CHAPTER NINE

Ceramic Clay: Meaning, Preparation and Methods of Production

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Introduction

Clay is a chief material used in ceramic production and as well the backbone of ceramic art. It is an abundant natural material that is found all around us, in gardens, fields, along riverbanks or roadsides which originated from feldspathic rock. Clay according to Igbinedion (1995) is a natural material found in the earth's crust or rock and it is characterized by plasticity when the appropriate amount of water is added. It can be defined as a heavy, damp, plastic material that sets upon drying and can be changed by heat into a hard, waterproof material. Clay can also be seen as an earthy raw material known for its sticky plastic nature. It is an earthy material that is soft and plastic when wet and very hard and rocklike when fired. It contains alumina, silica and water. However, clay is classified into two types; they are primary and secondary.

Primary Clay

This can be also called residual clay. They are clays that have not been transported anywhere, which is normally seen at the site of its formation. They are those clays formed from parent rock which are found at their

site of formation. They are usually white, do not contain impurities and are not plastic.
Example: Koalin

Secondary Clays

These can be also called sedimentary clays. They are those clays that have been moved from their original site to elsewhere by wind, flood**,** ice etc. This can be also seen as clay which has been transported from the site of the original parent rock. These clays can be found on the bank of the river, and on roads. They are earthenware, ball clay and stoneware. Secondary clays contain a lot of impurities like iron and organic matter which makes them vary in colour like brown, black, grey, green etc. They are very plastic.

Properties of Clay

The properties of clay comprise chemical and physical characteristics that can be seen to identify clay.
Chemical properties are Alumina, Silica, Hydrogen & Oxygen ($Al_2O_3+2SiO_2+2H_2O$). Physical properties are characterized by Plasticity, Shrinkage, Colour, Strength and Residue.

Plasticity: This is a property that enables clay to be deformed continuously under a force which exceeds a certain minimum value and to retain the new shape when the deforming force is removed or reduced below a certain value. It is also a property that helps clay to bend

to any shape or ability to retain any given shape when pressure is applied.

Shrinkage simply means the reduction in the size of clayware due to the loss of water when exposed to heat. It is also the decrease in the size of clay due to loss of water during drying and firing. During drying, water is lost from the surface of the clay, and as the water is lost, the clay particles come close together; in other words, it shrinks or contracts. During firing, some expansion takes place, and the porosity increases. As firing continues the strength of the clay is lower and some parts begin to melt thereby making the clay fuse together, the body shrinks and the porosity drops. All the water lost in both drying and firing brought about a reduction in the size of the clay work.

Colour helps in the classification of various clays both at the green stage and fired state (Otimeyin, 2008). Some clay appears white like kaolin while some appear red, brown, black etc., like ball clay, and earthenware clay. The colour of clays is affected by various oxides and impurities present. For example; when clay comes in contact with iron oxide and other dead organic matter, the colour will be brown.

Strength is very important in ceramic production because clay with high green strength and high fired strength will reduce handling breakages at both the green state and fired stage. This is the ability of the wet clay to withstand stress when handling. This is determined by the plastic nature of the clay.

The residue remains derived from sieving clay that could not pass through a mesh. These are particles that make up the clay. It comes in contact with clay during transportation. It varies in size. Such residues are sandstone, mica, quartz, feldspar, iron minerals etc.

Preparation of Clay

This can be done manually by two different methods

a. Dry method
b. Wet method

Stages of Dry Method

1. Dry the already-fetched clay under the sun.
2. Crush or pound with a pestle and mortar into smaller particle sizes.
3. Sieve with mesh to separate bigger particles from smaller particles.
4. Mix the sieved powdered clay with water.
5. Allow it to stay for some days for a further breakdown of clay.
6. Knead the clay for homogeneity, then store it for ageing.

Plate 1: Preparation of clay

Stages of Wet Method

1. Get already dried fetched clay and pour it into a sizeable plastic container that contains water.
2. Leave it for about five to six days to dissolve thoroughly.
3. Turn the clay with a long stick to loosen the remaining lumps.
4. Sieve with mesh by pouring the slurry clay to pass through the mesh into the container.
5. Leave the already sieved clay to settle at the bottom of the container for a day.

6. Decant the water from the clay and then pour the settled clay on a clay bat made with P.O.P. or cemented floor.
7. Depending on the weather, allow it to harden for about a week if it's the rainy season, but in the dry season, less than a week.
8. Knead and wedge the clay for homogeneity, then store it for ageing.

Modelling Techniques in Ceramics

Several methods of modelling in ceramic production include pinching, slabbing, coiling method, scooping, casting and throwing method.

Pinching

This is one of the oldest and most useful methods of production. It involves the palm and thumbs. It can be achieved by pressing in hand your thumb in a ball of clay on a palm and gradually forming a desired shape.

