The Need for Utilizing Glaze in Traditional Pottery/Ceramic Ware Production in Nigeria: A Historical Overview of Methods, Types, Compositions and Impact.

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Abstract
Pottery/ceramic wares have over the years evolved from plain red clay to glass like forms and many more flawless varieties as a result of advances in finishing, textures, and styles of production. This has been made possible by the incomparable efforts of local traditional pottery. This paper therefore, explores the historical development of glazes, types and compositions of glazes and their uses. It discusses the need for a comprehensive type of glaze to be prepared and put to use in traditional Nigerian pottery. Other aspects of this article include the challenges faced/ing the ceramic/pottery industry of Nigeria and as well as the significance in the use of glaze in the finishing of traditional ceramic products. The study adopted the use of an already administered questionnaire (Adelabu, et al 2013) combining it with the opinion sampling technique. The general outcome of the study indicated the need for the boosting of glaze use and application in traditional Nigerian pottery as a key element in the advancement of pottery production and subsequent export in Nigeria.

Keywords: Pottery/Ceramics, Glaze, Traditional, Nigeria

Introduction/Background

Ceramic wares and pottery production have seen little or no improvement over the years in Nigeria the little improvement registered is mainly in terms of the introduction of dynamic shapes, methods and techniques of production as well as the introduction of newer materials. Ceramic/pottery production as profession is majorly controlled by internal and external factors, internal factors includes variations in skills, dexterity and the machinery needed for efficient processing and production. External factors revolve around the availability and supply of raw materials and attitudes of potters who are further influenced by education, explorative/ creative wits, which are all essentials items that can move the industry forward. Improvements and other forms of cultural and creative adaptations need to made especially with regards to local practice of glazing pottery.

Glaze is an impervious filmy layer of usually transparent coating of a vitreous substance which is usually used together on a ceramic body through firing. Glazes serves the purpose of colour, decorations and also as a source for water proofing the items. Glazes are fused permanently on the surface of clay through a crystalline structure during firing. Glaze surface finishing can increase the compressive strength of the ceramic body. Glaze also imparts aesthetic look to the finished product.

The use of Glaze on locally produced Nigeria ceramic wares has the potential of visibility putting Nigerian ceramic wares industry on an International competitive edge with its limitless possibilities and advantages. Adelabu et al (2013) infers that a look through traditional history to contemporary life systems of clay-based products reveals a continues and consistent diverse satisfaction of humanity's needs from utility wares for culinary, sanitary and structural purposes to technical ceramics with advanced application. Irabor (2009), has remarked that pottery/ceramics has gone through varying developmental stages both in sciences, technology and engineering and has been able to grow and attach a formidable standard and also plays an equally impressive role in modern times.

Adelabu (2013), Irabor (2009) and this author all agree that, the prospect of glazed ceramics in Nigeria is remarkable; as it stands a chance to accelerate the socio-economic development of the country. This fact is supported by the 2009 estimate that, the Nigeria ceramics market is said to be valued at three hundred and twenty-seven million dollars (USD 327M) (Wray, 2009). Despite the

large market and a population of over 150m people who are available for a wide range of consumer products, a substantial percentage of the ceramic needs of Nigeria is still being met by foreign countries. Stock (2010) reports that, a 2009 report on the world production and consumption of ceramic tiles between 2005 and 2009 ranked Nigeria the 12th largest country consumer of tiles by importation more than any other African nation. This and many other indicators justify the prolonged stagnation in terms of growth and contributions/development. These unfavorable statistics are further made glaring by the presence of vast and available mineral resources within the country's borders.

The stagnant and somewhat slow-paced development of the Nigerian ceramic industry can be attributed to many factors amongst which include but are not limited to the following:

1. Gross inadequacies with regards to delivery and quality of finished products.
2. Poor and unaesthetic application of glazes on usually produced ceramic wares/pottery
3. Discrepancies in product output.
4. Unrealization of indigenous effective and dependable methods of applying glaze for sustainable productions.

