousand tonnes of ore reserved (90 percent barite) were listed by the United Nations Economic Commission for Asia and the Far East (United Nations, 1963). Geology of the region indicates that the amount estimated was conventional. As at 2016 Iran has a reserve of 24 million tonnes of barite and produced 400 thousand tonnes of barite (USSG, 2017).

2.7 KAZAKHSTAN

As at 2016 Kazakhstan has a reserve of 85 million tonnes of barite and produced 300 thousand tonnes of barite (USSG, 2017). Halliburton, in conjunction with the Kazakhstan company LLP Karazhal Operating, completed construction of a barite concentration plant in Karazhal in the Karaganda region. The facility, part of Kazakhstan’s Industrialization Map program, was designed to process as much as 200,000 t/yr of barite mined from the Bestobe deposit. Approximately 30% of the barite produced is anticipated to be used in the domestic oil and gas industry, with the remainder exported to other Commonwealth of Independent States countries including Azerbaijan, Russia, Turkmenistan, and Uzbekistan, as well as to oil and gas companies operating in the North Sea (Kazinform international News agency, 2015; Times of Central Asia, 2016).
2.8 Turkey
In Turkey, there are nine areas of barite deposits across the entire country, however, the most significant commercialized deposits are located at Mus Province (eastern Turkey) (Kaaden, 1963). Majority of Turkey’s barite are known for their hard crystalline material which exists in veins along shear zones or metasomatic replacement bodies within limestone, apart from barite reverse close to Mus majority of others seem to be small. In some areas, barite veins are 40 m wide and exist in schists, of early Paleozoic age, the strike continues westward and dip northward. Some veins strike coexist with schists, however, the dip of the veins usually passes through the schistosity at an inclined angle. Some veins pass through solidified shear planes beside the closest border linking the rigid quartzites and friable schists. Granular barite mixture of iron oxide and quartz indicates some post mineralization motion. The veins are usually filled with barite, mixed with hematite, quartz and manganese oxides. Generally, the ore has an average of 94 percent BaSO4 with < 0.5 % Fe2O3. Approximately, 3 million tonnes of barite are reserved, with proximity to the railroad. As at 2016 Turkey has a reserve of 35 million tonnes of barite and produced 250 thousand tonnes of barite (USSG, 2017).

2.9 Thailand
Thailand has two barite occurrences located at the northern region, namely, Ban Hin Khao and Ban Tin Pha, which are geologically profitable. Ban Hin Khao holds close to 2.5 million tonnes barite reserve. This occurs in the northwest region heading 7 km southeast of Ban That. The barite occurs in embedded replacement deposit in an arrangement of limestone, dolomite, shale, and tuff of Devonian and Early Carboniferous age. The barite deposits are huge, having different size of dolomite, striking northward towards the northwest region and the dip is steep towards the east. The length of the strike is 1,200 m of the main deposit and while the west has two smaller deposits. Trenches, holds massive barite beds about 9 m in width, with a mean width of 15.2 m. The trenches have a huge barite been revealed in flanked by soil containing barite boulders, therefore, it is difficult to determine the barite’s original width. At an estimated distance of 1 km west of Ban Tin Pha the prospect from the geology, is accepted to be the same as Ban Hin Khao deposit. The potential deposit is located at a region of badly revealed sandstone and shale of Devonian and Carboniferous age. Exposure of Barite pieces are discovered in a region 0.5 km square; this vulnerability has a bedrock 5 m in width and 30 m in length having 99.4 percent BaSO4. As at 2016 Thailand has a reserve of 18 million tonnes of barite and produced 170 thousand tonnes of barite (USSG, 2017).

2.10 Mexico
Mexico has barite ore occurring in almost 20 states; however, most mines are located at Muzquiz district, Coahuila, and Nuevo Leon (Reyna, 1956). The barite deposits in Galeana district, Nuevo Leon, are lenticular veins along northeast, and with dip that are steep to the northwest in red beds located at the Huizachal Formation of Jurassic age. Tavera Amezcuea, Lopez, and Avila (1960), reported nearly 60 deposits housing approximately 100 thousand tonnes of barite and an extra 100 thousand tonnes of resources. Little is been reported about the Mexico’s barite reverses, however, 3.8 million tonnes of barite has been mined in the early 1952 leaves Mexico as one of the greatest producers of barite in the world. Reserves and resources likely are relatively large. As at 2016 Mexico has a reserve of four million tonnes of barite and produced 250 thousand tonnes of barite (USSG, 2017).

