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# Evaluating the Advancement and Applicability of Green Technology Incinerators for Public Higher Education Institutions' Waste Treatment

Ibrahim G. W.<sup>1\*</sup>, Ajibola W. A.<sup>2</sup>

<sup>1</sup>Department of Mechanical Engineering, The Federal Polytechnic, Ilaro, Ogun State, Nigeria

<sup>2</sup>Department of Metallurgical Engineering, The Federal Polytechnic, Ilaro, Ogun State, Nigeria

\*Corresponding author, gbenga.ibrahim@federalpolyilaro.edu.ng

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## Abstract

One way to dispose of waste is by incineration, which is preferable to burning it outdoors, as is the case in the majority of underdeveloped nations. The amount of rubbish that is discharged into rivers and along the sides of roads will be decreased by the incineration process, which is a supplemental Municipal rubbish Management Program. In order to reduce waste volume and eliminate any hazardous materials or pathogens contained in the waste, this article describes the design and construction of a waste green technology incinerator for municipal waste disposal. The incinerator was built to handle 300 kg of bulk mass trash with a 6.81 m<sup>3</sup> volume. The incinerator's dimensions are 2.135 x 1.83 x 2.44 meters (L x W x H), and its total volume, including the ash chamber, is 9.53 m<sup>3</sup>. The ashes fall into a collector with a volume of 0.91 m<sup>3</sup> and dimensions of 2.44 m x 1.22 m x 0.31 m (L x W x H) that is constructed of angle bar, flat sheet metal, and wheels. The incinerator's centrifugal blower supplies and supports a substantial air flow to the combustion chamber. The combustion chamber's dimensions are 1.83 x 2.44 x 1.53 m (L x W x H), and its volume is 6.81 m<sup>3</sup>. It is composed of refractory material with high refraction qualities. Trash Green Technology Incinerator was designed and built with the purpose of disposing of trash produced within the organization. This will lessen the pollution issue that the institution faces as a result of its subpar waste disposal system.

**Keywords:** Higher Institutions, Green Technology, Incineration, Waste, and Treatment.

## 1. INTRODUCTION

Nowadays, human-generated trash is a source of environmental annoyance and is becoming more dangerous every day since it endangers human life. Finding suitable solutions to the issue is consequently essential, particularly at the institutional level. Uncontrolled dumping is a common method of disposing of solid waste in many underdeveloped nations. Often, these dumps are left to burn, either intentionally. The combustion process is completed by maintaining the temperature, and the gases are transported to an ash chamber and chimney via flues.

Depending on the waste's composition, an incinerator can reduce the volume of the original garbage by 15% and its solid mass by 20% (Ramboll, 2006). This indicates that incineration significantly lowers the volume required for disposal, even while it does not entirely replace land filling. To get rid of fly ash and gaseous pollutants, modern incinerators come with air pollution control devices as fabric filters, scrubbers, and electrostatic precipitators. Tall chimney stacks contribute to lowering air pollution by releasing the cleansed flue gases at a height. By lowering a community's solid trash to roughly 10% to 15% of its initial amount, incineration makes garbage disposal easier. The municipal or state government for the citizens' trash disposal. The goal of the green technology incinerator's design and construction is to advance society's technical advancement as well as its health and safety. People in underdeveloped nations have garbage disposal challenges as a result of inadequate government waste management systems, which are linked to health problems. This essay focuses on one method of trash processing that involves lowering the amount of solid garbage in the surroundings. Where to dispose of discarded waste that won't hurt the community is a dilemma that many people in our society face.

This study examines one method of resolving this issue, which involves burning household or municipal waste to minimize the amount of hazardous materials in the environment. It can then be utilized to turn trash into wealth in order to produce electricity

### **1.1. BACKGROUND OF THE STUDY**

According to study, 75–80% of districts in developing nations have extremely subpar waste management systems. Using Ilaro town as an example, 80–90% of the waste produced in the Orita area is burned in an open air space, while the remaining 10%–20% is disposed of in a flood path that floods away to an unidentified destination.

Eighty to ninety percent of the garbage produced on campus at The Federal Polytechnic, Ilaro, comes from offices and classrooms. Since it costs more to carry waste from the campus to the school dumping sites, the open burning method of waste disposal seriously pollutes the environment. It is noteworthy that there isn't a single authorized dumping location in Yewa South.

