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The Relevance of Composite Technique in Ceramics Practice

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Abstract

Ceramics, the science and art of burnt clay is a three-dimensional art that creates forms in the round, having length, width and height, thus possessing volume and depth. Potters have been quarrying, processing, formulating, blending and producing potteries with clay as the major material. Over the years, potters have limited themselves to the production of a piece with two or more forms from two or more production techniques as the only composite technique in ceramic practice. This paper therefore brings to the fore, the relevance of composite technique in ceramics general practice as regards composite materials, composite devices, composite pots and composite equipment brought together to create a unified whole.

Keywords: *Quarrying, Formulation, Composite, Visual devices, Unified whole*

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Background to the Study

Ceramic, the science of baked, fired, burnt or vitrified clay has over the years been adapted by artists and craftsmen for the production of earthen vessels and other forms or wares for either instrumental uses or beautification of our environment. This of course forms the three core design principles of firmness (firmitas), utilitarian (utilitas) and aesthetics (venutas). The material, clay which is the major material for pottery is the product of igneous rock formed as a result of mechanical, chemical and biological weathering of the rock. As a result of this, there is clay in almost every community in the world and this together with other natural elements such as water, sun, air and fire and man's desire to solve his daily problems, made the discovery of ceramics or pottery possible in many areas of the world at different periods. Clay in itself is a very interesting material fetched in lumps, offshore or onshore, powdery when crushed at its bone-dry state, disintegrates or slakes when soaked in water, malleable and plastic when gathered into wet lump and hard, rock-like, dense, vitreous and impermeable when baked or fired. It is interesting therefore to know that in all the communities in history where pottery is practiced, the production techniques remain almost the same and these also determine the tools and equipment. In pottery practice, the malleability or pliability of the clay determines the tools which are either purchased from the shop, picked from the environment or formed based on the problems encountered by the potters.

The basic techniques of pottery production include hand building technique, wheel throwing technique and the casting technique. While the wheel throwing and the casting techniques have been highly mechanized in many societies, the hand building technique which involves pinching, coiling and slab methods has remained almost the same. This is due to the fact that many potters do not have the funds to acquire the potter's wheel and the jigger and jolly machine or acquire the special skills required to use them. Many potters also lack the skills to produce Plaster of Paris (POP) mould and to formulate casting slip for slip casting. To this end, the highly mechanized wheel throwing with the jigger and jolly machine and the slip casting techniques which aim at mass-producing potteries are done in the industry. However, composite technique in ceramics practice is when a ceramist, especially the studio potter introduces useful ingredients or substances into a lump of clay to formulate a new and workable clay body, selects the necessary visual elements of design to create a unified and tangible entity as band-built forms, wheel-thrown forms and casted forms, and when he combines the forms in a hand-built approach to arrive at a new and very interesting form, usually referred to as a composite ware, and when vital parts are sourced and put together to create a unified equipment.

Aim and Objective

The aim of this paper is to highlight the relevance of composite technique in ceramics practice. The objectives will be to find out if actually composite technique exists at all in ceramics practice, to see the possibility of composing two or more necessary visual devices for the creation of a pottery form, to examine the possibility of selecting two or more vital substances as additives and modifiers to clay to create a superior material, and to explore the possibility of adopting the composite technique in the different areas of ceramics practice to produce superior materials, equipment and potteries.

Literature Review

Theoretical Framework

This study is premised on the Gestalt's Principle propounded in 1890 by Max Wertheimer, along with Kohler and Koffka. The theory focuses on the idea of "grouping". Wertheimer [1], who was especially concerned with problem solving opined that, it is the characteristics of stimuli that cause man to structure or interpret a visual field or problem in a certain way. According to Archi, [2], there are four primary factors that determine grouping, which include;

1. Proximity – elements tend to be grouped together according their nearness
2. Similarity -- items similar in some respects tend to be grouped together.
3. Closure – items are grouped together if they tend to complete some entity, and
4. Simplicity – items will be organized into simple figures according to symmetry, regularity and smoothness. These factors are called the laws of organization, explained in the context of perception and problem-solving

The Gestalt's principle is very relevant to this study of composite technique in ceramics practice since the vital materials selected to form the superior composite material, the vital visual elements selected to organize clay into unified tangible form, the different shapes selected and built into a composite piece and the deferent pieces of waste or found materials gathered and assembled (fabricated) by creative potters into deferent equipment for pottery practice are based on proximity, similarity, closure, simplicity, continuity and multi-stability. .

