

**KWAME NKRUMAH UNIVERSITY OF SCIENCE AND  
TECHNOLOGY, KUMASI, GHANA**

**PRODUCTION OF CLAY SPEAKER ENCLOSURES.**

**By**

**AGBLEATOR DIVINE KWEKU JUNIOR**

**(B.A INTEGRATED RURAL ART AND INDUSTRY)**

**A Thesis submitted to the Department of Integrated Rural Art and Industry in the**

**Faculty of Art**

**College of Art and Built Environment,**

**in partial fulfilment of the requirements for the degree of**

**MASTER OF PHILOSOPHY**

**MARCH, 2019**

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## DECLARATION

I hereby declare that this submission is my own work towards the award of a Mater of Philosophy degree in Integrated Art and Industry and that, to the best of my knowledge, it contains no materials previously published by another person nor material which has been accepted for any other degree of the university, except where due acknowledgement has been made in the text.

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## **ABSTRACT**

Clay is a moist sticky earth that hardens when dried, due to the unique properties or characteristics of clay, it is used to produce various house hold or domestic products such as cooking pots, water storages, flower pots etc. Clay is also used to build some parts of complex industrial machine which serves as a means of generating income. However, the local use of clay has been limited to a certain level. There is therefore the need for exploration into the issue to well understand and appreciate the unique properties and characteristics of the material to further expand or expose it use at the local level which will also reduce pressure on other raw materials. Written documents have shown that clay has been used to produce musical instruments in other countries. Ghana is a country that has boundless natural resources including clay which could be found in all the ten regions. Local potters and institutions use it in the best way they can but research has shown that the ability of clay is somehow limitless. This study is therefore being conducted with the aim to produce clay speaker enclosures. In order to achieve this aim the following objectives was set; to ascertain and describe the various forms of speaker enclosures, to identify the characteristics of clay suitable for the production of speaker enclosure and to design and produce clay speaker enclosure with the clay. Two types of clay from Ashanti region are selected for the study and these are Mfensi and Afari clay. Data regarding this clays will be collected both from the researcher's own research experiments and other literally written documents. The qualitative research method is used, experiments and observations being the main forms of data collection instruments. Out of the accessible population, Mfensi clay is selected as sample purposively based on the information gathered. The results of the study show how best Mfensi clay can be used for producing more interesting products. It is recommended that various reasons for understanding the behavior of clay be brought to light for further research in other to develop, design and expose or bring out new products from our local clay.

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# **CHAPTER ONE**

## **INTRODUCTION**

### **1.1 Overview**

This research is geared towards the production of clay speaker enclosures. In addition, the philosophies behind the production of the speaker enclosures were considered.

### **1.2 Background to the Study**

Reliance on local raw materials for making the living of humanity better has been a worldwide tradition. Although most materials upon which man stay alive exist as fundamental part of natural resources, their significance is actualised when a need arises in one form or the other: socially, culturally, economically or religiously.

Coleman (2007) stated that wealth generation in local industries aggregates to economic development which is turned by the transformation of locally available resources into marketable resources which enthusiastically meet man's current needs. Although wealth creation through indigenous industries are largely identical with poverty reduction in society, the prospective for growth, such as human and physical resources, advanced into the production of pottery are not yielding the economic output estimated towards improving or bettering the living standards in this case of potters and pottery sellers in Ghana.

In some part of Ghana, the northern parts predominantly, they rely more on clay for the manufacture of pots to serve internal purposes such as brewing and storage of local beer (pito), water storage, cooking and bathing, etc. Although these clay products could serve as a chief source of revenue generation for their upkeep or the

livelihood of many people in the clay industry, even though there is low investment for the pottery product (Craven, 2007). The main reason being that wood, plastic and metal have taken over in serving this roles. The local clay or pottery products are therefore rendered of less value and less useful in society due to their lack of economical designs, aesthetics and modernism.

Clays can be grouped into two main categories, which are primary clays also known as residual clays and transported clay also known as sedimentary clay. Primary clay are mainly initiated near the mother rock, on the other hand, sedimentary clays are found far away from the mother rock. Normally the moving of this clays are caused by the means of erosion and rivers. Primary or residual clays are mostly caused by weathering, this as a result causes the chemical breakdown of rocks, like alumina and granite, and silica. Moreover with rocks, like limestone, which has clayey impurities also being insoluble finally settle down as clay by disintegration. Chemical decomposition of feldspar is the common process of clay formation. (Anon., 2012). This contributes to the unique characteristics of clay which can be used to form various shapes.

### **1.3 Statement of the Problem**

Lack of exploration in the use of local clay in the production of artifacts for the Ghanaian market has placed pressure on other natural resources.

Cutting down of trees and not replanting them and the fuel price and manpower continue to increase the price of durable materials which are used for producing speaker enclosures (Apollonio & DellaSala, 2011).

Many homes in Ghana listen to the radio, watch television or play music which are all related to sound and are produced from speakers. The speakers are mainly or normally produced using wood, plastic, or metal but are hardly produced in clay.

With regards to this the researcher seek to explore with clay in this direction.

#### **1.4 Aim of the Research**

The aim of this research is to design and produce speaker enclosures using our local clay.

#### **1.5 Objectives of the Research.**

In order to achieve the aim of this research the following objectives were set.

1. To ascertain and describe the various forms of speaker enclosures.
2. To identify the characteristics of clay suitable for the production of speaker enclosure.
3. To design and produce clay speaker enclosure.

#### **1.6 Research questions**

1. What are the types of speaker enclosures?
2. What are the characteristics of clay suitable for the production of speaker enclosures?
3. What are the processes involved in the production of the clay speaker enclosures?

#### **1.7 Delimitation**

1. The study is limited to the use of clay, specifically 'Mfensi clay'
2. The final product is for indoor use only.



## **1.8 Definition of Terms**

These are common words used in unconventional ways in the study.

***Aging:*** This is the process of storing clay for a longer time to improve its plasticity level.

***Complementary materials:*** These are materials used alongside other materials.

***Clay:*** This is one of the most useful type of clay found in the Ashanti region of Ghana.

***Indigenous clay:*** These are local clay found in our environment.

***Integration:*** This is to combine, join or put different objects together.

***Pottery:*** These are local clay products or objects made of clay.

***Refractory:*** This is the ability of a material to endure high temperature.

***Speaker enclosures:*** They are usually containers that hold speakers

***Sound:*** Sound is produced by a vibrating body which propagates as an audible wave of pressure

***Transformation:*** The act of changing the current state of something.

## **1.9 Importance of the study**

1. This study will further expand the capabilities of the Ghanaian local clay industry.
2. This study will inspire exploration with clay to produce advanced and complex enclosure designs with clay.
3. This study will bring about variation in speaker system designs in Ghana.
4. This research will aid as a source of referencing for an advance study.

## **1.10 Organization of the rest of the text**

Chapter two considered the review of literature available, accessible and applicable to the study which includes the formation of clay, the types of clay, the characteristics of clay, types of speaker enclosures and their characteristics. Chapter three talks about the

research methodology; it recognizes and explains all the processes and actions used in gathering or obtaining the data for the research. Chapter four talks about the findings and the interpretation of the data. Chapter five considers the summary, conclusion and recommendations of the study. References and appendices are also delivered.

## **CHAPTER TWO**

### **REVIEW OF RELATED LITERATURE**

#### **2.1 Overview**

In this chapter, research documents related to the study are reviewed. They helped researcher to understand the types of speaker enclosures and the characteristics of clay suitable for the project. The literature reviewed were collected from literary sources, written documents and the internet, they have been discussed under the following sub headings;

- History of clay
- Formation of clay
- Types of clay
- Properties of clay
- Uses of clay
- History of speaker system
- Types of speaker systems
- Types of speaker enclosures

#### **2.2 History of Clay**

Clay is a moist sticky earth that hardens when dried. Though clay soils are known for their plasticity, clays like kaolin or china clays practically do not have the plasticity property but are added to other plastic clays for brickmaking and other clay products (Searle, 2013).

Additionally, Clay soils are also of great importance to the industries. Clay also provides nutrients for plants to grow. Clay provide porosity and aeration, thus, making it possible for air to mix with the soil. Also clay is able to hold and keep water, it furthermore has

the ability to store nitrogen, calcium oxide and potassium oxide. Clay has been the chief material in ceramic or pottery production from the beginning of human existence. Clay was used for constructing bricks for building (Anon., 2018).

Boateng (2004) inferred that, in science clay is called hydrated aluminium silicate. It is a kind of earth or soil which is soft and sticky when wet and hardens when dry and or fired.

The Oxford Dictionary (2014) states that clay is a heavy sticky natural material which becomes firm or hard when fired. It is also understood that not all clays are plastic, such as kaolin and therefore there is the need to form a body to make it workable. According to Boateng (2004) clay body is the product of the mixture of dissimilar types of clay or earthen materials for ceramic or sculptural use.

