

**DESIGN AND CONSTRUCTION OF A SMALL SCALE SOLID WASTE MOBILE
INCINERATOR IN UMARU ALI SHINKAFI POLYTECHNIC SOKOTO**

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ABSTRACT

The Umaru Ali Shinkafi Polytechnic Sokoto consists of the Civil and Mechanical Engineering Department in the College of Engineering. These departments have similar syllabuses for environmental engineering and pollution control on which specialization was based. In efforts to actualize one of the mandates both in teaching theory and practice and actualize the need to improve the livelihood of the citizenry of this country, at this moment, embark on the Fabrication of Municipal Solid Waste Mobile Incinerator in Umaru Ali Shinkafi Polytechnic Sokoto. This brought more technical know-how to students, self-reliance and economy-boosting in the society. This Work Plan for the fabrication includes Materials sampling, parameter designs and construction techniques. After constructions, test runs of the machine were carried out, and its performance was observed. Errors observed were corrected, imperfections were also swept. The machine was test runs for the second time. The Incinerator was subjected for use, its performance was certified. However, other methods employed included the visitations to stakeholders like SEPA, Ministry of Environment, SUDA, UDUTH etc., to collect related data. Parameter design, metal cuttings, construction and assembling began after the processes mentioned above had been achieved. The materials used include iron sheet metals, tricycle tires, ignition devices, burner, angle irons, clayey materials, insulators etc., Welding connections, bolts and nut connections. On the completion of this fabrication work, some of the benefits derived include: The Provision of opportunity for staff continuous refreshing of practical training, Acquaintance of staff, students, and the general public to the easy method of Fabrication of Municipal Solid Waste Mobile operated Incinerator and its uses, Provide an opportunity for in-house training and research center for sister institutions researchers, and other non-governmental organizations in terms of fabrication technicalities, As part of its inclusion in NBTE curriculum for NDCE, HNDCE and HNDME, this fabrication work provides the students of this two departments opportunity in their carrier guiding and practical experience and reports respectively, Provide an opportunity for school clinic in Umaru Ali Shinkafi Polytechnic to manage appropriately all biological/medical wastes generated.

Keywords: Fabrication, municipal, solid waste, mobile, Incinerator



INTRODUCTION

Incineration is a disposal method in which solid organic wastes are subjected to combustion to convert them into residue and gaseous products. This method is helpful for the disposal of municipal solid waste and solid residue from wastewater treatment. The process reduces solid waste volumes by 80 to 95 percent (<https://en.wikipedia.org/wiki/Waste-management>). Incineration is carried out on a small scale by individuals and on a large scale by industry. It is used to dispose of solid, liquid and gaseous waste. It is recognized as a practical method of disposing of certain hazardous waste materials (such as biological medical waste) <https://en.wikipedia.org/wiki/Waste-management>. Incineration is a controversial method of waste disposal due to issues such as the emission of gaseous pollutants. Proper management of refuse or solid waste disposal is necessary to prevent the spread of various diseases within both rural and urban communities. Incineration involves the burning of wastes in steel towers at a predetermined place. A small accumulation of wastes can be eliminated by burning in designated pits. However, large volumes of waste are best removed by incineration (Abdullahi, 2018). This construction work aims to design and construct a small-scale mobile solid waste Incinerator in Umaru Ali Shinkafi Polytechnic Sokoto.

BACKGROUND OF THE STUDY

As a field of studies in a civil and mechanical engineering discipline, designing and construction are indispensable factors to consider in every nation's development. In engineering practice, the design and construction are some of the most reliable and necessary in putting lives to a better hood. The knowledge of all these is of great concern to the technocrats. This construction work will enhance the students further to understand the technical know-how in construction and the use of incinerators in the environmental protection against pollution and health hazards and its implications to human health and the natural environment itself. This Incinerator will introduce an easy situation in managing waste products in the Umaru Ali Shinkafi Polytechnic Sokoto. Application of this project is followed with several advantages for: sources of manures to farmers, prevention of pollution, and environmental health hazards etc., it is against this background this fabrication work is slated to be undertaken.

