USE OF CRUMB RUBBER AS AN ADDITIVE IN ASPHALT CONCRETE MIXTURE

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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ABSTRAK

Memandangkan semakin banyak kenderaan di dunia, sisa dari getah tayar menjadi kebimbangan utama alam sekitar. Penggunaan getah serbuk tayar di dalam turapan asfalt telah menarik perhatian dan semakin meningkat di seluruh dunia. Getah serbuk kitar semula menunjukkan potensi sebagai bahan tambahan atau alternatif kepada sumber semula jadi yang digunakan dalam bahan asfalt , seterusnya menyediakan alternatif yang efektif untuk menggunakan produk sisa. Tujuan kajian ini adalah untuk mengkaji kesan menambah getah serbuk kepada campuran asfalt menggunakan proses basah serta menyiasat kekerasan dan konsisten asfat yang diubahsuai. Ujian reka bentuk asfalt campuran panas makmal dilakukan dengah kaedah Marshall. Dalam kajian ini, dua kandungan getah serbuk yang berbeza (1% dan 2% berat campuran asfalt) dan dua saiz getah serbuk yang berbeza (0.425mm dan 0.150mm) telah disiasat. Kajian komparatif dilakukan di antara campuran asfalt yang tidak diubahsuai dan diubahsuai untuk menilai kestabilan Marshall dan modulus berdaya tahan. Hasil kajian menunjukkan bahawa getah serbuk boleh disarankan sebagai bahan tambahan dalam campuran asfalt, disebabkan keputusan ujian menunjukkan ianya memenuhi piawaian yang telah ditetapkan. .Secara kesimpulannya, Penambahan getah serbuk kepada campuran konkrit asfalt cenderung meningkatkan kekuatan dan kualiti campuran asfalt dengan nisbah yang optimun.

ABSTRACT

As the rapidly growing number of vehicles in the world, the west of tire rubber becomes a major environmental concern. The use of crumb rubber in asphalt pavements has attracted increasing attention in many areas worldwide. Crumb rubber exhibits recycling potential as an additive or an alternative to natural resources used in pavement materials, as well as provides an effective approach to utilize waste products. The purpose of this study was to investigate the effect of adding crumb rubber to asphalt mixture using wet process and investigate the hardness and consistency of modified bitumen. The laboratory hot mix asphalt design tests were done by Marshall method procedure. In this study, two different crumb rubber contents (1% and 2% by weight of asphalt mixture) and two different size of crumb rubber (0.425mm and 0.150mm) were investigated. A comparative study was done among the unmodified and modified asphalt concrete mixtures considering the Marshall stability value and the resilient modules. The result showed that crumb rubber is recommended as an additive in asphalt mixture, as all the result are within the standard requirements. The addition of crumb rubber to asphalt concrete mixture tended to increase the strength and quality of asphalt mixture.

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LIST OF ABBREVIATIONS

CR	Crumb Rubber
WTR	Waste Tire Rubber
ASTM	American Standard
HMA	Hot Mix Asphalt
CRM	Crumb Rubber Modified
SHRP	Strategic Highway Research Program
DSR	Dynamic Shear Rheometer
ER	Elastic Recovery
CRWet	Crumb Rubber wet
DVR	Devulcanized Rubber
CRTB	Crumb Rubber Terminal Blend
CRDry	Crumb Rubber Dry
WMA	Warm Mix Asphalt
AASHTO	American Association of State Highway and Transportation officials
VMA	Voids Mineral Aggregate
PG	Performance Grade
VFA	Voids Fail Asphalt
AC	Asphalt Concrete

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

In today's industrial world, the automobile industry is producing many waste tires all over the world. Regarding this evolution, nowadays there is a heated controversy over reusing and recycling used tires, which seems a necessity, especially regarding the massive and emerging stocked pile tires in the current century (Fakhri et al., 2017). One of the main sources of pollution stemming from industries related to transportation infrastructures, resides in the manufacturing, spreading, and conservation of asphalt mixes (Rubio et al.,2012), In addition, the use of crumb rubber in asphalt pavements has attracted increasing attention in many areas worldwide. Crumb rubber exhibits recycling potential as an additive or an alternative to natural resources used in pavement materials, as well as provides an effective approach to utilize waste products (Farouk, A. I. B et al., 2017).