Following the above listed deficiencies of the Nigerian ceramic industry; it is congruent to conclude that, the development and production of indigenous ceramic wares using glaze amidst local potters is an essential step in the right direction. This can boost the development of the industry by increasing the socio-economic growth, and reduce significantly the consumption and purchase of foreign/imported ceramic wares. This article considers the production and utilization of glazes by local potters a specialized advancement that can enhance the science and technological based process of ceramic product finishing. This will ensure a heightened impact on the outcomes of indigenous ceramic manufacturing properties and processes of this country.

Problem of the Study

The use of glaze all over the world has over the years given ceramic wares their much loved and cherished finish. This systematic and aesthetic quality of applying glaze on ceramic wares has given them a distinct place in the hearts of consumers both domestic and international. African/Nigerian pottery possesses unique forms and patterns which have been in use for centuries until date. These patterns though unique have seen little or no improvement, change or even development for centuries thus the stagnation of improvement in the quality of products produced especially by local potters this stagnation. This discourse is of the view that, the development of a traditionally based type of glaze which potters at the grass root can utilize efficiently with regards to materials and cost implications is much needed. This is strongly believed to be a step in the right direction towards the elevation of the ceramic production industry in Nigeria.

Historical Overview of Glaze

Ceramic glaze is best described an impervious layer of a vitreous substance which has been fused to a ceramic body through firing. Glaze can serve many functions which includes as coloration, form/style of decoration, and as a waterproofing. The process of glazing renders earthenware/potteries and other fine clay vessels capable of holding liquids, and seals the inherent porosity of unglazed biscuit earthiness. The Potters Dictionary of Materials and Techniques (2014), posits that, "glaze is a special type of glass, made for coating ceramic products". Whereas normal glass is suitable for forming bottles, windows etc. Glaze is a different type of glass what is melted and applied on ceramic ware surfaces. It must form a hard-durable coating after it has been melted in the kiln at specific temperatures. When applied on a ceramic ware, it must not run off but stay glued to the surface without cracking after firing.

The first glazes were probably inented in middle eastern countries, where natural deposits of sodium and potassium (soda ash and pearl ash) exist that melt at low temperature (800^{o}-1000^{o}C). By chance, potters of the early periods discovered that some clays when put in the fire developed a shiny surface. These self-glazing clays are known as "Egyptians paste"; they are not very useful for making

household items, being very difficult to form. Glazing of earthenware has been around for almost as long as the human race, it is unknown exactly when people first started glazing their pottery but most archeologists believe and agree that, the process of glazing pottery started between the 9th and 8th century BC. Since then glazing has been used to keep many different style and compositions of pottery and other earthenware waterproof and decorated. Many of the glazing methods used today have their roots in the earliest glazing methods.

The earliest discovery of glazed pottery came from the 5th or 9th century BC or even earlier. Early glazing was also discovered in China, Egypt Mesopotamia and Greece. Each of these countries has been noted to have a particular style of glazing that was preferred. Egyptian glazes were largely Alkaline based as that of China and Mesopotamia. Greece and Rome used Lead or clay glazes. It is from these forms of glazing that modern practice of glazing was adopted and fine-tuned. Glazing material was usually incorporated into the body of the ceramic object which was known as "Frit Paste". Over succeeding millennia, developments in glazing techniques continued to be made thus making the practice of glazing now common place. Powdered glass was originally used as the base of historic glazes. Materials and water-soluble salts were added which altered the colour and texture of the final product.

Forms/ Types of Glazing

Lead Glazes

Lead glazing is believed to have been first used by the Roams from around the 1st century BC. A mixture of Lead Oxide and sand was placed over the pottery before it was fired. Lead glazing was used for thousands of years after the Romans first used it, it is believed that the introduction of lead into glazes was very important to the development of ceramic history. The practice of lead glazing continued from the Romans to Syria and quickly spared to China by 500 BC. The 6th century BC saw large improvements to the Kiln which now allowed glaze materials to melt at far lower temperatures than would normally be needed to get the materials to blend into the glaze. Prior to this discovery, it was common practice to add lead into glazes for any purpose until the discovery, in the 19th century; this was a common cause of poisoning of pottery workers in the industry.