In engineering, clay has an extensive diversity of uses. When appropriate quantity of clay is added to silica it raises the firing temperature, they become resistant to water like the earth dams. The loss of water in canals are limited by the addition of clay. Clays and limestones are the essential impure materials in portland cement (Anon., 2018). Pottery is known to be one of the greatest old industries in the world. As soon as it was discovered that clay soil could be used to shape or form products by mixing the clay with water and finally firing them pottery industry started. In the 24,000 BC, figures of humans and animals were produced from clay in addition to other materials and fired in kilns. (Guire, 2015). It is also believe that man was made out of soil or clay as said in the Holy Bible.

Clay soils are also produced from volcanic ashes as a result of weathering, furthermore it is also stated that the physical and chemical activities as a result of volcano to the environment aids in the formation of clay. The structure and composition of clay is

dependant on where they are deposited. As much as finger prints are not the same, it is also difficult to find the same clay types from different sources. Clay soils are found at diverse sources and locations, every source comes with its sole mineral structures. Moreover, it is also mentioned that clay contain minute particles that can hold great quantity of water, hence a lot of clays have the ability to expand massively when hydrated. The core source of life on earth are minerals and they are authoritative to human survival. Development in the body such as fats, vitamins and protein digestion and other activities are all aided by minerals. Muscle contractions to the production of hormones are all aided by minerals. Clay serves as a natural source of mineral taken in and used by mankind (Kos, 2016).The above literature shows that clay has been part of human history.

### **2.3 Formation of clay**

According to Richard (2006) as indicated by (Endene, 2015) weathering of rock is the principal way by which clay minerals are made on the earth. It is the mechanism by which clays are produced as a result of physical breakdown and chemical modification of rocks that changes the original minerals to clay minerals.

Clay is not formed overnight, the formation of clay is a gradual process which takes a much longer time to form as gradual weathering of rocks, basically silicate bearing rocks (Humphrey & Boyd, 2018). It is also said that clay is the product of chemical reaction between silicate rocks and water. Dissimilar types of clay and their different physical properties are formed by their individual chemical composition and structure (Cuadros, 2018). From the above literature clay is formed as a result of chemical reactions between silicate bearing rocks through weathering. Oxford (2018) defines weathering as the activity of sun, rain or wind on rocks, causing adjustment shape or colour. Webster (2018) also

agrees to that by saying that weathering affects the color, texture, specifically the physical breakdown and chemical breakdown of the surface of the earth surface.

## **2.4 Types of clay**

According to Manukaji (2013) as indicated by (Endene, 2015) clays are divided into two types; primary and secondary clays, which can additionally be divided into various sub-groups. Primary clays also known as residual clays, are clays produced from the parent rocks which have not been transported by any means, thus remain in the area of their formation.

They are generally white in colour and of low or normally not plastic example kaolin. On the other hand, secondary clays also known as sedimentary clays are those produced from the parent rock and moved mainly by erosion and water from their site of formation. They come in several colours and are of high plasticity. Wikipedia (2018) simplified it by saying that clays are in two types, we have the residual clay and the sedimentary clay. Residual clays are located at the site of formation, whilst on the other hand sedimentary clays are moved far away from the site of formation by means of erosion. Searle (2013) agreed by saying that residual clays are found near the parent or mother rock whilst sedimentary clays are found some distance away from the mother rock.

There are two types of clay considering the information gathered so far, the residual clay and also the sedimentary as mentioned by the various literature sources reviewed. Although there are two main types of clay, literature shows that there are classifications of clay types. McCormick (1997) agrees and classed clay into the following types: Oil-based clays, Polymer clays, Dough clay, Ceramic clays, Water based clays and Paper clays. Also McCormick (1997) went on to say that clays for pottery can be categorized in five, which are stoneware, earthenware, porcelain, ball clay and fire clay. He further

went on to say that the universally used clays are low fire clay bodies, middle fire clay bodies and high fire clay bodies. Bodies in this study as related to clay are produced by adding different type of clays together. Earthenware clays are part of the first used by potters and it is common. It is easy to work with and are plastic. The impurities in it cause the clay to fire between 950°C and 1100°C. Stoneware is also a type which is plastic and normally grey when wet, the colors ranges from light grey to brown. The colour is mostly determined by the type of firing done. Ball clay cannot be used on its own because it shrinks a lot during drying and firing but they can be worked with if mixed with other clay types to intensify its flexibility and easy to work with. Fire clays can fire at a very high temperature, and this type of clays differ widely in their characteristics. They are able to fire to about 1500°C.

Kaolin is a very pure clay type normally for porcelain production. This type of clay is usually white in colour when wet. Britannica (2018) supported that by stating that when producing white ware, kaolin is mostly added or mixed with reasonable quantity of feldspar and silica and little amount of high plastic clays like ball clay. These are very important to achieve reasonable shrinkage and plasticity properties.

The characteristics or the properties of clay may lead to different classification of clay types. Various types of clay can be mixed to produce clay bodies. As stated by Boateng (2004) clay bodies are produced as the result of the mixture of variuos types of clay materials for ceramic or sculptural purpose. Peterson (2017) also comfirmed when she said clay body is refered to as the exact clay mixture that is used in producing objects. It consists of different clay types in it. This is done to aid plasticity, to lower or increase firing temperature.

It was furthermore stated that clay bodies come in various types but the three commonly used are the earthenware, stoneware and porcelain. Their firing temperature is mostly dependent on the type of materials added to it. (Anon., 2018).

The workability of a clay is essentially what makes it comfortable to use and the colour of the clay is mostly affected by the minerals in it. Several clay bodies fire or mature at diverse or different temperature. The three common clay bodies such as porcelain, earthenware and stoneware clays all fire or mature at different temperatures.

Anon. (2018) also agreed by stating that different bodies fire or mature at different firing temperatures. The rate at which the clay is fired to make it bone dry or permanent is referred to as the maturing temperature. In common terms, when a clay body is purposed to fire at a very high temperature, the more glasslike it becomes. It is also noted that clay cannot to be made soft again when fired to the maturing temperature. Cones are used to check or determine the firing temperature in the kiln. They are treated specially to melt at different temperatures. The low fire cones known as cone 06 to 04, the middle fire cones as cone 5 to cone 6 and finally the high fire cone also known as cone 8 to cone 10. They are the temperature range in the kiln during bisque and glaze firing.

## **2.5 Properties of clay**

Clay is a very significant material in the area of ceramics. Before any clay material is used for producing anything, which ever way it may be used, either on its own or as a body, it is essential that proper understanding is gained (Nsiah, 2007). The properties of a clay depend on the type of clay or the clay body, thus the element, these could be chemical properties or physical properties.

According to Searle (2013) the site where clays soil may be located initially, and the process by which they were carried away from the parent rock is an influence to the



physical properties as well as the chemical properties of the clay and also influence the appropriateness of what they could be used for

For the purpose of this research the following are some common characteristics or properties found in clay.

### **2.5.1 Plasticity**

Plasticity of clay refers to the flexibility or the ability of a clay or clay body to be molded or altered easily. This is normally influenced by the particle size of the clay, amount of water in the clay and aging. This property of clay makes it easy to knead and shape the clay (Peterson, 2017). The common way to check the plasticity of a clay is to coil the clay and wrap it around the finger. Clay which is plastic will not break but clay which is not plastic will break. Harnetty (2018) confirmed by saying that the very fine particle size of clay plus water controls the plastic property of any given clay. The plasticity nature of clay is what make it easier to work with, thus to be able to take any shape given it but this characteristic is eliminated when the clay is fired.



*Plate 1 Showing the result of clay plasticity test*

*Source: ([https://digitalfire.com/4sight/material/bentonite\\_106.html](https://digitalfire.com/4sight/material/bentonite_106.html))*

### **2.5.2 Shrinkage Property**

When clay is exposed into direct contact with air it begins to shrink. Water is moved out of the clay until it reaches the moisture content of the surrounding atmosphere, even though it may still contain mechanical and chemical water. If it is fired rapidly, steam in the clay will cause it to crack or explode in the kiln. To avoid cracking due to water removal or shrinkage, the firing or drying processes should be carefully monitored (Zamek, 2003). According to Williams (2018) shrinkage occurs from when drying the clay to a leather hard state to firing to bisque ware state. All clays do not shrink at the same rate, they shrink at different rates depending on the materials and particle sizes. The rate of shrinkage will change the size of the product or the ware. So it is very necessary to know the rate of shrinkage of the clay before using it.



*Plate 2 showing shrinkage rate before and after firing.*

*Source: ([www.lakesidepottery.com](http://www.lakesidepottery.com))*

### **2.5.3 Refractory property**

The refractory property of clay is the ability of the clay to endure high heat temperature without melting or deforming. According to Hansen (2015) as a material is fired to a higher temperature, particles increasingly pack themselves together and extremely high fired strength is achieved. Material that have remarkably high melting point and that can maintain its shape or structural properties at a very high temperature (Britannica, 2018). In clay production, refractory bricks are formed into several shapes and are used to line the inside of kilns to process materials at high temperatures. Business Dictionary (2018) also defined refractory as materials that can endure very high temperature heat without degrading or becoming soft. Boateng (2004) confirmed by saying that it is the property in a substance or object that is capable of withstanding a high temperature without melting. With regards to the study this property makes it possible for the clay to be fired

to a high temperature to keep the design or the form of the project permanent without changing in shape.

