

**A REVIEW OF THE ASSESSMENT OF CERAMICS AND SLIP CASTING IN THE
INDUSTRIAL ARCHITECTURE IN BAYELSA STATE.**

BY

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ABSTRACT

The aim of this paper is to theoretically address and review “The Assessment of Ceramics and Slip Casting” as a growing industry in the study area. Mould making and slip casting is a complex activity in the ceramics processing, yet they are very fascinating. Today, it is purely an industrial process of ceramics production that is gradually being integrated into the potter’s studios.

The reasons for adopting slip cast ceramics in the manufacturing of pottery wares vary. These include uniformity of wares, good surface finishing, promotion of mass-production of wares on an industrial scale, provision of opportunities for unskilled personnel in the pottery manufacturing industry, and ease of making the finishing of intricate and moulded forms.

This project, therefore, is aimed at producing casts from moulds, and document the processes involved. It is hoped that this document will provide potters, as well as future researchers, with a fair knowledge of mould casting of ceramic wares using plaster moulds for reference, and encourage them to experiment the process themselves.

Key words: *Assessment, Ceramics, Slip Casting, Mould Making and Bayelsa State.*

INTRODUCTION

Bayelsa state will soon become an industrial hub for ceramics in Nigeria. This is largely due to the relevance of the physical and natural environment. The physical environment is endowed with abundant elastic clay soils. Given the geographical nature of the state, ceramic production in Nigeria may soon shift its base Bayelsa state owing to its abundant soil resources. One major advantage to the industry is the locational factor. Clay soil is abundant in all the communities and local government areas within the study area. The industrialization of the ceramic industry is becoming increasingly popular, and the presence and awareness of clay soil is becoming more relevant to the industry.

Clay is the result of the natural decomposition of certain igneous rocks such as granite and feldspar, which break down over time due to natural processes. As these rocks decompose, they turn into tiny, flat particles called platelets. Clay soil is the raw material mined from the earth, consisting of grained minerals. Ceramics, on the other hand, are hardened finished products made by shaping and intensely heating or firing clay. Clay ceramics are inorganic, non-metallic solids primarily made from clay and sand, and they are utilized for various applications such as art ware, pottery, and bricks. They have been used for thousands of years and are characterized by their ability to be burned to form durable structures (German, 2014). Archaeological findings show that shaped clay ceramic bodies were fired in open fire pits as early as 24,000 BC in what is now the Czech Republic. This was followed by the periodic advancement in ceramic production. Krishnakumar and Bejoy (2023) opined that the concept of photocatalytic applications of ceramics and generally classified ceramics into structural and traditional ceramics. The traditional ceramic objects are almost as old as the human race. Krishnakumar and Bejoy (2023), for instance, opined that naturally occurring abrasives were undoubtedly used to sharpen primitive wood and stone tools, and fragments of useful clay vessels dating from the Neolithic Period have been found (Bruce et al., 1947).

Slip casting technique is a fundamental process in ceramics design and production that opens up a multitude of possibilities for the creative potter. It promotes the development of valuable skills by ensuring the ability to design, own models and make casts out of it. It is a unique manufacturing process that was once regarded as an industrial technique but is now beginning to play an important role in the studios of artist potters. It presents the potter new and acceptable challenges daily, thereby expanding his creative horizon. Historically, before the advent of Plaster of Paris for mould making, objects such as baskets, wooden bowls and some other hollow containers were used as moulds. “Baskets were also used by Neolithic peoples as moulds into which clay was lightly pressed and smeared. It was necessary for the weave and shapes to be such that would allow the clay to come away easily as it dried and contracted.” (Leach, p.64). Then came the biscuit moulds, which have been successfully used even up till today in China and some other communities. “In pre-industrial times, biscuit clay moulds were employed on a small scale” (Leach p.93).

Two important things that architecture can give to humanity and its environment are shelter and beauty (Peter and Asante, 2016). Architecture, for instance, provides shelter for its users when walls are roofed. Roofs are made over buildings while doors and windows are provided to give security, ventilation and comfort. After all these have been provided, beautiful and befitting colours are chosen to paint the walls. This can be achieved by employing ceramics sculptor.