Clay

Ceramic practice begins with the major material, clay. Gilbert [3], Chapman [4], Omuaru [5], Grimmer and Konnard [6] and Memmott [7] agreed that clay is a wonderful earthen material, plastic when wet, non-plastic when dry and permanently hard, dense and vitreous when fired. Grimmer and Konnard [6] further added that clays exhibit several mineralogical and physical characteristics and understanding these properties helps the ceramist in proffering adequate solutions to his environmental issues in his practices. An accurate determination of the properties of clay will make appropriate application possible. Grim [7], posited that clays, products of weathering formed by hydrothermal action have been deposited as sediments. According to Savic et al [8], its malleability has made it useful in the production of utilitarian wares for homes, architectural, engineering, power and health sectors. Clays are also found to be useful in the building of furnaces for metal smelting and glass blowing, kilns for the conversion of clay to ceramic and incinerators for waste management while the excellent colloidal property of Bentonite, a type of clay has made it useful as drilling fluid for drilling boreholes and oil wells. Memmott [7], opined that the way of clay is to understand the nature of clay, its wonderful plastic response when handled with love and care, and its collapse and disintegration when maltreated, overworked and strained beyond its capabilities. To have a successful ceramics practice therefore demands a proper study and understanding of the factors that regulate the properties of clay such as the composition of the clay mineral, non-clay mineral composition, organic minerals and textural factors.

It is the rock mineral content and the mineral deposits from the host environmental components that define the clay mineral. Minerals are the variables which can be referred to as impurities, contaminants, pollutants or even modifiers in the clay depending on their

appearance in relation to size, colour, quantity and the purpose to which the clay is to be applied. When the number of impurities in clay, such as feldspars, mica, iron oxide, quartz and many other minerals on the earth crust is being taken into consideration, several researchers maintained that it is impossible to investigate and obtain all the data concerning non-clay minerals. Perhaps, the extent to which a researcher can attain and exhaust his investigation is practically dependent on the proposed purpose of the investigation. Grim [9], asserted that organic minerals can be present in clay as freestanding particles of flora (plant remains) and fauna (animal remains). These plant and animal remain when present in large particles and pieces can be seen with the naked eyes and handpicked just as rock fragments before slaking. They can also be separated from clay by sieving while the very tiny and invisible particles are left to further decompose, ferment and aid aging and plasticity. It is necessary to state here that having organic materials in excess will mar the performance of clay as the clay will turn out as humus soil. This organic mineral in its colloid state is responsible for the pigmentation of clays and plasticity as a result of fermentation which produces the colloidal particles, usually gelatinous or viscous.

The mineral, clay as quarried from the earth crust possesses several properties such as slaking, green strength, colour, plasticity, shrinkage, porosity, and firing range, as necessary to this paper. While earthenware and low stoneware clay can be sourced freely on the earth surface, high stoneware and porcelain clay bodies must be formulated with necessary substances, additives or modifiers. It is worthy of note that no single clay possesses all the properties as required, hence clay body formulation and blending.

The Relevance of Composite Technique in Ceramics Practice

The word, composite is something made of different parts, a complex or conceptual whole made up of complicated and related parts, a form consisting of separate interconnected parts, a material made up of different ingredients or substances or a compound or unified whole or entity made up of different parts. David [10], opined that the use of two or more elements to form a compound informed the law of chemical combination which forms the basis of chemistry and the law of multiple proportions which states that two elements A and B can combine to form more than one chemical compound. Kedward [11], asserted that in chemistry, composite material refers to a superior substance that is made up of a combination of two or more different materials. It is the strength and qualities of the different materials brought together that contribute to the superior strength and quality of the resultant composite material. Kedward [11,]said further that a composite material can provide superior and unique mechanical and physical properties because it combines the most desirable properties of its constituents while suppressing their least desirable properties which when separated or isolated, is not a characteristic of a composite. Ocvirk et al [12], asserted that the artist is successful only when he creates a work or form in which each of the parts, the visual elements are vital, not by itself but in the general functioning of the whole or unified entity. Thus, every part or element aids in the purposes of firmness, utility and beauty. This means that the individual parts brought in to compose or form a unified whole of material or structure, when separated or in isolation loses its strength, function and importance. This is to say that the visual elements of design or organization will not be useful on their own if not combined to create a form. Ceramics substances will also not be useful if not combined as additives or composites to modify clay for

the production of superior pottery wares. To this end, a composite material is developed with the fundamental aim of producing superior products to meet contemporary challenges. It is to say that the available material is not good enough and therefore must be revisited with new ideas to create new and superior products.

