UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Contribution of Lightweight Materials to the Design and Manufacturing of an Electric Vehicle

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Engineering Technology (Bachelors of Engineering Technology Process) (Hons.)

by

AHMAD ZUHAIRI BIN AZIZ

B071310475

930125-11-5719

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I hereby, declared this report entitled “Contribution of Lightweight Materials to the Design and Manufacturing of an Electric Vehicle” is the results of my own research except 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 Manufacturing Engineering Technology (Process and Technology) with Honours. The member of the supervisory is as follow:

Engr. Hassan Bin Attan
(Project Supervisor)

ABSTRAK

Bahan-bahan ringan dan reka bentuk telah sentiasa menjadi topik yang penting dalam reka bentuk produk di beberapa industries. Kenderaan moden mesti memenuhi banyak keperluan dari segi persembahan pengangkutan, keselesaan, keselamatan aktif dan pasif, penggunaan tenaga dan kos, kualiti dan kebolehpercayaan, kesan alam sekitar dan akhir-kehidupan sebenar. Tujuan kajian ini adalah untuk menyiasat sumbangan bahan-bahan ringan ke arah reka bentuk keseluruhan kenderaan elektrik (kenderaan santai) dan menilai proses pembuatan ekonomi bahan yang digunakan dari perspektif kitaran hidup serta kesan ekologi dan proses pembuatannya. Kajian ini akan memberi tumpuan kepada bahagian utama reka bentuk kenderaan seperti bahagian-bahagian utama dan besar. Untuk mencapai objektif kajian, beberapa alat analisis akan digunakan. Bentuk setiap bahagian yang dikaji memainkan peranan terbesar dalam menentukan indeks bahan yang akan menjadi matlamat untuk menterjemahkan pemilihan bahan dan proses berdasarkan oAshby dan Cambrigde Engineering Pemilih EduPack 2012, (CES). Bahagian-bahagian badan utama reka bentuk memberi sumbangan paling banyak dalam reka bentuk berat pengurangan tetapi dan juga menyumbang rendah dalam pengeluaran jejak CO2 dalam proses pengeluaran utama. Objektif kajian ini boleh dikatakan telah dicapai kerana banyak data maklumat telah dikeluarkan dalam kajian ini.

ABSTRACT

Lightweight materials and design have always been an important topic in product design across several industries.The design of modern vehicle must meet many requirements in terms of transport performances, comfort, active and passive safety, power consumption and costs, quality and reliability, environmental impact and end-of-life destination. The purpose of this research is to investigate the contribution of lightweight materials toward overall design of an electric vehicle (Buggy Cart)
and to evaluate the economic manufacturing process of the materials used from a life cycle perspective as well as its ecological impact of its materialization and manufacturing process. The study will focus on main part of the design such as base parts of the design and to achieve the objective of the study, several analysis tool will be used approximately. The shapes of the each studied parts played the the biggest role in determining the material indices that will became the objective of translating the material and process selection based onAshby and Cambrigde Engineering Selector EduPack 2012,(CES). The main body parts of the design contributes the most in the design weigh reduction but and also contribute low in CO2 footprint production in primary production process. The objectives of the study can be said to has achieved since many informational data has been retrieved in this study.

DEDICATION

This work is dedicated to my parent, Roziah Binti Ibrahim, without whose caring support it would not have been possible, and to the memory of my late father, Aziz Bin Ali, who passed on a love of reading and respect for education.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

ANSI	-	American National Standards Institute
Al	-	Aluminium
ASEAN	-	Association of Southeast Asian Nations
CO2	-	Carbon Dioxide
FMM	-	Federation of Malaysian Manufacturers
HU	-	Highly Used
LU	-	Least Used
M	-	Million
MITC	-	Melaka International Trade Centre
MF	-	Methyl Formaldehyde
MU	-	Moderately Used
PF	-	Phenol Formaldehyde
PP	-	Polypropylene
RM	-	Malaysian Ringgit
SD	-	Standard Deviations
USD	-	United State Dollar
<	-	Less than
>	-	More than
σ	-	Stress
ϵ	-	Strain
E	-	Young Modulus
M	-	Material Index
ρ	-	Density

