NAVIGATING CERAMICS OBSTACLES IN NIGERIA'S VOCATIONAL EDUCATION: OFF-GRID DETACHABLE GAS DRUM KILN'S CREATION TO THE RESCUE

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ABSTRACT

Given that some regions lack electricity power accessibility in Nigeria, the detachable gas drum kiln will be a sustainable solution for ceramics production. Epileptic power supply in Nigeria has been an age-long challenge. That crippled pockets of ceramics' students and professionals in their area of practice and interest. The Ability to construct build a gas kiln with local materials in a confined environment would positively advance vocational education in Nigeria. The innovative kiln design construction will enable easy assemblage, dismantling, and transport from one place to another by providing flexible and diverse off-grid settings. Leveraging gas as the primary energy source for the kiln will further ensure reliable firing without relying on the electrical power source. The kiln system's adaptability proves crucial for ceramics artisans in remote areas to foster self-sufficiency and sustainability of the production. This invention promises to cater to remote locations without a reliable power source which will enable the artisans to engage in ceramics production and also foster the creativity to sustain in the field of pottery. Ceramics and pottery production as a vital aspect of vocational education demand daily solutions, and this has spurred innovation of the new concept of a detachable gas drum kiln tailored to an off-grid environment. The kiln will not only address the challenges of power generation but could also provide a solution to create a portable and efficient kiln for trainees, artists, and artisans in remote locations practicing pottery and ceramics vocations. The detachable gas drum kiln will also allow learners, artists, and artisans to transcend to self-reliability in kiln production ranges such as kiln types, kiln walls, firebox control, and radiation heat acceleration control amongst others. It will further empower ceramics artists and practitioners to engage more in ceramics and pottery production. This paper delves into the transformative impact of this useful skill on vocational education in Nigeria and the traditional landscape of ceramics. It emphasizes its potential to revolutionize the strategies and the way professional artists, trainees, and artisans approach their crafts and ceramics wares in Nigeria.

Keywords: Electricity, Detachable kiln, Portable, Sustainable, kiln wall, and kiln clay body.

INTRODUCTION

The quest for sustainable and adaptable solutions has led to strategies and development for breaking through challenges with modern equipment in the ever-evolving world of ceramics production. This innovative idea emerges as a response to the challenges faced by ceramists working in remote environments where electricity power sources may be scarce or unavailable. Therefore, the introduction of this detachable gas kiln will not only address logistical hurdles but also open new avenues for creativity and production in remote locations in Nigeria. This

introduction set the stage for exploration and the transform of discarded metal drums into a detachable gas container kiln by cutting and reshaping the desired figure for ceramics production. The field of ceramics production stands at the intersect of traditional pottery and the modern ceramics industry by constantly evolving to the demands of contemporary challenges. One of such task is the necessity for sustainable and adaptable solutions in remote environments, where conventional power sources are often in-accessible. This paper endeavours to introduce and explore a novel technological advancement to local production of gas kiln building construction among trainees and ceramist artists to meet the demand of the populace in ceramics industry.

In remote locations, artists faced formidable obstacles in getting their ceramics works from green-ware to bisques stages during production processes due to the unavailability of electricity supply which is the major factor hindering the execution of ceramics works. Therefore, the detachable gas drum kiln demonstrates a potentially significant change to observed problems facing ceramics production. The paper will also suggest a solution that will address the practical constraints of the Do It Yourself (DIY) approach in the construction of a gas kiln from used or discarded metal drum or any container that can be divided into segments for easy mobility within and outside the primary location with the added flexibility to be functional. Furthermore, the paper seeks to delve into the technical intricacies of the process involved in the production of discarded used metal drums as a detachable gas kiln, as well as analysing its design, functionality, and performance in comparison to conventional or usual kilns. Investigating the adaptability of this technology in remote contexts, the study aims to shed light on its transformative impact on the artistic and sustainable dimensions of ceramics production in Nigerian's peculiar environments. This exploration will further represent a commitment to unravelling the potential of innovative solutions that can empower artists, trainees and other related fields of visual Arts such as glass technology and blasting, metal melting foundries. The resultant result would assist practitioners to practice their craft independently and creatively in an environments considered to be challenged with electricity for ceramics production and vocation.

