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The Study of Wood Waste Disposal Using Portable Incinerator

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Abstract

The increment in solid waste production is influenced by economic development, population growth, and the development of local industrial activities. Portable Incinerator is an innovation developed to reduce the problem of waste disposal site management. This study consists of three objectives which are, to produce a portable incinerator, to determine the effectiveness of full combustion time, and the quality of smoke produced. The scope of this study is Civil Engineering Wood Workshop Politeknik Mukah. The methodology of this study is qualitative, and observations are made during the combustion test. Pollution readings are taken every 5 minutes, during combustion, until it is completed. Combustion is carried out in two ways, namely, using a blower and without a blower. The air quality tested was Carbon Dioxide (CO^2), Total of Volatile Organic Compounds (TVOC) and Formaldehyde (HCHO). Based on observations, full combustion using a blower, for five kilograms of wood waste is 16:19:30 minutes, and full combustion without a blower is 21:34:38 minutes. It was found that pollution occurred at the 15th minute. The reading of Co2 is1818 ppm. Based on the Air Quality table, the appropriate value for Co2 is less than 1000 ppm. Despite this, portable incinerators managed to completely dispose of the wood waste, where there is no wood waste left and the ash produced is very minimal.

Keywords: - Portable incinerator, air pollutions, sustainability indicator

1. Introduction

Solid waste management is a huge issue due to the population increment, the rise in living standards, and industrial activities. Solid waste leads to harmful effects on the environment. Pollution will occur if the waste is not managed properly. Solid waste management consists of six elements, starting from waste generation, followed by storage and processing at the source level, collection process, transfer and transport, treatment, and transformation, and finally disposal. According to Rahman (2017), to fulfill the requirement of cleanliness and sanitation, local authorities should provide an efficient and systematic service. However, due to certain constraints, the authorities and unable to provide the best services for residents.

Incineration is a waste treatment process that involves the burning of waste; therefore, combustion is described as thermal treatment. A study conducted by Samah (2015) stated that an incinerator is a tool that processes waste materials through heat from combustion activities. Hazardous waste such as paint, asbestos, milk cartons, paper towels, disposable plates, and diapers are not safe if it is thrown in the trash. These types of waste are suitable to be disposed using incinerators. Portable Incinerator is a garbage burner that is capable and easy to use at home, commercial, and educational institutions. This study focuses on the disposal of wood waste in Civil Engineering Laboratories, Politeknik Mukah.

1.1 Problem Statement

The issue of solid waste site management is, the lifespan of a solid waste disposal site depends on the area and quantity of waste received throughout the operation of a site. However, most people don't bother about solid waste management issues, even though it starts in a trash can at home and ends at a landfill (Baharudin, 2020).

The bad habit of throwing garbage in impropriate places causes health and environmental pollution problems. Previous scientific studies prove that the population living near waste disposal areas faces health problems issues (Rahman & Suffian, 2015).

1.2 Objectives

This study consists of two objectives, that is:
1. To produce a portable incinerator.
2. To determine the effectiveness of full combustion time
3. To analyse the quality of smoke produced.

1.3 Research Scope

This study was conducted in Mukah Polytechnic (see Fig. 1). The portable size produced is 750 mm in height, and 470 mm in width. The wood disposed is 5kg. Combustion testing will be carried out using two methods that is by using a blower and without a blower.

Fig. 1. Location of wood laboratory Civil Engineering Department

2. Literature Review

A literature review is being carried out to find out the type of waste suitable to be disposed of using portable incinerators. Fig. 2 is the framework for this study. Six types of waste have been highlighted. Characteristics of each waste being analysed based on journals and articles published in previous studies. Wood waste can be recycled depending on the type of wood waste the facility receives. The benefits of recycling are based on the chemical content. The higher hazardous chemicals exist in the wood residues, the treatments will become more difficult and expensive. The recycling process will become complicated (Christensen, 2023). Based on the reading, the best solution to dispose of wood residues is by using a portable incinerator. It is cheaper than paying for transportation costs to landfill and flexibility in disposing of the item according to your preference.