CHAPTER 1
INTRODUCTION

1.0 Introduction

The continuously increasing consumption of raw materials and its influence on the ecological system are widely debated topics. Politics and society are more and more concerned about an anthropogenic climate change. In times of a beginning energy revolution especially automobile companies are facing the necessity to develop new driving concepts because they ought to react to pollutant emission levels defined by law for the future. According to a EU directive the average CO2 emissions of every manufacturer's new car fleet have to be lower than 130 g/km. This limit value decreases to 95 g/km in 2020 (Pehnt , M. et al . 2011). Also one of the main concern about automotive industry is related to the reduction of power consumption. In the last years, vehicle weight has progressively increased in order to guarantee higher vehicle performance, passenger comfort, safety and emission standards but, on the other hand, this has penalized the power consumption and the CO2 emissions. An obvious approach is to study the contribution lightweight materials used in Electric Vehicle that can lead to the reduction of the problem being stated. Weight can be reduced possibly without changing the structural of the design using sustainable Engineering software. By using sustainable tool, the LCA can be performed in a systematic and integrated manner during the design and material selection process(Poulikidou et al., 2015).

1.1 Background

The electric vehicle industry can follow its roots back more than 180 years. In the 1830's, the first electric auto was inherent Scotland. It utilized a non-rechargeable battery and was basically a horseless carriage. By 1881, rechargeable lead corrosive batteries had been produced which were useful for use in vehicles. Electric vehicles were so standard in 1887 that New York City had an armada of electric taxis. By the turn of the century, 38% of autos in America were electric. They were a more common sense auto for the day as gas controlled vehicles were grimy, boisterous, and a harsh ride. What's more, inner burning motors must be begun with a hand wrench. The 1902 Wood's Phaeton was a typical auto of the day, and had a scope of 18 miles and top pace of 14 mph. It wasn't until 1912, when the electric starter was created, that inside burning motors began to end up more famous than the electric and steam controlled autos. New oil disclosures in Oklahoma and Texas, base enhancements taking into consideration longer outings, alongside Henry Ford's advancements underway all added to the inevitable control of gas controlled vehicles.

The electric vehicle never vanished totally, however its utilization was to a great degree constrained. Obviously, the oil emergency in the 1970's impelled the developments of numerous EV concepts. Authoritative endeavours lead by California in 1990 impelled improvement recently. Significant car manufacturer, counting: Ford, Chrysler, Honda, Toyota and Nissan all began limited production of electric vehicles. The most celebrated of these was General Motors EV1s. For an assortment of reasons, including the annulment of controls in California as a consequence of campaigning endeavour’s via automakers, GM seized the greater part of the EV and truly devastated them. It was symbolic of the evident assumption of major automakers.

1.2 Problem Statements

(i) The problems regarding in existing design of an electric vehicle: -low performance.

(ii) In term of energy consumptions, rationally the heavier the vehicle the more energy is required. Manufacturer demands on study of lightweight material to manufacture Electric Vehicles.

(iii) Effects and impacts of lightweight materials used in the electric vehicles design and its manufacturing process to the environment contributed to pollution.

1.3 Objectives

(i) To investigate the contribution of lightweight materials toward overall design of an electric vehicle.

(ii) To evaluate the economic manufacturing process of the materials used in the EV's design from a life cycle perspective

(iii) To study on ecological impact of an Electric vehicle materialization and its manufacturing process with prioritizing environmental effect and sustainability.

1.4 Research Scopes

This project consists of four work scope, the first work scope is The study focus on main part of the design such as base parts, body parts, frames, rails parts, roof and seat box that contributed most weight to the EV. Then the methods configuration to assemble and disassemble each parts of an electric vehicle's design will be determined by using SolidWorks 2014 software and reverse engineering.

Next, the Bill of Material (BOM) of the vehicle's design will be studied and validated to determine total numbers of parts and Material used so that the total weight of the vehicle can be estimated.

Lastly, the study also will be done to determine the energy consumption by the Electric Vehicle using sustainable tool and also we can determine the contribution of the electric vehicle manufacturing process to the environment

CHAPTER 2
LITERATURE REVIEW

2.0 Introduction

In this chapter, the literature reviews founded have stated many diversity of contribution of lightweight materials toward Electric Vehicles which help the readers and researcher get better understanding on the topic that will be studied. These all included the EVs' categories, design optimization study, software application strategy and characteristics in materials selection process itself which can lead to main factor toward environmental impact.

