

Production of Porcelain Insulator Using Locally Sourced Materials

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ABSTRACT

Porcelain pin insulator was produced using Nsu-clay, Feldspar, Quartz, Talc and sherd. The basic raw materials were separately prepared using a 100um mesh and were formulated to produce porcelain samples by using sodium silicate as deflocculant, while the slip casting process was used in the production of the electrical porcelain pin insulator. Produced insulator samples were fired by means of bisque and glaze firing techniques respectively, samples with composition of Nsu-clay 45% feldspar, 25% quartz, 4% sherd and 3% talc was found to possess the highest quality for electrical porcelain insulators. This was based on the investigation and laboratory experiment made and was prepared using locally sourced materials.

Keywords: Insulators, porcelain, clay, Mbano, conduction, insulator

INTRODUCTION

An insulator is a material or method that restricts the transfer or flow of electric-heat. They are distinguish from electrolytes, which are electronic insulator, but ionic conducts from one another and to confine electric current to specific pathways as in the insulation of wires. Historically, ceramic insulator is said to be the best insulator use for electricity conduction. It was replaced by a glass insulator which was said to be the first insulators used in large quantities. The glass insulator had an unthreaded pinholes, which result to natural contraction and expansion of wires tied to it and also resulted in insulators unseating on their pin which mounted on an electric pole which required manual reseating. However insulators are classified into many ways based on the current voltage which each have to carry and the thermal strength which determine the high condensation of electric current. Because of these characteristics insulators were declared to be produced with “porcelain” made from clay, quartz or alumina and feldspar which made up a porcelain insulator.

STATEMENT OF THE PROBLEM

Due to cost of imported insulator we decided to use local sourced materials for our production to demonopolize the market, bring the cost to be barest minimum and also due to lack of effective insulator which have to trap the electric waves, we decided to produce porcelain insulator using locally sourced.

SCOPE OF THE STUDY

The scope of this research work is within Mbano in Imo State where we obtained our raw materials which is strictly for production of overhead line porcelain pin insulator.

LITERATURE REVIEW

According to Fred (1896), was convinced that porcelain is a superior insulating medium in which he began experimenting with clay mixture that would produce finer insulators. In addition, he was working to create new insulator designs that would hold up to high voltage service in companies to help him with his experiments and porcelain.

Fred Locke, thought correctly, that wet process porcelain was by far superior and could withstand higher voltage, wet process porcelain is mixed wet, blunged in a mould, threaded plunged shaped on a wheel or turning machine then dried and fired at very higher temperature. p

Buchanan (1991) said that porcelain is a ceramic material made by heating raw materials. Generally, including clay in the form of kaolin in a kiln to temperatures between 1200⁰c (2.192⁰f) and 1,400⁰c (2.552⁰f). the toughness, strength and translucence of porcelain arise mainly from the formation of glass and the mineral mullite within the fired body at these high temperature.

Unquestionably, porcelain insulators have a wide range of application in the safe transmission of electricity, also is primarily composed of clay, feldspar and filler material, usually quartz or alumina according to Buchanan 1991, he said the clay ($Al_2SiO_3(OH^4)$) gives plasticity to the ceramic mixture, flint or quartz (SiO_2) maintains the shape of the formed article during firing and feldspar ($K_2O.A1_2O_3.6SiO_2$) serves as flux. These three constituents place electrical porcelain in the phase system in term of oxide constituents, hence the term triaxial porcelain.

Onaji and Usman (1988) made an attempt to develop a slip casting technique for the electrical porcelain body using ball clay materials. The clay used was grossly inadequate resulting in poor characterization of the porcelain body produced. Thus the process developed was not suitable for mass production of electrical porcelain.

They said in spite of the enormous wide range of application and availability of raw materials, mostly, used insulators are still imported to Nigeria due to manufacturing of electrical insulators in small quantities and majorly restricted to the low voltage shackle and coach screw service. It is hereby imperative to facilitate manufacturing of locally produced electrical insulators to meet increasing demand.