Slip casting technique is a fundamental process in ceramics design and production, which opens up a multitude of possibilities for the creative potter. One of the easiest ways to distinguish old products from the new ones is to learn about slip casting. Slip casting, in general, is a process developed for high speed, low skilled factory production (Mark Chervenka, 1998). Slip casting usually suggests that an item is new, reproduced or at the very least, modern. Before the widespread use of slip casting, most ceramic and pottery items were made almost entirely by hand. Clay was either pressed into a mould by hand or made on a potter’s wheel, both of which were relatively slow and labour intensive processes. Slip Cast Ceramics encourage potters to use the slip casting method because it facilitates the mass production of ceramics without requiring any particularly specialised equipment and it can be carried out in studios. Depending on how many moulds available, slip casting can produce hundreds of identical pieces. Some potters tend

to favour specific methods of ceramic design, and slip casting makes pieces that are tricky to create on the wheel much easier to produce.

A significant advantage of slip casting is that it allows wares such as a jug with a handle to be made as a single piece. Slip casting is also an excellent method for creating more complicated pieces, such as a teapot (Sara D' Souza, 2017).

The ceramics industry holds significant potential for economic growth, employment generation, and cultural preservation in Nigeria (**OLOTU and Peters, 2026**). The functions of Ceramic and Sculpture in the Development of Nation building cannot be over emphasized (Oparaocha& Peters). The practice of pottery and Ceramics in Nigeria are commonly found among the womenfolk.

Contemporary Ceramic Design and Technology have undergone significant evolution, driven by the fusion of traditional craftsmanship with Modern Advanced Technology (Tam-George and Peters, 2024). This is why professionals require strategic planning, education of the masses and availing the professionals in public discussions. Generally, ceramics education has shifted towards interdisciplinary approaches, incorporating advanced materials science, digital fabrication, and sustainable manufacturing techniques (Binner et al., 2020).

The functions of Ceramic and Sculpture in the Development of Nation building cannot be over emphasized (Oparaocha& Peters) and the practice of pottery and Ceramics in Nigeria are commonly found among the woman folk. Contemporary Ceramic Design and Technology have undergone significant evolution, driven by the fusion of traditional craftsmanship with Modern Advanced Technology (Tam-George and Peters, 2024).

Ceramics is one of the most ancient industries, going back thousands of years. Once humans discovered that clay was abundant and could be formed into objects by mixing it with water and then firing, a key industry was born. The oldest known ceramic artifact is dated as early as 28,000 BCE, during the late Palaeolithic period. It is a statuette of a woman named the Venus of DolniVestonice, from a small prehistoric settlement near Brno, in the Czech Republic. Archaeologists have uncovered human-made ceramics that date back to at least 24,000 BC. These ceramics were found in Czechoslovakia and were in the form of animal and human

figurines, slabs, and balls. These ceramics were made of animal fat and bone mixed with bone ash and a fine claylike material. After forming, the ceramics were fired at temperatures between 500-800°C in domed and horseshoe-shaped kilns partially dug into the ground with loess walls. While it is not clear what these ceramics were used for, it is not believed that they served a utilitarian purpose. The first use of functional pottery vessels is thought to date back to 9,000 BC. These vessels were most likely used to store grain and other food items.

Concept of slip casting

Sara D' Souza (2017), in an article "*Slip Cast Ceramics*", encourages potters to use the slip casting method. She noted that slip casting facilitates the mass production of ceramics and does not need any particularly specialised equipment, as it can be done in a studio. Depending on the number of moulds available, slip casting can create hundreds of identical pieces. Some potters tend to favour specific methods of ceramic design, and slip casting makes it much easier to create forms that are difficult to achieve on the wheel. Another brilliant benefit of slip casting, as pointed out, is that it allows wares such as a jug with a handle to be made as a single piece. Slip casting is also an excellent method for creating more complex pieces, such as a teapot.