This study is again supported by the Design Theory of Antony Bertram, a British art critic and passionate advocate of modernism. The theory, according to Fiell and Fiell [13], posited that, Good design is not a matter of wealth, much less of the chic, the latest thing. It is not a matter of novelty for novelty sake, but of the production of cities, houses and goods which will satisfy the needs of the people; their need of practical, honest, cheap, lasting and beautiful things for them to see and use in their everyday lives. The theory emphasizes the core principles for good design which include firmness, utility and beauty. In order to meet this design task, previous ideas on materials, equipment, techniques and so on must be revisited with new ones to create new and superior products. The truth is that the world is earnestly waiting for the manifestation of creative people to come up with improved quality wares that will solve trending challenges. It is therefore the desire to produce superior products that gives rise to the composition or formulation of composite materials in many areas of human endeavor. In response to this challenge, Kedward [11], asserted that advanced composites have been compounded for superior products for aerospace, automotive and recreational applications, civil engineering structures such as bridges and freeway pillar reinforcement, manufacturing sector and biomedical and bio-ceramic devices. She went further to say that composite materials usually consist of (synthetic) fibers embedded within a material that surrounds and is tightly bound to the fibers, such as Metal Matrix Composites (MMCs) and Ceramic Matrix Composites (CMCs) which influence thermal or electrical conductivity and coefficient of thermal expansion. In his own contribution, Lindner [14], opined that Condensed-matter or Solid-state Physics is the study of crystalline solids, liquids, and irregularly structured materials such as glass, ceramics, organics, polymers and composite materials. It is therefore clear why potters who desire superior products are not satisfied with the commonly available earthen ware body but proceed to compose (compound or formulate) ceramic composite bodies such as hard stoneware, porcelain, engobe and glazes.

This study views the subject, composite technique in ceramic practice from four major angles namely, composite materials, composite visual devices (elements), composite pot and composite equipment.

Composite Materials

Composite material in ceramics is a material that is made up of two or more substances or ingredients as additives to modify the clay for better performance. Naturally, pure clay, kaolin as composed of alumina, silica and water (Al_2O_3 $2SiO_2$ $2H_2O$) remains non-plastic and therefore difficult to manipulate into forms. The presence of alumina and silica as refractories makes it difficult to fire to its vitreous point in earthenware, stoneware and even porcelain kilns. The movement of clay to its secondary location introduces the flora and fauna and other inorganic impurities (metals and non-metals) into the clay which over the years ferment to produce the colloidal particles or gel that gives pigmentation and fluxing agents to clays and renders the secondary clays more plastic or malleable for modeling. The truth is that ceramics

from its discovery has always been experimentation, where new things are discovered everyday as potters progress in the practice.

Okoronkwo [15], asserted that traditional potters explored the use of organic materials such as animal dung, ground dried plant parts and inorganic substances such as powdered oxide-lending stones and soil minerals found around their immediate environments as clay additives to alter the physical and chemical properties of their clays. These materials were introduced into clay as composites due to their individual characteristics which in turn gave colour pigment and fluxing strength to the resultant composite material.

Composite technique in ceramics practice involves clay body formulation and blending which are done to improve the quality of the clay in terms of plasticity, shrinkage, green strength, firing colour, porosity and firing range. It is the clay additives or composites that modify the clay, thus making the potter to approach his practice with confidence. While clay body formulation or composition involves the introduction of two or more vital substances or ingredients as additives to modify a lump of clay to a superior clay body or composite material for a particular production purpose, clay body blending refers to the bringing together or mixing to homogeneous state, two or more already formulated clay bodies, this time as composites to achieving a new and more superior composite material for better and special products. To blend two or more already formulated composite materials to arrive at better materials is to say that the already formulated clay bodies, though vital, were not good enough individually for the desired work of art, therefore must be used as clay composites.

