Suitability of Nafada Gypsum for the Production of Jute Fibre Reinforced Plasterboards

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Abstract

High demand for Plaster of Paris (POP) in the Nigeria building industry, particularly within the north-east geopolitical zone has made local procurement of the raw gypsum inevitable. The study was conducted to evaluate the characteristics of gypsum from Nafada mining site, one of the north-east rich gypsum deposits with an estimated reserve of 751,728.00 metric tons. Sample of gypsum from the site was obtained and its physical and chemical properties were determined. It was calcined into POP in an oven between 115^{o}C (240^{o}F) and 200^{o}C (392^{o}F). The ratio of water: plaster was adopted as 200ml/400g with impact resistance as 7.9mm and flexural strength as 4.72N/mm^{2}. Absorption tests were carried out to ascertain the viability of the mineral in POP production. 0.5% of sisal fiber showed lower rate of 25.4% water absorbency. The result confirmed that Nafada gypsum is suitable for the production of POP for use in plasterboards, with jute fibre as reinforcing material.

Key words: Nafada gypsum; Plaster of Paris; Building.

Background

The evaporation of sea water is one of the ways in which elements are concentrated in the sedimentary part of the rock cycle. Such evaporation results in the formation of minerals which include gypsum ($CaSO_4.2H_2O$), anhydrate calcium sulphate ($CaSO_4$), halite (NaCl) and sylvite (KCl) (Dinsdale, 1986). Relatively thick evaporate deposits occur in many parts of the world in areas covered by ancient seas millions of years ago. In Nigeria, such deposits have so far not yet been discovered and they are unlikely to occur because according to Anigbogu and Ogezi (1998), although the ancient seas covered parts of Nigeria during transgression and withdrew during regressions, the sedimentary basins were relatively shallow, narrow and they did not last long enough. The Nigerian basins are also much younger geologically and range in age from about 100 million years.

Gypsum is a common sulphate mineral of great commercial importance, it composes of hydrated calcium sulphate ($CaSO_4.2H_2O$). It is a white mineral of calcium sulphate found in deposits in the earth crust. Gypsum is a less reflective, glass-like soft stone; which is of great importance for the manufacture of many industrial products. Gypsum is formed through geological processes, hence it occurs in nature in various forms. These forms can basically be grouped, according to Coburn *et al.* (1989), into two broad categories of rock gypsum and sand gypsum. Rock gypsum is described as having different colours ranging from transparent or white; sometimes grey, yellowish to red. Gypsite is gypsum mixed with sand and dirt. By appearance and to an inexperienced person, rock gypsum can be mistaken for other crystals found in similar circumstances. However, the surface of rock gypsum can readily be scratched with a fingernail. More so, Coburn *et al.* (1989) observed that a crystal of gypsum if held over a flame would turn cloudy and opaque and give up water. Srebrodosky (1989) outlined some varieties of rock gypsum. The first variety is the selentine or the crystallized form; second variety, alabaster, is a fine grained and compact snow-white or light coloured massive variety. The third is known as satinspar or the fibrous variety which has a silky lusture. Crude gypsum is used as a fluxing agent in the production of fertilizer, filler in paper and textiles and retarder for Portland cement. Gypsum is also calcined for use as Plaster of Paris and other building materials.

Gypsum according to the Ministry of Solid Minerals Development (MSMD) (1977) is one of the major mineral resources in Nigeria which contributes much to the Nigerian economy. It is used in the production of various goods for local and international use such as Plaster of Paris, Chalk and as additive material for cement production. Gypsum occurrence in north-east Nigeria was first noticed by Carter *et al.* (1983), as reported by Munai (2000), as occurring within a sequence of blue-black beds with few in persistent lime stone beds. Munai (2000) further reported that Reyment in 1965 confirmed that Fika shales are occasionally gypsiferous with thickness not exceeding 430mm. The Raw Materials Research and Development Council (RMRDC) (1990) of Nigeria also reported that gypsum existed in

some parts of Sokoto state in non-commercial quantities. Until recently, demand for gypsum which was basically limited to cement production was met through importation from several countries. However by 1992 the Nigerian Mining Corporation (NMC) had discovered that gypsum is available in commercial quantities in some parts of Nigeria.

