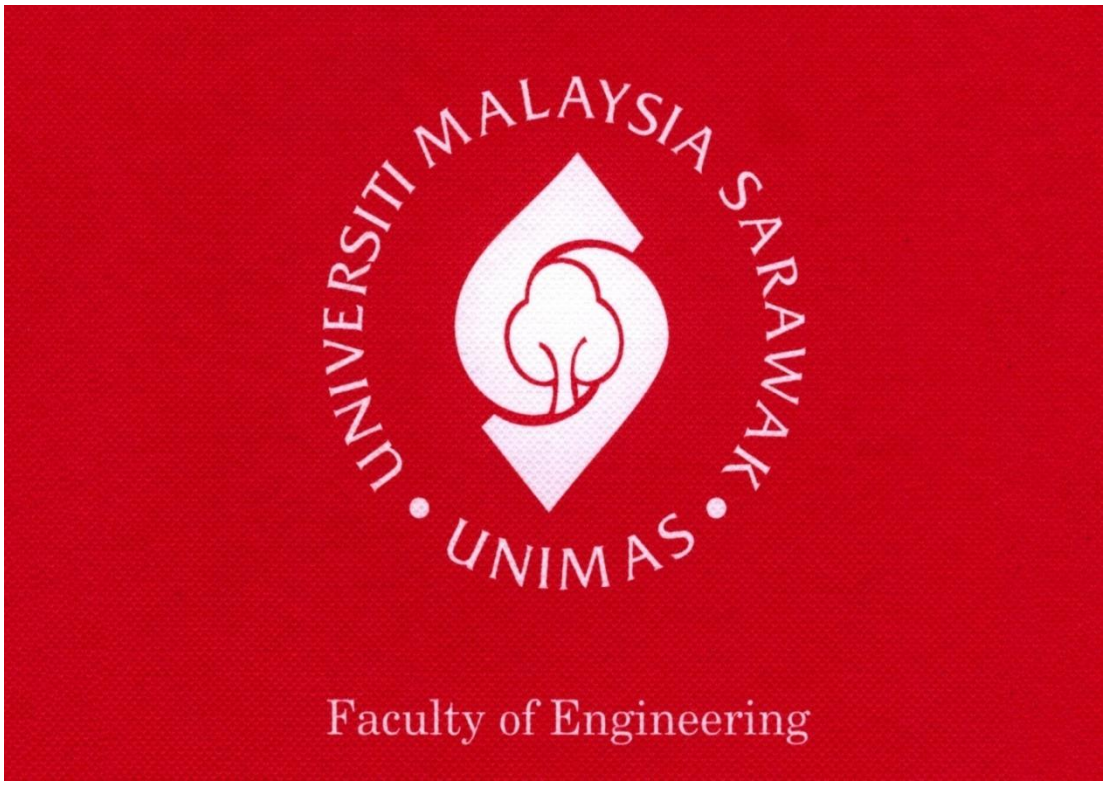

COMPARISON OF MARSHALL MIX PROPERTIES BETWEEN NORMAL ACW14 HOT MIX ASPHALT MIXTURE AND ACW14 WITH CARBIDE LIME AS FILLER REPLACEMENT MATERIAL

AZIZAH UMMIRA BT HJ ABOT

Bachelor of Engineering with Honours
(Civil Engineering)
2010

UNIVERSITI MALAYSIA SARAWAK

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SESI PENGAJIAN :2009/2010

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Name : Azizah Ummira Bt Hj Abot

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Has been read and approved by:

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Supervisor

Date

COMPARISON OF MARSHALL MIX PROPERTIES BETWEEN NORMAL ACW14 HOT MIX ASPHALT MIXTURE AND ACW14 WITH CARBIDE LIME AS FILLER REPLACEMENT MATERIAL

AZIZAH UMMIRA BT HJ ABOT

This project is submitted in partial fulfilment of the requirements for the degree of Bachelor of Engineering with Honours
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Faculty of Engineering
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2010

“ Dedicated to my beloved family…”

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ABSTRACT

Many researchers have been using Marshall Mixture design method for designing Hot Mix Asphalt (HMA) mixtures. The objective of this study is to evaluate the Marshall Mix properties for both types of mixtures using normal aggregate and carbide lime as filler material in ACW 14 mix. One using ordinate aggregate available at UNIMAS civil lab and another one the filler size of 75 μm was replace by carbide lime. The asphalt cement use varies from 4.5% to 6.5% and having penetration grades of 80/100. The mix were compare in term of Marshall Properties such as stability and flow; and volumetric properties are mixture density, Voids Filled with Asphalt (VFA), Voids in Mineral Aggregate (VMA), and Voids in Total Mix (VTM). Study show that the hot mix asphalt for the normal aggregate mix having a greater density but carbide mix having greater stability. The optimum binder content for the normal mix asphalt was 5.67% and 5.63% for the carbide mix. The ACW 14 for the carbide mix does not satisfied JKR requirement for flow, void in total mix and voids in aggregate filled with asphalt mean while the ACW 14 for normal only fail to satisfy the void in total mix and voids in aggregate filled with asphalt.

