Non-Metallic Potter's Wheel-Head: A Study of Clay, Grog, and Cement as raw Materials

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Abstract

The potter's wheel-head is a critical component at the center of the potter's wheel, providing the working surface upon which clay is centered and formed into objects or clay wares. Traditionally, wheel-heads are manufactured from metallic materials such as steel, aluminum, and cast iron due to their durability and resistance to wear. However, the high cost, corrosion susceptibility, and limited accessibility of metallic materials in some developing regions have encouraged the search for alternative materials such as clay, grog, and cement. This study investigates the feasibility of producing a non-metallic potter's wheel head using a composite mixture of clay, grog, and cement as raw materials. The research evaluates the physical properties, structural performance, durability, and suitability of the composite material (clay, grog, and cement) for a potter's wheel head. Through experimental fabrication and performance testing, the study demonstrates that clay, grog, and cement composites can provide a cost-effective and functional alternative to conventional non-metallic wheel-heads. The findings contribute to sustainable ceramic technology and promote the utilization of locally available materials in studio pottery.

Keywords: Potter's wheel-head, non-metallic materials, clay, grog, cement, ceramic technology, sustainable design.

Introduction

The contemporary global language revolves around technology. Technology is a contemporary tool used in solving societal challenges in all fields of study and works of life. Potter's wheel remains one of the most important equipment in ceramic studio and ceramics industry. Its efficiency and effectiveness largely depend on the quality and performance of the wheel-head, which serves as the rotating platform upon which clay is centered and shaped on. Wheel-heads are commonly fabricated from metal because of their strength, stability, and durability. Despite these advantages, metallic wheel-heads present challenges including high

manufacturing costs, corrosion in humid environments, and dependence on industrial production processes. Ajayi, O. J. et at. (2021). Potter's wheel head is a circular rotating disc located at the top of a potter's wheel on which clay is rotated, centered, and shaped into ceramics forms. It is the primary working surface that transmits rotational motion to the clay during throwing operations. Nnuzulike. (2013). Wheel head is the flat circular platform of the potter's wheel that rotates on a spindle and supports the clay during the formation of ceramic wares. Throughout the history of pottery wheel, technology has undergone significant transformation. Early potters relied on simple rotating platforms made from stone, wood, and other natural materials before the introduction of metal-based systems. Industrialization subsequently increased the use of metals due to their mechanical strength and ease of machining. In many developing countries, access to high-quality metallic wheel-heads remains limited because of financial constraints and manufacturing challenges. As a result, ceramic practitioners often seek locally available alternatives that can perform similar functions at lower costs. Clay, grog, and cement have long been used in construction and ceramic production. Clay provides plasticity and workability, grog improves dimensional stability and reduces shrinkage, while cement contributes compressive strength and durability. The combination of these materials creates a composite capable of supporting structural loads while maintaining resistance to wear. Despite their widespread use individually, limited research has explored their combined application in the fabrication of potter's wheel-heads. The growing interest in sustainable material encouraged this study to explore alternative materials for studio equipment. Non-metallic composites made from clay, grog, and cement possesses characteristics that may offer practical solutions to the limitations associated with metallic wheel-heads. These materials are widely available, relatively inexpensive, and compatible with ceramic production environments.

This study examines the potential of clay, grog, and cement composites as materials for manufacturing non-metallic potter's wheel-heads and evaluates their suitability for ceramic practical. Nwanoneze et al. (2020) demonstrated the suitability of Nigerian clay deposits for ceramic manufacturing through physical and chemical analyses. Clay contain plastic when wet, fine particle size, can absorb and retain water, also suitable for molding and shaping. Umoh (2022), clay is an earth mineral substance composed mainly of hydro-silicate of alumina which is plastic when it is in the wet state, hard when dry and rock-like when fired. Oyedeko and Olugbade (2009) established that several Nigerian clay deposits possess characteristics suitable for refractory and structural applications. Clay is the most important material in pottery technology because of its plasticity, availability, and ability to harden permanently when fired. Its unique properties make it suitable for producing a wide range of ceramic products used in homes, industries, and artistic practices.

