UNIVERSITI TEKNIKAL MALAYSIA MELAKA

EMISSION CONTROLLED BURNING SYSTEM

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BACHELOR OF MECHANICAL ENGINEERING TECHNOLOGY (MAINTENANCE TECHNOLOGY) WITH HONOURS

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Faculty of Mechanical and Manufacturing Engineering Technology

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A project report submitted
in fulfillment of the requirements for the degree of
Bachelor of Mechanical Engineering Technology (Maintenance Technology) with Honours

Faculty of Mechanical and Manufacturing Engineering Technology

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2023

DECLARATION

I declare that this research report entitled “Emission Controlled Burning System” is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : 

Name : CARLVIN BERASAP ANAK UJAN

Date : 11 JANUARY 2023

APPROVAL

I hereby declare that I have checked this thesis, and, in my opinion, this report is acceptable in terms of scope and quality for the Bachelor of Mechanical Engineering Technology (Maintenance Technology) with Honours.

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DEDICATION

To my beloved parents Ujan Anak Pulo and Shellen Anak Masing, I would be honored to dedicate this report for both of them as they are my courage, inspiration, dedication, and strength to complete my research until the end. I would also like to say thanks to my brother, sister, and friends because they also help me in term of financial during my year of study.

ABSTRACT

Globally, the amount of particulate matter concentration emitted are uncontrollable. Particulate matter PM 1.0, PM 2.5 and PM 10 emitted to the atmosphere through many ways which is one of them is through emission of open burning. In Malaysia, open burning activity are one of the reasons for this study. The emission of PM that is beyond our comprehend should be investigated and looked into as it causes a health complication in long term. The goal of this study is to design an emission-controlled burning system that filters and reduce the concentration of particulate matter (PM) emitted from the emissions. The aim of this thesis is to fabricate the system and conduct the PM filtration in three different types of filtering mediums. To do that, three combustion mediums are used, which is woods, plastic and paper. Data and result of PM will be analyzed and comparing the presence of concentration of particulate matter in each emission. Data and results will be taken by having a steel water barrel as the burning compartment and small water container as the second compartment as the filter compartment. Both are connected by a reinforced PVC hose that is channeling the emission from the burning compartment to the filter compartment. The filtered emission will be analyzed with DustTrax DRX, the monitoring device. Data and results are extracted using the TSI software to convert the reading into graph form to be analyzed. The data in each graph are compared and the concentration of PM in each filtering medium and combustion medium points out a significant reading. Through this experiment, the emission of PM can be reduced though it may not 100 percent eliminate the particulate matter.

ABSTRAK

Pelepasan bahan zarah yang tidak terkawal menyumbang kepada ketinggian kepekatan yang terbebas di seluruh. Maka dari itu, tujuan kajian ini adalah untuk membuat satu sistem pembakaran yang mempunyai kawalan pelepasan untuk menyaring dan menyingkirkan bahan zarah yangberbahaya di dalam pelepasan tersebut. Tujuan kajian ini dilakukan adalah untuk mencipta system pelepasan pembakaran yang terkawal untuk meyaring and mengurangkan kepekatan bahan zarah. Tujuannya adalah dengan menciptakan system penyaringan dengan menggunakan tige jenis bahan penapisan. Tambahan pula, untuk melakukan Langkah tersebut adalah dengan menggunakan pula tiga jenis bahan bakar iaitu kayu, plastic dan kertas. Data dan hasil kajian akan diambil dan dianalisis untuk menbandingkan kehadiran setiap bahan zarah yang terkandung dalam asap dari pemabakaran tersebut. Langkah untuk melakukan itu adalah dengan menggunakan tong air yang besar dan tong air yang berukuran kecil. Kedua tong air disambungkan menggunakan hos yang tahan panas. Tong yang besar sebagai tempat pembakaran dan yang kecil pula tempat bahan penapisan atau penyaringan. Asap yang telah melalui penapisan akan dianalisa menggunakan DustTrak DRX. Data hasil kajian akan dipindahkan ke computer riba menggunakan perisian TSI. Data hasil kajian di ubah kepada bentuk graf untuk dianalisa dengan menbandingkan titik-titik graf dalam setiap bahan bakar. Melalui kajian ini, pelepasan bahan zarah dapat dikurangkan walupun tidak dapat mengeliminasi sepenuhnya keberadaan bahan zarah di setiap pelepasan dari setiap pembakaran.