Geology, Mining, Processing and Marketing of the Nigerian Gypsum

Anigbogu and Ogezi (1998); Munai (2000) submitted that all known gypsiferous beds in Nigeria are relatively thin and occur in association with shales, clays, limestone and laterised iron oxide rich layers. Although the total gypsum reserve in Nigeria is hitherto not known, Nigerian Mining Corporation (NMC) (1993a) estimated the reserve to be about 2 million tonnes. The result of an independent study by Aliyu (1995) which put the gypsum reserve in Nigeria at several millions of tonnes is still controversial. In any case, the estimate showed that the largest known exploitable reserves are mainly in the north-eastern Nigeria and that the best gypsum localities are Nafada and Fika (NMC 1993a; NMC 1993b; Aliyu (1995); Orazulike (1988); Haruna (1998) and Anigbogu and Ogezi (1998). Tables 1 and 2 show the locations of gypsum resources in Nigeria and the estimated reserves of the main gypsum occurrences respectively.

Table 1: *Locations of some gypsum resources in Nigeria (from various sources)*

State	Location
Adamawa	Guyuk – Gwalura
Anambra	Adani – Igga
Benue	Umogidi – Adoka, Edumoga, Amoda
Borno	Gubio
Edo	Auchi
Enugu	Emene, Enugu
Gombe	Nafada – Baruwa, Pindiga
Imo	Ameki
Ogun	Abeokuta, Oja – Odun
Sokoto	Wurno, Mamona, Taloka
Yobe	Damagum, Ngenzelma, Fika-Fune, Gwareri

Source: Anigbogu and Ogezi (1998)

Table 2: *Estimated reserves of the main Gypsum occurrences in Nigeria (tonnes)*

Locality	State	Estimated reserve	Overburden	Shale
Adoka	Benue	11,899	1,025,000	1,372,500
Auchi	Edo	46,341	14,976,500	3, 495,000
Fika	Yobe	766,872	24,350,000	30,325,000
Guyuk	Adamawa	33,477	2,490,000	4,660,000
Nafada	Gombe	751,728	2,932,500	17,992,500
Sokoto	Sokoto	28,190	25,392,500	1,893,430
Eastern Nigeria	Southern/Eastern States	76,673	1,192,500	2,025,000

Source: Anigbogu and Ogezi (1998)

The exploitation of gypsum in Nigeria is mainly carried out by open pit methods. The closely associated sandy shales which constitute 60 – 70% contaminate the natural gypsum and result in processing which involves sorting and washing. This overburden (non-revenue producing excavation), according to Anigbogu and Ogezi (1998), increases the cost of mining. Nigeria's current total production of less than 100,000 tonnes per year is less than 0.1% of the world production of over 80,000,000.00 tonnes. However, conflicting statistics on the total annual demand in Nigeria still exist between agencies and trade associates. In 1995, it was estimated on the average to be about 70,000 tonnes per annum with a potential of increasing up to 230,000 – 300,000 tonnes per annum (Aliyu, 1995). Even then the estimate was based on the requirements for cement production alone. Little wonder that Anigbogu and Ogezi (1998) observed that the then production of gypsum satisfied existing demand for cement production. This could explayin the ban in importation of gypsum by the federal Government in 1995. Lately, gypsum supply became insufficient given wider utilization of gypsum in other areas such as the production of gypsum wall tiles and panels, ceiling boards, thermo-insulating panels, and plaster of Paris (POP) for architectural aesthetic purposes.

Gypsum and the production of Plaster of Paris

Even though it is a generally held belief that Plaster of Paris is obtained from gypsum rock the transformation process from gypsum to plaster varies as the use of the plaster itself. Coburn *et al.* (1989) explained that gypsum suitable for production of plaster of Paris has to be broken down into uniform size particles. The process involves several stages including drying, crushing, screening, grinding, sieving, etc. There are many grades of plaster, which vary in setting time, hardness and expansivity on setting. Coburn *et al.* (1989) supported Singer and Singer (1971) that plaster can be divided into two main groups: α and β (Alpha and Beta).

Table 3: *Types of plaster and their uses*

S/No	Types of Plaster	Principal uses
1.	Ash Plaster	Rendering of walls and ceilings, mortar, agriculture
2.	Plaster of Paris (POP)	Intricate casting, medical cast repairs, plaster board manufacture
3.	Retarded hemihydrate gypsum plaster	Modern building plaster
4.	Anhydrous gypsum plaster	Wall and ceiling plastering particularly where either a very flat finish or a pattered surface is required.
5.	Keene's plaster	Plastering where a very hard finish is required.