#### **2.5.4 Colour**

According to Boateng (2004) colour is defined from the perspectives of light and pigment, thus the sensation produced on the eyes by rays of composed light. Clays in their raw state comes in different ranges of colours; gray, brown, red and etc. The colour of clay is determined by the organic materials, moisture and exposure to air (Groome, 2018). The natural colour of clay gives it a unique appearance.

#### **2.5.5 Texture**

Texture refers to the surface feel of an object. Boateng (2004) agrees to this when he said it is the nature or appearance of a substance or surface whether it rough or smooth. The texture of clays may vary depending on the particle size. The particle sizes in clay may also influence the plasticity and shrinkage level of the clay.

**Table 1 Showing The clay locations in Ghana (Bawah, 2017).**

<b>EASTERN REGION</b>	
<b>(unit is metric tons)</b>	<b>Location</b>
Median: 2,240,099	Adihima and Asouya
Mean: 7,250, 692	Abrepotia
Mode: 34, 862, 223	Okwenya
<b>WESTERN REGION</b>	
<b>(unit is metric tons)</b>	<b>Location</b>
Median: 9, 343, 117	Nimzimirim
Mean: 49, 454, 677. 07	Bou-Bamakpolo
Mode: 34, 862, 223	Nzima East
<b>BRONG AHAFO REGION</b>	
<b>(unit is metric tons)</b>	<b>Location</b>
Median: 661, 188	Sunsam Valley
Mean: 5, 797, 348	Sunsam Valley
Mode: 16, 200, 200	Tanoso
<b>UPPER EAST REGION</b>	
<b>(unit is metric tons)</b>	<b>Location</b>
Median: 4, 563, 665	Tono and Sobole
Mean: 5, 396, 882	Tono
Mode: 12, 419, 998	Gambigo (Alamore)
<b>GREATER ACCRA</b>	
<b>(unit is metric tons)</b>	<b>Location</b>
Median: 10, 960, 115	Kpone
Mean: 14, 810, 094	Mobole
Mode: 51, 242, 553	Big Ada
<b>CENTRAL REGION</b>	
<b>(unit is metric tons)</b>	<b>Location</b>
Median: 2, 450, 000	Esuakyir number 2 and Simbrofo
Mean: 7, 438, 241, 714	Nkuntraw ( Ankaful)
Mode: 34, 862, 223	Kasua and Oduponkpehe
<b>ASHANTI REGION</b>	
<b>(unit is metric tons)</b>	<b>Location</b>
Median: 162, 017	Satang number 2, Aboabo and Dichem-Aprpong Road.
Mean: 2,436,008.625	Aferi
Mode: 33, 865, 955	Asokwa
<b>NORTHERN REGION</b>	
<b>(unit is metric tons)</b>	<b>Location</b>
Median: 234, 502,	Kunkuo
Mean: 2, 007, 377.6	Kpaliga
Mode: 9, 455, 892	Koblimahago

For geographical location and the purpose of the study, the research focused on Mfensi and Afari clay, which are mostly useful clay types in the Ashanti Region.

Mfensi clay is realistically plastic and when fired at 1100°C, becomes yellowish-brown. The clay is appropriate for earthenware and stoneware, aside tiles and bricks, due to its high refractoriness (Nsiah, 2007). According to Boateng (2004) as said earlier, refractoriness refers to the characteristic or property within a substance or object that is able to endure high temperature without melting.

## **2.7 Physical characteristics of Mfensi and Afari clays**

According to Amoanyi (2012) as indicated by (Endene, 2015) the physical properties of clays vary from colour, texture and particle size, etc. Afari clay is yellowish in colour while the Mfensi clay is greenish–grey in colour in its wet state. The yellowish colour of the Afari clay can be credited to its high concentration of aluminum oxides (Appiah, 1998) and (Endene, 2015). Usually the term clay has a varied sizes in terms of particles ranging from 10s of angstroms to millimeters. Unit for measurement of scale of atom is angstrom. Mfensi and Afari clays carry the implication of small particle size, though the particle size of Afari clay are relatively smaller than those of Mfensi clay (Amoanyi, 2012) also recorded by (Endene, 2015).

### **Plasticity characteristics of Mfensi and Afari Clay**

Work carried out by Amoanyi (2012) as indicated by (Endene, 2015) shows that, the liquid limit (LL) of Mfensi and Afari was 43.34 percent and 73.40 percent respectively. This indicate the rate at which they could hold water. When it comes to the plasticity limit of Mfensi and Afari clays, both clays were below 30%, with Afari clay having a plastic limit of 26.92% and that of Mfensi clay being 20.80%. The plasticity index (PI) of Afari clay was found to be higher than that of Mfensi clay with a value of 46.58% and 22.54% respectively.

## **2.8 Uses of clay**

According to Velde (1992) Clay soils have great value as sources of natural materials to mankind. He went on to say that the properties of clay make it appropriate as a material for constructing building products and pottery. In this century, clays have become an important parts of industrial technology, having many roles in production processes, and are major elements in products such as plastics and foodstuffs. The following are some important areas where clay is useful.(*Kos, 2016*)

- Clay is used as part of formulation in pharmaceuticals
- They are also used for oral and topical applications
- Clay is used as protector for gastrointestinal
- They serve as oral osmotic
- Clay is also useful in curing diarrhea
- They also serve as protectors for dermatologist
- Clays are useful product in the area of cosmetics
- They are also used as excipients
- In the liberation and degradation process of drugs clay is an influence

Based on the chemical and physical properties and characteristics of Afari and Mfensi clays, they have been found to be appropriate for industrial and academic purposes. The accessibility of these clays in quantities caused creative people to establish small scale pottery industries, producing products like cooking pots, water coolers or storage bowls for grinding, burnt bricks, building materials, and etc according to Amoanyi et al., (2012) as stated by (Endene, 2015)



*Plate 3: Products produced from Mfensi clay (Agyen-Berko, 2018).*

## **2.9 History of Speaker enclosures**

According to M.W. & Normandin (2014) in the olden days horns were used to magnify sounds and they did not use electrical energy. Magnavox, Thomas Edison, and Victrola all established innovative and good performing horns from 80's to the 1920's. The issue with horns was they were not able to magnify the sound load enough. With time loud speakers were used to produce or used to amplify sounds to fill big areas with electricity. At a normal look, speaker enclosures appear like containers usually in a form of a box. But this form is deceiving. The construction and form strongly influence the character of the sound produced. Understanding the minor philosophies involved is helpful in evaluating speaker enclosures. It has been said that a speaker without an enclosure is just like a string without the violin. The body of the violin is needed to produce the sound energy created by the strings during vibration. The speaker enclosures perform the same tasks as a vibrating parts of a speaker. Hans (1986) confirmed to this when he stated that the best speakers with no enclosure to hold it will not produce better sounds.



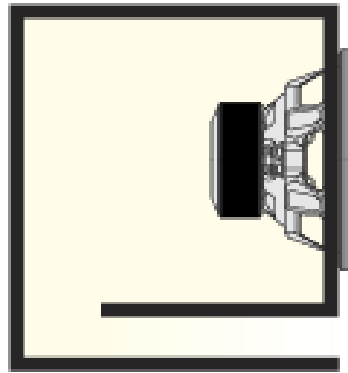
### **2.9.1 Purpose of Speaker Enclosure**

The tenacity of the speaker enclosure is in two folds, to deliver a skillful enclosure for the speaker to work very proficiently, and to produce a structure or an enclosure to embrace or contain the speakers while placing them optimally for the hearer (Apollonio & DellaSala, 2011).

### **2.10 Types of Speaker enclosures**

Briere & Hurley (2018) mentioned that the speaker enclosures come in two forms, which are sealed and ported. The sealed enclosures are airtight case. When the speaker moves outward and inward, the air pressure in it regularly changes. This puts additional pressure from behind on the diaphragm as it moves back and forth and that also demands more power to overcome. Ported enclosures are types of enclosure that have holes which level pressure between the inside and outside of the speaker (Briere & Hurley, 2018). According to Juan P Bello, he also agreed by stating that there are numerous types but the common types which are usually produced are the sealed enclosure and ported enclosures. He went on to say that the sealed enclosures are fully covered, normally has sound absorbing material inside, sound wave produced from behind of the speakers does not come out.