Slabbing

The constructive method of building pots and sculptures from slabs of clay is a relatively new development in ceramics (Charlotte, F.S; John, T, 2003). Slabs can be achieved by slamming lumps of clay on a flat board guided with wood, after which, use a roller to spread out the clay lump and as well maintain even thickness with a saw blade. Mark and cut the shape of each part with a knife when it is leather-hard. Join the

already cut-out shapes by fist scratching the surface and then applying the slips. Finally, use a saw blade to scrape the excess clay and dress the joints in and out.

Coiling Method

Coiling is an adaptable method for forming both sculpture and pottery, allowing one to achieve almost any shape, size or surface (Charlotte, F. Speight, John Toki, 2003). This can be achieved by first rolling clay lump on a flat surface to get coils, then the coils are placed in coil form on already made bases close to each other. Seal them together until the desired shape is achieved.

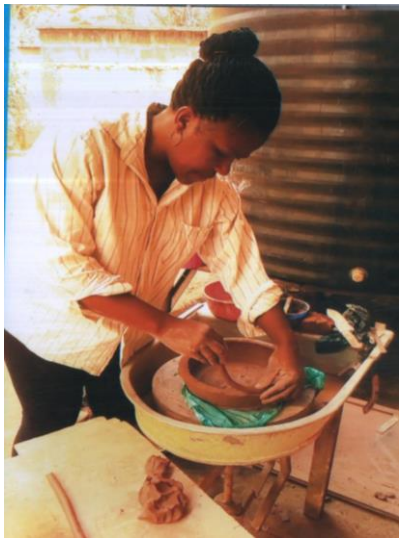

Plate 2: Coiling method

Scoop Method

This is one of the simplest methods of modelling in ceramics. This can be achieved by first modelling a particular object in solid then cutting it into two and using modelling tools such as a spoon to remove the unwanted clay from the inner part of the object to make it lighter. Scratch the surfaces of the two parts then apply slips and join them together, finally, dress the area so that the mark will not show.

Casting Method

This is a process that involves pouring a casting slip into a porous plaster of Paris mould, leaving it for a given time for total absorption of water by mould then excess slip will be poured out when the required thickness of the cast layer is achieved. When the cast is leather hard, it will be removed for proper smoothing and drying. Unlike clay used in throwing, the clay body for casting need not be very plastic to avoid excessive shrinkage.

Throwing Method

This is a process that consists of shaping a mass of spinning or twisted clay between the thumbs, fingers and palms of the hands. It is one of the fastest ways of producing pottery wares. Throwing is therefore the first or earliest mechanized aid used in the ceramic industry (Igbinedion, 1995). It is also useful in most institutions of learning for teaching ceramics. We have two types of throwing wheels; kick when and power wheel. There are

various operations in throwing a ware. Such operations include:

Centring: The first operation in throwing is to centre the lump of clay on the revolving wheel head. To avoid wobbly results, perfect centring must be achieved. This operation is done by forming a ball of clay, well kneaded and wedged, then stamping the lump onto the centre of the wheel. With the aid of two palms, the lump is forced down, centred and worked into a symmetrical form. In doing this, it is essential that water or slip is applied with a sponge, so that the clay flows through the hands easily.

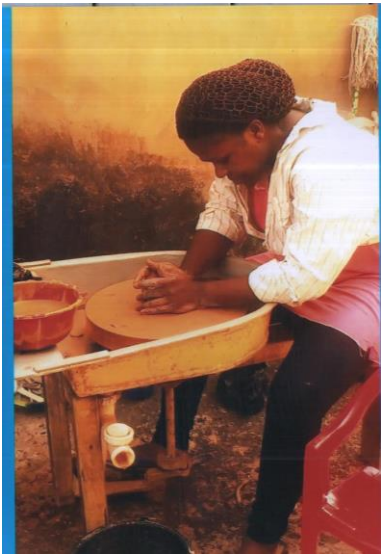

Plate 3: Centering

Opening up the Clay: This can be achieved by pressing the thumbs down through the centre of the clay, with the fingers on the outside of the ware as guides. To get the inner bottom diameter correctly, the opening operation has to continue. In this stage, water is also needed but excess of it will be removed with a sponge.

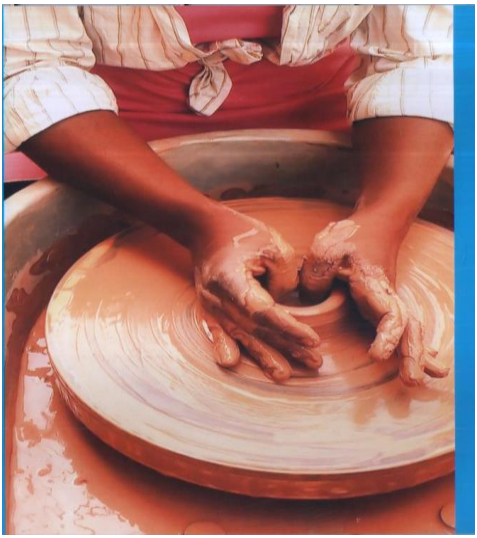

Plate 4: Opening up the Clay

Making a draft or Pulling to the desired Shape

This is drawing the clay up into a cylinder of desired height. It can be attained by using both hands, squeezing the lower wall between the thumb and fingers and slowly putting it upward. To make the wall thin down, gentle pressure should be added by both hands moving from

down to up, trimming the rim of the cylinder when the thickness is even.