The Problem

The dependence on metallic wheel-heads presents challenges related to cost, accessibility, maintenance, and corrosion. Many ceramic industries, studios particularly in the department of fine and applied arts, Ignatius Ajuru university of Education, struggle to acquire or replace metal wheel-heads when damaged. Although alternative materials are available locally, there is insufficient research regarding their effectiveness in meeting the functional requirements of a potter's wheel-head. The absence of documented studies on clay, grog and cement composites for wheel-head production limits innovation and hinders the development of

affordable ceramic equipment (potter's wheel head). This study addresses the need for a durable, economical, and locally sourced alternative to conventional non-metallic wheel-heads. The aim is to investigate the suitability of a clay, grog, and cement composite as a non-metallic material for the production of potter's wheel-heads. The objectives are to examine the physical and mechanical properties of clay, grog, and cement composites. Design and fabricate a non-metallic potter's wheel-head using locally sourced materials. Peters, E. E. and Gadzama, R. M. (2019) said pottery technology and the development of ceramics practice in Nigeria. In their work, they noted that potters construct and use throwing wheels and other equipment to improve ceramic production. They described the potter's wheel as an important tool in the formation of ceramic wares and in enhancing production efficiency. Samuel and Kashim (2021), the potter's wheel is an important technological device used in pottery production to shape clay into symmetrical ceramic forms. The study on pottery practices in Southwestern Nigeria highlights the role of wheel technology in improving efficiency, accuracy, and production quality in ceramics. On this note finding a solution to potters challenges is important in order to enhance production. Evaluate the strength, durability, and performance of the fabricated wheel-head. Compare the performance of the composite wheel-head with conventional metallic wheel-heads. Assess the economic and practical benefits of using non-metallic materials in ceramic equipment production.

Theoretical Framework

This study is anchored on Material Innovation Theory and Appropriate Technology Theory.

Material Innovation Theory

Material Innovation Theory emphasizes the adaptation and development of existing materials to meet new functional requirements. The theory argues that technological advancement often emerges from the creative recombination of available resources. In this study, clay, grog, and cement are combined to create a composite material capable of performing functions traditionally assigned to metal.

Appropriate Technology Theory

Appropriate Technology Theory advocates the use of technologies that are affordable, accessible, environmentally sustainable, and suitable for local conditions. The theory supports the development of equipment using locally available materials and skills. The clay-grog-cement wheel-head aligns with this approach by reducing dependence on imported metallic components while promoting local production capabilities. Together, these theories provide a framework for evaluating the technical and socio-economic viability of non-metallic wheel-head technology.

Clay: clay is one of the oldest craft media dated to pre-historic age. It helps provide plasticity to the formulated body. Peters, E. E. (2004). Clay is a naturally occurring earth material used as the chief raw material in ceramics and pottery. It is plastic and workable when mixed with water and becomes hard and durable when fired at high temperatures. Nwanoneze et al. (2020) demonstrated the suitability of Nigerian clay deposits for ceramic manufacturing through physical and chemical analyses. Clay contain plastic when wet, fine particle size, can absorb and retain water, also suitable for molding and shaping. Umoh (2022), clay is an earth mineral substance composed mainly of hydro-silicate of alumina which is plastic when it is in

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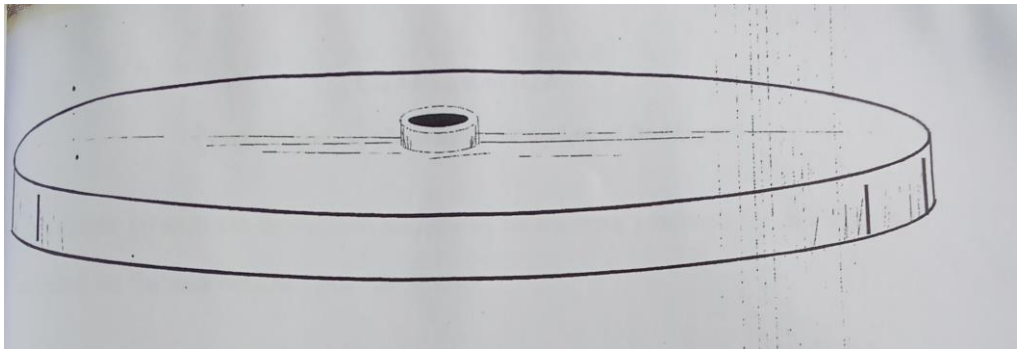
Grog: grog is grounded fired clay that gives the formulated body strength and reduces shrinkage. Umoh (2022) said grog is fired pottery, crushed, ground or pulverized into various grain size and introduced into clay to reduce shrinkage and give texture and strength to the fresh body.

