



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

COMPARISON OF TOBACCO AND ELECTRONIC CIGARETTE SMOKE POLLUTION

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Mechanical Engineering Technology (Refrigeration and Air Conditioning System) with Honours.

by

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DECLARATION

I hereby, declared this report entitled “**COMPARISON OF TOBACCO AND ELECTRONIC CIGARETTE SMOKE POLLUTION IN A CAR CABIN**” the result of my own research as cited in references.

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Refrigeration and Air-Conditioning system) with Honours. The member of

The supervisor is as follow:

.....
(Puan Noor Saffreena Binti Hamdan)

ABSTRAK

Dalam era pemodenan ini, penggunaan rokok elektronik telah mendapat populariti di antara yang termuda dan tertua. Di samping itu, rokok elektronik juga dikatakan sebagai alternatif untuk mengurangkan penggunaan rokok tembakau yang diketahui mempunyai banyak kesan buruk kepada pengguna. Tujuan projek ini adalah untuk mengukur, menganalisis dan membandingkan jumlah bahan zarah (PM_{2.5}) untuk keadaan yang berbeza di atas asap rokok tembakau dan rokok elektronik di dalam kereta. Terdapat 4 keadaan eksperimen yang dijalankan dalam kereta selama 20 minit. Jenis rokok tembakau adalah jenis biasa DUNHILL mengandungi nikotin 12mg tar dan 0.9mg nicotine dan rokok elektronik adalah coil double coil mengandungi nikotin 12mg. Peralatan yang digunakan dalam projek ini ialah Pemantauan Alam Sekitar (EVM) untuk mengumpulkan semua data bahan zarah (PM_{2.5}). Perbandingan pencemaran udara dibuat antara rokok tembakau dan rokok elektronik selepas data diperolehi. Hasilnya menunjukkan bahawa rokok elektronik bukanlah penyelesaian terbaik untuk berhenti dari rokok tembakau. Ia mempunyai kelemahan yang boleh menyebabkan kesan jangka panjang kepada pengguna.

ABSTRACT

In this era of modernization, the use of electronic cigarettes has gained popularity among youngest and eldest. In addition, electronic cigarettes are also said to be an alternative to reducing tobacco use which is known have many effects to users. The purpose of this project is to measure, analyses and compare the amount of particulate matter ($PM_{2.5}$) for the different condition on tobacco cigarette and electronic cigarette smoke in a car. There have 4 experimental condition is carried out in a car for 20 minutes. The type of tobacco cigarette is regular type DUNHILL contain 12mg of Tar and 0.9mg of Nicotine and electronic cigarette is double coil fairing contain 12mg Nicotine. The equipment use in this project is Environmental Monitor (EVM) to collect all the data of particulate matter ($PM_{2.5}$). Comparison of air pollution is made between tobacco and electronic cigarettes after data is obtained. The result shows that electronic cigarette is not best solution to quit from tobacco cigarette. It's had their owns disadvantages that can cause long term effect to user.

DEDICATION

Special appreciation, I dedicated the thesis to my beloved family project supervisor and friends. And I would like to express my deepest gratitude to my mother Puan Hasmah Binti Mamat for the sacrificed through my life until today. Not to forget my appreciation to my project supervisor Puan Noor Saffreena Binti Hamdan for supporting me throughout of my academic journey especially on this project and for whatever knowledge rendered to me from the beginning till the end of my final year project. I would like to send my gratitude to my friends and lecturers for their contribution whether it is directly or indirectly to my final year project.

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LIST OF ABBREVIATIONS

PM	Particulate Matter
VOC	Volatile Organic Compound
IAQ	Indoor Air Quality
EVM	Environmental Monitor
E-CIGS	Electronic Cigarette
TSP	Tobacco Smoke Pollution
ASHRAE	The American Society Of Heating, Refrigerating And Air- Conditioning Engineers
ANSI	American National Standards Institute
NHMS	The National Health And Morbidity Survey
WHO	World Health Organization
NAAQS	National Ambient Air Quality Standards
OSHA	Occupational Safety And Health Administration
EPA	Environmental Protection Agency
NIDA	National Institute On Drug Abuse
API	Air Pollutant Index

CHAPTER 1

INTRODUCTION

1.0 Project Background

Tobacco smoke pollution is a mixture of complex pollutants emitted by the combustion and transformation of tobacco products in the form of various gasses and particulate matter. Nowadays, modern cigarettes have been invented which are electronic cigarettes that are very popular among young people. Each smoking device has its own advantages and disadvantages for people and also could affect to pollution. Approximately five million Malaysians, or 22.8 percent of the population, are smokers, according to National Health and Morbidity Studies (NHMS). Deputy Health Minister Datuk Seri Dr Hilmi Yahaya said 50 per cent of smokers were over 30 years old; 40 percent is over 19 years old, while another 10 percent is under 19 years old. (Kannan, 2016). In the first survey of adult smokers in Malaysia, the regional consumer support group (Latiff, 2015) found that 83 percent of smokers see electronic cigarette as "positive alternatives" to tobacco products. Even more than 87 percent will consider switching to electronic cigarette "if it were legal, met quality and safety standards, and were conveniently available".

