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Incorporating Iron Filings from Zaria Nigeria into Clay Body for the Production of Decorative Ceramics

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Abstract
This research went through experimental processes for the actualization of the objectives. Materials were sourced from different locations; primary clay was sourced from Kankara in Katsina State, secondary clay was obtained from Bomo town, Zaria Kaduna State while Iron Filings were procured from from an area known as Randa Kano, Kwangila, Zaria. The primary and secondary clays were soaked together for a period of one week and sieved into watery past which was afterwards dewatered for readiness to work with. In the case Iron filings, they were analyzed by sieving into four aggregate sizes of 1.18mm, 600µm, 300µm for experimentation. Clay and iron filings were blended together in different percentages according to the aggregate sizes of Iron filings. Throwing of the different percentages of mixture of clay and iron filings were also carried out on the wheel to ascertain the level at which iron filings affected the throwing ability of the clay. Analysis of the physical appearances of the slabs and thrown tests were carried out and this enabled the production of the decorative wares. The decorative wares were in different sizes and shapes, manipulated to create more interest by restricting iron filings from some parts of the wares. The wares were fired in a kerosene kiln and with the aid of cone 1000^{o}C to control the temperature.
Keywords: Iron Filings, Clay body, Decorative Ceramics

1. Introduction

The world we live in is changing, as the human race advances so the urge and tastes for improved ways of life emerges. This has brought about innovations and improvements in ideas which cover the entire spheres of the human life.

According to Merriam (2011) “innovation is an improvement to something already existing”. The idea of innovation is important in whatever field including ceramics for the advancement of the specialization, as a ceramist is at liberty of developing clay body that suits his or her purpose to differ from the conventional clay bodies in ceramics (earthenware body, stoneware body and porcelain body) for the sake of advancement. This will be an attempt to innovate a decorative body out of an existing stone ware body in the ceramics section of Industrial Design Department, Ahmadu Bello University, Zaria, with the introduction of iron filings that has been in use as oxide in glaze formulation. Iron filings is perceived to be able to come in convenience with clay since grog could also be used in clay body.

The earliest type of decorative art was pottery, notably the Jomon style Japanese ceramics pioneered from about 14,500 Before the Common Era. Potters produced a wide range of pots in all shapes and sizes, and decorated them with abstract, historical and mythological designs, in a variety of styles which developed throughout the period 3,000 - 300 BCE. (Encyclopedia of Art, 2012).

At this point, let us make a distinction between the terms ‘clay' and 'clay body'. We will use the term clay to refer to those materials of a plastic quality which are formed by natural forces and which are to be found in nature. The term ‘clay body’ will be used to indicate a mixture of clay-like materials with other inclusions for a specific ceramic technique. In other words, a 'clay body' may have several different kinds of clay, fluxes, silica, grog, and other ingredients for color, plasticity, warping, cracking, shrinkage, porosity, firing temperature, and texture. (Fromme, 1994).

There are three basic types of clay bodies: Earthenware, Stoneware and Porcelain. Earthenware is porous and tends to be groggy; it can be white or red. It will not hold water no matter how high it gets fired. Stoneware comes in several colours and styles, textures and it will hold water all by itself when fired to the recommended temperature. Porcelain is the closest to glass and will vitrify (hold water) and display some transparency when held to a bright light (Winokur, 2006).

Cast iron which has melting temperatures closely relating usually ranging from 1150 to 1200 °C (2102 to 2192 °F), which is about 300 °C (572 °F) lower than the melting point of pure iron, is used widely in the automotive and heavy equipment industries for structural components such as engine, brake, suspension, and steering parts. Cast iron is formed by adding carbon (graphite) to steel. The characteristics of cast iron are formed during solidification and once solid cannot be changed through further heating (Nikon, 2011).

Malvern (2011) revealed that Metal powders are made either by gas atomization or grinding, and are then classified using dynamic classifiers or cyclones to obtain the precise particle size distribution to form the final end-user product, the metal powders are then used in various consolidation processes;

- Extrusion
- Injection molding
- Blending
- Compaction
- Sintering

Line blending is a systematic way of finding out the reactions of two different materials or mixtures of materials (Henrik and James, 1993)

Saliu (2005) disclosed that decorative art is an activity which arises from complex requirement in which scale and quality vary according to how strongly and cultural group feels the need to express the requirements. Decorative art, usually, but not always non- representational, is for design reasons and enhancement of a given surface and space.
Jefferson (1974) viewed decorative art as the end result from the simple urge to improve the appearance of things, to achieve designs that are pleasing to the eye, to enrich both utilitarian and religious objects with familiar patterns and symbols which are meaningful to the artist and his people.
Decorative ceramics ranges from tiles to ornaments and vases. Pottery and ceramics have been decorated in a large variety of ways. The use of glazes, slips, and impressed surface details are only a few of the options available to the ceramic artist. Pottery surfaces can run the gamut from glossy, to silky smooth, to sandpaper roughness, to complete cragginess.