Alkaline Glazing

This form of glazing employs some of the earliest forms of pottery glazing. A variety of materials were used to make the glazes. In Mesopotamia, ash was mixed with sand to create the surface glaze over the pottery constructed in that area. Another ancient method of Alkaline glazing used Soda and sand. Greek glazing was created using clay particles themselves some modern glazes still use Alkaline bases for their finishes. Alkaline glazes can produce brilliant colors, such as Egyptian blue, using low temperature firing. However, Alkali materials are often hygroscopic resulting in lumpy, poorly dispersed suspensions. Some modern glazes still use alkaline bases for their finishes.

Tin Glazing

Tin glazing was first introduced around 1100AD in Persia. Tin glazing was used as an alternative to porcelain, and pottery fired with tin Glaze took on an opaque, white cast. Mixtures of Kaolin and veldspar clays created the tin content necessary to cover the pottery in a coating of white. Tin glazed earthenware is also called tin enamelled earthenware. It is an opaque glaze that, unless colour has been added remains white. It is variously called faience, majolica and delftware. Tin glazing became very popular during the renaissance period and fell out of favour with the introduction of enamel glazing in 1700s, which could be fired at lower temperatures. Tin glazing is essentially the use of lead glaze made opaque by the addition of tin oxide. Tin glaze was no doubt originally devised to conceal flaws of colour in a fired clay body. Unlike Lead glazed objects, which is painted on a fired unglazed body, tin glazed earthenware is painted on a fired unglazed body, this is done on a fired body that has been coated with raw or unfired, glaze material. The ware is then fired a second time, at a lower temperature indelibly fusing pigments and glaze together. Sometimes a transparent lead glaze is added over the painted decoration requiring a third firing. The advantage of tin glaze over lead is that

it does not run when fired, and thus the pigments do not blur. The disadvantage is that the surface s absorbent making alterations impossible as is in frescos.

Modern Glazing

Modern glazing is created by making a mixture of glass particles and colored oxides. Glass powder is brushed onto the surface of the pottery, then heated to extreme temperatures to melt the glass powder over the glaze. Modern glazing has and continues to advance enough to provide thousands of different glazing combinations and appearances. Potters are constantly creating, changing and improving the way what they decorate ceramics. This is generally done in the form of glaze. The difference between the types of glaze and another type of glaze can be as complex or as simple as the potters imagines and the effects as numerous as the number of potters themselves.

Nowadays, a glaze is generally applied to the surface of a ceramic product/object after it has been through the kiln for preliminary firing, when it is dipped into a glaze mixture. Glazes can also be sprayed, air brushed onto the surface of the object to be decorated. A glaze usually takes the form of an opaque mixture similar to a thin cream in consistency. After firing the glaze becomes fused to the surface of the pottery and it is only then that it becomes transparent and the final colors are reveled.

Glazing in Traditional Nigerian Pottery

The Vanguard (2011) explains that, pottery is one of the crafts from Ancient Nigeria that is still in practice in most parts of the country. Pottery is Nigeria's most cultural material that has caught the attention and interest of every British archeologist such as Prof. Shaw whose early work of excavation of such baked clay objects remains outstanding and herculean in nature. Pottery is also seen as one of the cheapest art forms of craft being practiced in Nigeria and it is also heavily dominated by women. The reasons for the above assertions rally around the fact that the primary raw materials which are clay and water are common and can be easily found in major parts of the country; they are not scarce neither do they relay specifically on the use of specialized machinery to access them.

Nature of Nigerian Traditional Pottery

The practice of pottery in Nigeria is ubiquitous meaning it is practiced in nearly every ethnic group found in Nigeria including the three major groups namely: Hausa, Igbo and Yoruba. In its traditional setting, pottery is unique in the sense that it is majorly done manually hence, the uniqueness in each piece. The ethnographic efforts of the colonial archeologist Prof. Thrustan Shaw who excavated most of the early material evidences of prehistoric times show and proves that art of pottery making has been in existence dating as far back as 300BC in Nigeria.