The conventional ceramics production in Nigeria has relied on conventional kiln technology, leading to inconsistent firing temperatures and limited control over the firing process (Afolabi, 2013). However, with the rising demand for high-quality ceramics, there is an increasing need for more local kiln technology. Locally constructed gas kilns provide a low cost-effective and efficient solution to this challenge, offering improved designs of the different types of kilns such as updraft and down draft kilns and will have consistent firing temperatures (Adebisi, 2015). Numerous studies have delved into the development and implementation of locally constructed gas kilns in Nigeria. Ogunyemi et al. (2018) introduced a small-scale gas kiln for ceramics firing, highlighting enhanced temperature control and fuel efficiency. Similarly, Adedapo et al. (2012)

created a gas kiln using locally available materials, underscoring the potential for sustainable ceramics production in Nigeria. However, challenges persist. Afolabi (2020) observed that limited access to technical expertise and materials remains a significant barrier to the widespread adoption of self-built local gas kilns. Furthermore, the high cost of the kiln and the necessity for regular maintenance present additional hurdles (Adebisi, 2015).

Therefore, off-grid gas kilns offer a promising solution for ceramics production in Nigeria, providing an improved kiln design and mobility that can be used in these areas with adequate fuel efficiency to address the challenges of technicality, materials in adopting method of kiln production by ceramists and ceramics-ware production in vocational education.

STATEMENT OF THE PROBLEM

In the domain of ceramics production, contemporary artisans and trainees often encounter some challenges when working in developing environments where reliable electricity power sources are scarce, these obstacles hinder the smooth construction of ceramics craft. The lack of consistent electricity power poses a critical issue for individuals striving to engage in ceramics production in these remote locations. In off-grid settings, electric kilns are scarce, and unavailable for production, and this challenge poses a limitation options for artisans and vocational trainees in the area of ceramics production. Ceramics artists in Nigeria tend to lack knowledge of how to build ceramics equipment for production. Adaptation of local materials, such as metal drums and others for ceramics production in off-grid areas pose issues for ceramics artists. Transportation of traditional kilns to another location leads to reduce the production of ceramics

ELECTRICITY INTERRUPTIONS

Across Nigeria, the engagement of pottery wheels and the fiery embrace of kilns have long resonated with the creative spirit and economic heartbeat of every local community. However, in recent years, the dance between clay and fire has been marred by an unwelcome partner of inconsistent or epileptic electricity supply. This paper delves into the multifaceted ways in which the instability of electricity disrupts Nigerian ceramics production.

Powering pottery wheels, pug mills, and other equipment driving into electric kilns requires consistent electricity which is the main source of energy for ceramics and the studios or workshops (Agbo, 2019). When power cuts plunge studios into darkness, the potter's wheel becomes an idle sentinel, and kilns stand cold, halting production in its tracks. This disrupts creative flow, delays timelines, and translates to lost income for ceramic artists and artisans (Ajayi, 2020). Inconsistent electricity jeopardizes the quality of finished ceramics masterpieces; electric kilns offer precise temperature control which is important for achieving uniform firing of glaze test results. Power fluctuations during firing can lead to cracks, warping, and inconsistent colouring of actual glaze colours and also render pieces unusable or have low commercial value (Okoro, 2021).

DETACHABLE DOWN-DRAFT KILN DESIGN

Detachable downdraft kilns are gaining popularity among ceramic artists who want to break free from electrical grids and have a deeper interest in the firing process. These kilns are portable, offer gas fuel efficiency, and are environmentally friendly. This guide explores the construction of detachable downdraft kilns, including the use of local materials, design considerations, and hands-on methods for building the kiln wall.

ADVANTAGES OF DETACHABLE GAS DRUM DOWNDRAFT KILNS

1. Portability: These kilns can be easily disassembled and transported, allowing artists to fire in remote locations or adapt to changing studio spaces.
2. Fuel Efficiency: Downdraft kilns are more efficient in the firing process and reduce fuel consumption.
3. Improved Atmosphere Control: The design of a downdraft kiln allows for better control over oxygen and smoke flow, leading to consistent firing results and enhanced glaze development.

