UNIVERSITI TEKNIKAL MALAYSIA MELAKA

The Development and Analyse of Cooling System for Motorcycle Helmet

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Mechanical Engineering Technology (Automotive Technology) with Honours.

by

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Automotive Technology) with Honours. The member of the supervisory is as follow:

…….

Mr Muhammed Noor bin Hashim

(Project Supervisor)

ABSTRAK

Ringkasan yang boleh dibuat dari projek ini adalah ianya merupakan satu projek topi keledar motosikal yang mengandungi sistem penyejukan. Sebab utama mengapa projek ini dijalankan adalah untuk memberikan keselesaan kepada penunggang motosikal ketika menunggang motosikal. Zaman era globalisasi ini, pemanasan global merupakan isu yang serius di mana telah memberi kesan yang buruk kepada penunggang motosikal apabila mereka menunggang motosikal pada waktu panas. Oleh itu, topi keledar motosikal ini dicipta untuk mengatasi masalah yang dihadapi oleh penunggang motosikal yang tidak seslesa ketika penunggang motosikal dengan adanya system penyejukan di dalam topi keledar mereka. Untuk menghasilkan topi keledar motosikal ini, beberapa spesifikasi reka bentuk akan ditentukan. Selepas itu, proses fabrikasi akan dijalankan. Di antara proses-proses fabrikasi yang akan dilakukan adalah seperti proses pengukuran, proses pemotongan, proses menggerudi dan proses pemasangan.

ABSTRACT

The summary can be made from this project is a motorcycle helmet project that contains a cooling system. The main reason why this project is to run is to provide comfort to motorcyclists while riding a motorcycle. In the era of globalization, global warming is a serious issue which caused bad impact on motorcyclists when they ride motorcycles in the sunny day. Thus, this motorcycle helmet was created to overcome the problems faced by motorcyclists by creating cooling system in their helmets. To produce this motorcycle helmet, some design specifications will be determined. After that, the fabrication process will be run. Among the fabrication processes to be performed are the measurement process, the cutting process, the drilling process and the installation process.

DEDICATION

To my beloved parents,

Haslina binti Ishak and Sarputdin bin Mustapha

Thank you for all support, sacrifices, patient and willingness to share with me.

To my honored supervisor,

Mr Muhammed Noor bin Hashim and all UTeM lecturers.

Thank you for always giving me a guidance and persistent help to complete this project thesis.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURES

ABS	-	Acrylonitrile–Butadiene–Styrene
ASHRAE	-	American Society of Heating, Refrigeration, and Air Conditioning Engineers
BTU	-	British Thermal Unit
CAD	-	Computer Aided Design
CAE	-	Computer Aided Engineering
CATIA Interactive	-	Computer Aided Three Dimensional Application
CRP	-	Carbon Reinforced Plastic
DOT	-	Department of Transportation
ECE	-	Economic Commission for Europe
EPS	-	Expanded Polypropylene Sheet
EPF	-	Expanded Polypropylene Foam
FRP	-	Fibre Reinforced Plastics
GHSA	-	Georgia High School Association
GRP	-	Glass Reinforced Plastic
HVAC	-	heating, ventilation, and air conditioning
HIC	-	Head Injury Criterion

IPCC	-	Intergovernmental Panel on Climate Change
SET	-	Standard Effective Temperature
PC	-	Polycarbonate
PU	-	Polyurethane
PVC	-	Polyvinyl Chloride
PET	-	Polyethylene Terephthalate
MET	-	The Metabolic Equivalent of Task
cm	-	centimetre
J / g	-	Joule per gram
mJ / m^2	-	mili Joule per meter square
US $	-	Dollar of United States
°C	-	Degree of Celcius

CHAPTER 1
INTRODUCTION

1.1 Introduction

Chapter one consists of the background of the project for this dissertation. The information of the global warming, cooling system and the paraffin wax was presented in the background, Secondly, this section also consists of another four item which consist of the problem statement, the objective of this dissertation, scope of the work for this project and the dissertation outline.

1.2 Background

Now days, global warming is one of the most serious issues of globalization. According to the Intergovernmental Panel on Climate Change (IPCC) assessment, the average temperature on Earth has risen by 0.7 ° C since the beginning of the industry increases. Under the conditions of global warming, climate change in different parts of the world reveals different features (Elizbarashvili et al. 2017). The climate change has affected the situation in earth, flora and fauna, population and many more. In this situation, the motorcyclist also affected.

