ISSN: 6774 - 5001 INTERNATIONAL JOURNAL OF ARTS, HUMANITIES AND SOCIAL SCIENCES

THE CONSTRUCTION OF CLAY DRYER FOR SUCCESSFUL CERAMIC STUDIO PRACTICE

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ABSTRACT
It is important that potters understand the clay drying process to avoid problems. Understanding the clay drying process is a great way to protect your work from future cracks and warping. The clay drying process is, in many ways, more stressful to clay than the firing process. The period it take students to produce starts from the clay preparation which drying is one of them and an important stage as well. The clay dryer is very important and should be owned by every institution studying ceramics as to facilitate production. The clay dryer has been lacking in the Department of Fine and Applied Arts. The study will fabricate a clay dryer for a successful studio practice as it will look at the importance of plaster of Paris in the process of Fabrication. The study will employ the Design and Gestalt theories respectively. The studio design method will be adopted and will be carried out the ceramic unit of Department of Fine and Applied Arts Ignatius Ajuru University of Education, Port Harcourt. The clay dryer will be cited outside as to create more space for students to work.
Keyword: *Construction, Clay Dryer, Successful Ceramics, Studio Practice.*

1. Introduction

The drying of ceramic materials is a step that must be carried out under controlled drying conditions since poor drying results in low quality products. To optimize the process, it is necessary to know the characteristics of the clay used in the manufacture of the product. In this sense, there are several important properties of clay that must be considered in the process, such as plasticity, consistency index, resistance, water loss and shrinkage. Plasticity is the deformation of a body when subjected to a determined force that is retained after stress relief. The consistency index is the amount of moisture that a given sample must have to be properly shaped, being a measure of the workability of the sample. The strength of the clay body in the dry state is intricately linked to its granulometric composition, which is influenced by the drying rate. The removal of water depends strongly on operational conditions (temperature, relative humidity and speed), and the shrinkage phenomenon occurs because the place previously occupied by the water is empty during the drying process (Justice 2015).

The drying process is divided into two groups: natural drying and forced drying. The former is still widely used in small ceramic factories, as it does not require major technological procedures. However, natural drying results in some inconveniences, such as long drying times, excessive handling of pieces, occupation of large areas for the exposure of pieces and the need for favourable climatic conditions. The forced drying process, on the other hand, can eliminate all the previous inconveniences. It is not easy to eliminate the internal water of some clays when they are subjected to forced and fast drying cycles. The drying process should be controlled in a way that moisture leaves the clay body in balance, that is, a gradual migration of water from the inner body (diffusion) to the surface takes place being, in sequence, eliminated (evaporation). Therefore, the problem of drying ceramics is solved when the rate of evaporation does not exceed the rate of diffusion of water from the interior to the surface of the body. Consequently, water can diffuse and evaporate at a rate that does not damage the ceramic body that is drying up. Water will pass through the gaps left by the lamellar particles, that is, through the capillary channels formed by them, with a diffusion

rate that depends on the ceramic body temperature; the mineralogical nature of the clay; the size and shape of the particles and, therefore, the capillaries; the content of water; the dynamics shrinkage of the body; the ratio between the vapour tension of the liquid in the body and the vapour pressure of the air, that is, its hygrometric state and its relative humidity (Greg 2020).

These days, clay dryers are built using Plaster of Paris. This is because Plaster of Paris absorbs water and do not leave residuals in the clay body. Every individual practicing ceramic production and institution studying ceramics is supposed to have clay dryer to facilitate the process of production. As the case of the Department of Fine and Applied Arts, Ignatius Ajuru University of Education, Port Harcourt, the Ceramic unit needs multiple clay dryer to help in the process of ceramic production as to allow several students process their clay the same time. Hence, this studies, on "the fabrication of clay dryer for a successful ceramic studio production.