## 2.11 Characteristics of Speaker Enclosures

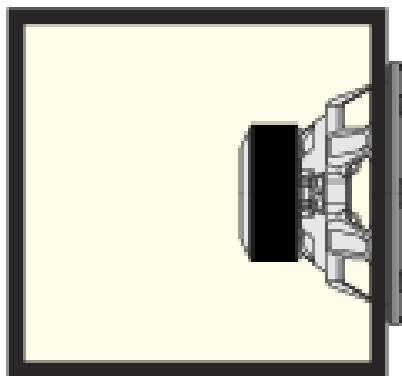


*Figure 1: Cross section of a ported enclosure.*

*Source: (<http://audiojudgement.com/types-of-enclosures-which-is-the-best/>)*

### Ported Enclosures

- They are vented to allow in and out flow of surrounding air
- Ported enclosures have actually been in existence long before the sealed enclosures.
- It is efficient
- Low distortion around port tuning
- The vent in ported enclosures extend the bass response in a more proficient manner (Dési, 2018).



*Figure 2 Cross section of a seal enclosure*

*Source: <http://audiojudgement.com/types-of-enclosures-which-is-the-best/>*

- The sealed enclosure is a common box design.
- There are no vent for in and out flow of air.
- They usually come in small sizes.
- The sealed enclosures produce good low frequency extension.
- The response of transient is good.
- Building or constructing sealed enclosure is easy.
- Sealed box to provide bass response; it replicates precise bass, but requires more power than other designs (Dési, 2018).

## **2.12 Materials for producing Speaker Enclosures**

Speaker enclosures can be produced from any material firm enough not to vibrate and cause damages or distortion, materials which are normally used are plywood, Particleboard, and Medium Density Fiber, heavy woods or denser wood will reduce vibrations in the walls. When the enclosure walls are large or thin they can resonate enough to cause hearable distortions (Eddie Runner, n.d.).

Intertechnik (2018) states that, any firm body vibrates at its usual resonance when it is moved by a sound. The type of energy produce by sound at the rear of the speaker produces an echoing vibrations in the enclosure walls. It also states that, when the enclosure walls vibrate it responses as a source of sound. This sound also adds up to the sound produced by the speaker. When this happens it produces distortions depending on the density of the material. In addition, the materials used for the enclosure must avoid sound from moving directly from the box. From this knowledge it is advisable to use materials of high density and sound absorber for internal lining when producing an enclosure. The sound absorber will serve as a reinforcement to the walls. According to DIY (2018) when producing speaker boxes, it is important to select materials that enable

the piece of equipment to work efficiently. There are six major types of materials one can use to produce speaker enclosures.

- Medium density fiberboards according to Intertechnik (2018) saying that it is packed down into an even board and are produced from fine wood fibers and binding materials, they have smoother surface and have finer pores than raw particleboard.
- According to DIY (2018) plywood is a material that is lighter than medium density fiber but it is still durable enough to work well.
- A fiberglass is a form of fiber-reinforced plastic where glass fiber is the reinforced plastic. This is possibly the reason why fiberglass is also identified as glass reinforced plastic or glass fiber reinforced plastic. The glass fiber is normally flattened into a sheet, accidentally arranged or woven into a fabric. According to the use of the fiberglass, the glass fibers can be produced from diverse glass. Fiberglass is lightweight, strong and less brittle. The finest part of fiberglass is its capability to get molded into various difficult or complex shapes. This pretty much explains why fiberglass is widely used in boats, bathtubs, roofing aircraft and other applications (Phelps, 2018).
- Standard Wood according to DIY (2018) stated that though plain wood is inexpensive and readily available in several thicknesses, this does not mean that it is always the finest option for producing a speaker enclosure. Natural wood can resonate to the point where it distorts the sound and causes the fasteners to loosen. Wood can also rent asunder when screws are used to secure one piece to another. Oxford (2018) defines standard wood as a tough fibrous material that forms the main substance of the trunk or branches of a tree or shrub, used for furniture, fuel or timber.

- Fasteners are used to build speaker enclosure, they come in the form of glue, screws and caulk to put the enclosure together. Glues are used at the initial point to hold the enclosure together before following it up with screws. Though nails can also be used, they slowly become loose due to the amount of vibrations that the speaker enclosure can go through. The braces used are vital to reduce vibration and must be fixed correctly to enable them to be useful (DIY, 2018).
- Sonotube; are produced from various layers of high quality fiber, spiral wound and laminated with a heavy-duty glue. Sonotube Builder's Tube Concrete forms are constructed strong to withstand the heavy pressure of wet concrete (Sonotube, 2018). A trademark for: a large tube of compressed fibre into which wet concrete is poured and left to harden, used to form pillars, columns, etc., in building and construction (Oxford, 2018).



***Plate 4: Showing enclosure made from MDF.***

***Source: Unknown***



*Plate 5: Enclosure made from Plywood.*

*Source: Unknown*



*Plate 6: Enclosure made from plastic.*

*Source: Researcher*

### 2.13 Clay and sound

Sound are produced by vibrating bodies. Movement of particles in the air are as a result of the vibrating bodies. These particles crash into the particles close to them, which makes them vibrate, too. This movement is called sound waves which is a form of energy produced. (Foushee, 2017).

Chile is a country whose traditions and cultural uniqueness are celebrated through the works of skilled artisans that hand down their own working skills from one generation to another. Chilean design encloses this, being still far from well-known brands and industrial factories. The designer Pablo Ocqueteau has realised handmade clay speakers that combine ancestral ceramic techniques with modern wireless audio technologies (Gaetano, n.d.).



*Plate 7: Showing Clay speaker enclosure (Grozdanic, 2015).*

In the world of musical instruments, those formed from clay have a special place. It may not seem like a noticeable place, after all, none of the usually used instruments of Western music are made from ceramics. But it is a unique place, a place of wide open possibilities

and exceptional attractiveness. Clay has limitations that make it less than ideal for making some of the instruments usually made with wood or metals. But the nature of the medium, with its boundless plasticity, gives rise to a world of other sound making forms. Dag Sorensen in Norway has produced a broad range of percussions and wind instruments, including panpipes, wind chimes, sound walls, bells, clay pot drums etc (Hall, 2006).



Spiral horn, 13 inches in height, thrown and molded stoneware with sprayed manganese dioxide decoration, fired to Cone 10.

*Plate 8 Horn made with stoneware (Hall, 2006).*



## **CHAPTER THREE**

### **METHODOLOGY**

#### **3.1 Overview**

The chapter recounts methods used in undertaking this research and gathering relevant data on producing the clay speaker enclosure. The information on the materials used for the study were gathered from various sources as well as fieldwork. The methodology also focused on the research design, the population for the study, the techniques for sampling and the data gathering procedures.

#### **3.2 Research Design**

This study mainly made use of the qualitative method. This was because the researcher tried to understand the nature, characteristics or the properties of clay, the qualitative research method proved to be the best option; in that, it allowed the researcher to study and understand the properties of the various types of clay and select the one suitable for the production of clay speaker enclosure.

According to Brikci (2007) the qualitative approach helps to answer the questions about what, why and how of an occurrence. In line with that, the qualitative research was best in answering the research question like ‘what are the processes involve in the production of the clay speaker enclosures? since it is going to provide detailed narrative descriptions of the process?. The leading reason for using qualitative research method is because the method focuses on the descriptive aspect of the study. The research is focused on understanding the properties of clay that make it suitable for the production of clay speaker enclosure.

### **3.2.1 Descriptive Design**

The descriptive research designs facilitated in providing answers to the questions of what and how they associated with a particular research problem. Furthermore, descriptive studies can yield accurate information that lead to significant recommendations (Anon., 2018).

According to Shuttleworth (2008) descriptive research design is a scientific method which involves observing and describing the behavior of a subject without influencing it in any way. In view of this, descriptive research was used to describe the production process to testing of the final project.

According to Glass & Hopkins (1984) as indicated by (Aect, 2001) descriptive research helps in collecting data that describes events. In this case, descriptive studies are used to describe various characteristics of the happenings. In the general format, it is used to describe characteristics and behavior of sample population (Dudovskiy, 2018).

Descriptive research was used to describe the various techniques used in the production process.

- Kneading
- Wedging
- Slab making
- Cutting
- Drying
- Scoring
- Joining
- Beating
- Firing
- Finishing

For the sake of this research, descriptive study was to gather information on the following questions.

1. What are the types of speaker enclosures?
2. What are the characteristics of clay suitable for the production of speaker enclosures?
3. What are the processes involved in the production of the clay speaker enclosures?

### **3.2.2 Experimental design**

This can be defined as an outline of the techniques that allowed the researcher to try or test his findings by reaching valid conclusions about relationships between independent and dependent variables. According to Key (1997) it is the conceptual framework within which the experiment is conducted.

This study made use of experimental research design to know the processes in producing the enclosures and how the clay speaker enclosure walls react to the vibration produced when plugged to sound.

### **3.3 Population for the Study**

The population of a research is normally a large collection of subjects or objects that the research is focused on. They are also group of subjects that have similar characteristics pertaining to a study. Explorable (2009) confirms when he said that they are subjects or individuals in a certain population with the same or common characteristics.

According to Missouri (2018) population is a complete set of individuals or subjects that possess some common characteristic well-defined by the sampling criteria established by the researcher. With regards to this research, the population used are clays available in Ashanti Region.