Shaping or forming of the Pots; The shaping can be done by using the fingers inside and outside the cylinder with both hands. This operation is very simple if a good cylinder is made.

Cutting and Removing of the Pots: This is the use of cutting the wire to cut the pot at the base for easy removal from the wheel head.

Trimming and Putting the Foot of the Pot: This is done when the post is on a leather hard stage so that it cannot deform again. With the aid of leather hard clay, the thrown pot is centred on the wheel head then spatulas and other turning tools are used to trim the edges and put the foot.

Pulling and Fixing the Handle: In this stage, the handle is pulled out from a lump of clay and it is allowed to be leather hard to avoid distortion. Proper fixing is done by adding clay slip on the scratched surface of both the handle and the pot to ensure firmness.

Kiln Firing

The main aim of firing wares in ceramics is to change the clay from a green stage to a permanent stage (hard and rocklike). It is a process that brings about change in

ceramics after forming and decorating work is complete. Firing converts ceramic work from weak clay into a strong durable crystalline glass-like form. Ceramic work is typically fired twice. It is bisque-fired and glaze fired. (ceramicartnetwork.org, Dec. 1. 2021). This history of the kiln is the evolution over a long period from simple shallow pits into a fixed structure designed to direct and contain the heat of the fire (Okonkwo 2006).

The kiln is a box-shaped structure built to conserve heat used in firing ceramics wares. It can be further defined as an insulated refractory box which retains heat either by the combustion of some fuels or by the radiant heat of the electrically heating elements.

Modern kilns are built using refractory insulator ceramic fibre wool called *kaowool* that helps to retain heat in the chamber. Such kilns have control buttons for easy adjustment during firing. There are several types of kilns which this book will mention some, they are: Electric kiln, Downdraft, updraft, muffle, gas kiln, oil kiln, and wood kiln.

Bisque Firing

The goal of bisque firing is to convert greenware to a durable, semi-vitrified porous stage where it can be safely handled during the glazing and decorating process. It also burns out carbonaceous material (organic materials in clay, paper, etc). Before any work can be fired, it must be allowed to become completely bone dry larger or

thicker pieces of work must be left for a longer time to dry.

The drying process is complete in the initial stage of bisque firing known as "water smoking" at about 100^0c – 600^0c, chemically combined water escapes as steam. At this stage, vents are allowed to be open for the easy escape of steam. It is advisable to proceed slowly in this stage, too much haste will cause the steam to push open or explode the work.

This creates a thundering sound in the kiln as a result of shattering all the pieces of work in the kiln. This occurs mostly on thicker wall vases. To ensure that work is safe to be heated further, it is pertinent to leave a biscuit firing at a low temperature overnight with the kiln vents open.

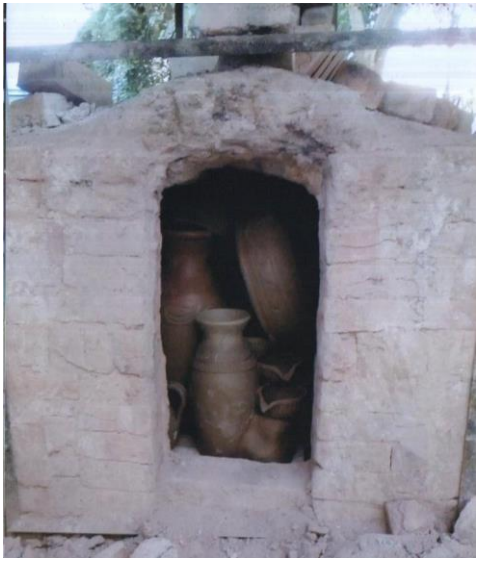

Plate 5: Bisque firing in a kiln.

Once, the initial firing is 600^0c and beyond, it is safe to turn up the heating rate, then close all the vents and proceed to the final temperature. Finally, the kiln is allowed to cool and offload at a very low temperature of about 50^0c.

Glaze firing

The temperature of glaze firing is determined by the glaze and clay body of the fired work. This should be started gradually. As the temperature rises to 600^0c, the rate of climb can be increased and the whole vents will be closed.

Plate 6: Glaze firing

During firing, the glaze fuses with not only itself but also with materials on the clay surfaces it lies on. This normally occurs in high-fired glaze-like stoneware glazes. The effect of heat on a glaze depends on the amount of time given to the final firing temperature. This combination of heat and time is called "heat works". It can be measured accurately by the pyrometric cones.

Vitrification occurs when the clay and glaze or colours come together and fuse. At the final stage, the glaze bubble and craters form as gas escapes and this may cause glaze defects called *pinholing* if it is not allowed to settle. But this will not result if the heat in the kiln is sustained at a constant temperature called soaking.

Evaluation

1. Explain two types of clay
2. Outline the methods of modelling with clay.
3. Define clay
4. Examine the physical properties of clay
5. Model a simple object of your choice.

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