ACKNOWLEDGEMENTS

First, I would like to praise the Lord for this opportunity. I would like to express my heartfelt gratitude to everyone who contributed to my successful completion of this report. My heartfelt thanks go to my supervisor Ts. Dr. Azazi Bin Ngatiman for guiding and encouraging me from the start and also heartfelt thanks to the lab technician and lecturers that helped along the process.

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LIST OF SYMBOLS AND ABBREVIATIONS

PM	-	Particulate Matter
API	-	Air Pollution Index
µg/m3	-	Microgram Per Cubic Meter
DustTrak DRX	-	DustTrak DRX Aerosol Monitor 8533EP
PVC	-	Polyvinyl Chloride
RESP	-	Respirable

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CHAPTER 1

INTRODUCTION

1.1 Background

Air pollution has continuing concern in many Southeast Asian countries, with Malaysia one of the worst impacted. Haze has been a serious problem for the country, owing to farmers' slash-and-burn tactics and peat fires blown in from Indonesia. At 2005, when the Air Pollution Index (API) reached 500, a state of emergency was declared in Port Klang. Malaysia has collaborated with Indonesian officials to help put out peat fires. Following a haze in 1997, Malaysia and Indonesia, along with other ASEAN nations, signed the ASEAN Convention on Transboundary Haze Pollution in 2002. The Air Pollution Index measures the quality of the air in Malaysia (API). Carbon monoxide, ozone, nitrogen dioxide, and sulphur dioxide are all reported in parts per million by volume, whereas PM10 particulate matter is measured in g/m3.

The Malaysian government uses the following scale to classify people's health.

• 0-50 Positive
• 51-100 Moderate
• 101-200 Negative
• 201-300 Unhealthy
• 301- Dangerous

If the API exceeds 500, a state of emergency is declared in the reporting area.

The regulated or unregulated burning of waste is one way of waste management that is used in practically all countries. While incinerators may be necessary to deal with hazardous garbage, such as medical waste, incorrect waste incineration and open, uncontrolled waste burning can pose a significant health and environmental risk for a variety of reasons. Unfortunately, only a little amount of extensive study has been done on the effects of ineffective garbage burning and inadequate waste management on public health in general. Studies have generally concentrated on the inadequacies of waste management systems around the world rather than the harm that these failures might cause to health and environment. (*Malaysia Air Quality Index (AQI) and Air Pollution Information | IQ Air*, n.d.)

In addition, the studies disregard the health effects of particular byproducts of inadequate incineration rather than the overall effects of poor waste management practices. This is an issue that need additional research, as poor incineration or waste burning systems are a problem that contributes to air pollution, which has major health effects. This research will look into the numerous public health effects of open waste burning and, to a lesser extent, waste incineration, as well as the magnitude of such effects around the world. To begin, it should be highlighted that while this study will not be able to capture all of the public health risks associated with poor waste incineration management methods, the many forms of waste burning that occur will be discussed. Second, the numerous contaminants produced by waste burning will be discussed, as well as their specific health effects. Proposed method to reduce the emission to the environment using variety of filtration system and analyse the findings results. Finally, recommendations will be made for future studies on open burning and for ways to reduce open burning, as much more research is needed to properly understand the health risks associated with open waste burning and incorrect incineration around the world.

1.2 Problem Statement

Globally, emission of variety of particulate matter whether chemical or non-chemical has caused environmental problem such as polluted air. Besides, health complications also increased regarding the inhalation of polluted air. In Malaysia, the kind of pollution are taken lightly only because it is not some kind of viruses the spread through air making it have less concern from the community. One of the contributions comes from the emissions of open burning sources. Therefore, emission controlled burning system fabricated to cater the problem to reduce the emissions of such particulate matter, there should be at least a device or filtered burning device. A simple working filtered burning device more importantly affordable can make up the mission 90 percent success rate as all class of people can participate to reduce the emission of such particulate matter.