### **3.3.1 Target Population**

This is the whole group of people or subjects to which the researcher wants to generalize the research findings as stated by (Missouri, 2018). According to Exchange (2018) it refers to the overall group of individuals or subjects to which researchers are interested in generalizing the conclusions.

Windham (2008) indicated that target population is simply the group of subjects that have been selected for a research. The target population for this research were Afari and Mfensi clay all located in Ashanti Region.

### **3.3.2 Accessible Population**

The accessible population is the group or subjects to which the researcher can further research on to draw conclusions. This population comes from the target population. It is from this group that the research can draw their (Explorable, 2009). According to Missouri (2018) he further went on to say that the accessible population part of the population to which the researcher has reasonable access. Also Mack (2014) as indicated by (Ebeheakey, 2015) defines the accessible population as a group that a researcher can actually measure. According to Trochim (2000) it is a group that is usually smaller than the target population (Ebeheakey, 2015). For the sake of this research the accessible population was Mfensi clay in the Ashanti Region of Ghana.

### **3.4 Sampling Technique**

The process of selecting a group of subjects or individuals by which the researcher conducts his study (Missouri, 2018). McLeod (2014) stated that sampling technique is the process of collecting a representative group from the population under study. Agrawala (2010) as indicated by (Ebeheakey, 2015) also defines sampling technique as a process of selecting and studying the characteristics of a relatively small number. The

data collected for this study were from literature source and experiment conducted by the researcher. The information gathered was used in the data analysis.

#### **3.4.1 Purposive Sampling**

Researcher uses personal judgement to select subjects that are considered to be representative of the population (Missouri, 2018). According to Crossman (2018) purposive sample is a non-probability sample that is selected based on characteristics of a population and the objective of the study. Purposive sampling is also known as judgmental, selective, or subjective sampling.

Dudovskiy (2018) indicated that purposive sampling (also known as judgment, selective or subjective sampling) is a sampling technique in which researcher relies on his or her own judgment when choosing members of population to participate in the study. A purposive sample is where a researcher selects a sample based on their knowledge about the study and population (Stephanie, 2015). With the knowledge on the characteristics and properties of Mfensi clay the researcher purposefully select it for the study.

#### **3.5 Data Collection**

According to Dudovskiy (2018) data collection is a process of collecting information from all the relevant sources to find answers to the research problem, test the hypothesis and evaluate the outcomes. Data collection methods can be divided into two categories: primary methods of data collection and secondary methods of data collection. Rouse (2018) states that data collection is the systematic approach to gathering and measuring information from a variety of sources to get a complete and accurate picture of an area of interest. According to Nalzar (2012) as indicated by (Ebehekey, 2015) states that data collection is the process by which a researcher collects the information needed to

answer the research problem. The selection of data collection instruments should be based on the following:

- The identified research problem
- The research design
- The information gathered about the variables

For this research, the data was collected using previous literature sources to get information about types of speaker enclosures and the characteristics of clay that proved relevant in providing possible answers to the questions and attempting to solve the research problem.

### **3.5.1 Primary Data**

Primary data is collected by a researcher with a specific goal in mind. The primary data for this research were gathered through experiments, observation and literature source.

### **3.5.2 Secondary Data**

According to Dudovskiy (2018) secondary data is a type of data that has already been published in books, newspapers, magazines, journals, online portals etc. Secondary data was collected from the General Art Studies Library in the Kwame Nkrumah University of Science and Technology, different related theses, books, publications, journal articles and documents from the internet. Curtis (2008) as indicated by (Ebeheakey, 2015) secondary data is data that has been previously collected by another researcher. Secondary data offers savings in both time and cost.

## **3.6 Data Collection Instruments**

To derive conclusions from data, we need to know how the data were collected; that is, we need to know the method(s) of data collection (Trek, 2018). The research made use

of two main instruments that aided in the data collection procedure. These instruments are experiments and observation.

### **3.6.1 Experiment**

According to Oxford (2018) it is a scientific procedure undertaken to make a discovery, test a hypothesis, or demonstrate a known fact. An experiment is a controlled study in which the researcher attempts to understand cause-and-effect relationship (Trek, 2018). Also Webster (2018) defines it as an operation or procedure carried out under controlled conditions in order to discover an unknown effect or law, to test or establish a hypothesis, or to illustrate a known law. For the sake of the study, the quest to know the characteristics of clay suitable for the production of clay speaker enclosures, and the processes involve in the production of the clay speaker enclosures. The researcher conducted an experiment to collect enough data for the study.

### **3.6.2 Observation**

According to Erlandson, Harris, Skipper, & Allen, (1993) as recorded by (Ebeheakey, 2015) observation enabled the researcher to describe existing situations using the five senses and providing a “written photograph” of the subject under study. As a means of gathering information for research, observation may be defined as perceiving data through the senses: sight, hearing, tastes, touch and smell, also it enables the researcher to directly gather primary data or first-hand information for his study for a more accurate description and interpretation.(Hugo, 2015). The researcher was able to gather data by looking at the walls and feeling the walls of the clay enclosure when sound is plugged in to identify any cracks. The researcher was also able to collect enough data by observing the reaction of the clay during the production process and through the firing.

### 3.7 Data Collection Procedure

The main form of data collection for this research was done through experiments and observation made by the researcher and from other literature source on clays in Ashanti Region. Data was collected from Mfensi and Afari clay which forms the accessible population in knowing the characteristics of clay suitable for producing clay speaker enclosures.

Albert Atterberg, a Swedish scientist was the first person to define the limits of soil consistency for the grouping of fine-grained soils. In about 100 years later, his methods are still being used to determine the Liquid Limit and Shrinkage Limit and the plastic limit of soils (Gilson, 2018). Liquid Limit is the water content at which clay soil changes from a plastic to a liquid state, This means that there is too much water and the clay soil cannot hold it any longer, hence the clay dissolves into fluid. Plastic Limit is the water content in the clay soil at which it changes from a plastic to a semisolid state. Shrinkage Limit is the water content where further loss of moisture does not cause a decrease in clay size. Plasticity Index (*PI*) is calculated as the Plastic Limit subtracted from the Liquid Limit and is an important value when classifying soil type (Gilson, 2018). Research conducted by Amoanyi (2012) indicates the Atterberg limits (Liquid limit, plastic limit and plasticity index) of Mfensi and Afari clays results and this is shown in the table below. The result indicates that Mfensi and Afari clay has liquid limits of 43 percent and 73 percent respectively, and the plastic limit result of Mfensi and Afari clays are 20.80 percent and 26.92 percent respectively. The difference in liquid limit and plastic limit give the plasticity index value of 46.48 percent for Afari clay and plasticity index value of 22.54 percent for Mfensi clay (Amoanyi, 2012).



**Table 2 Showing the Atterberg Limits Test (Amoanyi, 2012).**

Sample	Colour	Drying Shrinkage (%)	Volumetric Shrinkage (%)	Atterberg Limits Test (%)			Particle size distribution (%)		
				Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI) LL-PL= PI	Clay <2 $\mu$ m	Silt 2 $\mu$ m-60 $\mu$ m	Sand 60 $\mu$ m-2000 $\mu$ m
Afari Clay	Yellowish orange	9.8	27.42	73.40	26.92	46.48	48	27	25
Mfensi Clay	Greenish grey	7.4	21.89	43.34	20.80	22.54	37	43	20

The physical properties of clays vary from colour, texture and particle size, etc. (Endene, 2015). From the table above Afari clay is yellowish in colour in its wet state while the Mfensi clay is greenish–grey in colour in its wet state. According to Appiah (1998) as indicated by (Endene, 2015) the yellowish colour of the Afari clay can be attributed to its high concentration of aluminium oxides. Both clays carry the implication of small particle size, though the particle sizes of Afari clay are relatively smaller than those of Mfensi clay (Amoanyi, 2012). Based on their properties (physical, mineralogical and chemical) the Mfensi and Afari clays have been found to be suitable for industrial and academic purposes (Endene, 2015).

### 3.8 Validation of Data

According to Sarantakos (1994) as indicated by (Ebeheakey, 2015) has asserted that validity is a methodological element not only of the quantitative but also of qualitative research. In other words, it is a quality that data gathering instruments have that enables them to determine whether or not the data is reliable. The authenticity and clarification of the data were compared to other literature sources and checked by some lecturers both for review and to make them free from error.

## **CHAPTER FOUR**

### **PRESENTATION AND DISCUSSION OF FINDINGS**

#### **4.1 Overview**

The chapter presents the analysis and discussion of data gathered from the study. Data was gathered from other literature sources and observations made from the experiment conducted by the researcher. The data is analyzed and discussed according to the research questions.