The functions of Ceramic and Sculpture in the Development of Nation building cannot be over emphasized (Oparaocha & Peters). The practice of pottery and Ceramics in Nigeria are commonly found among the woman folk. Contemporary Ceramic Design and Technology have undergone significant evolution, driven by the fusion of traditional craftsmanship with Modern Advanced Technology (Tam-George and Peters, 2024).

In the case of combining different production method in one piece, Paul (2016) expresses the relevance of using a particular slip. Ready-made casting slip is commercially available in all firing ranges, making it very convenient. Although it is possible to combine hand built or thrown elements in your slip cast pieces, it can be very difficult to find a casting slip with the exact same shrinkage and absorption characteristics as your regular throwing or hand-building clay body.

A common studio challenge is trying to keep the number of different clay bodies on hand to a minimum. Throwing, hand building, casting and surface design techniques often require different clay bodies to suit the demands of how your work is created. Sometimes the clay bodies also

need to be in different forms such as regular moist clay, slip or casting slip. For instance, if you are hand building with a cone 6 clay body and want to add a slip-cast element to it, you may be hard pressed to find a commercial cone 6 casting slip with the exact same shrinkage and absorption characteristics.

Mark Chervenka (1998) in his writing “*Clauses to Modern Ceramic Reproductions*”, stated that one of the easiest ways to separate old products from new ones is to learn about slip casting. Slip casting, in general, is a process developed for high speed, low skilled factory production. In other words, slip casting usually means that an item is new, reproduced or at the very least, modern. Before the widespread use of slip casting, most ceramic and pottery items were almost entirely made by hand. Clay was either pressed into a mould by hand or made on a potter’s wheel, both of which were relatively slow and labour intensive.

In addition to increasing production speed, slip casting also saves time and money by using fewer and simpler moulds. Although the majority of all new decorative ceramic and pottery reproductions are made through slip casting, certain shapes are easier to identify than others. Fortunately, the most popular pieces to reproduce, pitchers and figurines, are also the easiest pieces to detect as new.

Jennifer Harnetty (2016) observed that moulds are a simple way to create either simple or complex forms and to make multiple copies of them with little effort. With the construction process simplified, the individual forms lose their preciousness, thereby allowing freedom for creative experimentation. This was similar to how Christiana Liu (2014) described her first experience using the slip casting method.

According to Christina, “I have spent the last few months taking a slip casting course at green which house pottery. I had never done any kind of mould making or slip casting before, so immediately after the first class, I felt like I had gained access to a whole new world of possibilities. It is been interesting figuring out how to use the slip casting process to my advantage, to make pieces that come from the same mould, yet are still unique and retain a handmade spirit. My processes eventually become taking my slip-cast forms and breaking the rims of each piece to create a rugged, jagged horizon. Then, I take a sponge and gently smooth those jagged edges into rounded, undulating slopes”. Thus, while the pieces might share the

same basic form, each individual piece has to go through a transformative process in my hands to emerge as completely unique.

Another Potter in an interview titled “*Experience with the Mass Production of his Pottery*” by Jennifer Harnetty (2019) shared his experience. He opined on the reason why someone who has spent most of his adult life pursuing excellence in handmade pottery enthusiastically pursue mass production.

That is the question potter, ceramics consultant, inventor, and entrepreneur David Pier asked himself when he faced the conflict between wanting to maintain high levels of craftsmanship and design while still keeping the prices on his pots affordable. As a result, he explored the option of having some of his pots mass produced. What he learned from this experience, as he shared with Jennifer Harnetty, might surprise you and, if I know my readers, it will definitely spark some debate. According to David from early on, he felt a conflict between his desire to perfect his designs and his desire to price pots low enough so that the cost would not negate their functionality. He never bought into the dogma of the humble potter, but he was also not happy making only pedestal pieces for collectors while there are obvious shortcomings in the quality and design of most mass-produced items. He said “I never disapproved of the concept of mass production. In fact, as my work developed over the years, I start to wish I could have my items mass produced. While I understand the many positive attributes of the unique or limited-production of handmade pots, I also value the benefits of mass production”.