1.3 Research Objective

The aim of this research is to fabricate an emission controlled burning system and to filter the emitted particulate matter. Specifically, the objectives are as follows:

a) To fabricate Emission Controlled Burning System

b) To conduct particulate matter filtration in three different types of filtering medium.

c) To analyze and compare the presence of PM in each emission.

The scope of this research are as following:

- Two different sizes of water container or barrel were chosen for this research: a regular steel water barrel and a medium sized container for the water tank, to carry out the process.
- Design a connection between two barrels using a temperature resistance hose, to direct the smoke emitted from the burning barrel to the water filled container to be filtered.
- Conduct emission controlled burning outside using three different filtration mediums.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The literature review on the emission of particulate matter into the environment will be discussed in this chapter. This study's references come from journals, books, and the internet. What is particulate matter? Fine particles, also known as particulate matter 2.5 (PM2.5), are microscopic particles in the air that are two or one-half microns in width or less. A micron, like inches, meters, and miles, is a unit of distance measurement. In an inch, there are around 25,000 microns. The widths of the larger PM2.5 particles are around thirty times smaller than the width of a human hair. (*Fine Particles (PM 2.5) Questions and Answers*, n.d.)

The purpose of reviewing previous articles on how to reduce particulate matter emissions is to have a better understanding of how to create an emission-controlled burning system.

Water filtration reduces the amount of particle matter as well as the number and quantity of harmful particulate matter in the emission that filtered through, according to research. Hoffman discovered that the water pipe retained 90% of the phenol and 50% of the particulate matter and benzo pyrene of the initial tobacco smoke in a 1963 investigation. When 6 tobacco smoke components were painted onto mouse skin after being passed through a water pipe, they showed just a modest hyperplastic reaction and no sebaceous gland degradation. Applied to mouse skin at the same quantity, tobacco smoke condensate that had not been water filtered caused severe hyperplasia and full sebaceous destruction. Using the mouse skin test, Salem and Sami 7 found that while water filtered smoke had a lower carcinogenic potential than the water remaining in the pipe, the material that was left in the water was more carcinogenic than the smoke that passed through it. The water itself had two carcinogenic substances, but only one in the filtered smoke, according to thin layer chromatography data analysis. As a result, water filtering removes at least some chemicals to know that they would generally be found in smoke. (*MAPS - Volume 4 Number 2 Summer 1993 - Effects of Water Filtration on Marijuana Smoke*, n.d.)

This shown that water filtration system can be used to filter the emissions of particulate matter.

Any form of fire forest, crops, structure, wastes, or wood burning emits a mixture of particles and chemicals created by incomplete carbon-containing material combustion. Carbon monoxide, carbon dioxide, and particulate matter are present in all types of smoke (PM or soot). Aldehydes, acid gases, sulphur dioxide, nitrogen oxides, polycyclic aromatic hydrocarbons (PAHs), benzene, toluene, styrene, metals, and dioxins can all be found in smoke. Depending on what is burning, how much oxygen is available, and the burn temperature, the type and number of particles and chemicals in smoke changes.

Smoke inhalation should be avoided at all costs. Individuals should minimize their physical activity if they cannot avoid being exposed to excessive levels of smoke. Individuals suffering from cardiovascular or pulmonary problems for example, Asthmatics, newborns, young children, and the elderly may be more sensitive to smoke's harmful effects.

Inhaling smoke for a short period of time can trigger acute symptoms. According to studies, people who are exposed to the smoke from a cigarettes experienced lung complications leading to breathing difficulties. Carbon monoxide gas and fine particles, or PM2.5, are two main factors in smoke that can cause health problems. Individual particles are too small to be seen with the naked eye and are two and a half, 2.5 microns or less in size (25,400 microns equals an inch).