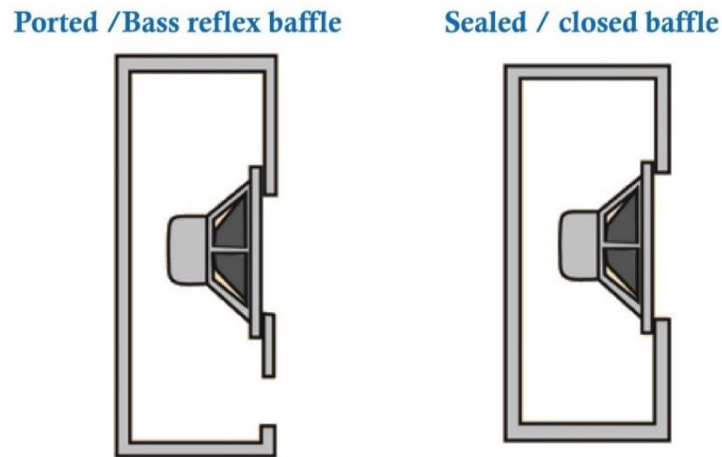
#### **4.2 Types of speaker enclosures?**

There are many types of speaker enclosure but the common are sealed and ported.

According to Briere & Hurley (2018) the speaker enclosure is critical in a home theater system. From the information gathered, there are two major types of speaker enclosures which are sealed and ported enclosures. Either way, a speaker enclosure should be able to handle vibrations with ease and add little sound interference to the sound emanating from the speakers. India (2015) also stated that speaker enclosures are critical. Any speaker will produce sound in any cabinet, but improving the relationship between the speaker and the enclosure is the key to good bass. Shaping the low-end which is the bass frequencies below 200Hz is the reason for picking a particular enclosure type. In order for the researcher to identify the types of speaker enclosures, the following criteria were outlined.

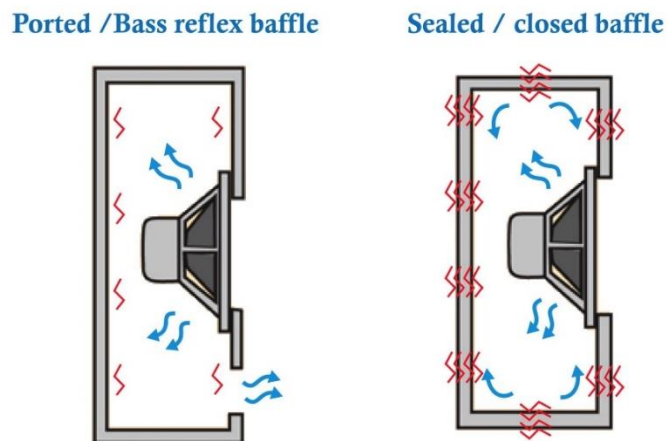
Criteria for identifying the types of speaker enclosures.

- Functionality / Purpose.
- Shape.
- Size.
- Where it is used.



**Figure 3: Main type of enclosures**

**Source: Researcher**



**Figure 4: Showing movement of air and level of vibration**

**Source: Researcher**

Speakers produce a lot of vibrations, so if a weak speaker enclosure is used, it is going to create a lot of noise, fall apart, or both (Briere & Hurley, 2018).

From the above criteria for identifying the types of speaker enclosures, the researcher came up with the following. Ported or the bass reflex baffle; allows air that circulates inside the enclosure to freely move in and out of the enclosure so the vibration of the enclosure is reduced. Whereas a sealed enclosure requires a stronger and heavier

enclosure so that the pressure from the inside does not break or vibrate the enclosure unnecessarily.

#### **4.3 The characteristics of clay suitable for the production of clay speaker enclosures**

For the sake of this study and based on the properties (physical and chemical) the Mfensi and Afari clays have been found to be suitable for industrial and academic purposes (Endene, 2015). According to Amoanyi et al. (2012) as indicated by (Endene, 2015) the availability of these clays in commercial quantities caused indigenes to establish small scale pottery industries, producing products such as bowls for grinding locally known as ‘asanka’, palm wine pots, water coolers, burnt bricks, building materials, etc.

Millions of tons of clays are utilized annually in a large variety of applications. Many and varied products are made from it due to their low electrical and thermal conductivities, chemical inertness over a relatively wide range of pH, soft and non-abrasive nature, good plasticity characteristics and cost effective than most competing materials according to Appiah(1998) as recorded by (Endene, 2015). The good plasticity characteristics of the clay also prevent it from breaking or cracking easily.

#### **4.4 The processes involved in the production of the clay speaker enclosures?**

With regards to the nature of material used, researchers identified the ported or the bass reflex baffle to be the suitable type of enclosure. Considering the type of enclosure the following designs were made.

For the sake of this study the researcher went through the design process to come up with the speaker enclosure.

According to Bee (2013) the design process involves the transformation of ideas, needs or wants into a product that satisfies these needs / wants.

The designing and the production process of the speaker enclosure went through the following stages.

- The design brief process
- The product design specification process
- The concept design process
- The testing process

#### **4.4.1 Design Brief**

As stated by Bee (2013) the design brief is usually a statement of intent. With regards to the purpose of this research, the intent is ‘To design and produce clay speaker enclosure’.

#### **4.4.2 Product Design Specification (PDS)**

The PDS is a document listing the problem in detail.

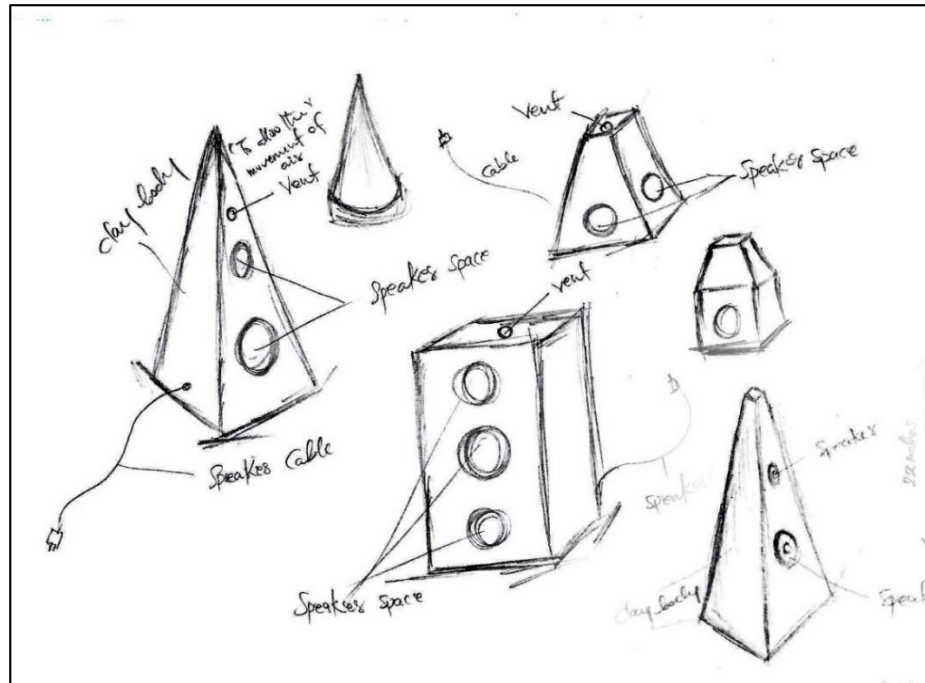
Lack of exploration in the use of local clay in the production of artifacts for the Ghanaian market has placed pressure on other natural resources. Deforestation and the price of fuel and labor keeps rising and the cost of high quality materials used in producing speaker enclosures. (Apollonio & DellaSala, 2011).

#### **4.4.3 Concept Design**

This is the stage where the designer tries to put together some possible ideas to solve the problem at hands. Using the product design specification as the basis, the designer attempts to provide plans to the solution. A conceptual design is usually an outline of the key components and their arrangement with the details of the design left for a later stage.

#### 4.4.4 Concept Generation

Normally at this stage of the designing process, the designer captures his or her ideas by sketching them on paper. Annotations or footnotes help to identify key points so that their ideas can be communicated with other members of the company.



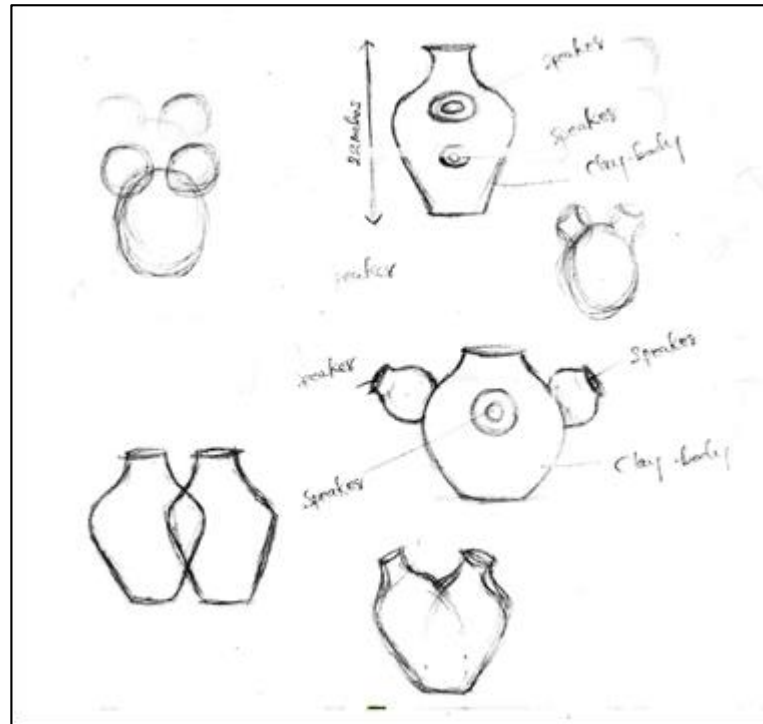
**Figure 5: Showing initial sketches, Concept A**