According to investigations, the deep well and small drill holes located close to the disposal site are extremely polluted. Approximately 50% of municipal solid trash in developing nations is made up of organic garbage (Adigio and Amula, 2011). According to Kotvicova, Toman, Vavekova, and Atwajskal (2011), gas released while burning damages internal organs and produces an odor from decomposing organic materials. According to reports, examination of deep boreholes and the areas surrounding landfills did not reveal water that was significantly contaminated (Akinbile, 2012).

### **2.0. LITERATURE REVIEW**

This chapter reviews the research on evaluating the advancement and applicability of green technology incinerators for public higher education trash treatment. The following subheadings cover it in more detail. Reducing waste output and increasing emissions are the best waste management methods. Waste management is defined by different ways in industrialized countries by international city authorities, according to Adejobi and Olorunnimbe (2012). Although it is a frequent practice, dumping sites can have serious consequences when authorities fail to maintain them correctly, leading to fires. These dumps are allow

to burn either on purpose or as a means of reducing waste volume (Taylor, 2004).

**Table 1: The temperature needed to burn different types of municipal refuse**

| WASTE   | MELTING POINT RANGE | IGNITION TEMPERATURE °C |
|---------|---------------------|-------------------------|
| Plastic | 160-2275            | 255                     |
| wood    | 100-115             | 600                     |
| Pvc     | 100-110             | 435-557                 |
| Wool    | 70-85               | 227-230                 |
| cotton  | 50-60               | 255                     |
| rubber  | 40-50               | 260-316                 |
| paper   | 30                  | 234                     |

Source: <http://en.m.wikipedia.org/wiki/waste>

## 2.1. INCINERATOR

It has long been believed that fire contributed to the development of human language and civilization. Although an incinerator has gone by many names, the fundamental idea is the same: burn to garbage. Since the invention of fire, burning has been considered a way to eradicate infection. Disease outbreaks plagued the Belgian villagers in the area following the Battle of Sedan in 1870. Numerous individuals and animals interred in mass graves served as the source. Naturally, there were no incinerators at the time, but the dead were dug up, burned, and the bones—which made up 25% of the original material—were reburied, and the residents were spared any more hardship.

## 2.2. TRASH THAT IS SUITABLE FOR BURNING

The waste that can be incinerated include:

1. Paper products, Paperboard packing including boxboard and cardboard Untreated wood including lumber and plywood
2. Food waste Food packaging Natural fibre textiles Plastic.

## 2.3. ADVANTAGES OF INCINERATION

The use of incineration for garbage management has benefits. The decrease in waste volume is one of incineration's main benefits and the waste's bulk. The heat produced by waste-to-energy technologies can be converted into energy using steam boilers. Another fundamental benefit of incineration is that it reduces the possibility of air, water, and land pollution. It costs more to construct, run, and maintain an incinerator. Additionally, waste management facilities needed trained labor to operate and maintain. Acid gasses, nitrogen particles, and dioxin are among the smokes and ashes released by incineration chimneys. It costs more to construct, run, and maintain an incinerator. Additionally, waste management facilities needed trained labor to operate and maintain. Acid gasses, nitrogen particles, and dioxin are among the smokes and ashes released by incineration chimneys.

## 2.4 DISADVANTAGES OF INCINERATION

It costs more to construct, run, and maintain an incinerator. Additionally, waste management facilities needed

trained labor to operate and maintain. Acid gasses, nitrogen particles, and dioxin are among the smokes and ashes released by incineration chimneys.

### **3.0. METHODOLOGY**

#### **3.1. MATERIALS AND TOOLS USED IN THE INCINERATOR'S PRODUCTION**

The following lists of material and equipment were used for the fabrication and utilization of the incinerator: Red Brick, Angle plate, cement, granite, hinge, cement block, sharp sand, sheet metal, chimney, gas cylinder mech, blower and iron rod.

#### **3.2. MAINTENANCE**

Wear and tear always occurs during operation, regardless of how well-designed the equipment was. Inadequate maintenance and operation procedures result in component degradation that produces toxic gasses and poor emissions. The equipment's dependability, efficiency, and lifespan are also impacted by operation and maintenance.

##### **3.2.1. STEPS IN PREVENTIVE MAINTENANCE**

- i. Take an inventory of conditions of tools and equipment
- ii. Grinding welding
- iii. Check the charging door for latch blockage in the door frame
- iv. Check the charging door for damaged hinges
- v. Check the external brickwork for evidence of thermal damage
- vi. Check the cement seal to brickwork
- vii. Check the charging door for corrosion
- viii. Check the top sand seals

#### **3.3. SAFETY**

Infection control, equipment safety (to avoid operator harm), and fire safety are all aspects of safety. Among the particular suggestions are:

- i. Eye protection and a face mask should be worn when opening loading door or visually
- ii. Checking the unit to protect against glass shards from exploding ampoules and glass bottles.
- iii. Heavy-duty gloves and apron should be worn when handling health-care waste.
- iv. Ash must not be handled by hand.
- v. An adequate cool-down period (3 to 5 hrs) is necessary before ash removal. Appropriate disposal of ash is necessary.