In my years as a lecturer in the university, I have worked with several undergraduate and graduate students on several interesting research topics aimed at proffering solutions to man's contemporary issues. Two of those researches related to this study are the ones by Udohaya, Emedung of the University of Port Harcourt in 2021 and Okoronkwo, Uju S. of Ignatius Ajuru University of Education in 2022, both in Rivers State, Nigeria.

In his thesis, "Formulation of Porcelain Body for Studio Ornamental Wares with Local Materials from Akwa Ibom and Cross River States", Udohaya [16] , not satisfied with the low temperature clay bodies used by potters which do not produce high quality and superior wares to compete favorably with the imported wares, decided to source for relevant materials from the two neighboring states and used them as additives, modifiers and composites in a porcelain body as a superior composite material. Below are two of his recipes that fired up to 1250^0C and 1280^0C respectively, which he used in producing some superior porcelain wares as in figure 1.

Composite Material Recipe 1
Ikot Ebom Itam Kaolin ----------50%
Akamkpa Feldspar----------30%
Eket Flint ----------20%
Maturing Temperature ---------- 1250^0C

Composite Material Recipe 2
Ikot Ebom Itam Kaolin ----------60%
Akamkpa Feldspar----------30%
Eket Flint ---------- 10%
Maturing Temperature ---------- 1280^{0}C
Source: Udohaya, 2021.

In the same vein, Okoronkwo, Uju Sylvia was not satisfied with the weight of pottery wares which to her, has affected pottery production, movement and patronage. She decided to venture into a dual-purpose research. It is a dual-purpose research in the sense that apart from producing light weight potteries, it was environmentally friendly. The research made use of waste paper as recycled into paper pulp and composite in a project which she titled, "Clay Additives: Investigating Paper Composite Stoneware for Workable Properties in Lightweight Studio Ceramics". The researcher gathered waste paper from offices and turned it into paper pulp which she introduced into the main stoneware clay body at different ratios of Paper Composite Stoneware (PCS) 20: 80, PCS 40: 60 and PCS 60: 40.

According to Okoronkwo [14], Ratio PCS 20:80 comprised of 20% stoneware clay and 80% paper composite, Ratio PCS 40:60 comprised of 40% stoneware clay and 60% paper composite and Ratio PCS 60:40 comprised of 60% stoneware clay and 40% paper composite. After series of scientific tests and results, the new composite materials were used for the creation of light weight potteries of superior quality as in figure 2.

The resultant effects of the cellulose fiber, either as paper pulp, saw dust, straw chips or animal dung is that less amount of clay is used for production which gives a light weight pottery. There are reductions in plasticity and shrinkage levels with increase in porosity level. The highly porous body reduces shrinkage, eliminates warping and enhances heat energy migration during firing, though the body remains weak and subject to breakage, scratches and corrosion, except fired to vitreous temperature, hence her choice of stoneware clay. These organic composites, in addition to their functions as fluxing agents to the stoneware clay, the ash as glaze material within the body aids the melting of any glaze applied onto the ware.

Composite Visual Devices (Elements)
Another type of composite technique in ceramics practice is the visual devices or elements of design composites. These visual elements such as line, shape, colour, form, texture and so on though very vital, would be of no use on their own if not selected and creatively put together to create a work of art as a unified whole or entity. This is why Ocvirk et al [12], opined that an artist is successful only when he creates a work in which each of the parts, the visual elements is vital, not by itself, but in the general functioning of the whole or unified entity. In the creation of potteries, only the necessary visual devices are selected and creatively organized to create the pot. In other words, a pottery is the totality of the elements and principles of design or organization, the materials, tools, techniques and style. When a potter conceives a design, he selects the visual elements only necessary for the work and delegates tasks by putting them where and how they should be to perform the task of composing or formulating a form, thus

making concept accessible to others. These selected visual elements are vital only as parts of the unified entity but if separated or isolated, have no value because they are no longer characteristics of the composite form. This means that the composite visual devices is developed with the fundamental aim of giving form to thoughts, ideas or concepts in material deposit as superior products to solve human challenging issues.