2. The Problem

Clay is a touchy material, and it is important that potters understand the clay drying process to avoid problems. You can hardly blame clay for being fussy. It undergoes a lot of physical and chemical changes from wet clay to glazed, fired, and finished piece. Understanding the clay drying process is a great way to protect your work from future cracks and warping. As Scott (20121) pointed out, rushing the clay drying process is almost never good and care should always be taken to help pieces dry evenly.

The clay drying process is, in many ways, more stressful to clay than the firing process. Uneven drying can lead to separation at small joints, and warped or cracked edges. While some clay bodies and forms are more vulnerable than others to these stresses, ensuring an even drying process before firing is always helpful.

Design Theory

Design theory by Robert H. McKim in the 1950's involves the fundamentals and principles of creating visual communication and all types of art. It deals with how we see and perceive visual information, and separate ideas of style, taste and trend from the universal principles of aesthetics that are common to every person. It is foundational to the pursuit of design and construction, photography, illustration and visual arts in general. This common visual language connects designers and image makers from history to current day and continent to continent (Heldman, 1996:90).

Design theory involves an understanding of the tangible elements including form, space, proportion, colour, scale, texture, structure (grid), composition, line, shape and volume and how to arrange them to achieve balance, rhythm, pattern, hierarchy, emphasis, and unity. Design theory, blended with a purpose or problem to solve, results in effective design solutions (Heldman, 1996:92).Markus (2002) take a more practical view of design theories, using these theories to explain the means ends relationship as a practical, prescriptively causal mechanism to justify design components.

The value of designers to their clients is the thinking and the ability to combine form (design principles) and function (the purpose of the design) to achieve an effective and pleasing result. Form and function as universally applied design concepts were first defined and formalized at the Bauhaus, and have been the basis for good design ever since. Software has changed the design process and the way we work with design elements, but it has not changed the elements themselves (Wiley, 2002:18).

The reason behind learning design theory is to make one become a Ceramic designer and not simply a Ceramic technician. When you understand the principles of balance, order, hierarchy, composition, structures, and the elements, colour, value, shape, space, scale, texture, etc," one will have the foundation to create effective, appropriate and appealing design, and be far more valuable to the arts than a "wrist" could ever be.

Design theory suits this research work in that it is an engineering work where a dryer will be designed to cover a gap of time wasting drying clay under the sun in ceramic production. It will solve

the problem of space. Since it will be built outside, there will be enough utility ground for students to work on. In the designing of the work, scales shall be taken for proportion and balance. At the end, the the dryer will be tiled for aesthetics and protection. The functionality of it covers effectiveness as it will meet its purpose of production. Though, the theory suits the work, it is not comprehensive enough to cover the research.

In the Ceramic Unit of the Department of Fine and Applied Arts, Ignatius Ajuru University of Education, Port Harcourt, the students forces their clay to dry to fast because of not having a facility to dry the clay as at when needed. The method the use in drying the clay actually results to the works produced with it not survive the firing process. Therefore, the students need clay dryers which are the main cross of this research work on "the fabrication of clay dryer for a successful ceramic studio production.

Concept of Clay Dryer

The clay dryer is mainly used for the drying of various types of clay mud such as bentonite, kaolin, aluminum, and iron clay, and solves some problems of sticking, crushing, and drying. Dingli Group successfully launched the bentonite dryer according to this development direction. The bentonite dryer can adapt to various fuels such as coal, oil, gas, etc. At present, the fluidized boiler is favoured by users due to its convenient operation, energy saving, environmental protection, and easy purchase of raw materials. Some manufacturers also choose natural gas or coal gas generators for conversion, and the gas is burned for a second time to achieve the drying effect. It conforms to the country's policy of creating an environment-friendly and resource-saving society and is an environmentally friendly and energy-saving product that replaces traditional drying equipment (Scott 20121).

