UNIVERSITI TEKNOLOGI MARA

THERMAL BEHAVIOUR OF BRAKE PAD LIGHT RAIL TRANSIT

MOHD ZAKI BAHROM

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Candidate's Declaration

I declare that the work in this thesis was carried out in accordance with the regulation of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledgment as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

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Name of Candidate	**Mohd Zaki bin Bahrom**
Candidate's ID No	**2004202466**
Programme	**Master in Mechanical Engineering**
Faculty	**Mechanical Engineering**
Thesis Title	**Thermal Behaviour of Brake Pad Light Rail Transit**
Signature of Candidate	
Date	13/10/2009

ABSTRACT

Material specification and operating temperature are very important for product performance especially for transportation application such as brake pad material. For light rail brake pad, other than strength, wear and friction, thermal stability is also an important property to investigate due to temperature variation during operation. Hence, four sample differences of laboratory formulation are used to study the thermal stability of brake pad material. The thermal behaviour is determined by thermal gravimetric and differential thermal analyser which are heated up to 1000°C were used in combination with evolve gas analysis. Scanning electron microscope equipped with energy dispersive x-ray and quantitative x-ray florescence techniques are used to determine the element present in formulated brake pad samples. Friction and wear test was conducted to determine the thickness losses.

A brake pad is basically a mixture of iron (Fe), carbon (C), fibre, lubricant material and binder system. The materials distributed in samples were found to be non-homogeneous. On EDAX surface mapping, iron elements in higher contents were present compared to carbon and other materials. The selected raw material are analysed to have record data on its composition and characteristic especially thermal properties, maximum decomposition temperatures ($T_{max\ dec}$) were evaluated from DTG (Differential Thermal Gravimetric) curve and analysed as to whether there is any decomposed by products formed. The formulations of brake pads materials weight loss are around 5% to 10%. The friction and wear test results showed different value of friction coefficient (μ) in the range 0.2 to 0.5. The lowest thickness loss is around 1.44 % and the highest thickness loss is around 5 %. Higher thickness loss means shorter brake pad life and thus, incurred more material and maintenance cost.

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INTRODUCTION

1.1 General Introduction

There are many friction materials in use today. Not only for braking system but in other application such as in automotive clutches. By the start of more modern vehicle such as the steam locomotive at the beginning of the nineteenth century and in particular the motor car at the end of the nineteenth century, friction brake systems were developed and materials for this purpose are commercially produced. Developing of brake materials for Automotive Transportation is not easy tasks. Different amount of materials used, give different of properties and functions such as the mechanical and chemical properties, and will be effect on wear resistance during braking. There are a wide variety of compounds which are included in friction materials, often in small amounts (1-5%) in order to change a particular property of the material. For example, the value of the coefficient of friction between a material and mild steel disc or drum is too low; it can be increased by the presence of small amounts of an abrasive material such as aluminium oxide. Alternatively, the friction level may be lowered by the inclusion of soft lubricating materials such as silicates for example talc.

The purpose of brake is to decelerate a vehicle by transforming the kinetic energy of the vehicle to heat (thermal), through friction and dissipating the heat to the surrounding. During the brake material (stationary part) and disc (moving part) is rubbing together and the heat is started to generate. If the brake application still continues, the temperatures on both sides are increased. When the temperature