The earliest examples of pottery making in Nigeria were found in Afikpo in Ebonyi State. There the archeologist Professor Shaw is recorded to have excavated some material remains of the pottery at Iwo Eleru in Yoruba land which are order. He also discovered the ritual potteries of Igbo Ukwu in Igbo land which were also excavated by Shaw in the company of other museum professionals. With these excavations and many other discoveries, led to the strategic placement of Nigeria on the international scene. However, despite the prehistoric genius and advancements in Nigerian pottery practice, there appears to have been a stagnation in the industry's development. Irabor (2009) attributes such slowness in the pace of traditional pottery development in Nigeria to the gross inadequacies initially enumerated at the opening sections of this article. These are considered to be responsible for the slowness in progress towards attaining quality finish in the produced objects. Irabor considers and posits that, the local development and production of specialized glazes such as has been discussed in earlier segments of this article; using established science and technological based processes, glazes can be formulated and applied to enhance the unexplored area of quality finish in traditional Nigeria pottery.

Concept of Glazes Formulation Methods and Design Techniques

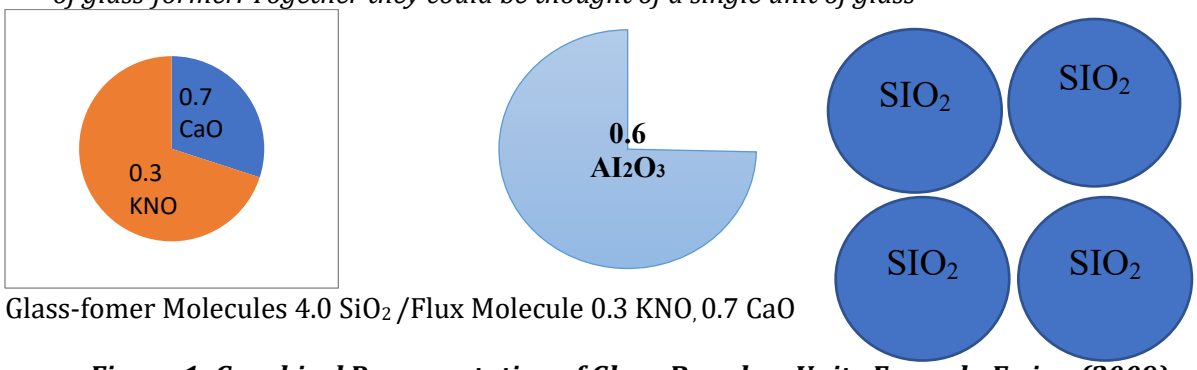
Basically, the design and formulation of new glaze have involved two major approaches. Adelabu et al (2013) identify these to include "the trial and error method and more currently the scientific

method which now incorporates advance computer application". The trial and error method are usually characterized by guesswork and rigour with various uncertainties while the latter is offering a methodical and systematic approach to glaze formulation, which however might help the designer to have a greater level of control on the final result. To design a new glaze successfully as described by Buck (1999), it requires no mysterious chants, but just a thorough understanding of the factors involved in the process. According to Buck (1999), two main steps are involved and can be explained as follows.

1. Choosing suitable raw materials and mixing them in various proportions to meets a planned series of glaze test; or
2. Choosing an appropriate formula based on previous practice, and deriving a mix-batch recipe for testing, etc. in either case, one needs to have proper underlying knowledge about the raw materials at hand.

One way to enhance a glaze formula process and evaluate a glaze recipe is through the molecular Unity Formula otherwise called Seger Formula. This approach was developed by a German ceramist Hermann Seger who a century ago arranged glaze component into a particular order- the RO/R_2O group for basic oxides, R_2O_3 group for amphoteric oxides and RO_2 for the acidic oxides. Hermann Seger carried out in-depth research into the importance of the ratios which are of outstanding importance to the potter when compounding glazes. Unity Formula as noted by Latorre (2009) provides a means of comparing different glaze formulas with each other or a way to show the relative amounts of the oxides in a fired glaze as pictorially described by Ewing (2009) in figure 1 below.

For every 1 "molecule" of flux in the glaze there is 0.6 of a "molecule" of stabilizer and 4 "molecule" of glass-former. Together they could be thought of a single unit of glass



Glass-fomer Molecules 4.0 SiO_2 /Flux Molecule 0.3 KNO, 0.7 CaO

Figure 1: Graphical Representation of Glaze Based on Unity Formula Ewing (2009)

Table 1 below shows an example of a computer glaze software generated recipe derived from Nigerian local materials based on the unity formula.