The drying system is mainly composed of a hot air stove, belt feeder, drum dryer, belt discharger, induced draft fan, cyclone dust collector, bag dust collector (or wet dust collector), and operation control system. The equipment adopts a downstream drying process, and its working principle is as follows: After the wet material enters the drying drum, it is divided into the following working areas: One is the guide area, where the mineral slag enters this area and contacts with the high-temperature hot air to quickly evaporate water, and the material is at a large lead angle When the material guide plate is moved, it is led to the next working area; the second is the plate cutting area, where the mineral slag is picked up by the plate to form a material curtain. At this time, the material is in full contact with the hot air, and the slag in the mineral slag The water evaporates and strips into water vapor, and the water vapor is drawn away by the induced draft fan, so as to achieve the purpose of drying the mineral slag; the mineral slag is dried into a loose state with moisture less than 5% (or lower) in this area. After the heat exchange, the material reaches the required moisture state and enters the final discharging area; the third is the discharging area, where the drum is not equipped with a copy plate, and the material rolls and slides to the discharge port in this area to complete the entire drying process (Donatus, 2021).

Clay Preparation in Practice

Clay preparation starts with the mining of the clay. For small scale production units with the clay pit nearby, most potters will have only a small stock of clay available at the factory and dig and transport the clay to the factory as and when needed. Larger production units may subcontract the clay supply. In both cases sufficient supplies should be available to meet requirements over any period when the clay pit may not be accessible.

Where the semi-dry method is used, the clay will subsequently have to be dried, depending on the moisture content of the clay as delivered. Normally, if left in an uncovered stock, wind and sun will be sufficient to dry the clay.

Crushing

Crushing the clay can be done in two ways: manual or mechanical with roller mills, pan grinders, disintegrators, hammer mills, jaw crushers, etc. Most methods will work well even when the clay still contains some moisture, with the exception of a hammer-mill which needs dry clay. Crushing the clay manually with the help of heavy wooden pestles and hammers can be done, but it is a tedious, time consuming and dusty method. Two people working could possibly prepare from about 500 to 1,000kg of clay per day, depending on the hardness of the clay.

Another method is a foot operated crusher with the wooden or metal (or stone) pestle attached to a lever beam. By stepping on one side of the beam and by letting it fall by its own weight the clay is crushed in the mortar. The system is simple and cheap and can easily be locally made. The capacity is low and two people are needed to operate it: one stepping on the lever beam, the other adding and removing crushed clay in the mortar.

When using mechanical means, the equipment available or which could be locally made, as well as the availability of capital, will be a limiting factor. A cheap and simple solution but which needs sufficient space is a heavy concrete roller on a concrete floor. The concrete roller is attached to a beam, fixed to a central pole. A draft animal is used to rotate the roller by pulling it in a circular fashion. One person turns the clay and keeps it in the path of the roller. However, for very hard clay this system does not work well. A more mechanized system is a pan grinder. Two heavy cast iron rollers, turning at a speed of about 200 rpm move in a circular way inside a tub-like enclosure. Part of the bottom of the tub is perforated and part is not and scrapers push the clay in front of the rollers.

The crushed clay in all cases will have to be sieved to remove the larger particles. The upper limit of what can be allowed in a clay mixture to be used for stove production will have to be found out experimentally. In Kenya an upper limit of 5mm is taken as it has been shown that these particles will dissolve in the subsequent process of mixing with water and soaking or "souring". Any material sieved out can again be fed into the crushing equipment for further crushing and pulverising.

Each step in the process of producing and handling dry pulverised clay is a dusty undertaking. Workers should be supplied with face masks. Breathing in the clay dust can cause silicosis, an irreversible lung disease. Daily exposure to large amounts of dust can lead to death within a few years and bronchitis in a matter of months.

Research Design

The research design is practice led as it deals with the fabrication of clay dryer for the ceramic unit of the Department of Fine and Applied Arts of Ignatius Ajuru University of Port Harcourt. The researcher employed the use of ceramic studio to execute the job. Therefore this research is studio based and adopted the studio based research design.

Area of Study

The research was carried out in the ceramic Unit of Department of Fine and Applied Arts of Ignatius Ajuru University of Port Harcourt.