2.11 Nigeria
In 2010, the Ministry of Mines and Steel Development reported that majority of barite from Nigeria occurs as vein infilling materials associated with lead - zinc lodes, veins in both Pre-Cambrian basement and Cretaceous sedimentary rocks at the lower and middle Benue valley (MMSD, 2010). The mineral commonly occurs as reddish brown or white, rich in silica (SiO2) with density (3.5 - 4.4). The veins vary from 10 centimetres to 5.3 metres in width. Quartz, celestite, iron oxide, calcite, fluorite, galena, chalcopyrite and siderite are the usual gangue which can associate with barite in Nigeria, based on deposit location (Baryte, 2010; Ebechidi, 2014; Ibrahim, 2015).

In 1959, geological survey carried out by the Nigerian Mining Corporation on the barite deposit reserve of Benue valley revealed an estimate of approximately 41 thousand tonnes, and Azara deposit located at Nassarawa state holds approximately 70 thousand tonnes (MMSD, 2010). It had been mentioned recently, that the Nigerian Geological Survey Agency carried out an assessment of the barite located at Cross Rivers, Benue, Nassarawa, Ebonyi, Plateau and Taraba States, and the inferred deposit of barite for potential mining was estimated to be approximately, 21 million tons (MMSD, 2010; Fatoye et al., 2014). Table 3 gives a summary of various barite deposits located in Nigeria.

In Nigeria, barite processing has been carried out by non-conventional methods to process small quantity for personal consumption. This method is non-conventional, but helps in separating the valuable from the impurities. First, the barite ore is washed with water to separate adherent argillaceous impurities, preceded by comminution of the raw barite, crushing (80 – 100 mesh) and classified. The crushed and ground barite is charged and fired in the furnace at 1200 °C (Ibrahim et al., 2015).

The black ash (Barium Sulphate) obtained after calcining has approximately 80-85% barium. Leaching with hot water is carried out on the impurities, then filtration is performed to recover the barite from the ores. 17% barium sulphide can be obtained from the leached solution, is then pumped into a precipitation tank and sodium sulphide is added to precipitate barium sulphate. Lastly, the precipitated barium sulphate formed from the reaction is filtered, washed, dried, pulverized and packaged (Ibrahim et al., 2015). This is Nigeria’s barite processing technology for commercial application.
Table 3. Description of barite deposit and locations in Nigeria (Oden, 2012; Fatoye et al., 2014; Kolawole et al., 2019).