According to Antonio Licciulli (2011), slip casting is the process of filling a porous mould, usually a gypsum mould, with a ceramic slurry. The water is removed from the slurry through capillary action via the small pores in the mould. As the water is removed, the ceramic particles are collected against the surface of the mould. This process is allowed to continue until the correct thickness is achieved, after which the remainder of the slip is drained out of the mould. The green body is dried further and removed from the mould. After the removal, it is dried and fired so that it can undergo the final machining process.

However, Antonio stated that avoiding defects during the process is vital. Here are some of the merits and demerits of using of slip casting methods.

The Advantages Ceramics includes:

1. Low capital investment required to start production.
2. Highly homogeneous slurries and ceramics can be produced.
3. A wide variety of complex shapes can be produced that could not be produced using other conventional methods.

The disadvantages are:

1. In comparison to dry pressing or powder injection moulding, lower dimensional precision can be achieved, and the production rate is lower than the rate of dry pressing, injection moulding or extrusion.
2. Differential shrinkage can be as a result of the packing factor gradient which can be induced in the moulds during water removal.
3. The moulds used are not so tough so they can fracture easily so, a large mould inventory has to be maintained, in order to ensure a constant production rate.

F. Singer, Chapman & Hall (1971) stated that ceramic mould casting, also ambiguously known as ceramic moulding, is a group of metal casting processes that use ceramics as the mould material. It is a combination of plaster mould casting and investment casting. There are two types of ceramic mould casting; the Shaw process and the Unicast process. These casting processes are commonly used to make tooling especially drop forging dies, as well as injection moulding dies, die casting, glass moulds, stamping dies and extrusion dies,

Unicast Process

The Unicast process is very similar to the Shaw process, except it does not require the mould to be ignited and then be cured in a furnace. Instead, the mould is partially cured so that the pattern can be removed, after which it is completely cured by firing it at approximately 1,900⁰F (1,980⁰C). If a metal with a low melting point is cast, the firing process can be skipped because the mould has enough strength in its “green state” (unfired state).

History of Slip Casting

This process was introduced into many European porcelain factories in the eighteenth century and was commonly employed for the casting of terracotta sculptures in the nineteenth

century. Today, many common items such as figurines, doll faces, dishes, flower pots, lamp bases and toilets are produced using this mass production technique.

Slip casting is the process in which a suspension of metal or ceramic powder (slip) in water or other suitable liquid is poured into an absorbent, Plaster of Paris, mould dried and subsequently sintered. Slip are usually made up of powder, a dispersing agent to stabilize the powder against colloidal forces, a solvent to control the slip viscosity and facilitate casting, a binder for giving green strength to the cast shape, and plasticizer to modify the properties of the binder.

HISTORY OF CERAMICS

Ceramic is one of the most ancient industries, going back thousands of years. Once humans discovered that clay could be found in abundance and formed into objects by first mixing with water and then firing it, a key industry was born. The oldest known ceramic artefact is dated as early as 28,000 BCE, during the late Palaeolithic period. It is a statuette of a woman, named the Venus of Dolni Vestonice, from a small prehistoric settlement near Brno in the Czech Republic.

Archaeologists have uncovered human-made ceramics that date back at least 24,000 BC. These ceramics were found in Czechoslovakia, took the form of animal and human figurines, slabs, and balls. These ceramics were made of animal fat and bone, mixed with bone ash and a fine claylike material. After forming, the ceramics were fired at temperatures between 500°C and 800°C in domed and horseshoe shaped kilns, partially dug into the ground with loess walls. While it is not clear what these ceramics were used for, they are not thought to have been utilitarian. The first use of functional pottery vessels is thought to be around 9,000 BC. These vessels were most likely used to hold and store grain and other foods (Turan Tambas, Z. Engine Erkmen and Serdar Ozgen (2019).

