UTILIZATION OF COCONUT SHELL AS FINE AGGREGATE IN ASPHALTIC CONCRETE AC14

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To my beloved parents for love and support

Miron & Asmaliah

To all the siblings for pray and motivation

Radzi, Nazri, Amin, Hani, Fahmie, Nurul, Muhammad, Syafiq

To all the niece & nephew, you are my strength

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To all family members

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ABSTRAC

Many previous studies have been done to carry out the waste material that can use to increase the performance of road pavement. Oil palm kernel shell, scrap tyre, and building waste material are the example of waste material that have been investigate to replace aggregate in road construction. Another alternative is to use coconut shell. Coconut shell is by product from agriculture activity. This study present the laboratory evaluation of aggregate properties on coconut shell and the performance of asphaltic concrete that use coconut shell to replace the fine aggregate. Only AC14 and 80/100 PEN bitumen were consider in this study. The investigations on the aggregate properties containing coconut shell are aggregate impact value (AIV) and specific gravity & water absorption. While, tests for performance of conventional asphaltic concrete AC14 and ACCS are volumetric properties, indirect tensile strength, resilient modulus and dynamic creep test. The result of the test shows that conventional asphaltic concrete AC14 give better volumetric properties than ACCS. For mechanical properties, replacement 10% of coconut shell as fine aggregate ($ACCS_{10}$) shows better result than conventional asphaltic concrete AC14. Since this pavement has low strength, it will be only suitable for low traffic volume and at rural area.

Keywords: *Coconut Shell, Asphaltic Concrete, Fine Aggregate, Waste Material*

ABSTRAK

Terdapat banyak kajian lampau telah dilakukan terhadap bahan buangan yang boleh digunakan untuk meningkatkan kualiti turapan jalan raya. Tempurung kelapa sawit, tayar sekerap, dan bahan buangan binaan adalah contoh buangan yang telah dikaji untuk menggantikan batu baur dalam pembinaan jalan raya. Alternatif lain adalah dengan menggunakan tempurung kelapa. Tempurung kelapa adalah produk hasil daripada aktiviti pertanian. Kajian ini membentangkan penilaian makmal hartanah agregat pada tempurung kelapa dan prestasi konkrit asfalt yang menggunakan tempurung kelapa untuk menggantikan agregat halus. Hanya AC14 dan bitumen 80/100 PEN yang digunakan dalam kajian ini. Siasatan ke atas sifat-sifat agregat yang mengandungi tempurung kelapa adalah nilai hentaman agregat (AIV) dan spesifik graviti & penyerapan air. Sementara itu, ujian untuk prestasi konvensional AC14 konkrit asfalt dan ACCS termasuk perlakuan isipadu, kekuatan tegangan tidak langsung, modulus berdaya tahan dan ujian rayapan dinamik. Keputusan ujian menunjukkan bahawa konvensional AC14 konkrit asfalt menunjukkan sifat volumetric adalah lebih baik daripada ACCS. Bagi sifat mekanik, penggantian 10% daripada tempurung kelapa sebagai agregat halus (ACCS10) menunjukkan keputusan yang lebih baik daripada konvensional AC14 konkrit asfalt. Oleh kerana turapan ini mempunyai kekuatan yang rendah, ia akan hanya sesuai untuk jumlah trafik yang rendah dan di kawasan luar bandar.

Kata Kunci: *Tempurung Kelapa, Konkrit Asphalt, Agregat Halus, Bahan Buangan*

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Malaysia is a country which economic growth rapidly. Therefore, Malaysia must have good roadway and transportation to cater the demand on the road. There have many factors that can give good highway such as material used to construct the road, road furniture, infrastructure and drainage.

Basic materials that being used in road pavement construction for wearing course are aggregates, bitumen and filler. Aggregate is the main material that makes up about 93% of the mix. The strength is resulted from the interlocks between the aggregate and assist to distribute loads from the traffic in the pavement. While, bitumen or known as asphalt is a binder to glue the aggregate together to form an improved mix. Next, filler will fill the voids between aggregate and helps stiffening the binder to produce a stronger and stiffer mix could last longer.