**Source: Researcher**



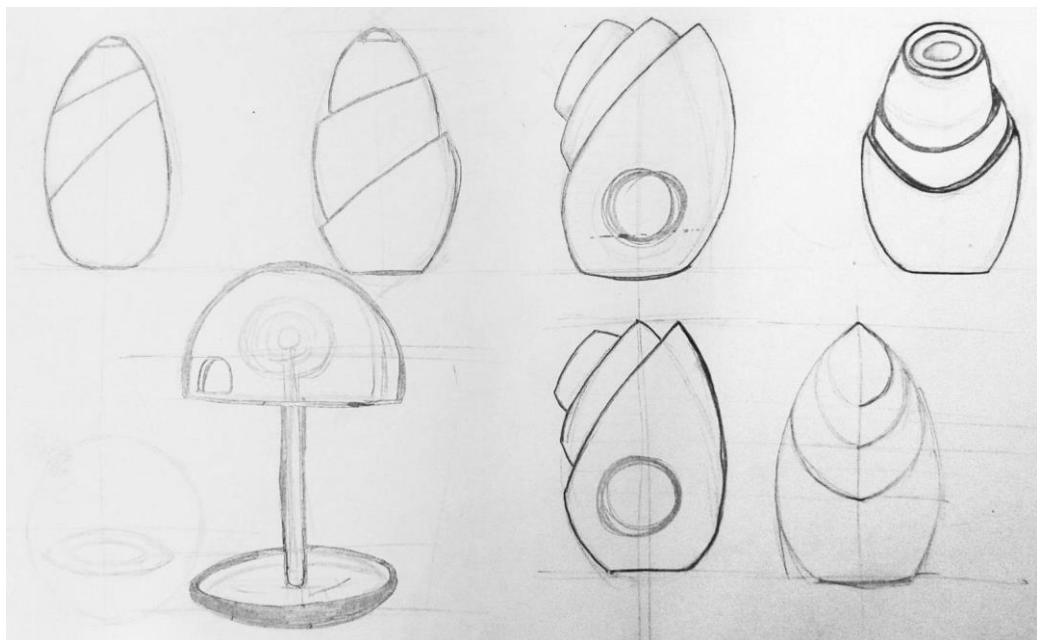
**Figure 6: Showing initial sketches, Concept B**

**Source: Researcher**



***Figure 7: Showing initial sketches, Concept C***

***Source: Researcher***



***Figure 8: Initial sketches, Concept D***

***Source: Researcher***

#### 4.4.5 Concept Evaluation

According to CFE (2018) this is a criteria-based evaluation tool used to determine the objective value of a number of solutions, it also helps to produce a consensus as it allows the designer to select and evaluate a variety of promising solutions against selected criteria.

The researcher used the Matrix Evaluation to select the best design based on the following criteria.

Functionality / Purpose, Shape, Economy of cost, Portability, Sustainability, User Friendliness and Product presence.

#### 4.4.6 Matrix Evaluation (Importance Rating)

Criteria	Importance rating	Concept A	Concept B	Concept C	Concept D
Functionality / Purpose.	20	16	4	10	2
Shape.	10	10	6	8	6
Economy of cost	20	15	10	18	8
Portability	5	4	3	4	3
Sustainability	10	10	7	10	6
User Friendliness	25	22	15	17	20
Product presence	10	9	6	9	7
<b>Total</b>	<b>100%</b>	86%	51%	76%	52%

**Table 3 Importance Rating**

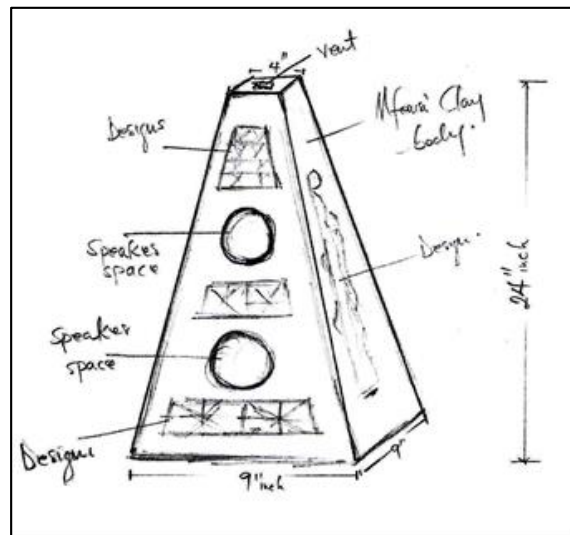
*Source: Researcher*



Based on the table above concept A and concept C were selected as the best designs for the clay speaker enclosures from the set of criteria.

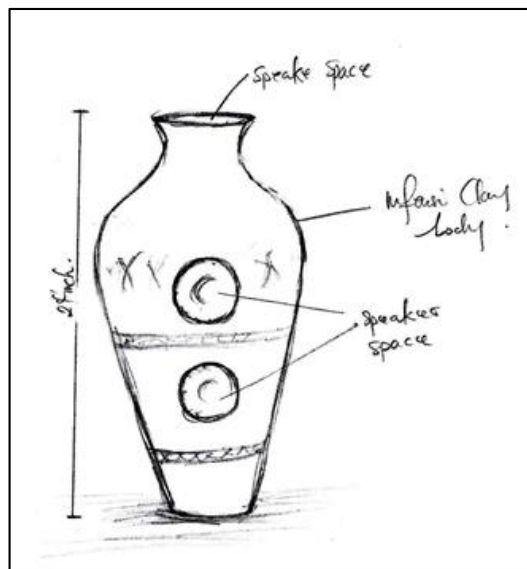
#### 4.4.7 Detail Design

In this stage of the design process, the chosen concept is developed in details with all the dimensions and specifications necessary to make the design specific or it can also be describe as detailed drawings of the design.



**Figure 9 Final design for concept A**

**Source: Researcher**



**Figure 10: Final design for concept C**

**Source: Researcher**



***Figure 11: 3D model of final design concept A***

***Source: Researcher***



***Figure 12: 3D model of final design, concept C***

***Source: Researcher***

This outlines the step by step procedure in producing the speaker enclosures.

#### **4.5 Identifying the right clay:**

As mentioned earlier Mfensi clay was selected as the clay type for this study. The clay was first kept in a plastic bag for some few days to improve its plasticity. The process of storing the clay to improve plasticity is called aging. Aging realigns the composition or layers in the clay body.



*Plate 9: Sample of Mfensi clay*

*Source: Researcher*

#### **4.6 Preparing the clay**

- Kneading
- Wedging
- Making of slabs
- Throwing
- Cutting
- Turning
- Scoring

- Beating
- Joining
- Decorating
- Drying
- Firing

#### **4.6.1 Kneading**

The technique of working on clay with the hand to get rid of air pockets and objects (stones, stick, etc.) in clay (Boateng, 2004).

Kneading is one of the essential initial processes of preparing clay for production. It involves manipulating or working the clay like kneading dough for normal bread. Kneading ensures the even distribution of moisture in the clay body and it also removes air pockets trapped in the clay, hence it improves even consistency the workability of the clay body. There are machines for kneading but with regards to this study the research used his hands. Using the hand gives much control on the clay.



*Plate 10: Showing the Kneading process of the clay*

*Source: Researcher*

#### **4.6.2 Wedging**

Wedging is the process or procedure for preparing clay or a clay body by hand, a lump of clay body was repeatedly thrown down on a working bench and between each action the lump is turned and sometimes cut through and rejoined in a different direction. The purpose is to disperse the water more evenly, to remove lamination and to remove air pocket just like kneading. Air pocket in the clay may cause it to creak or explode during firing.

According to Boateng (2004) it is the process of cutting and slamming clay, and working on them so that it becomes evenly consistent all over, with no hard or soft lumps.



*Plate 11: Showing the wedging process of the clay*

*Source: Researcher*

#### **4.6.3 Making of slabs**

In slab making, a rolling pin is used to roll the clay flat. The guard sticks are placed at both ends of the rolling pin for the ends to rest on, as the rolling pin is rolled on the clay



it picks the thickness of the guard. This process was done on the suck board for easy picking of the slab and also so a flat surface. Grog was sprinkled on the suck board so that the slab does not stick on it, otherwise it will be difficult to pick from the board.



*Plate 12: Showing the slab making process*

#### **4.6.4 Throwing**

Throwing is the process of producing clay products on the potter's wheel or creating ceramic shapes on the potter's wheel. According to Boateng (2004) throwing is the art of forming pottery shapes of plastic clay on a potters' wheel. Throwing was best for producing round parts of the work. Small and large object can all be produced on the potter's wheel.