Cement: cement is a binding material used in construction that hardens and sets after mixing with water. It is a key ingredient in concrete and mortar. Its roles is to bind and provides strength to the formulated body and prevent water penetration**.**

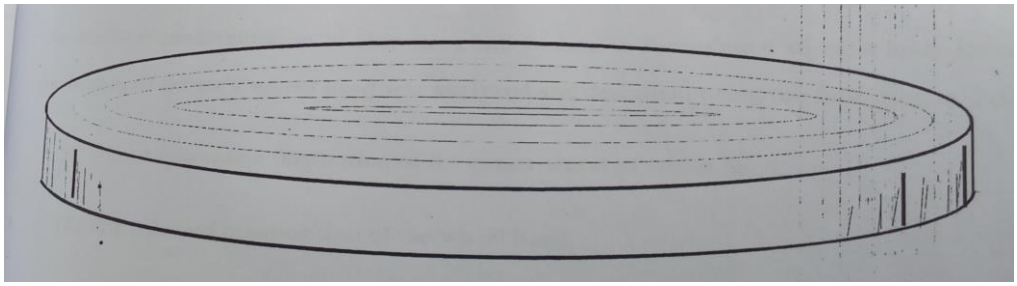
Methodology

The study employed an experimental research design involving material testing and prototype development.

Procedure: sketches were developed to guide the fabrication. The wheel-head were also produced with clay cast to extract mold. Two kg of Clay, one kg of grog, and three kg of cement were measured and mixed with water to produce a homogeneous composite. The mixture was cast into a circular wheel-head mold and demoded after two days.



Down view sketch of wheel head



Detailed sketch of the wheel head



Plate 1: prepared mould
Artist: Uche Amaechi
Photography: Amadi Kinsley
Size: 18x18
Year: 2025



Plate 2: potter's wheel head
Artist: Uche Amaechi
photography: Amadi Kinsley
Size: 18x18
Year: 2025

The fabricated wheel-head was mounted on a pottery wheel system.
Performance tests were conducted to evaluate load-bearing capacity, rotational stability, moisture resistance, and wear resistance.



Plate 3: test running
Artist: Uche Amaechi
photography: Amadi Kinsley
size: 10x6
year: 2025

Findings and Discussion: The experimental investigation yielded several significant findings.
Strength and Stability
The addition of cement increased the compressive strength of the composite material. Grog reduced shrinkage and minimized cracking during curing. The resulting wheel-head demonstrated sufficient rigidity to support normal pottery operations.

Durability: The composite wheel-head exhibited good resistance to repeated use and maintained structural integrity under rotational stress. Minor surface wear was observed after extended operation but did not significantly affect functionality.

Moisture Resistance: The cement component enhanced resistance to water absorption. Surface sealing further improved moisture protection and reduced degradation during routine use.

Economic Advantages: The cost of producing the composite wheel-head was substantially lower than the cost of acquiring a comparable metallic wheel-head. The use of locally available materials reduced production expenses and increased accessibility for small-scale pottery studios.

Environmental Benefits: The composite material reduced dependence on energy-intensive metal manufacturing processes. The utilization of clay and recycled grog contributed to sustainable material use within ceramic practice.

Limitations: The composite wheel-head was heavier than some aluminum alternatives and required adequate curing time before use. Proper material proportioning was essential to prevent brittleness and ensure optimal performance.

Conclusion
The study demonstrates that a clay-grog-cement composite can serve as an effective non-metallic alternative for potter's wheel-head production. The material exhibited satisfactory strength, durability, moisture resistance, and operational performance while offering significant economic and environmental advantages. The findings suggest that locally sourced composite materials can contribute to the development of affordable and sustainable ceramic technologies, particularly in regions where access to metallic equipment is limited.

Recommendations
Based on the findings of the study of Non-Metallic Potter's Wheel-Head: A Study of Clay, Grog, and Cement, the following recommendations are proposed:

(1) Given the abundance of clay deposits and ceramic raw materials in Nigeria, institutions such as National Council for Arts and Culture, National Gallery of Art, and university ceramics departments should support research into locally sourced ceramic equipment. Such initiatives can reduce production costs, create employment opportunities, and advance the growth of Nigeria's ceramic industry through sustainable and affordable technological innovations
(2) Ceramic workshops should explore more on the use of clay-grog-cement composites for wheel-head fabrication.

(3) Ceramic practitioners and pottery studios should consider using clay, grog, and cement composites as alternative materials for wheel-head production, particularly where metallic wheel-heads are expensive or difficult to obtain.
(4) Government agencies, educational institutions, and ceramic organizations should support the development and commercialization of locally produced ceramic equipment as a means of promoting indigenous technology and reducing dependence on imported products.
(5) Ceramic training institutions and universities should incorporate the design and fabrication of non-metallic pottery equipment into their curricula to encourage innovation and problem-solving among students.

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