Data collection

The Theoretical materials used for this research were sourced from primary and secondary sources. The primary source materials were gathered from oral discussions which took place between the researcher and the ceramics lecturers and students of the ceramic unit. The secondary source materials were retrieved from libraries, research report booklets, textbooks, magazines, the internet etc.

Materials for the Practical Work

The materials for the study such as Plaster of Paris and cement were sourced from the art market.

Why choose Plaster of Paris for the clay dryer

Scott (20121) noted that in pottery, plaster refers to a material commonly used for various purposes, including creating molds, drying pottery, and controlling moisture during the ceramic process. Plaster plays a crucial role in shaping and refining pottery objects. Consider the nature of your project, the desired level of detail, durability, and firing requirements, to make an informed decision. Remember, P.O.P have strengths and can be utilized effectively in different pottery contexts (Mendy, 2009).

Here are two primary applications of plaster in pottery:

Mold Making: Plaster is extensively utilized in the creation of molds for pottery. It is poured into a mold frame that contains the desired shape or pattern. The plaster absorbs water from the clay, causing it to harden and solidify. Once the plaster mold is fully dry, the clay can be pressed or poured into the mold, allowing it to take the shape of the mold and facilitating the reproduction of identical pottery pieces.

Drying and Absorption: Plaster bats or plaster slabs are frequently employed in pottery to assist in the drying process. These are flat, porous surfaces made of plaster that absorb moisture from freshly formed clay objects. By placing the pottery on a plaster bat, excess moisture is drawn out from the clay, allowing it to dry evenly and gradually. Plaster also helps prevent warping or cracking during the drying phase (Scott 20121).

Moreover, plaster is utilized in other pottery techniques such as slip casting, where liquid clay (slip) is poured into plaster molds to create hollow forms. The plaster absorbs water from the slip, resulting in a layer of solidified clay on the mold's interior, which is then removed to create the final pottery piece.

Overall, plaster in pottery serves as a versatile material that aids in mold making, drying, and controlling moisture, enabling potters to achieve desired shapes, textures, and consistency in their ceramic creations.

3. Conclusion

Pottery plaster, also known as pottery plaster of Paris or ceramic plaster, is a specific type of plaster that is specially formulated for use in pottery and ceramics. It is a variant of plaster of Paris, but with specific properties tailored to meet the needs of pottery making. Pottery plaster is primarily used in mold making and other pottery-related applications. Here are some key characteristics and uses of pottery plaster: Pottery plaster is widely used in the pottery and ceramics industry for mold making, slip casting, and other related applications. Its specific properties make it a preferred choice for potters and ceramic artists who require high-quality, durable molds that can capture intricate details and withstand the firing process (Mascot, 2020).

Pottery Plaster is specifically formulated for ceramic work. It is renowned for its exceptional strength, durability, and ability to capture intricate details. Pottery plaster is often preferred by professional potters and artists due to its superior quality and reliability. It has a fine particle size, which results in a smooth finish and minimizes the risk of cracking during drying and firing processes. Pottery plaster also offers excellent absorption properties, making it ideal for creating molds, slip casting, and creating precise replicas (Flinge, 2022).

These days, clay dryers are built using Plaster of Paris. This is because Plaster of Paris absorbs water and do not leave residuals in the clay body. Every individual practicing ceramic production and institution studying ceramics is supposed to have clay dryer to facilitate the process of production. As the case of the Department of Fine and Applied Arts, Ignatius Ajuru University of Education, Port Harcourt, the Ceramic unit needs multiple clay dryer to help in the process of ceramic production as to allow several students process their clay the same time. Hence, this studies, on "the fabrication of clay dryer for a successful ceramic studio production.

4. Recommendation

Based on the findings of this study, the following recommendations are made:

The authorities of any institution, NGOs or the government should furnish the ceramic studio or workshops with equipment like the clay dryer

Ceramics students in higher institutions of learning and workshops practicing pottery should be encouraged and support provided with incentives to carry out relevant research in their various areas as to benefit the environment they find themselves
There is always the need to sensitize students to research in areas that will benefit mankind.

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