Table 1. A glaze software formulated recipe in Unity format using Nigerian local materials

Flux	Stabilizer (Amphoteric)	Glass former (Acid)	Oxides % Composition value	Recipe in %
KNO 0.363 CaO 0.637	Al_2O_3 0.407	SiO_2 2.309	Flux - 26.81 Ampho. – 10.92 Acid. – 62.27	Auchi feldspar – 78.69 Auchi Kaolin – 7.08 Auchi Whiting – 14.23
1.000			100.00	100.00

Source: Adelabu (2011) Si: Al 5.67

Cardew (1969) opined that, the main use of the Seger Formula is that it provides a simple means for controlling the balance of the three-oxide group (i.e. RO, R_2O and RO_3 and RO_2) and the composition within the group. He added that this combination plays the chief part in determining the character of a glaze like its fusibility, its maturing range (the length of the temperature over

firing), crazing, viscosity, the colour and stability of the in-glaze pigments (especially iron pigment); and the surface (whether bright or matt). Adelabu (2011) presented a comprehensive report on computer aided approach to apply the Unity Formula for glaze formulation based on locally available materials in Nigeria.

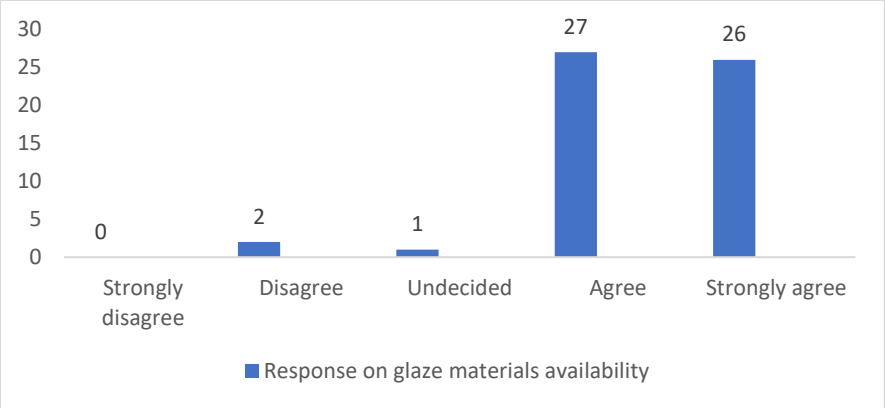


Figure 2: Response about the availability of abundant glaze materials for local ceramic production in Nigeria

On the subject of availability of glaze raw materials in Nigeria, about 95% of the respondents in the field process agreed that there is a vast presence of glaze raw material in Nigeria (Figure 2 above.) Meanwhile in Figure 3 (below), it was observed an equivocal response on the issue of accessibility to local glaze materials by the respondents.

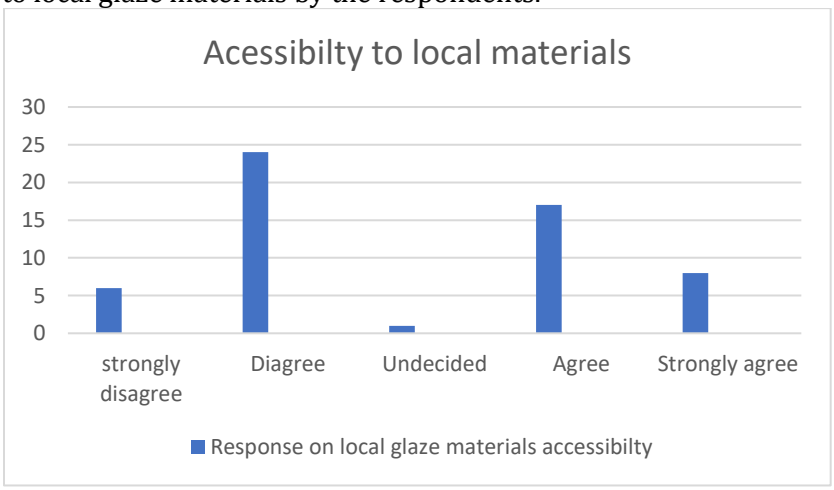


Figure 3: Response about the non-availability of glaze materials for local ceramic production in Nigeria