*Plate 13: Showing the throwing process*

With regards to the project the lower and upper parts of the vase were thrown on the potter's wheel and the middle part was built up with slabs.



*Plate 14: Showing the thrown and slap work*



#### **4.6.5 Cutting process**

This is the process of cutting the slab of clay into various parts before joining them together. Firstly, marks were made on the slab for accuracy and cut with knife.



*Plate 15 Showing the Marking and cutting process*

#### **4.6.6 Scoring**

This is the process of making marks on the two surfaces that would be joined together edges of the clay before joining with slip to fuse them together. The marks were created using fork, the mark serves as the tooth which will lock the two ends together.



*Plate 16: Showing the scoring process*

*Source: Researcher*



*Plate 17: Showing the scoring process with slip.*

#### **4.6.7 Joining**

During this stage, parts of the clay slabs were fused together as a whole using clay slip.

The ends which were scored or marked was joined



*Plate 18 showing different parts joined together.*



#### **4.6.8 Beating**

Hitting the clay for it to join or fuse well.

#### **4.6.9 Decoration**

Creating textures on the surface of the clay for beautification. The decoration was a cast figure of a woman carrying a pot of water and a little baby at a back.



*Plate 19: Showing casted figures for decoration*



*Plate 20 Showing decorations on the work*



*Plate 21 Showing decorations on the work*

Different ornamental designs and Adinkra symbols were used for decorating the work.

#### 4.6.10 Drying

Exposing the clay object to the air for it to harden.



*Plate 22: Drying process*



*Plate 23: Drying process*

The drying process was critically controlled to prevent cracking. Plastic bag was used to cover the work from time to time to prevent fast drying.

#### 4.6.11 Firing

The following outlines the processes involve in firing the work after they have become bone dry. The works produced were allowed to dry completely in open air. At this stage all cutting or trimming had been done when the clay was leather hard. The works were packed gently together with other ceramic products into an electric kiln. During the packing process large works were placed into the kiln first on a props. After the first layer of works were placed in the kiln, shelves were placed on top of the supports for the next layer of works. After the kiln was filled, suitable firing duration and temperature was set for the kiln to fire. For the bisque firing process, the general temperature was about 1750

degrees, also known as cone 07. cones are used to measure the temperature in the kiln, the cones melt at different temperatures. The works were allowed to fire for about 17 to 18 hours. After firing the works the kiln was left to cool down before the fired pieces were removed. The fired works were drawn out from the kiln and allowed to cool completely.

#### **4.7 Finishing**

This is the process of applying final touches to the work. During the finishing process, two of the works were painted and two were left unpainted. The fixing and wiring of the speakers were also done at this stage.

##### **4.7.1 Fixing of the speakers**

The speakers were attached or fixed inside the enclosures by an adhesive called ‘UHU’. ‘UHU’ is a multipurpose type of glue which is used to fix wood, glass, leather, cardboard, textiles, pottery and paper.

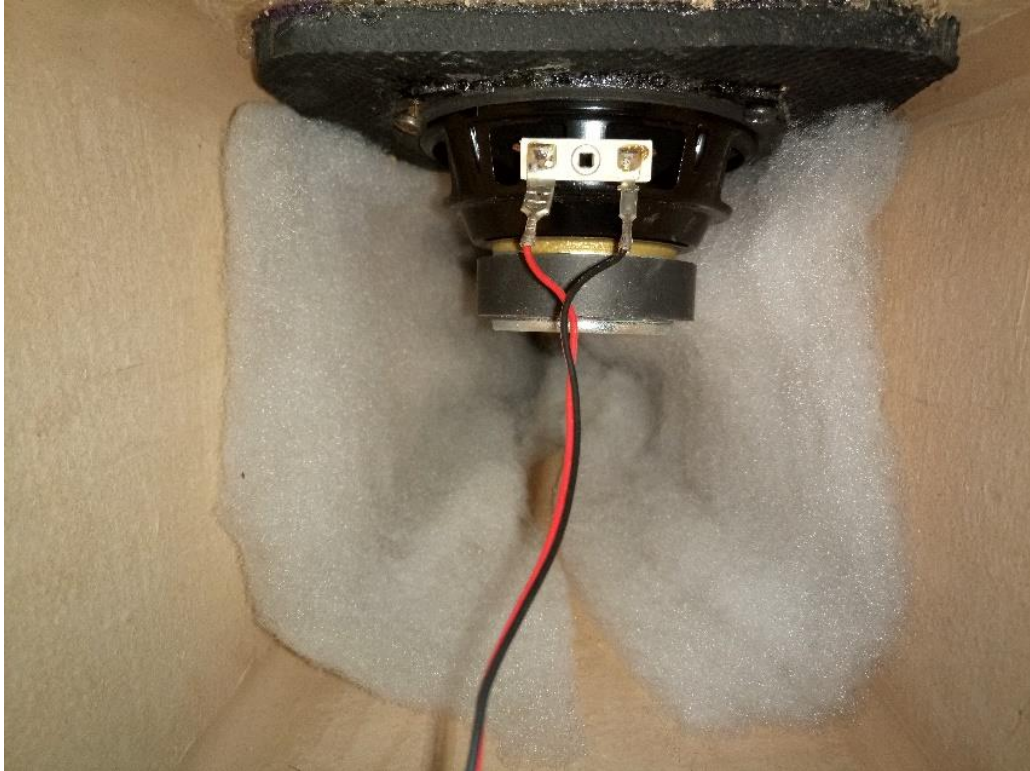


*Plate 24: Adhesive used for mounting the speaker in to the clay speaker enclosure.*



#### **4.7.2 Fixing of sound absorber**

Sound absorber was used to line the interior of the enclosures to reduce the amount of vibrations entering the wall of the clay.



*Plate 25: Sound absorber used to line the interior of the walls.*

#### **4.7.3 Painting of the clay speaker enclosures**

Two of the fired products were painted to give it an aesthetic appealing look while the other two were left unpainted to show the true natural look of the fired clay. The fired colour of the clay was yellowish brown.





*Plate 26: The colour of the final product (Clay enclosure) in it natural fired state.*



*Plate 27: The final product (Clay enclosure) Sprayed with acrylic white paint and gold.*

## **CHAPTER FIVE**

### **SUMMARY, CONCLUSIONS AND RECOMMENDATIONS**

#### **5.1 Overview**

This project is an attempt to contribute to the expansion of knowledge about the various characteristic of clay and to promote its usage in Ghanaian pottery. This chapter summarizes, concludes and gives recommendations on the study.

#### **5.2 Summary**

The main objective of this study was to design and produce clay speaker enclosure. To achieve this two other objects were set; first to identify and describe the various types of enclosures for speakers and to compose the type of clay body suitable for the production of clay speaker enclosures. There were research questions that needed to be answered at the end of the study. To obtain the necessary information, data was gathered from other literature sources, careful observations were made throughout the experiment during production process.

#### **5.3 Conclusions**

With reference to the foregone result, discussion and literature reviewed, there are different types of speaker enclosures namely sealed and ported, which are made mainly from wood and plastics. The plastic nature of Mfensi clay makes it suitable for producing speaker enclosures and other home and industrial products, also sound absorber was used to line the walls to reduce vibration. Finally, it is vital to understand the various properties as well as the processes they go through during drying and firing. The understanding will assist in preventing drying and cracking and firing defects of the clay used in this project

Finally because of the plasticity property of Mfensi clay drying of green products should be carefully controlled to avoid cracking.

#### **5.4 Recommendation**

1. Adequate research should be done about other clay types to identify their characteristics suitable for producing clay speaker enclosures and other useful products.
2. There should be education among pottery producers to explore more into the use of clay to create more variety of clay product and better their lots
3. Researcher recommend that local speaker enclosure producers should try and experiment with clay in their production through organizing workshops for them.
4. The various institutions should encourage clay students on the benefits of producing various products with the local clay in Ghana.
5. Pottery production should not be looked down in schools but encouraged in order to come up with new ideas.
6. Clay products have several uses in everyday life, researcher recommends that the attitude towards our local products should change to promote its production and usage.

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## **APPENDIX ‘A’**

**KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY**

**DEPARTMENT OF INTEGRATED RURAL ART AND INDUSTRY**

**‘PRODUCTION OF CLAY SPEAKER ENCLOSURES.’**

### **INTERVIEW GUIDE**

1. What materials do you use to produce your speaker enclosures?
2. Why do you use this particular material?
3. Since when did you start using the material?
4. Are the materials easy to come by?
5. Are the materials expensive?
6. Have you thought of trying any other materials?
7. Do you think clay can be used to produce speaker enclosures?
8. Will you be interested to use such a product?

**APPENDIX 'B'**

**KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY**

**DEPARTMENT OF INTEGRATED RURAL ART AND INDUSTRY**

**'PRODUCTION OF CLAY SPEAKER ENCLOSURES.'**

**OTHER PICTURES OF THE PROCESSES**



