Source: Coburn et al. (1989)

For reinforcement in POP, various types of materials have been discovered and used to improve conventional structural materials, such as glass, steel, wood, polymers, fibre etc. Generally, fibres could be natural or synthetic. Jute fibre was selected for this study because of its relative availability.

Table 4: *Properties of Jute used in the study*

Property	Jute
Ultimate cell length L (mm)	0.8 to 6.0
Ultimate cell breadth B (mm)	10 25µm
Length/Breadth (L / B) Ratio	110
Fineness (Denier)	15 to 35
Tenacity (gm./denier	c
Elongation at break (%)	1.0 t0 1.8
Density (gm./cc)	1.46
Degree of crystallization (X-ray)	55 to 60%
Angle of orientation (X-ray)	7 to 9^0
Initial modulus	17 to 30 N/mm^2
Flexural rigidity (dyness.cm)	3.0 to 5.0
Moisture regain (%) at 65% R.H.	12.5
Moisture regain (%) at 100% R.H.	36
Diameter swelling (%) at 100% R.H.	20 to 22

(Field survey, 2015)

Methodology

2000 kg of the Nafada gypsum were randomly collected from heaps of gypsum at the mining site as samples. Because the samples were collected from a population of many pits, two different types of blocks were prepared for subsequent tests. Integrity test of the gypsum was conducted. Further, the following tests were conducted:

1. Physical properties of the Nafada gypsum
2. Chemical properties of the Nafada gypsum
3. Tensile strength test on the Nafada gypsum

Sample of gypsum from the site was crushed to fine particles in stages. The final crushing resulted in flour like texture. The powder was loaded into kettles and calcined at about 115°C (240°F), a temperature reasonably above the minimum temperature necessary for calcinations as reported by Coburn *et al.* (1989). The result obtained from each sample was added and an average result obtained. A ratio of 70:100, water: plaster mix was used for the study. This is close to 100:130 mix ratio obtained from the mix ratio chart of Hammer as reported by Munai (2000). The study discovers that two mix ratios of 70:100 and 100:130 are not statistically significantly different. The absorption rate recorded in the study was 39% and the pouring and setting times were averagely recorded as 300 and 1,140 seconds respectively.

Formation of the Plasterboards

The Plasterboard panel consists of a layer of gypsum plaster sandwiched between two layers of paper. The raw gypsum, $CaSO4.2H_2O$, was heated to drive off the water then slightly re-hydrated to produce the hemihydrate of calcium sulphate ($CaSO4.^1/_2H_2O$). The plaster was mixed with Jute fibre, plasticizer, foaming agent, finely ground gypsum crystals as an accelerator, starch as a retarder, various additives that may decrease mildew and increase fire resistance (fiberglass/vermiculite) wax emulsion were used to lower water absorption. The board was then formed by sandwiching a core of the wet mixture between two sheets of jute fibre mats. When the core set it was then dried in a large drying chamber, and the sandwich became rigid and strong enough for use as a building material.

Results and Discussion

Physical and Chemical analysis of Nafada Gypsum and its plaster

Table 5 gives the physical characteristics of the sampled block of Nafada gypsum specimen used. The specific gravity of 2.30 of this specimen conforms to the data reported by Coburn *et al.* (1977) of good gypsum. Two samples from different quarries were ground to fine powder using mortar and pestle and were turned into liquid form using standard solution. Table 5 gives the percentage composition by weight of the two samples.

Table 5: *Physical properties of Nafada Gypsum*

S/No	Description	Result
1	Colour	White, tinted
2	Hardness	2 (MOH's scale of mineral hardness
3	Specific Gravity	2.31
4	Crystal System Habit	Tabular, Prismatic
5	Cleavage	Perfect (lanite flexible but not classic)
6	Lusture	Silky
7	Streak	White
8	Chemical Composition	$CaSO_4..2H_2O$
9	Type of Gypsum	Satlinspar

(Field survey, 2015)

Table 6: *Percentage composition by weight of two samples of Nafada gypsum*

Chemical Compound	Sample A (wt%)	Sample B (wt%)
So_2	43.4	39.8
Ca	29.7	26.9
K_2O	0.33	0.17
TiO_2	0.15	0.18
MnO_2	0.05	0.05
Fe_2O_3	0.21	0.03
H_2O	29.25	35.1