SUSTAINABILITY OF DETACHABLE GAS KILNS IN DEVELOPING LOCATIONS

The use of detachable gas kilns in remote locations presents a unique set of sustainability considerations. While they offer advantages such as portability and easy operation, their environmental and social impacts need to be carefully evaluated. Considerations include:

1. Fuel Choice: Using gas-burning fuels like propane or natural gas over black used vehicle engine oil will reduce air pollution and gas emissions.
2. Recycled Materials: Utilizing recycled firebricks or insulating materials whenever possible can minimize resource consumption.
3. Kiln Maintenance: Regular maintenance and repairs of the gas kiln wall will reduce weight damage that could occur during and after firing sessions.

SOCIAL SUSTAINABILITY:

- Fuel Accessibility and Cost: In remote areas where most of the areas are surrounded by gas stations will be able to access gas fuel for the gas kiln and be less expensive than the failed electricity power supply which will lead to optimized production of ceramics wares to such community.
- Community and Cultural Impact: The introduction of a new approach to gas kilns in developing/off-grid areas can have unintended social consequences and careful consideration should be given to the potential impact on traditional craft practices and cultural heritage.

POTENTIAL MATERIALS TO BE USED AND STRATEGIES:

I. **Locally sourced and recyclable materials**
Choosing materials with **low environmental impact** and ensuring responsible disposal practices can improve sustainability**.**

II. **Capacity building and knowledge sharing**
Providing training on efficient kiln design operation and maintenance can minimize the inactive production

of ceramics and pottery in remote environments.

III. **Community engagement and collaboration in training how to build a gas kiln**

Involving local communities in gas kiln design processes and procedures will encourage the community people to learn ceramics and pottery with local technology which will align with their needs and production of their cultural values and social sustainability.

It can be reasoned that detachable gas kilns offer potential benefits in remote locations, but their sustainability requires careful consideration by adopting choice fuel to be used, local materials such as clay, kaolin, and silica. These kilns can be integrated into a more sustainable development approach.

PREPARATION OF THE HAND-CASTING KILN WALL

Proper preparation of hand-cast kiln bricks is a crucial aspect of kiln production that involves utilizing locally sourced materials for construction. These local source materials such as clay, silica, wood ash, sawdust, and kaolin will be mixed for the inner of the drum gas kiln wall, providing protection and reducing the heat generated during the firing process. Ensuring the efficiency and safety of the heat generated requires meticulous preparation of the kiln bricks. The process of preparing these bricks involves these essential steps

1. **METAL DRUM:** Used metal drums will be collected from the local environment and then cut into the appropriate sizes to fit the specific kiln design, such as UPDRAFT or DOWNDRAFT kiln. See plates 1 and 2

Plate 1

Plate 2

Plate 1 Picture title: Cutting the Scavenged used metal drum, image source: Dipeolu H.A
Plate 2 Picture title: Metal drum cut into sizes, image source: Dipeolu H.A



Plate 3 Plate 4 Plate 5

Plate 3: Picture title: putting 2mm wire mesh, image source: Dipeolu H.A
Picture title: Welding all Metal handles, image source: Dipeolu H.A
Picture title: All welding completed, image source: Dipeolu H.A



Plate 6 Plate 7 Plate 8

Plate 6-8 Picture title: Different arrangement of the kiln heights, image source: Dipeolu H.A

2. RAW MATERIALS: The first step is to source and gather two primary raw materials which are clay and sand and other additives such as sodium silicate, animal bone calcium powder, and others could be added in desired quantities and water to mix it.
Refer to plates 9-11.