2.1 Electric Vehicle

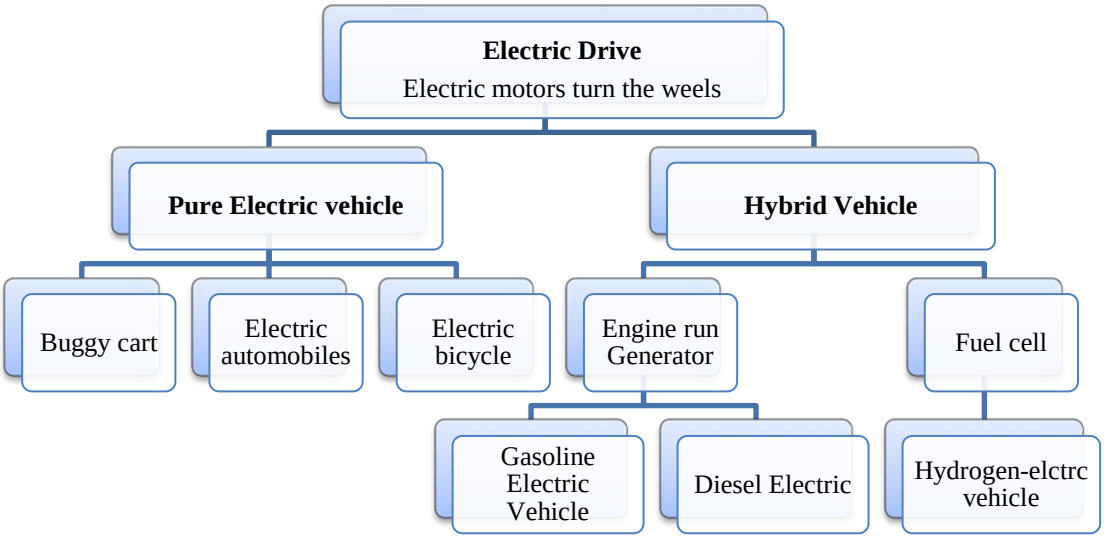

Figure 2.1 The common Categories of Electric Drive Vehicle

2.1.1 Introduction of Electric Vehicle

Electric cars and trucks are powered by electricity, which as an energy source is cleaner and less expensive than oil. Even when the electricity originated from the dirtiest coal-dominated grid, electric vehicles still produce less global warming pollution than their conventional counterparts, and with fewer tailpipe emissions (or none by any stretch of the imagination).

Electric vehicles are down to earth as well: 42 per cent of U.S. households could use a battery-electric or plug-in electric vehicle, and all households could use a hybrid-electric vehicle. Doing so could spare drivers billions in fuel costs and significantly decrease the the amount of global warming pollution we emit.

Indeed, boundless reception of electric vehicles could save 1.5 million barrels of oil a day by 2035. To get there, we need smart government policies that incentivize investment in clean vehicle technology helping move world toward a cleaner, safer, Half the Oil future.

The term “electric vehicle” refers to an extensive variety of cars and trucks, big and small. These incorporate cross breed electric, plug-in electric, and battery electric vehicles, and also fuel cell technologies.

2.1.2 Hybrids, or hybrid-electric Vehicles

Hybrids are defined as combinations of a combustion engine with an electric motor and battery to reduce fuel consumption and tailpipe emissions. Hybrids that can't be charged by an outlet aren't considered EVs. Conventional vehicles use gasoline or diesel to power an internal combustion engine. Hybrids *also* use an internal combustion engine and can be fuelled like normal cars but have an electric motor and battery, and can be partially or wholly powered by electricity.

By using both a conventional engine and electric motor, the best hybrids achieve significantly better fuel efficiency than their non-hybrid counterparts. They also pollute less and save drivers money through fuel savings. The most advanced hybrids have larger batteries and can recharge their batteries from an outlet, allowing them to drive extended distances on electricity before switching to gasoline or diesel. Known as "plug-in hybrids," these cars can offer much-improved environmental performance and increased fuel savings by substituting grid electricity for gasoline.

PHEVs combine the fuel-savings benefits of hybrids with the all-electric capabilities of battery-electric or fuel-cell vehicles.