Nowadays, there are so many researches that has been done to improve and upgrading the materials for preparing hot mix asphalt. The utilization of waste

material as a replacement in materials for producing hot mix asphalt can give a lot of benefit to the humans. Coconut shell is a one of the alternative that can be used to replace aggregate in preparing a flexible pavement.

Coconut is grown in more than 93 countries. South East Asia is regarded as the origin of coconut (Maninder and Manpreet, 2012). India is the third largest, having cultivation on an area of about 1.78 million hectares. Annual production is about 7562 million nuts with an average of 5295 nuts per hectare. The coconut industry in India accounts for over a quarter of the world's total coconut oil output and is set to grow further with the global increase in demand. However, it is also the main contributor to the nation's pollution problem as a solid waste in the form of shells, which involves an annual production of approximately 3.18 million tones. Coconut shell represents more than 60 % of the domestic waste volume. Coconut Shell, which presents serious disposal problems for local environment, is an abundantly available agricultural waste from local coconut industries. In developing countries where abundant agricultural and industrial wastes are discharged, these wastes can be used as potential material or replacement material in the construction industry. This will have the double advantage of reduction in the cost of construction material and also as a means of disposal of wastes.

1.2 Problem Statement

The construction of a local two-lane highway consumes more than 15,000 tonnes of aggregates per kilometer while six-lane asphalt freeway consumes over 48,000 tonnes of aggregates for each kilometer of roadway (Khabiri, 2010). These facts show that the demand of the natural aggregate is very high. Furthermore, aggregates are not only use for new construction, but also in maintenance process like reconstruction and rehabilitation. Since of that, more hills have been

exhaustingly exploited to get natural aggregate. However, should be known that aggregates are finite natural sources in which shortage of aggregates will occur because of depletion of sources. As a result, other resources of aggregates need to be searched and more cost is needed.

Therefore, others waste material can be used to replace natural aggregate and also to save the environment. Coconut milk which produces from coconut meat is needed to produce good and quality taste of food in Malaysia. After the coconut meat are taken, coconut shells being useless. Then, it will increase the generation of coconut shell. These coconut shells will be dispose at their backyard (by burning) or throw it at the landfill area and it will increase the environmental problem. Besides of dispose it, coconut shell also can be used to replace natural aggregate in the construction of wearing course. It is one way to sustain our environment and world.

1.3 Objective of Study

The study on utilization of coconut shell as fine aggregate in asphaltic concrete AC14 have some objective as the guideline for the overall study which are:

- To investigate the performance of AC14 containing coconut shell,
- To determine the optimum percentage of coconut shell as fine aggregate in asphaltic concrete.

1.4 Scope of Study

All the samples are prepared in accordance with the JKR specifications (JKR/SPJ/2008) using Marshall design procedures. This study was focus on the performance of coconut shell as aggregate in asphaltic concrete with 14mm nominal aggregate size. The size of coconut shells that being used was retained on 3.35mm. Coconut shells that replace aggregate are 10%, 20%, 30% and 40%. This study used standard penetration grading which is 80-100 PEN and only use one optimum bitumen content (OBC) for all the samples include the sample which have coconut shell as fine aggregates replacement (ACCS). Value OBC is following the result of conventional sample OBC.

Coconut shell was added in the mixes by using dry process method where the coconut shell was added as part of the aggregate component before it was mixed with asphalt cement. Marshall test was done to give the volumetric properties of each mix design. Besides, resilient modulus test, dynamic creep test and indirect tensile strength test was conducted to identify the best percentage of coconut shell that can be replace in asphaltic concrete.

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1.5 Significant of Study

From this study, the feasibility and performance of AC14 using coconut shell as fine aggregate replacement can be obtained. Marshall samples will determine with JKR specification either the mixes meet the specification or not. Coconut shell samples will be compare with natural aggregate based on their performance and then determine the best application for that performance. The coconut shell production can generate money by producing it for highway material construction. It also can reduce the cost for dumping area to dispose the agriculture waste like coconut shell.

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