2. Methodology
Kankara Kaolin and Bomo Clay were obtained in the form of fine grain materials with some lumps. Kaolin and clay were soaked in water in different bins but in the same quantity of 50/50 for two weeks; this was followed by blunging the clay and kaolin together to form a homogenous mixture which was sieved to improve the clays plasticity resulting in the formation of stoneware clay. While Iron Filings were obtained in the form of semi powder in different particle sizes, it was subjected to sieve analyses and three grain sizes were obtained as 1.18 mm, 600 microns, and 300 microns. Stone ware clay and Iron Filings were blended in different percentages and subjected to throwing test. Just as the percentages of clay and iron filings differs, so their behavior in the throwing tests. Each aggregate sizes of iron filings had peculiar actual texture feel when it was been thrown and plasticity was been affected as the quantity of iron filings changes in each body. The tests were dried in room temperature for three days and later exposed under the sun for final drying.

Table 1: Line blend 10 steps

MATERIAL PARTS BY VOLUME
material A 0 1 2 3 4 5 6 7 8 9 10
material B 10 9 8 7 6 5 4 3 2 1 0

An example of a line blend in ten steps, which gives the full range of combinations of two materials

Table 2: Percentage distribution of iron filings and clay in each sample

Samples	A	B	C	D
Clay / Iron Filings	95/5	90/10	85/15	80/20
	95/5	90/10	85/15	80/20
	95/5	90/10	85/15	80/20
	95/5	90/10	85/15	80/20

Alphabets A – B represents the different aggregate sizes, percentages 95/5 – 80/20 is for the ratio of clay and iron filings.

Plate I : 1.18mm aggregate sizes of iron filings

Plate II : 600µm aggregate sizes of iron filings

Plate III: 300µm aggregate sizes of iron filings

Plate IV: un–sieved iron filings

From the above tests, the following considerations were made before some specific combinations of iron filing and clay were considered for the production of decorative wares:

- Out of the four different mixtures of 95/5, 90/10, 85/15 and 80/20 of stone ware clay and iron filings, 95/5 and 90/10 composition were more appropriate as they not only have enough plasticity but also allows reasonable amount of iron filings to be appreciated.

- The aggregate size of 1.18mm became the biggest and fortunately the largest in quantity of the entire iron filings with 60% after the sieve analyses and this was considered.

- Haven carried out four different firing temperature tests, 1100^{o}C, 1000^{o}C and 900^{o}C had their peculiar effects on iron filings and are suitable as they all enhanced on the speckled effects of iron filings on the test slabs on different degrees. Notwithstanding, 1000^{o}C was adopted in firing the wares because there was no defect of any sort and the speckled effects were reasonably enhanced.