In global warming, motorcyclists are facing uncomfortable situation when riding the motorcycle. When riding, motorcycle helmets instantly reduce airflow, increasing head temperatures and affecting heat dissipation from head to environment. This condition leads to increased heat-related stress over the long term riding under

the sun and making riders feel uncomfortable by producing extreme sweat (Pang et al. 2015).

Then, an innovation for helmet cooling system need to be done to overcome the uncomfortable conditions faced by the motorcyclist. The ventilation system in a motorcycle helmet is a set of sources dug in the entire cover of a protective helmet that must be able to create some fresh air inverted inside it. Mostly, the helmet manufacturers are not exposed to the complete lack of fluid dynamics guidelines for such channel models, prescribed only with experience, without sufficient evidence to provide good ventilation (Canuto & Cimolin 2011).

For the great cooling system, paraffin wax is chosen as the coolant agent. Paraffin is probably the most common phase change material due to the high storage density feature, the minimum inclination to super cool, low vapor pressure liquid phase, chemical stability, non-toxic, and relatively low cost (Wang et al., 2009; Kuznik et al., 2011; Nihal et al., 2011).

1.3 Problem Statement

One of the biggest problems facing the world today is global warming. Many scientists believe that carbon dioxide emissions and other greenhouse gases have a warm-up effect in the atmosphere. One of the problems associated with global warming is the impact on humans. Thermal infertility has been proven to be a problem with bicycle helmets (Gisolfi et al., 1988) and industrial helmets (Liu et al., 1999), and he can also be expected for motorcycle helmets (Buyan et al., 2006; Patel and Mohan , 1993). The rider is exposed to open warm air on a sunny day while riding a motorcycle. The one-inch layer thickening layer that covers the interior of the helmet and restricts almost eliminating heat exchanges with the outer walls of the most unseen parts of the body (Tan & Fok 2006). Plus, he added, this creates a warm environment

that is uncomfortable and harmful to the rider's head. Riding motorcycle under the sunny day make the rider feel uncomfortable.

On the other hand, warm air around the head also distract the rider's concentration. Inside the helmet can quickly rise to temperatures between 37 ° C and 38 ° C (Tan & Fok 2006). Tans and Fok also stated that when this happens, physiology and the psychological impact on very real and potentially unlucky riders for the senses and deadening reduce ability to concentrate. Concentration when riding is the most important thing to make sure the safe journey and to avoid any halted to happen. Additionally, it turns out that the head is the most effective cooling of any part of the body as it has the highest skin temperature and also a steady flow of blood. In addition, the cooling of the head has been regarded as an essential requirement to provide overall comfort to the rider.

Besides that, incomplete heat release from helmets to the environment induces heat pressure in the head area. (Pang et al. 2011). He added that heat is transferred between the head and the environment through heat radiation and convection, as well as with sweating evaporation (Pang et al. 2015) also stated that the increased pressure associated with heat during long travels in the sun and subsequently will make the riders feel uncomfortable by producing excessive sweating. The excessive sweating made the rider uncomfortable around their head which lead the rider become distract of concentration when riding.

1.4 Objectives

More specifically, this study has the following objectives:

1) To fabricate a prototype of motorcycle helmet that have cooling system.

2) To study to give the comfort condition to the rider when riding the motorcycle with cooling system in the helmet.

1.5 Scope

This project is using an existing helmet in the market for the cooling system. The paraffin wax is selected as the cooling agent for the cooling system. The paraffin wax is placed in the helmet for cooling agent in the helmet as a cooling system.

The design concept development by the previous research is used how to place the paraffin wax in the helmet. After study the design concept development, the prototype of the motorcycle helmet that have paraffin wax will be fabricate.

The effectiveness of the paraffin wax will analyze as the cooling agent for the helmet ventilation system. The analyzation of paraffin wax will be test the temperature of the paraffin wax by using the testing in the lab.

1.6 Dissertation Outline

This dissertation consists of five main chapters. Chapter one concerning about the general introduction of cooling system using paraffin wax for motorcycle helmet, problem statements, objectives and scope of works. Chapter two elaborates about the previous study about the paraffin wax, motorcycle helmet, thermal comfort which is about the findings and the theory used. Chapter three explaining about methodology which is how the study is going to carry out. Chapter four will discuss about the result collected and to verify the objectives. Chapter five is the conclusion about the study and recommendation will be made for improvements in future.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

This chapter will provide the review from previous research that is related to this final year project. There are previous researches understanding the paraffin wax, motorcycle helmet and human brain.