LITERATURE REVIEW

Preamble

An environmental hazard is one of the dangers of indiscriminate refuse dump in human dwellings. It gives off an offensive odor that chokes our lungs, affecting breathing. If one cannot breathe very well, it can lead to death. The provision of a waste disposal bin by the Sokoto Urban Development Authority (SUDA) is inadequate. The removal of waste from the bins is ineffective because of insufficient evacuation trucks and workforce (Yanda & Abdullahi, 2016). Various solid wastes disposal methods have been identified, out of which plasma gasification, landfill, which involved the burying of waste, incineration, supercritical water decomposition, recycling

which involved the sorting and re-use of waste as raw materials for new products, biological processing and energy recovery (Tunde, 2016). These waste disposal methods can only be efficient when the value and amount of waste generated in a particular community are highly understood and known. An incinerator is selected based on waste properties, characteristics and usage location. An incinerator must focus on three things; Time – flue gas residence determines better emission; Temperature – within the incinerator chamber(s); and Turbulence – agitation within the Incinerator; to ensure the best destruction/removal efficiency, combustion efficiency and emission efficiency (HAAT, 2018).

A typical incinerator consists of the furnace chamber, the heat recovery boiler, and the flue gas treatment plant (<https://www.thermopedia.com/content/873/>). A mobile incinerator is an incineration system mounted on a semi-trailer. Modern incinerators enable complete and sterile incineration of waste. The incinerators can be operated virtually anywhere. The modern mobile incinerator unit (MIU) can incinerate waste at a temperature of up to 1,200 °C (2,192 °F). This Incinerator is designed to incinerate all kinds of waste and infected hazardous waste (<https://groups.google.com/g/soc.retirement/c/2lWc5elCHUE>). The Incinerator satisfies the requirement for the burning of waste of hospitals and health facilities at a minimum temperature of 1,100 °C (2,012 °F). The Incinerator can also dispose of household and institutional waste to measure environmental protection. The design of this Incinerator ensures extra air is drawn into the main chamber aiding primary combustion to ensure the efficient disposal of waste or carcasses at minimum cost. These units are the highest standards for waste disposal and benefit from being highly durable to long working life (<https://www.agrieexpo.online/prod/inciner8/product-181156-46851.html>). The control panel is set up for easy use and will automatically shut off when the required incineration time is completed (<https://sswn.info/sites/default/files/referenceattachments/INCINER8%202004%20MKobil%20Waste%20Incinerators.pdf>).

Primary purpose and Forecast of future developments

The primary purpose of incineration is to reduce the waste volume and destruction of potentially dangerous substances. The Waste Incineration is classified as an act of exploitation in the Waste Framework Directive adopted in May 2008. The waste used for energy production is subject to the free trade policy and may be moved in the EU transboundary. The waste to be eliminated, for example, hazardous and toxic waste, must be disposed of in the vicinity of its origin. Since the volume of waste is growing continuously, landfilling is not a long-term solution for waste disposal. The interest in the new design of incinerators and incineration processes focuses on further improvements in energy efficiency and the further savings of CO₂. Engineers are working on several aspects of it, from the fuel consumption of the plants to increase the efficiency of the equipment. Today more than 80 percent of slag and flying ash are used, mainly in earth filling or road construction (<https://en.wikipedia.org/wiki/Mobile-incinerator>).

METHODOLOGY

The Work Plan is as summarized below;

- Materials sampling and parameter designs
- Construction techniques include three units: the chimney, the combustion chamber and the gas and ignition unit
- After constructions, test runs of the machine were carried out, and its performance was observed.
- Errors observed were corrected, and imperfections were swept.
- The machine was test runs for the second time.
- The Incinerator was subjected to use under supervision for one week, and its performance was certified.

However, other methods employed include visitations to stakeholders like SEPA, Ministry of Environment, SUDA, UDUTH etc., to collect related data. The parameters, metal cuttings, construction and assembling, begin after the processes mentioned above have been achieved. The materials and tools used in constructing this Incinerator include iron rods, sheet metals, tricycle tires, angle iron, clayey materials, insulators, hammer, rulers, scissors, welding machine, bolts and nuts etc.