Nevertheless, it was reasoned that the level of access to various local materials sources may not be consistent since there are existing challenges of land ownership and territorial land resource control. In addition, it was noted that there is a low presence of industries involved in mining and beneficiation of locally available materials which in turn could have facilitated the distribution and access to these materials for local consumptions. While there might seem to be several factors downsizing access to local glaze materials. Figure 4 below indicates the low prospects for locally available foreign substitute, hence an under-utilization of local materials.

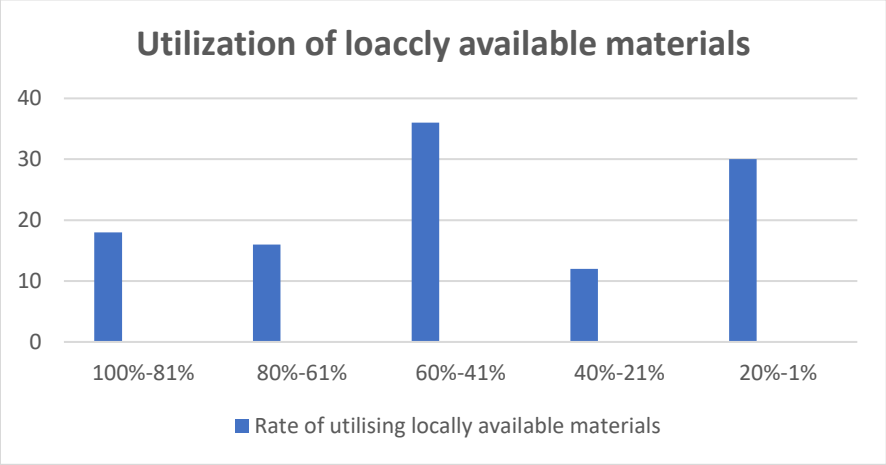


Figure 4: Utilization of locally available glaze materials for composition of glaze recipes.

From Figure 5 below, we can infer some key influential factors affecting an advance development of glaze ceramics practices using local materials. These factors could be summed up as under-utilization of glaze materials due to inadequacies of technical knowledge and paucity of efficient glazing facilities.

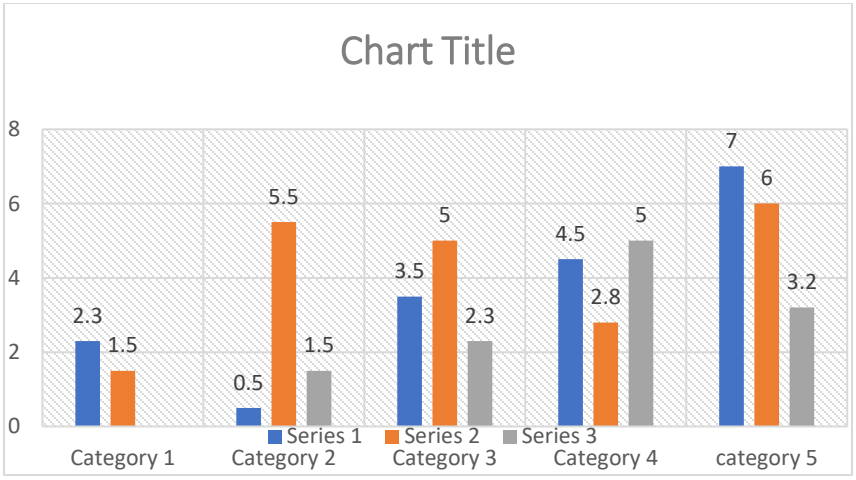


Figure 5: Responses to factors affecting the development on glaze ceramics practices. Keys: SD-Strongly disagree, D-Disagree, U-Undecided, A-Agree, SA-Strongly agree