2.2 Paraffin wax

2.2.1 History

For years, candle production has been based on grease and candles. At the beginning of the 19th century, the haired silk creation and the stearin discovery completely changed the quality of candle burning. Figure 2.1 show the Paraffin Wax.

Figure 2.1: Paraffin Wax

A few years later, paraffin wax has been found. Fuchs extracted mineral oil from paraffins and Buchner produced the first paraffin wax in 1819. In 1830, Von Reichenbach overturned paraffin from a beech wood solution. (http://europecandles.org/raw-materials-and-candles-production-processes). On the same year 1830, paraffin wax was also identified by Carl Reichenbach (Sciences 2009).

The production of coal paraffin wax began in Glasgow in 1845. Paraffin wax was introduced in the 1850s, after chemists learned how to separate natural wax from petroleum and refine it (http://candles.org/history/). In 1861, the industry produced 750 tons of paraffin wax, ten years later the amount had reached 5000 tons.

In 1890, paraffin waxes were found throughout the world. From the future, candle industries have raw materials at disposal, beeswax, stearin and paraffin candles. These raw materials can be mixed with each other such as paraffin wax with stearin wax and paraffin wax with candles. These days, the candle industry uses paraffin wax above all, followed by stearin. Beeswax is the least used for candle making.

Some types of paraffin wax are more expensive than others, according to the filtration level, the color changes from dark yellow to white, and the oil content from 0 to 15%. Paraffin wax is served in slabs, bead or powder. It is also transported in liquid form in tanker trucks. 350,000 tons of paraffin candles are produced in Europe every year. About half are sent to the candle industry. Some properties are more appropriate than others, depending on the industry they will use. For example the leather or textile industry, paper and card treatment industries, plastic materials, explosives, cables and also for the manufacture of cheese and chewing gum (http://europecandles.org/raw-materials-and-candles-production-processes).

2.2.2 Definition

Paraffin wax is a solid white or colorless solid which is available from oil, coal or flake oil, comprising a combination of hydrocarbons containing between twenty and forty carbon atoms. It's different from kerosene, another petroleum product that is sometimes called paraffin. The paraffin's name comes from Latin parum ("almost no") + affinis, which means "lack of affinity" or "reactive deficiency", referring to inactive properties of paraffin (Kusumawati et al. n.d.).

In chemistry, paraffin is a term that can be used in conjunction with "alkanes", says hydrocarbons with the general formula CnH2n + 2. Paraffin wax is found in solid state at room temperature and starts accessing phase pore at about 37 ° C (99 ° F) (Charanjeet Singh Sandhu & Sharma 2012).

The easiest paraffin molecules are methane, CH4, gas at room temperature. Particles heavier than this series, such as octane, C8H18, and mineral oil form as liquid at room temperature. The solid paraffin form, the

paraffin wax, comes from the heaviest molecules from C20H42 to C40H82. Paraffin candles were identified by Carl Reichenbach in 1830 (Sciences 2009).

2.2.3 Properties

Paraffin may be the most common phase change material due to its high storage density properties, minimum inclination to super cool, low-pressure vapor pressure, chemical stability, non-toxic, and relatively low cost (Li et al. 2017). One of the qualities of paraffin wax is, it gives a better surface finish (Charanjeet Singh Sandhu & Sharma 2012).

Paraffin wax (or simply "paraffins") is mostly found as solid white, odorless, tasteless and candles. Insoluble in water, but soluble in benzene, and certain esters. Paraffins are not affected by chemical reagents, but are flammable (Sciences 2009).

The paraffin features are they have a great resilience to penetrate wet, melt easily and froze quickly. It also has a small wooden power to cloth, so it is easily removed from the fabric. Paraffin wax is a low melting point at a temperature of 56-60 ° C but has a high boiling point of> 370 ° C (698 ° F). Although paraffin wax is not very durable, it is resistant to alkaline solution (Kusumawati et al. n.d.). Table 2.1 shows the properties of paraffin wax.

Table 2.1: Properties of paraffin wax.

No.	Name of the wax	Density	Melting point	Volumetric shrinkage	Flash point
1	Paraffin wax	0.78gm/cc	52-74°C	6.20	275 °C

Source : (Charanjeet Singh Sandhu & Sharma 2012)