(Field survey, 2015)

The two gypsum samples were dried under natural sunlight and later soaked in tap water for 24 hours to reduce impurities such as clay within the gypsum. With the aid of wire brush, most of the surface clay was removed and gypsum spread on a clean surface for re-drying. The gypsum minerals were placed on wire mesh on three steps in an oven in order to allow free circulation of heat in the oven. The temperature of the oven was regulated at 100^{o}C as a preliminary test for 24 hours. Only partial transformation to hemihydrates was observed. To achieve the required calcination of gypsum, the temperature was raised to about 200^{o}C (392^{o}F) for another 24hours. The oven was then switched off and allowed to cool. The calcined gypsum was brought out and the mineral was observed to become completely whitish in physical presentation. The same process was carried out for the second batch of calcination. In order to achieve smooth and homogenous finish to the board surface, the calcined mineral was ground and 200μm sieve was used to obtain fine powder as suggested by Coburn et al. (1989). The powder was then placed into clean polythene bag to avoid moisture absorption. The average chemical composition of Nafada gypsum is shown in Table 7 while Table 8 gives the chemical composition of Nafada plaster in percentage by weight. Tables 9 and 10 give comparison of the chemical composition of Nafada gypsum and Nafada plaster with those of pure gypsum respectively.

Table 7: *Chemical composition of sample average*

Properties	Percentage
Ca	28.5
So_4	39.7
H_2O	33.0
Impurities	0.45

(Field survey, 2015)

Table 8: *Chemical composition of Nafada Plaster in percentage by weight*

Properties	Percentage
Ca	31.44
So_4	52.39
H_2O	15.00
Impurities	1.23

(Field survey, 2015)

Table 9: *Comparison between the Chemical composition of pure gypsum and Nafada gypsum by percentage weight*

Chemical compound	Pure gypsum (wt%)	Nafada gypsum (Wt%)
$CaSO_4$	79.10	67.33
$2H_2O$	20.90	32.22
Impurities	0.00	0.54

(Field survey, 2015)

Table 10: *Comparison between pure gypsum plaster and Nafada gypsum plaster in percentage by weight*

Compounds	Pure gypsum (Wt%)	Nafada gypsum A (Wt%)	Nafada gypsum B (Wt%)
$CaSO_4$	93.50	90.0	87.9
$2H_2O$	6.50	8.73	10.42
Impurities	0.00	1.27	1.68

(Field survey, 2015)

It was recommended by Singer and Singer (1971) that pure gypsum should have about 93. 8% CaSO4 and 6.2% H_2O while the American Standard of Testing Materials (ASTM) – C-59 (1990) recommends 85% minimum of dehydrated purity. Thus, specimens A (90.00%) and B (87.90%) have met the ASTM – C – 59 (1990) requirements.

Consistency of calcined Nafada gypsum

To determine the consistency of the gypsum plaster, a plunger rod which is both clean and wet weighing 50g and cross section of 19mm diameter (Vicat apparatus) was held so as to be just touching the surface of the sample of a freshly mixed liquid plaster. The plunger was then released and the penetration was recorded. The penetration was taken as a function of mixture consistency (BS 1191, 1991). When the plunger penetrates by 30mm (± 2mm), the plaster is considered to have a "normal" consistency. This normal consistency is then expressed as the number of millimeter of water which should be added to 100mg of dry powder to achieve that consistency (BS 1191, 1991). Table 11 shows the consistency test result of the Nafada plaster.

Table 11: *Consistency test for Nafada Plaster using Vicat apparatus*

Quantity of water(ml)/ Dry plaster (g)	Penetration depth (mm)	Mixing time (sec)
180/400	21.3	92
190/400	25.9	107
200/400	28.6	118
210/400	39.2	85
220/400	31.0	79

(Field survey, 2015)

In Table 11, 200ml/400g indicate the right proportion or normal consistency of the Nafada plaster which has 28.6mm penetration depth conforming to the 30mm (± 2mm) as recommended by the American Society of Testing Materials (ASTM) C – 472 (1979) standards; 220ml/400g is also within acceptable range; but, 180ml/400g and 190ml/400g fall short of the requirement while 210ml/400g is above the acceptable range.