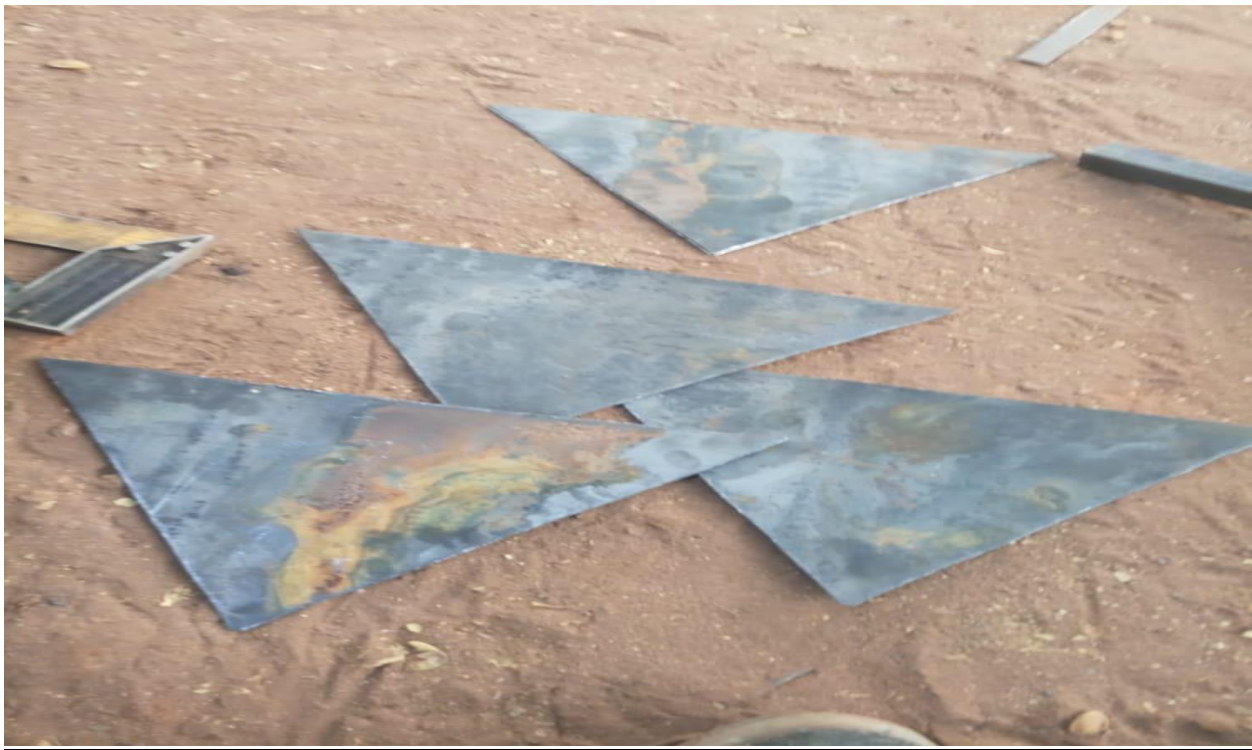


Plate 1: Sheet metal cutting in progress



Plate 2: Joining/Connection of sheet metal for chimney construction in progress



Plate3: Construction of the Incinerator in progress



Plate 4: A fabricated incinerator the showing position of filling with clay for lagging



Plate 5: Lagging of combustion chamber with clay material in progress



Plate 6: Positioning of a gas cylinder for generating gas to the burner (ignitor) in progress

