

CHAPTER 1

INTRODUCTION

1.1 Background of Study

The environmental pollution due to the waste material of tire rubber has been increasing from year to year. Disposal of waste tires is a serious environmental concern in many countries. Besides that, nowadays capacity of the road user has been increases year by year is one of the factors that make the road pavement prone to defect or damage such as cracking. Many of researcher has been investigate the usage and application of waste material of tire rubber in concrete, roadways pavement, brick and etc. Recycled waste material of tire rubber is referred to as crumb rubber. The crumb rubber modified in bitumen mixture is not new issue in nowadays. Crumb rubber modified bitumen has many good characteristics such as improved resistance to rutting due to higher viscosity, higher softening point and better resilience, improved resistance to surface initiated, reduced fatigue/reflection cracking, reduced temperature susceptibility, improved durability and lower pavement maintenance costs, and saving in energy and natural resource by using waste products (Wong, 2007).

In Malaysia, the application of crumb rubber in the pavement is still in the research period according to the climatic condition in this country. Crumb rubber modified in bitumen mixture is a rubber from waste tyres which is truck tyres, car tyres, motorcycle, bicycle or automotive tyres. The crumb rubber contains synthetic rubber, natural rubber, total rubber hydrocarbon and acetone extractable, which make a crumb rubber have high durability, viscosity, high softening point and better resilience. Moreover, it can also save the cost for the maintenance roadway pavement because ingredients in crumb rubber more benefits to solve the problem in term of cracking and can also solve the environmental problem from waste tyres.

The function of the crumb rubber is as additive modifier in bitumen mixture. Crumb rubber modified bitumen is a process to enhance the performance characteristic and life of pavement. A crumb rubber will prevent the pavement to crack in the cold or melt in the heat. Crumb rubber also has higher durability than virgin asphalt. Hence, crumb rubber will be used as additives in bitumen pavement. The potential of crumb rubber as additive in bitumen mixture will be tested in this study.

1.2 Problem Statement

Over the years, the increase of damage in roadways pavement in Malaysia has been become a serious issues. The increase demand on highway roads might be reduce its performance and pavement life. It is also can make roads more susceptible to permanent distresses and failure. In general, pavement performance properties are affected by bitumen binder properties which is known that the conventional bitumen has limited range rheological properties and durability that are not sufficient enough to resist pavement distresses (Mashaan *et al.*, 2013b). The cracking and failure of roadways can become worse because of climatic condition in Malaysia. Due to the change climatic condition, bitumen cannot withstand the weather change. The weather condition in Malaysia leads to variation of temperature of about 55°C at the surface to 25°C at the subgrade during hot days. Virgin bitumen 80/100 penetration grade is commonly used in Malaysia. In addition, bitumen is known as brittle and hard in cold environments and soft in hot environments. As a pavement material, it is characterized with a number of failures represented by the low temperature cracking, fatigue cracking, and the rutting (or permanent deformation) at high temperature, causing its quality and performance in pavement of roads to decrease (Sulyman *et al.*, 2014).

Due to an increase in service traffic density, axle loading, and low maintenance services, road structures have deteriorated and are therefore subjected to failure more rapidly (Shaw *et al.*, 2011). Besides that, a lot of maintenance work has to carry out because of to reduce the defect or cracking of the roadway pavement. This is because damage of roadways due to the increases of heavy traffic load in term of increasing road users in Malaysia. Other than issues about damage of the roadways, in Malaysia is also face the problem of waste material. The waste material issues need to be take serious because waste tire material are not easily to be disposed. It is thought that the application of recycled automobile tires and plastics will not only solve the environmental of these

industrial solid wastes problem but also act as very promising modifiers for the improvement of a bitumen pavement material (Sienkiewicz, 2012). Therefore, to overcome this problem that has been serious issue, the crumb rubber modified in bitumen mixture is suggested as one of the method could be able solved environmental problem and improve the performance roadways pavement.

1.3 Objectives of the Study

The main objective of this study is to investigate the characteristic of the crumb rubber as additive in bituminous mixture on pavement. The specific objectives for the study are:

- i. To determine the optimum crumb rubber content by substituting in the bitumen in Hot Mix Asphalt design (HMA).
- ii. To determine the air void content in bitumen mixture by different percentage of crumb rubber.

1.4 Scope of the Study

The crumb rubber modified bitumen was prepared in accordance with the ASTM or BS standard using Marshall Design Procedures. The sample of crumb rubber that was used in modifying bitumen mixture from the various type. There is truck tire, car tire, motorcycle tire and bicycle tire that are meet requirement according to the supplier. For each type of mixture, the numbers of samples prepared were divided into four categories where the percentages of crumb rubber modified bitumen used were varied from 1 to 3 percent by the total weight of bitumen. Besides that, the unmodified sample use 0 percent of crumb rubber and the range percentage of bitumen binder in each sample start from 4 to 6 percent. For the modified samples, we use 1 to 3 percent of crumb rubber, samples 1 added with 1 percent crumb rubber, sample 2 added with 2 percent crumb and sample 3 added with 3 percent crumb rubber in order to identify which mixture are meet the best performance. Crumb rubber was added in the mixture by using 'Wet Process' method where the process of mixing the crumb rubber with virgin bitumen and then mixing it with the aggregate and lastly formed into crumb rubber modified bitumen. Crumb rubber react as the additive to improve the properties of mixture. Wet process is used for bitumen modification.