Freedom from coarse particles

In order to achieve a smooth and homogenous finish to a plastered surface, BS 1191 (1991) recommends that the plaster is relatively free from coarse particles. To determine the coarse particles content, 100g of plaster sample was sieved for 5 minutes using 1.18mm sieve. Lumps were broken up with the aid of fingers but were not rubbed on the sieve. The weight of the residue in grams gives the percentage of the coarse particles. The percentages considered appropriate for the various classes of plaster under the British Standard 1191 (1991) are shown below:

Plaster of Paris 5%

Retarded hemihydrate 3%

Anhydrous plaster 1%

Keene's plaster 1%

The freedom from coarse particles test revealed that the Nafada plaster has 5.4% for the sieved plaster and 92.6% for the un-sieved plaster. The 5.4% of the sieved plaster although slightly more than that recommended by the BS 1191 (1991) was considered to be Plaster Of Paris (POP)

Setting Time

The plaster of Paris has a very short setting time which sometimes limits its usefulness, in some conditions like in buildings; however, the short setting time is a useful property. The optimum setting time is usually determined by the user's needs and convenience which can also be controlled through the use of additives. Table 12 shows the setting time of various mixes.

Table 12: *Variation in setting time of calcined Nafada Plaster using varying quantity of water*

Quantity of water(ml)/ Dry plaster (g)	Pouring time (sec)	Setting time (sec)
180/400	21.0	405
190/400	26.0	610
200/400	28.0	635
210/400	39.0	650
220/400	31.0	730

(Field survey, 2015)

Table 12 reveals that, as the quantity of water increased so did the setting time. Although 220ml of water was poured in 31 seconds, 8 seconds less than the pouring time of 210ml, a longer time of 730 seconds was recorded as the setting time for the 220ml as against that of the 210ml (650 seconds). This shows that the setting time is dependent upon the water content rather than the pouring time.

Bending or Transverse strength

Plaster's strength in bending is of particular importance in plasterboard or other prefabricated panels since they are used to span an area and hence the plaster should structurally resist transverse loads. The board bending strength was tested in accordance with Hegger and Manfred (2006) recommendations. From Table 13, the zero percent jute specimens (control) has the highest strength and collapsibility among the entire specimens while specimen with 0.5% and 2.0% jute fibre shows the same failure rate in both transverse strength and collapsibility. However, it was observed that the specimens with 0.5% and 2.0% jute fibre do not experience total collapsibility as in the case of the control specimen (0% fibre).

Table 13: *Bending strength with varying percentage of jute fibrer*

Jute fibre in percentage (%)	Average failure load (kg)	Modulus of rupture for plaster = failed load in kg x 0.00706 N/mm^2)
0.0	43	0.30
0.5	37	0.26
1.0	23	0.16
1.5	33	0.23
2.0	37	0.26
2.5	35	0.19

(Field survey, 2015)

3.6 Production and testing of Board specimen

400g of dry plaster, jute fibre in percentage (0.5 – 2.5) and 200ml of water was used to get the desired ratio that gives enough time to work in the casting of plasterboard. Hamer (1975) as cited by Munai (2000) suggested five minutes as pouring time and twenty minutes for setting time in mould casting. Water to plaster ratio of 200ml/400g was used, this was determined from the values obtained from the pouring consistency test, setting and impact tests. The jute fibre content was varied between 0.0% and 2.5% (0.0, 0.5, 1.0, 1.5, 2.0 and 2.5 %). Although the average weight of the board samples did not vary significantly from the varied quantity of jute fibre, the average densities remained constant throughout.

Table 14: *various ratio, size, weight and density with respect to the size and percentage of jute fibre used.*

Water/ Plaster ratio(ml/g)	Jute fibre (%)	Average size of board specimen (mm^2)	Quantity produced (No.)	Average weight (g)	Average density (Kg/m^3)
200/400	0.0	200x100x20	10	502	0.0013
200/400	0.5	200x100x20	10	525	0.0013
200/400	1.0	200x100x20	10	502	0.0013
200/400	1.5	200x100x20	10	508	0.0013
200/400	2.0	200x100x20	10	500	0.0013
200/400	2.5	200x100x20	10	510	0.0013

(Field survey, 2015)

Compressive Strength of Board Specimen

Compressive strength was obtained from the average of the board specimens of size 200 x 100 x 20mm with each increase in percentage of jute fibre. The test was carried out with Universal Material Testing Machine; the result is as presented in Table 15. There is a decrease in strength with an increase in the percentage of jute fibre. The higher the fibre content the lower the compressive strength of the specimen.