The past two decades have proved an efficient method by modifying asphalt with polymers, among which waste tire rubber (WTR) is one of the most attracting modifiers for being environmentally friendly, comprehensively effective, and economically feasible (Liu et al., 2018). Accordingly, from the environmental perspective, the waste tires have been considered as a serious threat that can dramatically impact the green environment, and eventually result in a serious health hazard in human life; hence, the waste tires have an essential potential to threaten human health and cause irreversible damage to the environment (Fakhri et al., 2017).

The use of waste tires in civil engineering applications dates to the very early ages when automobiles were first invented. Waste tires became natural candidates for construction materials, such as landfills and cushion materials. However, largescale

recycling of waste tires in civil engineering applications did not happen until the 1960s, which was stimulated by both an ever-increasing number of scrap tires and a stronger environmental awareness movement (Shu, X., & Huang, B. 2014).

Adding polymers are a beneficial way to enhance the quality and performance of asphalt reducing, concerning on the application of recycled polymers as replacement for polymers has grown in recent years which are an environmentally friendly way to dispose of wastes. The remaining waste tires are added to stockpiles and landfills, giving rise to environmental problems. Therefore, the use of tire scrap rubber as an additive to asphalt can not only endow asphalt with improved elasticity but also be an effective way to solve a waste disposal problem (Liang et al., 2015).

With civilization development and the advancement of human life, the percentage of waste advances as well. There are numerous amounts of waste types being deposed by various sources and industries. Among which are of high degree of to the mother nature such as rubber. There have been several attempts in proposing the appropriate measures in disposing these wastes.

The vital use of rubber has been the focus of investigation due to its vital use in the construction field (Toutanji, H. A. 1996). The rubber production differs from one country to another, for example in United States it is estimated to be 3.6 million tons of rubber annually; Iran on the other hand produces up to 100 thousand tons of rubber annually, whereby Malaysia produces 200 thousand tons of rubber per year (Alam et al., 2015).

1.2 PROBLEM STATEMENT

Asphalt binder resistance to deformation at several temperatures appreciably affects normal pavement resistance to rutting deformation beneath heavy traffic. To enhance asphalt resistance to deformation, researchers have used more than a few modifiers and components such as crumb rubber modifier.

Asphalt Bitumen is widely used in road pavement as the binder of aggregate. However, the use of asphalt is limited due to severe temperature that cause rutting

cracking of asphalt cement or coating layer. Therefore, it is necessary to modify asphalt and improve its quality with less affects to environment (Zhang, F., & Hu, C. 2015).

1.3 OBJECTIVE OF RESEARCH

i. To investigate the hardness and consistency of modified bitumen
ii. To investigate crumb rubber modified asphalt binder characteristics.

1.4 SCOPE OF WORK

This study focused on compering between to two asphalt binder which is unmodified and modified asphalt mixture, for the modified asphalt used crumb rubber as an additive to the mixture by different percentage and different size. The study will conduct at highway and traffic laboratory in University Malaysia Pahang by preparing aggregate AC 14 and bitumen 60/70, these samples will be 101.6mm diameter by 76.2mm high and provided with base plate and extension collar. Also, the tests will conduct according to ASTM standard.

1.5 EXPECTED OUTCOME

Clearly these researches and experiments are expected to provide different type of asphalt mixture which are modified and unmodified asphalt mixture. Also produce asphalt from waste rubber which leads to reduce the cost of asphalt manufacturing, the result of these asphalt mixture is within the standard requirement.

1.6 SIGNIFICANT OF STUDY

The result of this research is to produce an optimum asphalt mix consisting of aggregate, binder and tires crumbs rubber. Also, researches are always more interested in the use of such products in the asphalt mixture. This makes the asphalt more economic and, at the same time, there is a reduction of the problem in waste. Moreover, the addition of crumb rubber tended to increase the strength and quality of asphalt mixture (Wulandari, P. S., & Tjandra, D. 2017).

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