ABSTRAK

Banyak pengkaji telah menggunakan kaedah rekabentuk campuran Marshall dalam mereka bentukan asfal campuran panas (HMA). Objektif kajian ini adalah untuk menilai parameter ujian Marshall untuk dua jenis sampel yang menggunakan "carbide lime" dan agregat biasa telah digunakan dan dicampurkan dalam campuran asphalt haus ACW 14. Satu menggunakan agregat biasa yng tersedia di makmal sivil UNIMAS. Satu lagi agregat berukuran 75μm digantikan dengan "carbide lime". Kandungan asfal berbeza dari 4.5% ke 6.5% dengan gred penembusan 80/100. Kedua-dua campuran ini dibandingkan dari segi Marshall parameter seperti kestabilan, aliran: dan ciri-ciri volumetric seperti lompang dalam campuran (VTM), lompang dalam agregat (VMA), lompang terisi simen asfal (VFA) dan kekukuhan. Keputusan kajian menunjukan campuran menggunakan agregat biasa mempunyi ketumpatan yang lebih besar tetapi campuran menggunakan "carbide lime" akan mempunyai kestabilan yang lebih tinggi. Kandungan asfal optimum untuk campuran biasa adalah 5.67% manakala 4.67% untuk campuran "carbide lime". ACW14 untuk campuran "carbide lime" gagal menepati piawaian JKR dari segi aliran, lompang dalam campuran (VTM) dan lompang dalam agregat (VFA) manakala campuran *agregat biasa* gagal nenepati lompang dalam campuran(VTM) dan lompang dalam agregat (VFA) sahaja.

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%	percent
ºC	Celsius
ºF	Fahrenheit
µ	Micron
mm	Millimeter
m	Meter
G_{Sa}	Apparent specific gravity
G_{Sb}	Bulk specific gravity
G_{Sc}	Effective specific gravity
V_B	Volume of constituent binder
M	Mass of specimen
V	Bulk volume of specimen
V_{MM}	Volume of void-less mix
V_A	Volume of air between coated aggregate particles in the mix
M_G	Mass of aggregate
V_G	Bulk volume of aggregate
V_{GE}	Effective volume of aggregate
W_a	Weight of specimen in air (kg)
W_w	Weight of specimen in water (kg)
ρ_w	Density of water (= 1000 kg/m3)
W_{pa}	Weight of specimen and paraffin wax coating in air (kg)

W_{pw}	Weight of specimen and paraffin wax coating in water (kg)
G_p	Relative density of paraffin wax
M_B	Mass of constituent binder
P_{AG}	Binder absorption, % of mass of aggregate
P_B	Binder content, % of total mass of specimen
ρ_B	Density of binder
ρ_G	Bulk density of aggregate
m^3	Meter cubic
kg	kilogram
g	Gram

LIST OF SUBSCRIPTS

HMA	Hot Mix Asphalt
VMA	Voids in Mineral Aggregates
VTM	Voids in Total Mix
VFA	Voids Filled with Asphalt Cement
SMA	Stone Matrix Asphalt
OGFCs	Open graded asphalt friction courses
ASTM	The American Society for Testing and Materials
OPC	Ordinary Portland Cement
OAC	Optimum Asphalt Content
SSD	Saturated Surface Dry

CHAPTER 1

INTRODUCTION

1.1 General

Asphalt concrete pavement, or hot mix asphalt (HMA) pavement as it is more commonly called, refers to the bound layers of a flexible pavement structure. For most applications, asphalt concrete is placed as HMA, which is a mixture of coarse and fine aggregate, and asphalt binder. Hot mix asphalt (HMA) is the widely used primarily as paving material for road construction and consists of a mixture of aggregate and liquid asphalt cement, which are heated and mixed in measured quantities.

During World War II, the U.S. Army Corps of Engineers (USCOE) began evaluating various HMA mix design methods for use in airfield pavement design. Motivation for this search came from the ever-increasing wheel loads and tire pressures produced by larger military aircraft.

The most promising method eventually proved to be the Marshall Stability Method developed by Bruce G. Marshall at the Mississippi Highway Department in 1939. Wes took the original Marshall Stability Test and added a deformation

measurement (using a flow meter) that was reasoned to assist in detecting excessively high asphalt contents [White, 1985].

Marshall Mix Design was widely use because it had several advantage: Firstly, it was designed to stress the entire sample rather than just a portion of it. Secondly, it facilitated rapid testing with minimal effort. Thirdly, it was compact, light and portable. It produced densities reasonably close to field densities. Lastly, it also cheap to be carries out.

The aggregates size smaller than 75 μm are call filler. Filler was a very importance element in term of producing high quality of hot mix asphalt. The filler act as the fill up material between the aggregate void and give the maximum contact surface to all the binder aggregate and avoid segregation of aggregate. Suitable amount of filler added in the hot mix asphalt will produce a dense-grade and strong material.

The filler use in the hot mix asphalt must be not rotten in nature and must able to withstand the heavy load of the traffic flow hence normally nature material like limestone dust or river sand will be chosen as a filler material. In this study the filler will be replace by the carbide lime dust. Carbide was chosen because is a hard metal and stable in term of physically and chemistry. Carbide lime mostly exist in gray color since it was a hard metal hence it able to sustain a very high temperature.

1.2 Problem statement

Carbide lime is the byproduct of liquid oxygen processes. Since carbide lime was belong to metal hydroxide family hence it need to be treated before it can be dump safely. In term of sustainable development it is encourage turning the waste into useable material and in this scope of study the carbide was tested its potential for replacing the fine aggregate in the pavement design.

Then normally use fine aggregate were obtain by harvesting limestone or river sand they need to blast down the mountain or dig the big hole near the river just to obtain the sand. When all this activities were done in big scale it will create a big impact to the nearby ecosystem. In term of sustainable development this should be avoid or reduce.

1.3 Objectives

This study is conducted to achieve several objectives. The objectives for this study are to:

a) Determine the Marshall properties of hot mix asphalt ACW14 by using carbide as a replacement material for filler element.
b) Compare the Marshall properties of the carbide HMA ACW14 with the normal HMA ACW14