The primary concern is about the health hazard that occurs by smoking device expose is to children who are still physically and naturally evolving. Different with adults, children inhale more quickly and could ingest more poisons on their little size. Which is has fewer immune systems, it also connected with a more probability of asthma, and chronic lung problem. It has been recognized as a cause of sudden death syndrome.

Secondhand smoker is exposed to the combination of smoke from the consuming end of a cigarette and the smoke inhaled out by smokers. Secondhand smoker also may expose to 7,000 chemical compounds and hundreds of that are poisonous that cause cancer (Human, 2006). Thus, this study aims to demonstrate that smoke pollution in cars reaches unhealthy levels, even under realistic ventilation conditions, lending support to the ongoing efforts across the country to educate the public and prohibit smoking in the car in the presence of passenger.

1.1 Problem Statement

The present study investigates the level of particulate matter (PM_{2.5}) released in car cabin during smoking the tobacco cigarette and electronic cigarette that has been identified as a serious public health threat to passenger. Furthermore, this smoke also could constitute potentially serious pollution because of complex mixture of contaminants released by burning exhalation of tobacco and nicotine products in the form of various gasses and particulate matter. There is past research has been done by (Taryn Sendzik, June 2009) for tobacco smoke pollution in cars, therefore this research has been selected to compare between tobacco smoke and electronic cigarette smoke pollution.

1.2 Objective

Expose to airborne particulate matter (PM) is of increasing concern to the general public. Several past studies have revealed that expose to high levels of particulate matter is linked to increase in respiratory problem, so this study is to:

1. To measure the amount of particulate matter (PM_{2.5}) data for different condition on tobacco cigarette and electronic cigarette smoke in a car.
2. To analysis the result of data on particulate matter (PM_{2.5}) for different condition.
3. Compare the result of particulate matter (PM_{2.5}) of smoke tobacco and electronic cigarette.

1.3 Scope

The present study will be held at Ayer Keroh Height Melaka for 20 minutes in a car cabin. During the data collection, there will have 2 participants which is a driver and a passenger. Driver will smoke for 5 minutes for a single tobacco cigarettes and electronic cigarette for each condition, in this collection data will conduct on 4 condition of air sampling. Type of tobacco cigarette use in this study is regular types that contain 12 Mg of Tar and 0.9 Mg of Nicotine. Then for the type of electronic cigarette is double coil with contain 12 Mg of nicotine. Air quality in a car cabin is monitored by using Environmental Monitor (EVM). Environmental Monitor (EVM) is used with 2.5-micron impacted to measure the value of (PM_{2.5}) that will be calibrated for each condition to avoid error.

CHAPTER 2

LITERATURE REVIEW

2.0 Definition of Indoor Air Quality

The term indoor air quality (IAQ) represents a closed contaminated air concentration known to affect human comfort, satisfaction, health, or performance of a space. While this position is not deserve, it is important for the IAQ because temperatures and humidity can affect the level of emission rate, the growth of microorganisms on the surface of the area, the survival of airborne pathogens, the survival of household dust mites as an allergen source, the public's perception of air quality inside room, level of health related symptoms, and work performance. Other indoor environmental factors such as noise and lighting are also not addressed. (ANSI/ASHRAE, 2007). Li et al stated that IAQ also could affect the comfort and performance of its residents. In other word, health that affected by poor IAQ is lung cancer may from the radon expose, respiratory problem and pulmonary tuberculosis (TB) because of air infections (Li, 2007).

2.1 Indoor Air Quality in Car Cabin

The previous research has been studies on the effect of air pollution toward human health, and it's stated that air pollution can cause the risk of death increased. In this new era, human keep busy and spends time in enclosed environment such as in car cabin. As in the internal environment, the micro environment in the cabin has become an important source of exposure to various air pollutants, such as particulate matter (PM), volatile organic compounds (VOC), and organic compounds (SVOCs), carbon monoxide, nitrogen oxides. Even though people spend little time on a car daily the risk of poor air quality are high in car cabin. Concentration of particles seen in vehicle cabin usually reported within 100,000 to 500,000 particles / cm³. (Xiong, 2016). Particulate matter (PM) exposure now is really worsening the public. Recently studies by Dockery et al, has shown that there were in increasing hospital admission because of respiratory problem and death. (Dockery, 1994). It may relate with high expose with level content of particles during daily activity. From the past research it could state that the higher level of particulate matter (PM) in car cabins is related with the ambient environment. While the past research by Geiss et al. also stated that concentrations of VOCs in vehicle were depend on how the condition of driving but it is higher than other normal level of the surrounding. Furthermore, car cabin has a small space that can cause all passengers could expose to particulate matter for in a time (Geiss, O., Tirendi, S., Barrero-Moreno, J. and Kotzias, D., 2009). All of this pollution also is higher than other outdoor and indoor microenvironments.