### **4.0 RESULT**

The main goal of the incinerator's design and construction is to address the environmental pollution and land fill issues that many members of our society and the government face. After fabricating the incinerator, it is

crucial to report the outcome and talk about the incinerator's success. When fabricating the incinerator, proper clearance and alignment are taken into account to provide a consistent outcome.

#### 4.1 THE INSTITUTION'S WASTE GENERATION SOURCES

- i. Two students' worship centre (often referred to as CU and Mosque)
- ii. Cafeterias/Market
- iii. Bakery/Pure water industry
- iv. Residential students' halls (hostel)
- v. Centre for Learning Resources (Library)
- vi. Lecture Theatres
- vii. ICT Centre
- viii. Engineering Complex
- ix. Three Multi-purpose hall

**Table2:** Composition of solid waste produced at the School of Environmental Studies (Percent by weight)

| Categories Waste         | Weight of waste (kg) | % by weight |
|--------------------------|----------------------|-------------|
| PAPER                    | 140.02               | 12          |
| PLASTIC AND NYLON        | 56.24                | 7.1         |
| TEXTILE                  | 26.42                | 3.5         |
| LEATHER                  | 13.05                | 4.9         |
| METAL(TINS AND CANS )    | 45.06                | 15          |
| GLASS                    | 18.33                | 37.4        |
| ORGANIC (BIODEGRADABLES) | 58.34                | 15.6        |
| Other                    | 16.47                | 4.5         |
| TOTAL                    | 374.5                | 100         |

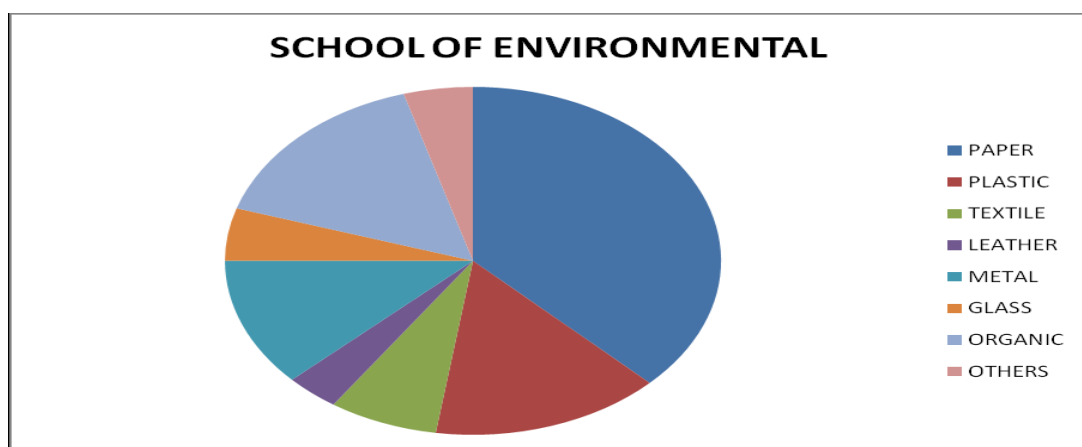


**Figure 1:** Solid waste generated at the School of Environmental Studies, broken down by composition (percent by weight).The US Environmental Protection Agency is the source.

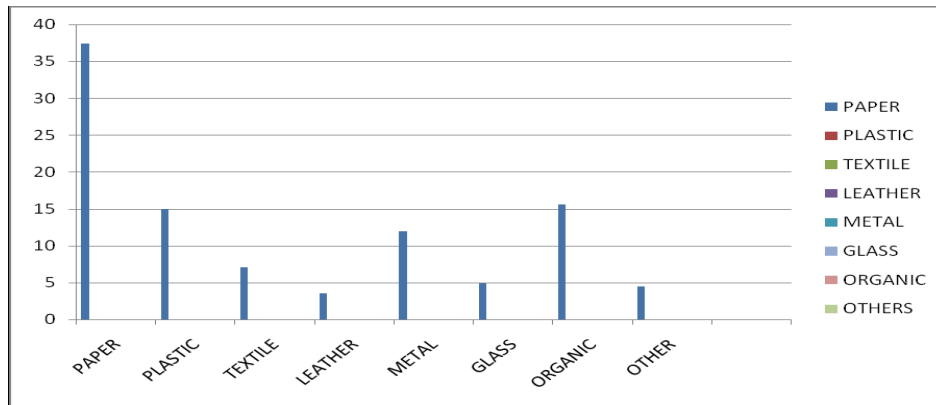


**Figure 2:** Bar Chart of Solid Waste Composition (% by weight) at the School of Environmental Studies. The US Environmental Protection Agency is the source.