It is thought that ancient glass manufacture is closely related to pottery making, which flourished in Upper Egypt about 8,000 BC. While firing pottery, the presence of calcium oxide (CaO) containing sand combined with soda and the overheating of the pottery kiln may have resulted in a coloured glaze on the ceramic pot. Experts believe that it was not until 1,500 BC that glass was produced independently of ceramics and fashioned into separate items. Since these ancient times,

the technology and applications of ceramics (including glass) has steadily increased. We often take them for granted. Below are just a few examples of how important ceramics are to society.

Safety Precautions:

When mixing powders, be cautious not to breathe in the loose powders (a dust mask can be worn for protection). Always wear safety glasses. If using heat lamps to dry moulds/parts, the lamps will be hot so caution should be used when working around them.



Ceramic materials, in the form of clay figurines and pots, were the first man-made materials over 10,000 years ago and may be even as long as 25,000 years ago. We have come a long way since then and now use ceramic materials in applications ranging from artificial bones to light-weight body armour, and even coatings on the leading edges of hypersonic vehicles. Since ceramics have very high melting temperatures, they are not as easy to shape into complex forms as metal or plastics, which are typically melted, poured into moulds, and are allowed to cool to achieve the final object.

In studying the slip casting method, we can gain a better understanding of how materials can be utilized to create simple or intricate parts for various industries. It is important to learn about the various components that make up slip casting method as it is one of the most widely used today.

First and foremost, it is necessary for the student or potter to have a greater understanding of the basic technique in which gypsum-plaster moulds are created. Gypsum plaster, or plaster of Paris is one of the most commonly used materials producing porous mould for slip casting. It is used because it has the property of absorbing water from a liquid suspension called slurry or slip. For instance, the removal of the water leaves behind a relatively strong clay object.

The plaster mould reproduces fine details in a mould that can be easily trimmed and manipulated. Typically, plaster of Paris can be found in art, hardware, and hobby stores. When the plaster of Paris powder is mixed with water, it reforms into gypsum. One important thing to know is that the ratio of water to gypsum in the mould suspension will have a direct effect on the time it takes to remove water from the cast.

The advantage of this technique is that is inexpensive and time efficient for casting complex parts when compared to other conventional methods. When gypsum is mixed with water, it hardens very quickly, and the mixture heats up rapidly. The reaction is very exothermic. It is importance to wear safety glasses and gloves when mixing the gypsum and water suspension because the chemical reaction can cause skin irritation.

Ceramic materials also possess high hardness, meaning they are difficult to cut into complex shapes. Another method used to form complex shapes of metals and plastics is slip casting. One of the more sophisticated methods manufacturing ceramics into complex shapes used today is called slip casting. Slip casting is a method used to make the shapes such as coffee cup without the use of heat. Heat is usually applied after the material has been formed into the desired shape, in ceramic processing that processing is called sintering (Andrew, P.W. (2016).

By mixing a fine ceramic powder in water, along with some chemicals that help the powder disperse throughout the liquid, you create what is called a slip. A slip is fluid but contains solid particles. For instance, porcelain slip is made from a mixture of clays and minerals. Because the ceramic powder does not dissolve in the water, the solid particles remain after the water is removed.

In slip casting, the slip is poured into a mould that removes some of the liquid from the slip near the mould wall. This occurs because the mould is porous, and the liquid drawn into the pores by capillary action. This is the same force observed when a straw is inserted into a drink; the liquid is drawn up the straw by capillary action. The moulds used for slip casting are usually made of plaster. They are formed by mixing gypsum and water in a 4:3 ratio and allowing the mixture to harden around a replica of the shape you wish to produce.

CONCLUSION

The ceramic industry is still at the developmental stage. This study highlights the prospects of ceramic design and production using slip casting method to produce cups, jugs, tiles, flower vase, etc. The knowledge gained from this study serves as a reference point for prospective industrialists and students alike to practice at small, medium and large scale levels, as the industry continues to advance into the digital stage.

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