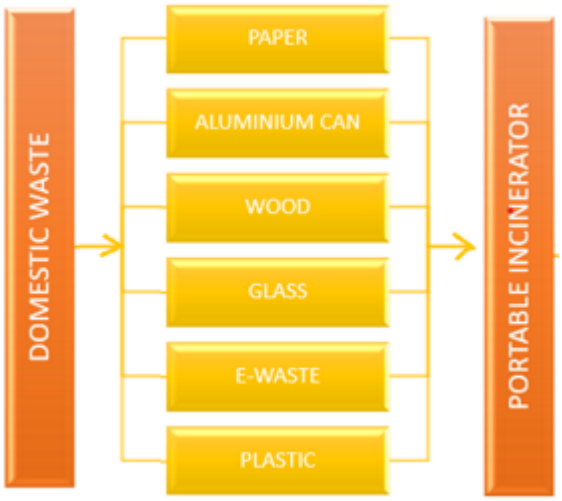

Fig. 2. Framework for this study

Fig. 3 shows the air quality monitoring indicator. Air quality monitoring is based on three indicators, that is the reading of Carbon Dioxide (Co^2), Formaldehyde (HCHO), and Volatile Organic Compounds (TVOC) content. Carbon dioxide, (CO^2), is a colourless gas having a faint sharp odor and a sour taste. The concept of carbon dioxide refers to a molecule in which two oxygen atoms are bonded to a central carbon atom, i.e. CO^2 (Zimring & Rathje, 2012).

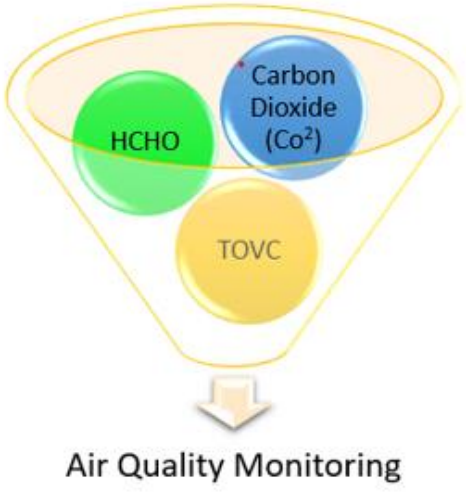

Fig. 3. Air quality monitoring indicator

According to Johnson et.al. (2024), formaldehyde (HCHO) is one of the most common and concerning air pollutants in various environments. Formaldehyde (HCHO) in outdoor air is a known carcinogen. Exposure to a mean HCHO concentration of 1 μg m−3 (about 0.7 ppb at STP) over one's lifetime will cause up to 13 people in a million to develop lung and nasopharyngeal cancer.

Volatile Organic Compounds (VOCs) include a variety of organic chemicals emitted as gases from certain solids and liquids. The nature and extent of these health effects depend on the concentration levels of these VOCs and the duration of their exposure and pose adverse health effects to humans (Pandey & Yadav, 2018). This indicator will be compared against environmental standards, to determine the quality of smoke emission during the combustion process.

3. Methodology

Qualitative approaches were used as the methodology for this study. The observation and data were collected to fulfill the objective stated. Based on the observations, a conclusion is made.

4. Analysis and Findings

The analysis and findings are to answer the objective stated.

4.1 Objective 1

The first objective achieves by design and producing a portable incinerator. The portable incinerator is produce partly using recycle item such as used drum and used tyre. The design produce using AutoCAD software. Fig. 4 shows the AutoCAD design, and Fig. 5 shows the physical portable incinerator produced in the laboratory.

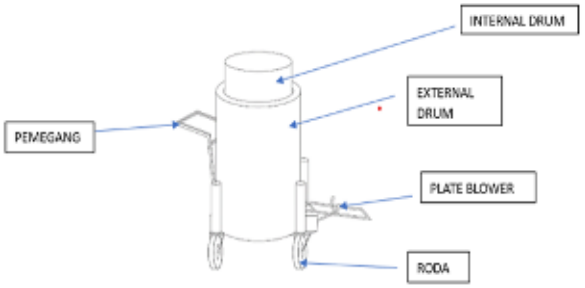

Fig. 4. Portable incinerator design

Fig. 5. Portable incinerator

4.2 Objective 2

Objective two of this study is to determine the effectiveness of full combustion time. 10kg waste wood use to carry out this study. 5kg of wood waste disposed using portable incinerator with blower, and another 5kg is disposed without blower. Table 1 shows the result of combustion after it has been completed. The wood waste has been fully disposed using portable incinerator.

Table 1. The result of full combustion

Full Combustion Time	
Combustion using blower	16:19:30 minutes
Combustion without blower	21:34:38 minutes

4.3 Objective 3

The third objective is to analyse the quality of smoke produced. The outcome from the data will be compared with air quality standards, to determine if it is complied with Environmental Quality Act 1974 (Amendment 2001) Act 127 Section 22 and Section 34A.

Fig. 6 shows that in the first 5 minutes, there is no pollution detected. After 10 minutes of combustion using blower, the reading exceeds the pollution level. Meanwhile, as for combustion without blower the Co^2 reading only increase after 15 minutes, that is 1811ppm.