| S/No. | States   | Locations                                      | Description                                                                 |
|-------|----------|------------------------------------------------|-----------------------------------------------------------------------------|
| 1     | Adamawa  | Gban and Mayo-Kpoki                             | Adamawa’s Barite geology is known to be associated with fissure and cavities in-filled by hydrothermal fluids found with faults and fracture zones of the Upper Benue trough. Having SG (4.0 - 4.36). Total inferred resource of Adamawa state is 332,130 metric tonnes. |
| 2     | Benue    | Ambua, Torkula, Makurdi, Kaseyo, Yandey, Orgba, Ilugh, Lessel, Tombu, Korinya, Iye, Zanjan, Logo | Benue’s barite deposits occur in igneous-metamorphic rocks of Pre-Cambrian, sandstones and shale of Benue trough sedimentary formations. Its SG varies from 3.7 to 4.4 and contains 76 – 87% BaSO4, impurities of 5 - 21% silica and nearly 3% iron oxide. The inferred barites deposit of Benue is 307,657 metric tonnes. |
| 3     | Cross River | Okumurutet, Okangha, Agoi Ekpo, Agoi Ibi, Akpet Central, Okurike, Lefin, Bitol, Ugbem | The barite deposit of Cross River state’s veins occurs in hard and soft rocks, 11 locations are in sedimentary areas and most in the North, while only 2 locations are in the South. Having vein widths between 2.5 - 5.3 metres. SG between 3.5 - 4.4, with a total vein length between 1 - 6 km. The inferred resource of Cross River state is 8,612,880 metric tonnes. |
| 4     | Ebonyi   | Ishiagu near Abakaliki                          | Ebonyi’s barite is composed majorly of low-lying sedimentary terrain with some intrusions of different episodes. Not much details are known of Ebonyi’s barite. |
| 5     | Gombe    | Gombe town and Liji Hill                        | Barite from Gombe occurs in gneiss-migmatite complex and coarse sandstone of the Benue trough. The thicknesses of the veins are between 0.3 - 1.5 m. Some can be traced along strike up to 400 m. Fluorite, quartz and chalcopyrite are the gangue minerals associated with the barite. Gombe barite has SG between 4.09 - 5.3. The inferred deposit of Gombe state is estimated as 352,800 metric tonnes. |
| 6     | Nasarawa | Azara, Akiri, Aloshi, Chiata, Gidan Bera, Gidan Tailor, Wuse Kuduku and Ribi | Nasarawa’s barite deposits occur in sedimentary rocks such as shale, mudstones silstones and limestones. They occur in veins with a maximum width of 3.5 metres, it also has SG between 3.6 - 4.0. The impurities are silica, quartz, celestite, siderite and iron oxide. Nasarawa inferred resource of barites is approximately 3.2 million metric tonnes. |
| 7     | Plateau  | Panyam (Wase), Faya                             | The barite of Plateau state occurs in vein and is estimated to be 500,000 metric tonnes, with SG between 4.0 - 4.2. Fluorite is impurity. In some other areas within the state, low quality barite has calcite and celestite as impurity. The vein is held by sandstones of the Keana formation of Cenomanian age. It also contains very low content of Hg and Cd, making it suitable for drilling offshore. |
| 8     | Taraba   | Sardauna, Karim Lamido, Yoro, Lau and Ibi       | Barite deposit from Taraba state occurs in porphyritic granites and fine-grained sandstones; vein lengths is between 3.5 - 5 km and between 3.5 and 5 meters wide. Quartz and galena are the main impurities. The state has an Inferred resource estimated at 8.9 million metric tonnes, with SG approximately, 4.2. |
| 9     | Zamfara  | Dareta, Rekebu, Yarkatsina (Gidan Saro) and Tofa forest reserve | Zamfara’s barite deposits are traced to epigenetic hydrothermal fluids leaches barium from adjacent rocks and precipitated in the vein. Veins width can occur between few centimetres to 2 m, and 100 m in length. Majority of veins in the state are likely formed from rising hydrothermal solution which precipitated the barites in the veins. |

3. CHALLENGES OF BARITE PRODUCTION IN NIGERIA

Nigeria’s economy is majorly dependent on oil resources as a result the other sectors contribute very little to the GDP of the country. For instance, the Nigerian mining sector contributes only 0.3% to national GDP. Nigeria constantly depends on imported minerals from other countries instead of processing locally, due to the underdevelopment of the mining sector (MMSD, 2010). Barite is among the 34 mineral deposits identified in Nigeria (Ibrahim et al., 2015). All ownership rights of mineral resources in Nigeria, belongs to the federal government alone and reserves the power to grant permission to registered mining companies to explore, mine and sell mineral resources (NMMS, 2016). The challenges which generally affects the mining various mineral resource is also like mining and beneficiation of barite in Nigeria. Investors have an established market perception that Nigeria is not business friendly; however, recently, Nigeria offers favorable investment
opportunities in terms of corporate tax, tax holiday and custom duties (NMMS, 2016). Below are some issues faced by the Nigeria mining sectors are;

**Financing of project:** It is taken the Federal government of Nigeria lengthy time to transform the mining sector; multinational corporations and small scale mining companies are reluctant to invest in major exploration and mining project across the country including barite mining (NMMS, 2016).

**Lack of infrastructure:** Poor infrastructure in the mining sector in Nigeria, has been a great challenge, basic infrastructure like adequate electricity supply, availability of loans, technology know-how and access roads to sites of mineral deposits (NMMS, 2016).