While traditional ceramic practice seems to have come of age in Nigeria, this study findings indicated that the global advance in ceramic glaze technology in Nigeria is yet to be felt. Generally, many challenges remained unresolved as ineffective traditional approach to glaze formulation and paucity of equipment continues to abound. The trial and error are still common practice in most ceramic institutes and cottage ceramic outfits in Nigeria. This does not often deliver as expected due to varying conditions which cannot be accounted for scientifically in the course of replication of an existing glaze or trying out new ones. Another point worthy of mention is it that most of the opinion that the generality of the respondents (practitioners) discontented to the opinion that glazes composed basically with local materials are often problematic. This indicates that, they are confident about the viability of glaze material resources which are locally obtainable. It was also observed that within the south-western area of Nigeria, local pottery productions appear to be driven by demand for artistic and studio potters. In this regard, unity articles such as glazed tableware, dinnerware or sanitary ware are rarely produced as contrary to the studio production culture around the northern areas.

Conclusions

Irabor (2009) having observed the big opportunity in the ceramics business awaiting the nation, considering that 85 percent (85%) of raw materials that would be needed could be obtained locally, described the current challenges facing ceramics and its being enormous. Oyeoku (2003) simply referred to modern Nigeria ceramics as a sick baby as he questioned why the sector was not enterprising enough with the opulent raw materials that abound in the country. Irabor (2009), however noted that there are a number of crucial factors necessary for the development and growth of ceramic and glaze technology and manufacture in Nigeria and such varied factors ranges from government policy frame work, financial structure, politics, expert manpower, technology, to availability of appropriate raw materials. Of significance is the science and engineering nature of the ceramic discipline as obtained in the developed and developing worlds, except in the under-developed worlds where a degree of lack of knowledge exist in the area of pottery, its technology and engineering. All of the foregoing situations can be tracked down on the issue surrounding understanding of glaze raw materials and low level of technical know-how for the emerging glaze technology. From issues bothering on glaze materials to composition methods, this paper has considered investigating more deeply into some of the main clog in the wheel of progress towards maximizing the untapped potentials for glazed ceramic productions with survey findings drawn from selected areas in Nigeria. Many a reason has been attributed to this abysmal performance of the productive sector, with over-dependence on the country's vast and non-renewable oil resources as the most convincing reason. Akinbogun (2008) decried the downtrend of the small-and medium-scale businesses which are supposed to be the economic nerves center of a developing country like Nigeria. For the educational sector, Akinbogun (1997, 2006) identified one of the major factors responsible for student skepticism on specializing in the area of ceramics being the fact that prospective students without science background tends to avoid anything that has to do with chemistry of ceramic materials and glaze calculation. As observed, the retarded growth of the local glazed ceramics practices can be justified against the fact that the trial and error methods of glaze formulations are still being used which proves unpredictable. Therefore, the importance of gaining materials and chemistry of composition cannot be overstressed. This enables the chemists to have better control over glaze preparation of dependency on pre-mixed glaze bodies.

Recommendations

Despite the previous achievement following the pioneering works of Michael Cardew in the Angola-Nigeria pottery experiment (Akinbogun, 2009) there is a need to constantly review local ceramic production process on the background of content technological possibilities as supported by Kashim and Akinbogun (2007). An appraisal of the traditional method vi-a-vis the scientific approach somewhat shows that the former is liable to suffer much setback modification, creativity, accuracy and analytical approach to glaze formulation.

There is a large potential growth prediction for Nigeria as a world emerging economy. Interestingly, Nigeria is rated first among top 11 nations (referred to as 3G countries) that will experience an unprecedented economic growth between 2010 and 2050 (Citi investment Research and Analysis, 2011). One of the stated reasons in that Nigeria has large natural resources endowments that is hoped will be more beneficial than often have been in the past. Adelabu and Kashim (2020) rightly affirmed that the when local materials are effectively utilized. It creates impetus for industrial development, thus minimizing over-dependence on imported materials with its derailing effect on the economy.

Despite the current abysmal performance of Nigeria ceramic industries, there is a ray of hope. Glazing process expedited through technological inventions of new methods, tools and energy management. Hence, the best of ceramic practices in Nigeria could be achieved if technological inventions on glaze processing and composition are explored.

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