3.0 MATERIALS AND METHODS

The kaolin is (Nsu-clay) which is the major constituent of the of the porcelain insulators formation production was sourced from AgbagharaNsu in Ehime Mbano, Imo State, Nigeria with other materials like feldspar, quartz, sherds and talc was allowed to dry. The dry materials was crushed and milled by a milling machine and then screen through the use of a 100um mesh sieve also the chemical composition of the clay was also determine.

MOULD PROCESSING

Plaster of Paris (P.O.P) was used to produce the mould for the casting of the pin electrical insulator. This powdered P.O.P was mixed with water at the ratio of 2:1 by weight. The setting time was 15 minutes. The original model of porcelain insulator which have the design of the particular insulator which is to be produced was covered with a separator (a bar soap dissolved in hot water was used as the separator) and half of the master piece was covered with a plastic clay slap enclosed with wooden barricade like bat.

Rubber stripe was used to hold the wooden barricade together. All form of undercut was blocked for easy removal at the end of the casting process. The moist top was poured on the model embedded half of the clay slab and allowed to set. After the plaster had become solid the mould was trimmed by scraping, and key holds was put without yet removing the model. The other half of the mould was made

by repeating same procedure used above. The model was then removed from the P.O.P and the mould was ready for use.

INSULATOR PRODUCTION PROCESS

The raw materials which was milled separately (Nsu clay, feldspar, quartz and sherd) was sieved through 100um. After which the whole raw materials were then mixed together by which talc was added. Themixture was wet milled for about 3hours and was mixed with the same quantity of water and sodium silicate (Na₂i O₂) was added as a deflocculant in the jar mill pebbles was added to deflocculant the milling process to form s uniform mixture. The sample of the formulated porcelain body was cast in the mould which was allowed prepared and allowed to set and dry for about 24 hours was and kept to dry under room temperature before it was placed inside the oven. Also it was bisque fired from 0⁰ c to 900⁰ c after bisque fired it was glazed that the klin was allowed to cool and the ware was offloaded and stored.

RESULTAND DISCUSSION

BATCH PERCENTAGE COMPOSITION TABLE

TABLE (1)

Samples of the materials	Batch composition in %
Nsu clay	45%
Feldspar	23%
Quartz	25%
Sherd	4%
Talc	3%
Total	100%

SHRINKAGE LENGTH TABLE

TABLE II

Wet length	Dry length	Fired length
10cm	9.5cm	8.6

4.4.CALCULATION OF THE SHRINKAGE LIMIT

1. Dry shrinkage calculation

$$\frac{L_w - L_d}{L_w} \times 100\% = \frac{10 - 9.5}{10} \times 100 = 5\%$$

Where L_w = Wet length
 L_d = Dry length
 L_f = Fired length

2. Fired shrinkage calculation

$$\frac{L_d - L_f}{L_d} \times 100\% = \frac{9.5 - 8.6}{9.5} \times 100 = 0.095\%$$

3. Total shrinkage calculation

$$\frac{L_w - L_f}{L_w} \times 100\% = \frac{10 - 8.6}{10} \times 100 = 14\%$$

WATER OF ABSORPTION OF WORKING SAMPLE

Dry weight = 115.1g

Soak weight = 129.9g

CALCULATION

$$\% \text{ absorption} = \frac{\text{weight soak} - \text{weight dry}}{\text{Weight dry}} \times 100$$

$$\frac{129.9 - 115.1}{115.1} \times 100 = 12.9\%$$

SUMMARY AND RECOMMENDATION

Good qualities of low voltage porcelain bodies was produced from kaolin ieNsu clay, feldspar, quartz, talc and sherds. The sample with composition of 45% Nsue clay, 23% feldspar, 25% quartz, 4% sherd and 3% talc, was used for the production workThe pin insulators was obtained at 1200⁰c base on the slip casted it was found slurry when defloculant was added. Having done a successful production of 11kilo volt insulator, using local source materials.

We strongly urged the Nigerian government and private sectors to go into commercial production of insulators in Nigeria using our local sources raw materials. This will go a long way in reducing the cost of the finished product and encourage local industries which inturn will lead to employment opportunities for ceramic graduates in Nigeria.

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