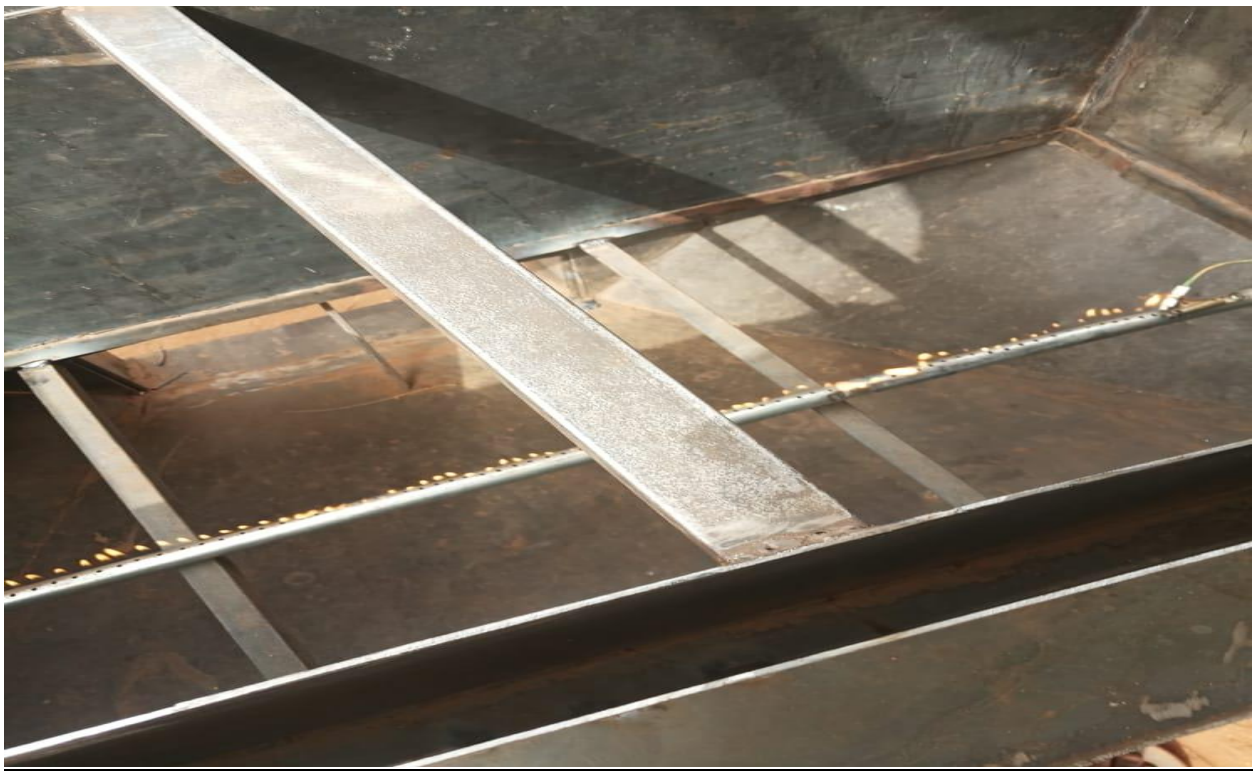


Plate 7: Position of a burner (combustion unit) of the Incinerator



Plate 8: Provision and ignition of heating element showing fire flame (as a burner) to the Incinerator



Plate 9: A fabricated incinerator showing a combustion chamber and outlet of ashes of a burnt materials/waste



Plate 10: A fabricated incinerator incorporated with a chimney before wheel and axle were coupled



Plate 11: A fabricated mobile incinerator showing three units (chimney, combustion chamber and the gas and ignition unit) coupled with wheel and axle

CONCLUSION

The environmental health concerns with medical waste management and disposal. The hazardous materials management and the prevention of hazardous materials release to the environment and responses to emergencies resulting from such releases. The dirty environment has an impact on people's health status. Environmental health must address the societal and environmental factors that could increase the likelihood of exposure and disease. The mobile incinerators provide a valuable addition to the available standards in waste management. The elimination of hazardous and toxic waste on-site is one of the primary uses of mobile incinerators. The mobile incinerator unit is the most suitable product for countries that are starting to tackle waste, in such cases; there are no previous statistics about the amount of waste and its composition (<https://en.wikipedia.org/wiki/Mobile-incinerator>)

RECOMMENDATIONS

On completing this fabrication work, there are many benefits derivable from it. However, some of the benefits include:

- Provision of opportunity for staff continuous refreshing of practical training.
- An acquaintance of staff, students, and the general public to the easy fabrication method of Municipal Solid Waste Mobile operated Incinerator and its uses.
- Provide the in-house training and research center for sister institutions, researchers, and other non-governmental organizations regarding fabrication technicalities.
- As part of its inclusion in the NBTE curriculum for NDCE, HNDCE and HNDME, this fabrication work provides the students of these two department's opportunity in their carrier guiding and practical experience and practical reports.
- Provide an opportunity for the school clinic in Umaru Ali Shinkafi Polytechnic to manage appropriately all hazardous wastes generated.

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