Table 15: *Compressive Strength of the Board Specimen*

Jute fibre (%)	Failure load (KN)	Average size of board specimen (mm)	Compressive strength = load/area (mm^2)
0.0	11.6	200x100x20	0.575
0.5	12.0	200x100x20	0.595
1.0	11.3	200x100x20	0.560
1.5	10.0	200x100x20	0.495
2.0	9.2	200x100x20	0.450
2.5	9.0	200x100x20	0.425

(Field survey, 2015)

Impact Resistance Test

The impact resistance is a measure of plaster wall's resistance to impacts. This is particularly important in public buildings and circulation space where walls are frequently knocked. Four beams were prepared. A ball bearing was dropped from a height of 182mm as recommended by BS 1191 (1991) onto one of the surfaces of the beam which was formed in the mould. The diameter of the impression made measured and then re-measured at right angle to the first measurement. The test was repeated on the opposite face of the beam and then on the remaining three beams, given a total of 16 measurements. These results were then averaged. The British Standard 1191

(1991) gives the following diameter:

Plaster of Paris	not specified
Retarded hemi-hydrate	5.0mm
Anhydrous plaster	4.5mm
Keene's plaster	4.0mm

In regard to these parameters, the results obtained on the impression made by the ball bearing on the board specimens were averaged for each percentage of jute fibre as shown in Table 16.

Table 16: *Result of Impact Resistance Test*

Jute fibre (%)	Average diameter of impression made on specimens (mm)	Mean value (mm)
0.0	7.85	
0.5	7.91	
1.0	8.33	7.76
1.5	7.92	
2.0	7.71	
2.5	6.85	

(Field survey, 2015)

The result in Table 16 indicates that 1.00% of jute fibre shows high value of impact on the board specimen, but an increase in the percentage of fibre reduced the impact.

Modulus of Rupture

Munai (2000) reported Chong (1977) to have explained the formula used in the determination of modulus of rupture as $M = 3WL / 2bd^2$. The failure load (in KN) of the three specimens used to determine the moduli of rupture were:

Specimen 1 = 0.3

Specimen 2 = 0.4

Specimen 3 = 0.4

The average failure load of the specimens = (0.3 + 0.4 + 0.4) / 3 = 0.37 KN

Thus $M = 3WL/2bd^2$

Where:

L = 85mm

b = 100mm

d = 10mm

W = 0.37KN

M = $3 \times 0.37 \times 10^3 \times 85 / 2 \times 100 \times 10^2$ = $4.72N/mm^2$

The American Standard of Testing Materials (ASTM-C-59) (1990) recommends a minimum bearing strength of 267N for boards' specimen and 445N for 13mm thickness flexural strength. From the result obtained in modulus of rupture test, the Nafada gypsum plaster board showed 472N.

3.7.4 Water absorption test of the board specimen

Six board specimens of different percentage jute fibre were placed in an oven to dry for 24hours and weighed on a digital scale (dry weight); specimens were then immersed in water for another 24hours and the weighted (saturated surface dry weight). The average weights were taken and presented in Table 17.

Table 17: *Absorption rate of the board specimens with jute fibre in varying percentage*

Jute fibre (%)	Average dry weight (g)	Average saturated weight (g)	Sat. wt. – dry wt. x 100 / Dry weight
0.0	511.6	643.4	25.76
0.5	535.0	668.2	24.89
1.0	512.4	655.2	27.86
1.5	517.8	651.2	25.76
2.0	488.5	622.2	27.37
2.5	522.0	665.0	27.39

(Field survey, 2015)

From Table 17 show the board specimen with 0.5% jute fibre having lower (24.89%) water absorption.

4.0 Conclusion

Based on the results of the physical and chemical analyses in this study, it can be concluded that Nafada gypsum has satisfied the requirement of good gypsum. The tests carried on the plasterboards produced revealed that the gypsum is suitable for the production of Plaster of Paris. The results of physical analyses showed an increase in the strength of the specimen with 0.5% - 1.5% (0.575, 0.579, 0.560) jute fibre. The results also indicate that 1.0% of jute fibre showed high value of impact resistance (8.33mm) on the specimen but an increase in the percentage of jute fibre showed a decrease in the impact. The results of the test suggest that in as much as 0.5 – 1.5% of jute fibre can be incorporated into Nafada gypsum to produce plasterboard with the satisfied strength and high impact values.

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