2.2 Potential Sources of Indoor Car Air Pollution

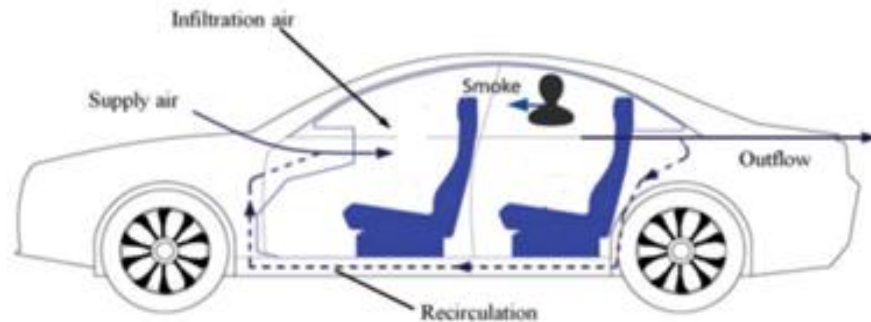


Figure 2.1: Potential source air pollution

2.2.1 Particulate Matter

A past study evaluates fine air particulate matter $PM_{2.5}$ in car cabin by (Riediker M, 2004). It has been reported that this may be related to cardiovascular events and death in older and cardiac patients. Potential physiological effects on vehicles, roadside, and ambient $PM_{2.5}$ have been investigated in young, healthy and non-smoking teams, pedestrians from North Carolina Patrol. Controlling potential exposure has a minimal impact on estimates effects. Health points with $PM_{2.5}$ are around and roads are smaller and less important. Observations in healthy young men show exposure to $PM_{2.5}$ in vehicles can cause pathophysiological changes involving inflammation, coagulation, and cardiac rhythm. The second study by Riedecker et al. assess whether fine particulate matter ($PM_{2.5}$) of traffic could affects the variability of heart rate, thrombosis, and inflammation. These researches have been analysis and the component that could affect health is investigated among participant of North Carolina male patrol policeman. The research is more to compare the cardiac and blood parameter among the participant every 10 to 15 hours

measurement. From the result effect of PM_{2.5} could increase the level of uric acid, nitrogen urea blood, C protein and blot clot that were danger if too high. (Riediker, 2007). Below are the factors that can affect to the level of particulate matter in a car cabin.

2.2.1.1 Tobacco Smoke

Fortmann et al. recently focused on tobacco smoke pollution (TSP) in the car caused by smoking in the microenvironment of the vehicle. The researcher uses surface wipe, air and dust sampling of used cars sold by non-smokers and smokers and tested for nicotine. Inside the vehicle's interior is inspected to find the differences between car dustiness and the sign of past smoking. Interestingly, smokers reported that they often used less air conditioning and open windows than non-smokers. Additionally, smoker cars are dustier and show more ash and burn than non-smokers. The number of cigarettes captured by the main drivers was the strongest predictor of the remaining TSP in the next analysis. (Fortmann AL, 2010). However, this relationship was delivered by ash or burning sign, or attempting to remove residual TSP from the vehicle (cleaning, ventilation) or attempting to prevent absorption of tobacco smoke in smoking (near / external cigarettes). Recently, the same group developed and compared the methods used to measure the residual TSP of used passenger cars on used cars sold by non-smokers and smokers. (Matt GE, 2008). It has been found that cigarette smokers in the vehicles could increase the concentration in dust, surface air and nicotine concentrations than nonsmoking cars.

2.2.1.2 Electronic Cigarettes Smoke

Electronic cigarettes (e-cigs) breathe in a nicotine and deliver that vaporizes the nicotine solution. Vapor streams into pressurized by electronic cigarette that are breathed in by the user (vaper). Molecule size, synthesis and thickness of pressurized by the electronic cigarette then exchange of nicotine through the alveoli framework and venous and the portion is lost through breath. The nicotine solution as of now consist of water, nicotine and nonpolar vehicles, generally propylene glycol (pg) or vegetable glycerol (vg). (National Institute of Standards and Technology. NIST, 2011). Past analyses for estimating the vaporized molecule size of electronic cigarettes more likely detected significant particulate matter evaporation during the high dilutions required for measurement with an electrical portability, which prompted the perception of little molecule estimate estimations for airborne particles from electronic cigarettes of under 50 nm. (Laugesen, 2009). It to be noticed that bigger particles will disappear when the temperature increase and evaporation is occurring under the testing conditions on a minute's time scale.

2.2.2 Bacterial And Fungal Endotoxin

Exposure to bacterial and fungal endotoxin can also occur in car covered environments and may cause major respiratory problem. It is realized that the vehicles is a disclosure allergenic source yet are not specific known whether, and how much exposure is in fungal. It has been stated recent study by Wu et al. from Taiwanese group from the Changhua Christian Hospital; Changhua City addressed bacterial and fungal levels in automobiles. Therefore, the project objective is to evaluate whether the car is a potential source of exposure to this product. The sample of 40 passenger seats is use in the studies by Wu et al. Specific limestone amine kinetic examinations are used to measure bacterial and fungal