**Security:** Militancy, terrorism and kidnapping activities in regions where mining project are ongoing are a major challenge. Most times, victims (mine workers) are targeted and only released for a high ransom, demanded by the kidnappers, while militancy and terrorism activities lead to loss of life (NMMS, 2016).

**Illegal mining:** There are several illegal mining activities in most areas where minerals are located, some of the illegal mining activities are influenced by foreigner, who do not have the required license to mine mineral resources including barite. Consequently, resources meant for the federal government to enter hands of foreigners or individuals. (NMMS, 2016).

**Low grade barite:** Majority of the barite ore with SG lower than 4.2 are dumped and considered as waste or not mined at all. Consequently, due to the low production of barite, it is imported to blend the locally produced barite with imported barite in order to meet the API SG requirement of 4.2 (Ayim and Enoch, 2009; Raju et al., 2016).

**Importation of barite:** Despite huge barite deposits in Nigeria, barite is still imported into Nigeria for use as weight material (drilling mud) in the oil and gas sector.

The Nigerian’s former Minister of Mines and Steel Development, Dr. Kayode Fayemi said that the government soon commence a ban on barite importation to ensure the patronage of locally produced barite according to the Premium Times of Nigeria (NMMS, 2016). Barite mined from Nigeria is about to enter a new era of development which will enable it to compete with barite produced from any part of the world more favourably (NMMS, 2016).

**4. Proposed Solution to Barite Production in Nigeria Research and Development (R&D)**

The role of research and development can never be underestimated in the drive to setup a strong mineral mining/processing industry in the country. Nigerian Universities and barite processing industries should collaborate to carry out cutting edge researches on the Nigerian barite with necessary equipment as may be obtained in countries leading to barite processing in order to adopt similar beneficiation methods for Nigerian barite. This will also bring about more understanding of the nature of barite and the associate minerals (gangue minerals). Also, through research and development, equipment can be designed, developed and manufactured to aid in beneficiating and processing Nigerian barite.

**Beneficiation of low-grade barite:** Low grade barite should be beneficiated using techniques like gravity separation, flotation, magnetic separation, electrostatic separation techniques. The process of beneficiation will assist in upgrading the low-grade barite to meet up with the API requirement for oil and gas drilling. However, after the beneficiation the remaining barite which refuse to meet up with the API grade of 4.2, can be further used in manufacturing glasses or paint.

**Prohibition of illegal mining and issue licenses to private companies:** The Nigerian government should prohibit illegal mining of all mineral resources including barite. Only licensed private companies should be allowed to mine barite in Nigeria, making sure that they have all the necessary technology know-how and experience in mining barite.

**Improved security and infrastructure:** Adequate security should be provided for the staffs of the mining or processing companies that will be involved in the mining or processing/beneficiation of barite. Access roads to the mining site and electricity supply should be available.

**Prohibition on importation of barite:** All forms of barite importation into Nigeria should be discouraged. The government should put a total ban on the importation of barite into Nigeria and focus on how to upgrade the available barite mineral resources. This will reduce the cost of barite importation for usage in the oil and gas industries. This implies that locally processed and cheap barite can be obtained within Nigeria and easily transported to the oil and gas drilling locations.

**Ban exportation of unprocessed barite:** Every form of exportation of unprocessed barite should be banned by the Nigerian government. Government should encourage companies to export only processed barite which meets with the international recognized API standard of 4.2 specific gravity. This will bring higher revenue to the barite processing companies and the Nigerian government.

5. **Conclusion**

In conclusion, it can be seen that Nigeria’s barite reserve is nearly 15 million tons, and is still relying on the importation of barite from other countries for use in the drilling of oil and gas in Nigeria.

Nigeria is an oil producing country; therefore, if the Nigerian government make policy which will ensure that Nigeria begins to process and make use of its on barite, this will have a positive impact on the cost of drilling the oil and gas. Also, Nigeria will be able to export barite to other oil and gas producing countries that do not have barite deposit in their countries, but depend on importation. This will serve as revenue to the Nigerian government.

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