**Table 3:** Solid waste composition (percentage by weight) produced by the entire institution

| Waste Categories         | Weight of waste (kg) | % by weight |
|--------------------------|----------------------|-------------|
| PAPER                    | 998.2                | 35          |
| PLASTIC AND NYLON        | 342.24               | 12          |
| TEXTILE                  | 142.6                | 5           |
| LEATHER                  | 57.04                | 2           |
| METAL(TINS AND CANS )    | 285.2                | 10          |
| GLASS                    | 85.56                | 3           |
| ORGANIC (BIODEGRADABLES) | 827.08               | 29          |
| Other                    | 114.08               | 4           |
| TOTAL                    | 2,852                | 100         |

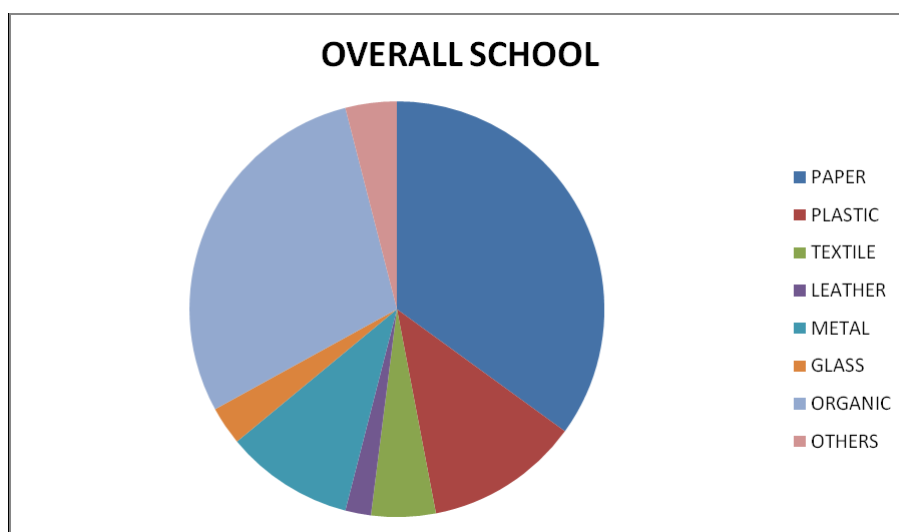


**Figure 3** shows the composition (percentage by weight) of the solid waste produced by the entire organization. The US Environmental Protection Agency is the source.