Carbon monoxide depletes the body's oxygen supply when inhaled. This can lead to headaches, decreased alertness, and the worsening of angina, a heart ailment. Fine particles can penetrate the respiratory tract and enter the lungs. Inhaling small particles can cause a range of health problems, such as respiratory irritation and shortness of breath, as well as exacerbate medical disorders including asthma and heart disease. Carbon monoxide and particulate matter exposure can worsen cardiovascular consequences after increasing physical work. Symptoms from inhaling carbon monoxide or tiny particles usually fade as exposure ends, but they can continue for a few days.

The best approach to avoid exposure is to avoid smoky environments. Exposure to the components of smoke can potentially have long-term health consequences. Long-term exposure to fine particle has been linked to an increased risk of cardiovascular disease and mortality in populations living in areas with higher fine particle pollution levels. Short-term exposure to smoke might also have long-term health complications. Long-term health risks on firefighters who are subjected to smoke on a constant schedule have been researched, including cancer, lung disease, and cardiovascular problems.

These studies' findings are inconsistent and inconclusive. Some studies demonstrate that firemen have a higher rate of certain diseases than similar male reference populations, such as police officers or men in the general community, but plenty do not. (*About Smoke and Health | Santa Barbara County Air Pollution Control District*, n.d.)

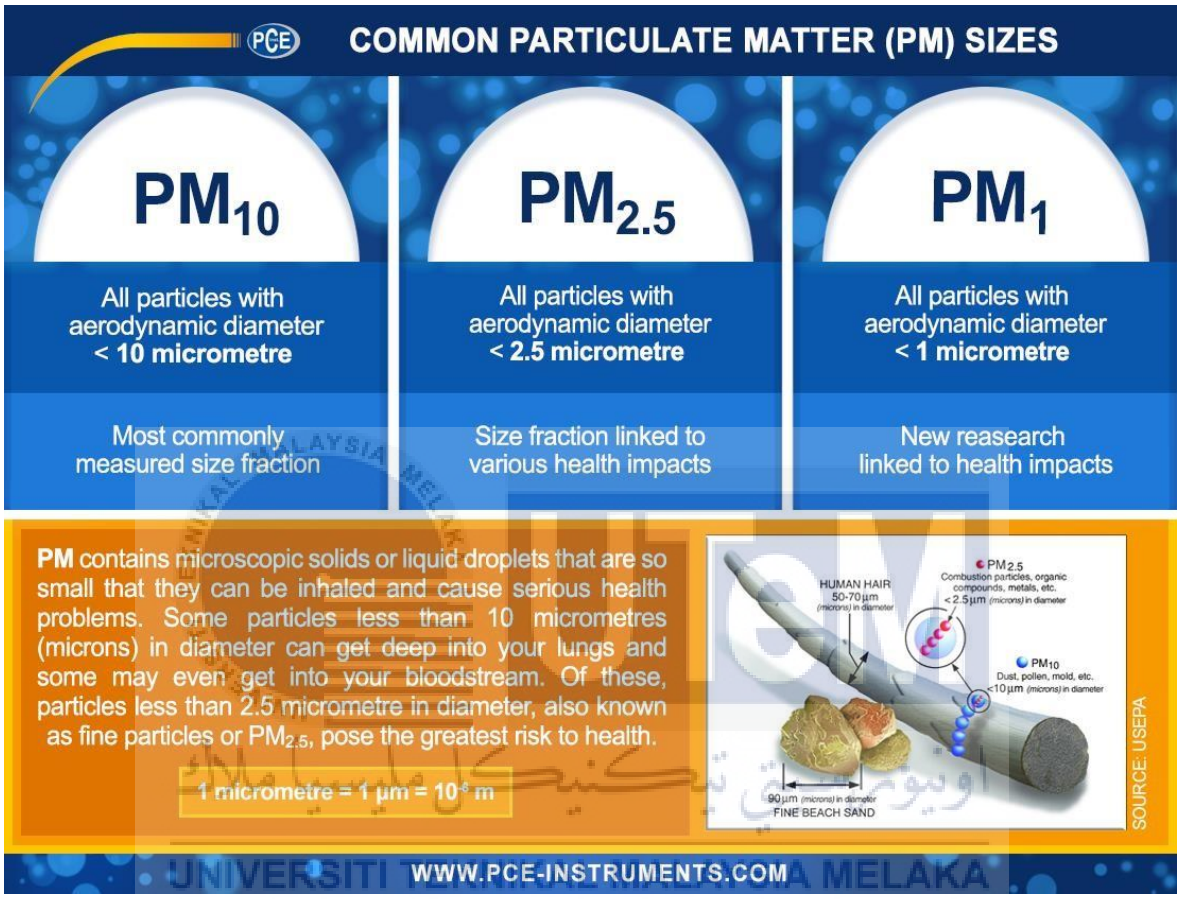

Figure 1.1: Common Particulate Matter (PM) Sizes

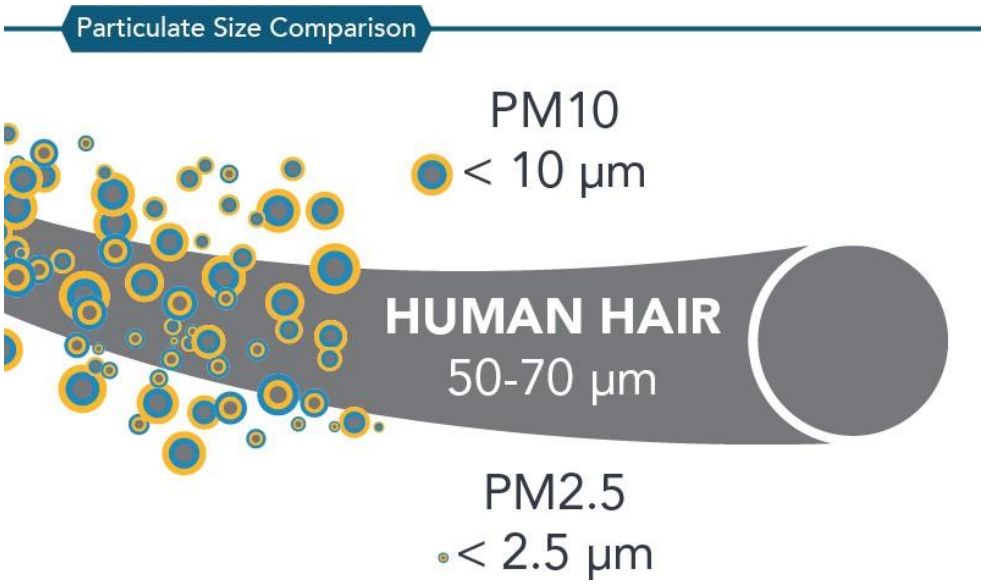

Figure 1.2: Health Effects of Particulate Matter (PM) Air Pollution

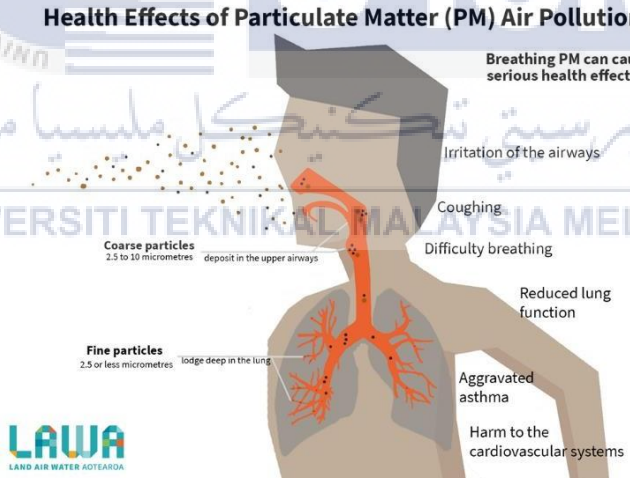

Figure 2.1: Health Effects of Particulate Matter (PM) Air Pollution