Composite Pots

The third and the most commonly known composite technique in ceramics practice is the process of achieving a composite pot from two or more techniques. In ceramic practice, the techniques of production include hand building, wheel throwing, and casting. As stated earlier, the hand building technique which also comprises pinching, coiling and slab methods is commonly adopted by all potters, especially in traditional societies where pottery is practiced. It remains the first technique of pottery making that every potter learns before acquiring the special skills for wheel throwing and casting. While the wheel throwing is practiced by those who can afford the cost of the potter's wheel, acquire the special skills, and are ready to marry tradition with modernity for superior products, the casting technique usually referred to as industrial ceramics is carried out with the help of many sophisticated equipment in the industry to maximize profit by mass-producing wares to meet high demand. A composite pot is therefore achieved when the necessary parts of a designed pot are produced by two or more techniques of production and brought together as composites to form a unified whole. In other words, it is formed by two or more vital parts produced by two or more pottery techniques such that each part is vital, not by itself, but in the general functioning of the whole, thus every part aids in the purposes of expression and solving other human challenges. In a typical composite pot, the body and the neck can be hand-built, the rim, formed on the potter's wheel while the handle and legs are cast from moulds, pulled or pinched. These parts are creatively put together by hand building technique to create a new and superior pottery. The different parts, though vital, cannot function by themselves if separated or isolated because they are no longer characteristics of the whole.

There are instances where mistakes are made in the course of production, especially during wheel throwing, when forms collapse on the wheel head, either because the bodies were not well prepared, they have absorbed too much water, the walls are too thin and weak for the heavy tops, the wheel head is vibrating and wobbling or the lumps were not properly centered before pulling. Whenever this happens, the potter removes the faulty forms from the wheel head and continues with fresh lumps till the end of the throwing exercise. The different faulty forms become the pot composites which are creatively assembled to create a new form, the composite pot. Composite pottery is all about assemblage, whereby different parts or shapes of pots are intentionally thrown, hand-built and casted and finally composed or assembled by hand-buildng to create a new and composite piece as in figures 3 and 4.

Composite Equipment

This involves the gathering of different materials from market and junk yard by potters and engineers and assembling them by fabrication and construction to create useful ceramic equipment such as potters' wheel, wheelers, clay extruder, to mention but a few for the

practice. See figure 5, a manual potter's wheel fabricated with found objects. The aim, according to Onu [17], is to stop dependency on foreign made wheels (equipment) which cost a fortune to import and which has deterred a lot of people from practicing. The materials gathered and fabricated into composite parts can only be useful as parts of the unified whole but useless if separated or isolated.

Conclusion

Pottery as the science and art of baked clay has been adopting the composite technique in its practice. As a three-dimensional art, it is created to have length, width and height, thus enclosing space as volume and depth and occupying positive space defined by the negative space which makes it appreciated in the round. To achieve all these requires a form and the form is created with clay as the major material which requires modifications for successful pottery making. To modify clay is to formulate and blend a new clay body by introducing two or more vital substances, ingredients or already formulated bodies as clay additives or composites as modifies to create a new and superior composite material for better potteries to meet man's trending challenges. Though there are many and vital visual devices or elements of design, they remain useless unless selected and brought together as composite devices to create a form as a unified whole or entity useful to man. Composite technique is also involved when two or more forms or shapes created by two or more production techniques are brought together as composite forms to create more interesting composite potteries.

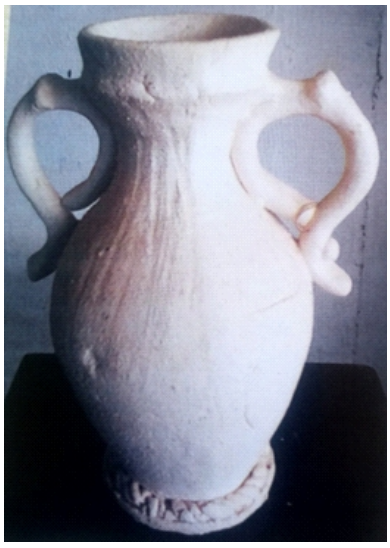

Fig .1: Product of composite material
Artist: Udohaya, E.
Medium: Porcelain body
Year: 2018

Fig. 2: Product of composite material
Artist: Okoronkwo, U. S.
Medium: Paper Composite Stone Ware 60:40
Year: 2019

Fig. 3: Composite pot
Artist: Umoh, J. J.
Medium: Unglazed earthenware
Year: 2020

Fig. 4: Composite pot
Artist: Peters, E.
Medium: Unglazed earthenware

Fig. 5: Composite equipment (Assemblage)
Artist: Amaechi, U.
Medium: Found objects.

End Note

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