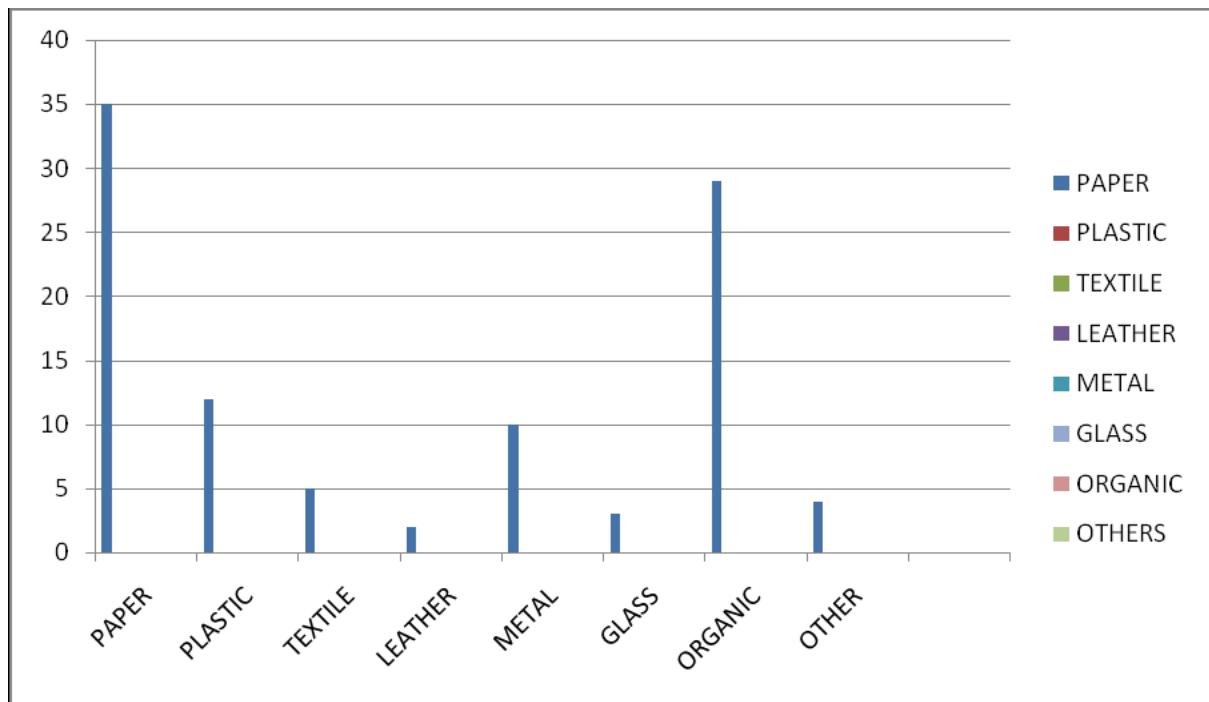


**Figure 4:** Bar graph showing the composition (percentage by weight) of solid waste produced by the entire organization. <http://en.m.wikipedia.org/wiki/waste> is the source.

The study's findings indicate that the largest percentage of garbage produced is paper (35%), followed by plastic and nylon (12%), metals (10%), and organics (29%). Because paper is used so frequently for information transfer (memory, newsletter, etc.), it has the largest percentage.

#### 4.2. WASTE CHARGES AND REDUCTIONS IN VOLUME

The incinerator's capacity for batch treatment of solid waste is 6.81 m<sup>3</sup>, and it was built to handle 300 kg of bulk garbage. The incinerator's design calls for reducing trash to 15–25% of the total amount of solid garbage that is charged there. There will be a reduction in the amount of ash content that remains in the incinerator to either 45 kg (85% reduction) or 60 kg (80% reduction).

#### 4.3. MAXIMUM BURNING CHAMBER TEMPERATURE

The burning chamber's maximum temperature, which can burn 300 kg of municipal waste, is between 100 and 150°C. The operator should shut the door and begin the burn cycle after the incinerator has been filled with the proper mixture and amount of 300 kg of waste. To check for full burn, wait 20 to 30 minutes after the burn before opening the charging door to break the burn cycle.

#### 4.4. COMPUTATIONS

The purpose of the incinerator was to handle a large amount of 300 kg, as well as the amount of solid waste in the batch treatment incinerator is 6.81 m<sup>3</sup>. In order to recycle the energy utilizing a blower fan, a heat recovery unit was consequently also incorporated into the design via a heat exchanger. To lessen the impact of lost heat

on incinerator operators, the unit is surrounded by red bricks that measure 2.135 m in height, 1.83 m in width, and 2.44 m in length. The chimney, which is situated on the incinerator's roof, allows the flue gas to escape. The incinerator's overall volume, including the ash chamber, is 9.53 m<sup>3</sup>.

## 5.0. CONCLUSION AND RECOMMENDATION

A great deal of waste management research and development went into the incinerator's design and construction, which provided the rationale and understanding for its inclusion. The study successfully designed and constructed a green technology municipal waste incinerator capable of handling up to 300 kg of bulk waste per cycle, significantly reducing waste volume and associated environmental pollution. The incinerator's structural design, adequate combustion chamber capacity, and efficient air supply system ensure effective combustion, pathogen elimination, and safe ash collection. By integrating refractory materials and a centrifugal blower for sustained airflow, the system demonstrates reliability and operational efficiency. Overall, the developed incinerator provides a practical and environmentally preferable waste management solution for institutions and developing regions, contributing to improved sanitation, reduced improper waste disposal, and enhanced environmental protection.

## RECOMMENDATION

Hereby, the following suggestions are made:

- i. Equipment for reducing air pollution, such as fabric filters, scrubbers, and electrostatic precipitators, should be installed in incinerators
- ii. Each incinerator's chimneys would have a changeable catalytic converter to transform the hazardous flue gas into environmentally beneficial materials like oxygen (O<sub>2</sub>), carbon dioxide (CO<sub>2</sub>), nitrogen (N<sub>2</sub>), and water (H<sub>2</sub>O).
- iii. Every school ought to have an incinerator so that waste can be disposed of properly.

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