Plate V: Fired thrown tests showing the resultant outcomes

Plate VI

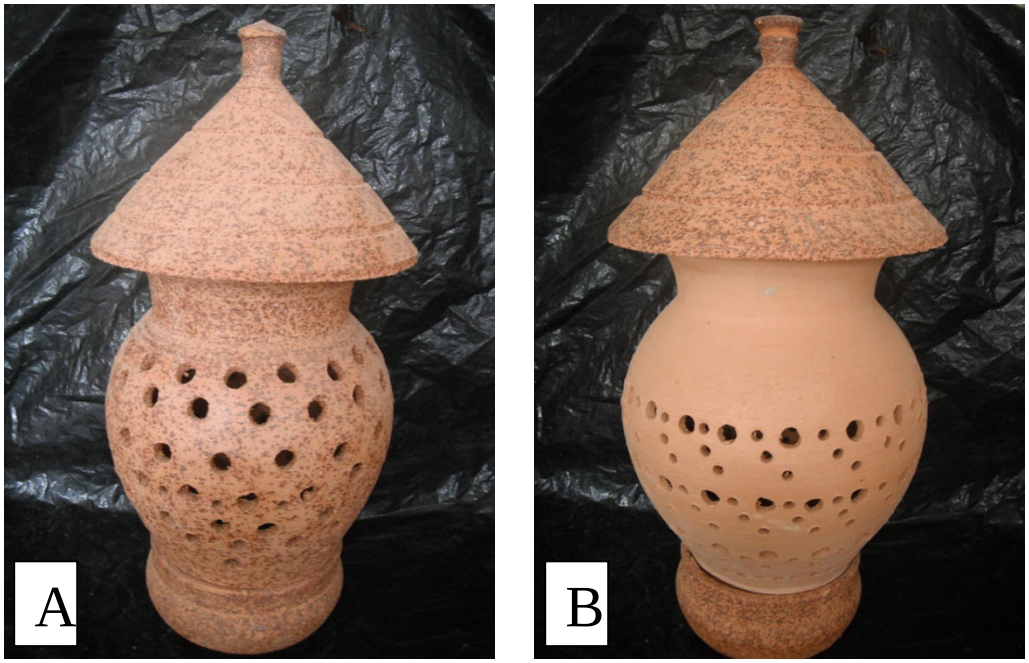

Plate VII

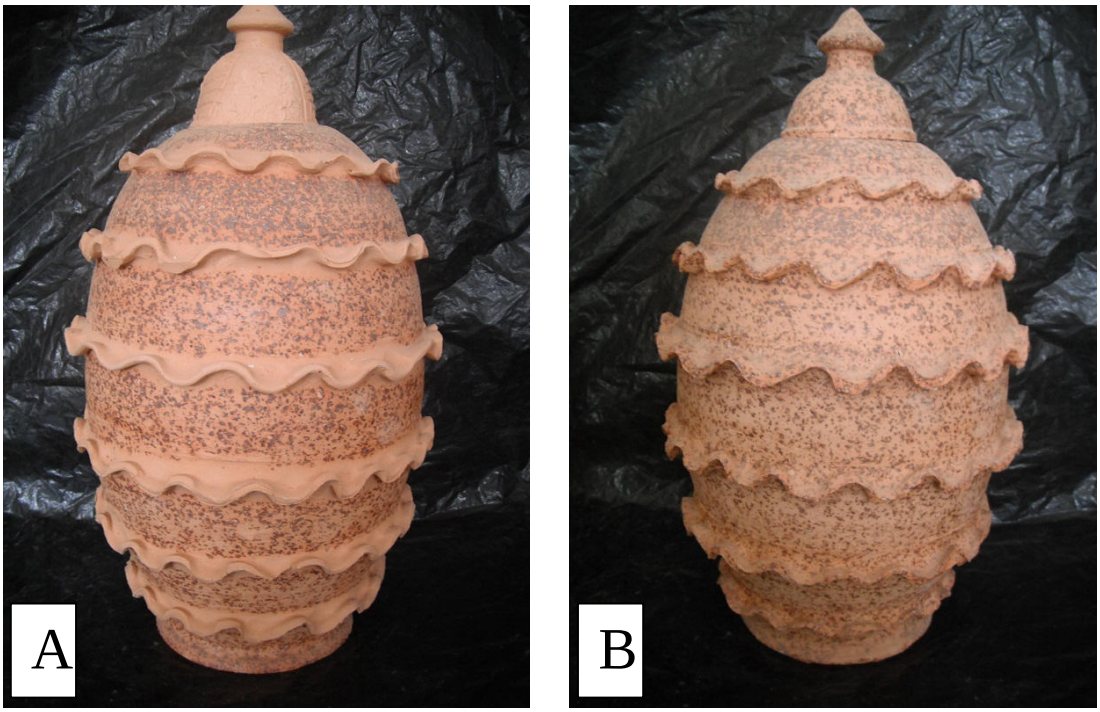

Plate VIII

Plate VI

The satellite vases, 'A' is completely covered with speckled effects while 'B' has the top and the ring appendages around the ware without speckled effects, the variation is to create more interest. This was achieved at leather hard stage of the wares.

Plate VII

lamp shades, 'A' is covered with speckled effects totally while 'B' has no speckled effects on the body.

Plate VIII

Decorative storage jar, 'A' has no speckled effects on the cover and on the wavy appendages but on the body, 'B' storage jar is adorned completely with speckled effects. This shows that iron filings can be added to any part of a ware as desired.

3. Conclusion

This study has shown that innovative possibilities abound in inculcating iron filings into clay for the production of decorative wares as a result of speckled effects of iron. Mixing iron filings with clay proved that decorative ceramics can be produced not only by glazing, burnishing, or over glaze decorations but also in the body decoration. Throwing method of production as applied in the research gave a good opportunity to really feel the effect of iron on the body as it affected plasticity which ultimately is needed for pulling and shaping of wares on the wheel. Iron filings being used in this study, though not in abundance as compared to Kaolin and secondary clay, but are always available when needed. The uniqueness of the speckled effects on decorative ceramics is an additional aesthetic value which is capable of increasing marketability of ceramic wares. The usefulness of iron filings for the production of ceramic wares can only be applied to decorative pieces since the material contains chemicals that might not be healthy for it to be employed in the production of table wares.

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