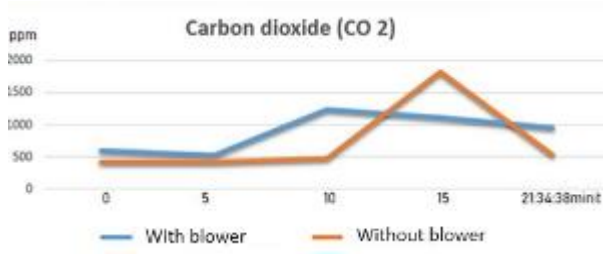

Fig. 6. Carbon dioxide level

Fig. 7 shows the reading for TOVC. Based on the reading, it is found that combustion without blower reaches the highest point after 15 minutes that is 2mg/m^3. It is considered as pollution, due to the range are between 0.601mg/m^3 – 3mg/m^3.

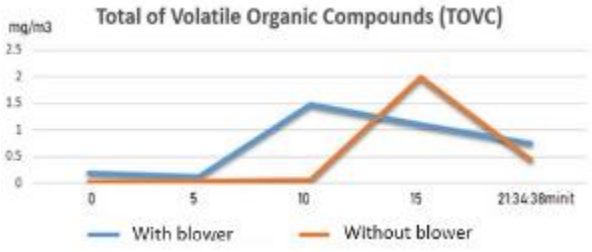

Fig. 7. Reading for TOVC

Fig. 8 shows that HCHO reading has reached 0.2mg/m^3 in 10th minute combustion with a blower. As for combustion without blower, the increment only occurs after 15 minutes of combustion. The maximum reading is 0.25mg/m^3. This maximum reading is pollution. A good reading is between 0.081mg/m^3-0.1mg/m^3.

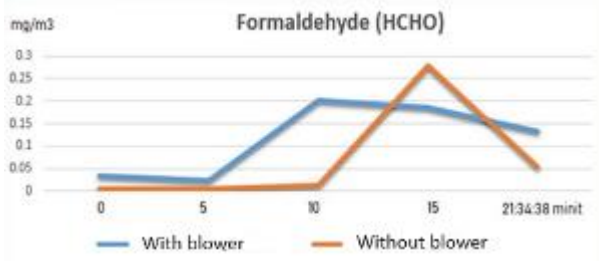

Fig. 8. Reading for HCHO

Based on the test run result, smoke emissions did not meet the standard required by Environmental Quality Act 1974 (Amendment 2001) Act 127, Section 22, and Section 34A. The portable incinerator was able to dispose of the wood residues appropriately, unfortunately, the smoke emission exceeded the standard of environmental pollution. Therefore, it is necessary to consider fixing a smoke filter on this portable incinerator.

5. Conclusion

This study has been carried out to test the quality of smoke emission from portable incinerators during wood waste disposal, complying with the Environmental Quality Act 1974 (Amendment 2001) Act 127. The products produced are expected to be used in Wood Laboratory Mukah Polytechnic. There are some modifications that will be made to the incinerator so that the smoke emission will be less polluted compared to the current portable incinerator. The usage will be expended to the community as well as in the small, scaled industry nearby. It will be able to help the community in reducing the issue of inadequate landfill sites.

References

Baharudin, A. K. S., & Aziz, S. (2020). Menganjak ke Satu Pengurusan Sisa Pepejal Secara Lestari di Kampus UKM Bangi, Selangor: Pertimbangan Awal. *Jurnal Personalia Pelajar*, *23*(2).

Christensen, J. (2023). Possibility to reuse and recycle wood waste and CDWW.

Pandey, P., & Yadav, R. (2018). A review on volatile organic compounds (VOCs) as environmental pollutants: Fate and distribution. *International Journal of Plant and Environment*, *4*(02), 14-26.

Rahman, H. A. (2017). Penglibatan komuniti dalam pengurusan sisa pepejal di Malaysia. *Malaysian Journal of Environmental Management*, *16*(1), 13-22.

Rahman, H. A., & Suffian, R. (Eds.). (2015). *Pemanasan Global: Impak Terhadap Masyarakat dan Kesihatan (UUM Press): UUM Press*. UUM Press.

Samah, M. A. (2015) *Meneroka interaksi dinamik dalam kesihatan persekitaran: himpunan siri kajian di Malaysia*. Faculty of Medicine and Health Science, Universiti Putra Malaysia, Serdang, Selangor. ISBN 9789832408291.

Zimring, C. A., & Rathje, W. L. (Eds.). (2012). *Encyclopedia of consumption and waste: the social science of garbage* (Vol. 1). Sage.