THE EFFECT OF WASTE COOKING OIL IN WARM MIX ASPHALT

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ABSTRAK

Terdapat banyak kajian telah dilakukan untuk menentukan bahan buangan yang boleh digunakan untuk meningkatkan rintangan terhadap aluran, ubah bentuk kekal dan keletihan retak kerana pengikat pengerasan dan meningkatkan lekatan pengikat kepada agregat. Dalam kajian ini, prestasi sisa minyak memasak sebagai pengubahsuai bitumen dalam turapan asfalt konkrit telah dikaji. Kajian ini memberi tumpuan kepada penambahan sisa minyak memasak dalam mengikuti perintah 0% sebagai kawalan, 3%, 4%, dan 5% oleh berat bitumen. Tujuan kajian ini adalah untuk mengkaji kesan sisa minyak memasak pada ciri-ciri kejuruteraan Asfalt Konkrit 14. peratusan yang berbeza sisa minyak memasak telah dicampur ke dalam bitumen dengan menggunakan pengadun ricih yang tinggi pada kelajuan malar 1000 rpm selama satu jam pada 140 °C. ujian Marshall Kestabilan telah dijalankan untuk menentukan kandungan bitumen optimum campuran. Prestasi sampel dinilai melalui kestabilan dan isipadu sifat-sifat, modulus kebingkasan dan rayapan dinamik.

ABSTRACT

There are many studies have been done to determine the waste material that can be used to improve resistance to rutting, permanent deformation and fatigue cracking due to binder hardening and improve adhesion of binder to aggregate. In this study, the performance of Waste Cooking Oil (WCO) as a bitumen modifier in asphalt concrete pavement was investigated. This study focuses on the addition of WCO in following order 0% as control, 3%, 4%, and 5% by the weight of bitumen. The aim of this study is to investigate the effect of WCO on the engineering properties of Asphaltic Concrete 14. The different percentage of WCO was blended into the bitumen using a high shear mixer at a constant speed of 1000 rpm for one hour at 140℃. Marshall Stability test was carried out to determine the optimum bitumen content of the mixture. The performance of the samples was evaluated through the stability and volumetric properties, resilient modulus and dynamic creep.

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LIST OF ABBREVIATIONS

WMA	Warm mix asphalt
HMA	Hot mix asphalt
AC 14	Asphalt concrete 14
WCO	Waste cooking oil
JKR	Jabatan Kerja Raya
ASTM	American Society for Testing and Materials
BS EN	British Standard European
VFB	Voids Filled with bitumen
VTM	Voids in Total Mix
VMA	Voids in Mineral Aggregate
UTM	Universal Testing Machine
KOH	Potassium Hydroxide
NaOH	Sodium Hydroxide

CHAPTER 1

INTRODUCTION

1.1 Introduction

Most roads in Malaysia are applying the Hot Mix Asphalt (HMA) or asphalt concrete on the roadway because HMA pavement classified as flexible pavement due to the total pavement structure that deflects under loading. The asphaltic concrete pavement mixture is conventionally composed of 5% asphalt cement and 95% aggregates such as stones, sand and gravel. Asphalt concrete locks the soil surface which regulates the rainwater from percolation & natural recharge from the ground (Bhavana, 2017). Asphalt concrete must be heated to be mix with aggregates due to highly viscous properties. Asphalt is a dark brown to black is a highly viscous, hydrocarbon produced from the petroleum distillation residue. Lately, the asphalt industry has been concerned about the sustainable roadway to reduce the pollution and environmental friendly on global warming as the HMA pavement may emit the gas that is harmful to the environment and the heating of asphalt at high temperature causes the binder to lose its viscosity.

As petroleum asphalt becomes in short supply as a non-renewable resource, a lot of noteworthy studies conducted all around the world to investigate possible resource from waste materials as additive or replacement of asphalt and binder (Wan Azahar et al, 2016). Hence, waste cooking oil is one of the significant studies that highlighted the best performance and workability of waste materials as asphalt binder substitute. Not only that, waste cooking oil can diminish the environmental issues such as wastewater treatment and waste oil disposal due to the littering activity of the waste cooking oil into the landfill or river by recycling it or treat the waste cooking oil. Additive or replacement materials that are used in bitumen are designed to against fatigue, rutting, thermal cracking, and moisture susceptibility, therefore the laboratory performance conducted to evaluate the properties of the waste cooking oil. Due to the degradation process from the

frying activity, the quality of waste cooking oil was affect the modified asphalt binder later. In order to overcome this issue, a chemical test was be done to treat and get a better quality of waste cooking oil

Warm Mix Asphalt (WMA) is a kind of new pavement material, which the temperature used during mixing activities is 100°C to 140°C and it is between hot mix asphalt and cold mix asphalt, and the performance of this pavement material is close to Hot Mix Asphalt (HMA). In general terms, Warm Mix Asphalt technology gives benefits for better construction environment and higher recyclability of materials that related to the reduction of fuel consumption and gases emission by lowering the temperature during mixing compared to Hot Mix Asphalt (HMA), (Shuang Wu & Shunzhi Qian, 2014). It is because when using the traditional Hot Mix Asphalt (HMA), the construction pavement of asphalt concrete not only consumes enormous amounts of energy, but HMA also emits the greenhouse gases that harmful to the environment and lead to the air pollution. By using the new pavement method of Warm Mix Asphalt it was ensure the good workability and sensible long term performance of the asphalt.

1.2 Problem Statement

Road infrastructures play an important role in the growing economy industry and a great investment. Public roads play a critical role in aspect and reflecting the country's developing status. Having a sustainable road infrastructure design requires a good balance between environment, cost and social aspects (Saad Issa, 2015). Sustainability in road infrastructure should be addressed with the understanding that highway is are one part of transportation infrastructure that meets the human needs. Transportation makes the movement on roadways from one place to another place between the cities and towns. The travelling of the transports including cars, buses and lorries, lead to negative externalities in the form of overcrowding and traffic jam conditions on the roads, accidents, greenhouse emissions and air pollution and psychological and another health hazards (Chidambara,2010).

Cooking oil as an additive and medium of heat transfer plays a remarkable role in food preparation. It is one of the elements that provide the food with good taste, colour and aroma favoured by consumers. Recently, a big volume of waste cooking oil (WCO) is produced and released into the environment in various countries of the world. Waste Cooking Oil which is expected to be treated and handled in a good way that could not be harmful to the human health and to the environment, is being disposed of by consumers via sink, waste bins, drainage systems, toilets or directly to the immediate water bodies and lands.

Warm Mix Asphalt represents the technologies that allow reducing of asphalt binder mixing and compaction temperature by reducing its binder viscosity. Global energy insufficiency and weather conditions have become serious issues commonly concerned by the international community, and it has been the common responsibility of each country to save energy, reduce emissions and ensure sustainable development. By implying the Warm Mix Asphalt techniques, is not only concerned towards environmental issues but it also beneficial towards the economic, construction and recycling issues. By lowering the temperature during mixing and compaction of asphalt, it does not disturb the properties of the mixture instead it provides more work friendly

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