Plate 9 Plate 10 Plate 11

Picture title: wood sawdust, image source: Dipeolu H.A
Picture title: sieving the wood sawdust. Image source: Dipeolu H.A

Picture title: Clay powder, sand & calcium Carbonate. Image source: Dipeolu H.A

Plate 12

Plate 13

Plate 12, Picture title: hand -mixture of clay, kaolin, sand Image source: Dipeolu H.A
Plate 13, Picture title: Hand – cast application of the kiln wall and sawdust, Image source: Dipeolu H.A

3. MIXING: The mixture of clay, kaolin, sawdust, and sand is carefully blended in specific ratios, usually comprising 60% to 70% sand and 30% to 40% clay. Additional elements like water and wood ash may also be incorporated to improve the strength and longevity of the kiln wall. For visual reference, see plates 12 and 13.

Plate 14

Plate 15

Plate 16

Picture title: Hand – cast application, Image source: Dipeolu H.A
Picture title: Completed kiln wall, Image source: Dipeolu H.A
Picture title: Welding 2mm metal plate to rim of the kiln wall, Image source: Dipeolu H.A

4. **SHAPING THE MIXTURE**: The mixture is shaped into a cylindrical metal drum with a thickness of 3-4 inches, allowing for the desired width of the inner part of the kiln. Welding 2mm metal plates ensures good friction between segments during the firing process.
5. **DRYING PROCESS:** The kiln brick is air-dried for two months until it is thoroughly dried, creating a surface that cannot be penetrated by sharp objects.
6. F**IRING PROCEDURE**: The gas kiln is arranged in the drum to prevent heat from escaping during

the firing process. The temperature during the firing ranges from 900 to 1200 degrees Celsius, with the first firing process starting at a low temperature to form a durable and heat-resistant kiln wall.

Plate 17

Plate 18

Plate 17: Title: Welding 2mm metal plate to rim, Image source: Dipeolu H.A
Plate 18**:** Title: Using the kiln for firing**.** Image source: Dipeolu H.A

Therefore, preparing a kiln wall requires careful attention to detail, patience, and skill. Inadequate preparation can lead to errors and problems during the firing process which can result in critical issues for the kiln as it is shown in picture plate18 above.

CONCLUSION

Analysing the historical evolution of gas kiln construction, it becomes clear that a hand-casting wall kiln is more efficient to work with compared to a kiln made of bricks. The most fascinating aspect of hand-casting is that it results in a lightweight gas kiln wall that can be easily relocated once construction is complete. Furthermore, it can be easily managed and maintained for subsequent kiln maintenance at each segment, or repaired if any issues are detected during or after the firing process. Assembling the gas kiln is also advantageous for off-grid communities, as the kiln can be customized to a desired height to accommodate more ceramics wares and can be used as a test kiln for ceramics experiments within a specific temperature range while conserving gas fuel. Using hand-cast wall gas kilns reduced construction costs, as all materials can be locally sourced. It is however advisable to thoroughly examine the stages and procedures outlined in this paper before attempting to create a local kiln. This can be accomplished within a short period and may be the most suitable choice for individuals

interested in ceramics' vocation and skill development in off-grid areas. By recognizing the challenges and actively seeking solutions, Nigeria can revive its creative kiln and ensure that the future of its ceramics remains as vibrant and enduring as the clay itself.

RECOMMENDATIONS

The paper recommends the inspire ceramics artists and vocational trainees to explore innovative methods for constructing gas kilns in off-grid/developing areas. It is crucial to thoroughly research the specific materials required for building these kilns in off-grid environments and to secure ample funding before commencing the construction process. In addition, it is important to highlight the gas kiln project as a way to nurture entrepreneurial skills within the broader society and local communities. Furthermore, this initiative should strive to generate internal revenue (IGR) for local environmental leaders by facilitating the cost-effective assembly of a mobile gas kiln within the local area. It is recommended that appropriate authorities encourage ceramic and vocational artists to explore innovative ways of constructing gas kilns in off-grid areas. It is also important to conduct thorough research on the materials needed for building these kilns in off-grid environments and secure sufficient funding before starting the construction process.

Additionally, promoting the gas kiln project as a means to foster entrepreneurship skills within the broader society and local communities is crucial. Furthermore, this paper should aim to generate internal revenue (IGR) for local environmental leaders by facilitating the low-cost assembly of a mobile gas kiln within the local area in Lagos, and by extension in Nigeria.

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