CHAPTER 1

INTRODUCTION

1.1 Background

Many of research have been conducted to improving the quality of conventional asphalt. Recently, crumb rubber start to get more attention among the researchers as the modifier in order to improve the properties because of its promising a better performance in hot mix asphalt. Even though crumb rubber is one of the waste material, but it has potential to modify the conventional asphalt and overcome the structural damage in a form of rutting due to traffic loads. In Malaysia, the use of crumb rubber in pavement has been constructing but it’s still under observation compared to the other countries such as Europe and United State. In fact, at United State the recycling crumb rubber has been used as modifier since 40 years ago (Lo Presti, 2013).

Thus, to use the crumb rubber as a modifying agent in hot mix asphalt in Malaysia, the detail research needs to conduct. A details research need to conduct regarding to the using of crumb rubber as a modifier in terms of performance of hot mix asphalt according to Malaysia’s climatic condition. Therefore, the crumb rubber has been used to replace the fine aggregate in hot mix asphalt in this study to get a better performance. The properties of crumb rubber as fine aggregate in hot mix asphalt are expected to be determined throughout the test. Hence, crumb rubber could be a competent material in hot mix asphalt to improve the quality of road pavement compare to conventional pavement.

1.2 Problem statement

Nowadays, pavement problem is not a new issue to the highway engineers even though the pavement design life should be consider up to 10 years. The road damage becomes a critical due to some distresses like fatigue failure happen causes of the
repeated traffic movement occurs by the wheel track. In addition, the climatic condition also one of the factors that contributed on pavement damage because the climatic condition in Malaysia is hot and wet over the year. In general, road pavement distresses are related to asphalt binder (bitumen) and asphalt mixture properties. Rutting and fatigue cracking are among the major distresses that lead to permanent failure of the pavement surface (Mashaan et al., 2014). In order to improve the pavement problem, crumb rubber has been studying a few decades as a modifier in pavement mixes. Crumb rubber or waste tire is expected to overcome the pavement problem and it’s also helping to reduce the environmental pollution by recycling the dumpling tires at the landfill (Abdul Hassan, 2007).

The other concern is about the cost effectiveness of using the crumb rubber in pavement mixture. The cost of using crumb rubber in pavement mixture is still under observation, but the early cost has been expected increases 15 percent compared to conventional pavement. However, the cost can be economical because of the pavement life can be increased due to the use of crumb rubber (Ali, 2015). The effectiveness of using crumb rubber not only occurs in Malaysia but it’s also happens at developed countries such as United State because of lack of data regarding this crumb rubber in pavement mixture. Although many countries do a research about the usage of crumb rubber in hot mix asphalt, but the result is still difference. The difference result might be because of the difference devices used, climatic condition and size of the experimental conducted. Hence, the detailed study needs to be conducted to evaluate the performance of crumb rubber as a modifier in hot mix asphalt (Abdul Hassan, 2007).

1.3 Objective of Study

The main objectives in this study are to evaluate the performance of crumb rubber as fine aggregate in asphalt mixture. The focus of this study is on the following:

i. To determine the air void content in fine rubber particle in difference percentage.

ii. To evaluate the optimum fine rubber particle by replacing fine aggregate in hot mix asphalt in percentage.
1.4 Scope of Study

This study focuses on performance of crumb rubber as a modifier in hot mix asphalt. On this study each sample of hot mix asphalt was prepared based on Public Work Department (PWD) specifications using Marshall Design procedures after passing the entire characteristics test. The samples prepared were divided into 4 categories that is 0 to 3 percent of the weight of aggregate, so the numbers of samples are 36. All the samples must consists the per cent of crumb rubber as fine aggregates except the unmodified samples which is 0 per cent in order to find the suitable mixes that meet the better performance.

Crumb rubber was replaced the fine aggregate in a certain percentage in mixes by using Dry Process method according to the crumb rubber size, which is 0.3 mm. A dry process method where the rubber was replaced as part of the aggregate before it was blended with the asphalt. Even though the use of crumb rubber in this mixture was not going to replace all the aggregate, but it’s still improving the performance of the mixes. To evaluate the improvements of crumb rubber performance as additive in hot mix asphalt the laboratory test was performed on the mix design.

1.5 Importance of Study

This study is important to improve the pavement damage due to traffic loads and study also helps to manage the issues of environmental pollution among waste tire. According to the study, the result of properties can be obtained from the Marshall Stability Test. The Marshall Stability test should be conducted to know the best properties between the control samples and modify crumb rubber samples to get a better performance. Thus, if the addition of crumb rubber can affect the properties of hot mix asphalt, the optimum content of crumb rubber can improve the performance of hot mix asphalt was determined.

1.6 Limitation of Study

This study covers on the topic of modified hot mix asphalt (HMA) with crumb rubber using dry process. For this study the crumb rubber will be used to replace the fine aggregate in HMA mixes. The size of crumb rubber is 0.3 mm and for the samples only cover dense graded (AC14) because there are commonly used for pavement