

UNIVERSITI TEKNOLOGI MARA

**PERFORMANCE EVALUATION OF
RECLAIMED ASPHALT PAVEMENT
PROPORTION IN RECYCLED MIX**

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ABSTRACT

Malaysia spends a substantial amount of money in maintaining the road pavements. Adverse climatic conditions and high traffic volume loads are the major contributing factors for pavement distress and are hazardous to the road users. Asphalt overlay is the conventional technique used in pavement maintenance and rehabilitation. However, alternative technique is being developed to replace the increasingly high cost of asphalt overlays. Pavement recycling has the advantages in terms of reduced cost of the pavement maintenance and preservation of environment by reusing in-situ materials and avoiding disposal of waste. One of the recycling techniques that can be used is the Hot In-Place Recycling (HIPR) technique. The HIPR technique consists either mixing the existing pavement material with rejuvenating agent and/or the addition of virgin HMA to the material. This technique requires the addition of rejuvenating agent in the mixture to rejuvenate the existing aged binder in the RAP. This study was carried out to investigate the volumetric properties and performance of compacted recycled mixes using rejuvenating agent. The recycled mixes were designed using Type 1 (Specialty Mix 4 - Hot In-Place Recycling) gradation and the control mix used was the AC 14 dense graded Hot Mix Asphalt (HMA) designed in accordance with Section 4 of Public Works Department Malaysia's Standard Specification for Road Works. Marshall Mix Design Method was used to produce control mix samples (0% RAP) and all recycled mixes samples, which consists of 70% RAP, 80% RAP, 90% RAP and 100% RAP. In order to determine the optimum amount of rejuvenating agent to be added into the recycled mix, five different concentrations of rejuvenating agent were added ranging from 0.5 % to 1.7 % by weight of the mix at intervals of 0.3 %. The volumetric analysis was performed to ensure compliance with Marshall requirements. The resilient modulus test was performed to measure the stiffness of the mixes while the Modified Lottman test was conducted to evaluate the moisture susceptibility of these mixes. In addition, the Hamburg wheel tracking test was used to evaluate rutting performance of these mixes. The results obtained showed that there were no substantial differences in volumetric properties, stability values and stiffness properties between the control mix and recycled mixes. It can be concluded that recycled mixes performed as good as the performance of conventional Hot Mix Asphalt (HMA) in term of resilient modulus, moisture susceptibility and rutting. It is recommended that further research be carried out on actual pavement sections using the HIPR technique to ensure the technique is effective to be used for pavement maintenance and rehabilitation.

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TABLE OF CONTENTS

	Page
AUTHOR'S DECLARATION	ii
ABSTRACT	iii
ACKNOWLEDGEMENT	iv
TABLE OF CONTENTS	v
LIST OF TABLES	x
LIST OF FIGURES	xii
LIST OF ABBREVIATIONS	xv
CHAPTER ONE: INTRODUCTION	1
1.1 Background of Study	1
1.2 Problem Statement	3
1.3 Objectives	5
1.4 Scope and Limitation	5
1.5 Significance of Study	6
CHAPTER TWO: LITERATURE REVIEW	7
2.1 Introduction	7
2.2 Hot Mix Asphalt (HMA)	9
2.3 Pavement Distress	12
2.4 Pavement Rehabilitation	13
2.4.1 Pavement Maintenance	14
2.4.2 Pavement Resurfacing	14
2.4.3 Pavement Reconstruction	15
2.4.4 Pavement Recycling	16
2.5 Asphalt Pavement Recycling	16
2.5.1 Full Depth Reclamation (FDR)	19
2.5.2 Cold Mix Recycling (CMR)	20
2.5.3 Cold In-Place Recycling (CIPR)	20
2.5.4 Hot Mix Recycling (HMR)	21

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF STUDY

Road is the most important infrastructure that gives significant contribution to the nation's economic growth and brings important social benefits in Malaysia as it carries the highest percentage of transportation of passengers and goods. Increasing accessibility to road infrastructure facilities will dramatically increase in road users. Roads in Malaysia are mostly paved with flexible pavement compared to rigid pavement because flexible pavement is more comfortable to the road user. The initial construction cost for flexible pavement is cheaper than rigid pavement. Malaysian road network consists approximately 17,474 km of federal roads, 137,951 km of state roads that was maintained by Public Works Department and 1834 km of the toll expressways that was maintained by private highway concessionaires (Public Works Department, 2013). The total road length increased from 67,591 km in 2000 to 182,628 km in 2012. Under the Tenth Malaysia Plan, upgrading of roads and building new highways were given priority. The road network would be increased to more than 200,000 km by the end of the Tenth Malaysia Plan period (Economic Planning Unit, 2013). The federal road maintenance work estimated budget in Malaysia for 2014 and 2015 are RM 1.069 bilion and RM 610 million respectively (Ministry of Finance, 2014). The budget was allocated in upgrading and refurbishing the existing road infrastructure to meet rising demand and ensure smooth operation on the road network.

Hot Mix Asphalt (HMA) is a designed mixture of aggregate and asphalt binder considered as primary materials that can be used in specific paving applications such as roads, highways and bicycle lanes. Aggregate and asphalt are relatively cheap and abundant materials that exhibit properties such as elasticity, stability, durability and moisture resistance when combined effectively to make HMA pavements. It is important that these materials perform at the required levels to overcome the effects of traffic and environment. Furthermore, Malaysia is a country situated within the equator region with warm and humid weather where temperatures ranging from 21°C