CHARACTERISATION OF RECYCLED POLYETHYLENE TEREPHTHALATE AS PARTIAL FINE AGGREGATE REPLACEMENT PROPERTIES AND BEHAVIOUR OF ASPHALT MIXTURES FOR ROAD PAVEMENTS

Wan Mohd Nazmi Wan Abdul Rahman [1], Mohammad Affendy Omardin [2]

[1]Faculty of Civil Engineering and Earth Resources,
[2] Faculty of Engineering Technology,
.Universiti Malaysia Pahang (UMP), Lebuhraya Tun Razak, 26300 Gambang, Kuantan, Pahang, Malaysia

E-Mail: nazmi@ump.edu.my

ABSTRACT

The primany objective of this study is to evaluate optimum bitumen content and the characteristic of recycled polyethylene terephthalate (PET) as partial fine aggregate replacement in asphalt mixtures for road pavements by determining the rutting, fatigue and stiffness properties. The percentage of recycled PET replace fine aggregate in asphalt mixture start up 25% and bitumen content start from 4 to 6% of weight of asphalt mixture. The recycled plastic subsitute aggregate of sieve size aggregate between 3.36 and 1.18 mm content as follow with hot mix asphalt wearing course 14 (AC 14) in Standard Specification of Public Work Department (PWD) of Malaysia. The Indirect Tensile Stiffness Modulus Test (ITSM) was used to determine the optimum bitumen content of modified asphalt mixture and followed by the Repeated Load Axial Test (RLAT), and Indirect Tensile Fatigue Test (ITFT) both at 1800 cycles to investigate the rutting and fatigue properties of PET modified asphalt mixture consist of optimum bintumen content. The result shows the highest value stiffness modulus of 0% PET modified asphalt reach at 5.5% bitumen content. All the PET modified asphalt appears to be capable in resist rutting of road pavemet. Meanwhile 5% and 15% PET modified asphalt show more fatigue resistance than unmodified asphalt at 1800 cycles. In conclusion, the 5.5% bitumen content and additional 5% replacement aggregate of recycled PET plastic on asphalt mixture would enhance all engineering properties of asphalt mixture for road pavement

Keywords: Recycled Polyethylene Terephthalat • Modified Asphalt Mixture • Rutting • Fatigue •

INTRODUCTION

Durable and long lasting pavements are most desirable to improve good riding comfort, safe and low maintenance costs. Over the years, many studies have been conducted to enhance hot-mix asphalt (HMA) mixture design for better performing pavements. In contrast, improving asphalt mixture design alone is insufficient to guarantee a good quality pavement. Accurate and effective characterisation of pavement material is crucial to understand the behaviour or response of these asphalt mixtures under external stimuli of traffic loading as influenced by construction quality and environmental conditions (Juraidah, 2010).

According to the Waste and Resources Action Programme (WRAP) survey, most plastics collected for recycling from the household waste stream are plastic bottles. While there are many polymer types, the majority of bottles are made from either Polyethylene Terephthalate (PET) or High-Density Polyethylene (HDPE) material. They estimated that the ratio is 55-60% PET to 40-45% HDPE (WRAP, 2007).

Meanwhile, most of those recycled plastics come from industrial and commercial sources. Recycled plastics are mainly used in the form of street furniture, insulation, ducts, pipes etc. However it is not commonly used in pavement (WRAP, 2003; Huang et al., 2007). Waste re-cycling is especially important in dealing with certain waste materials like plastic bottles because their longer biodegradation period i.e. very harmful to the environment and ecosystem balance (Esmaeil et al., 2012). Thus, to decrease the negative impact of these plastics waste materials on environment and nature, it seems to be logical to propose ways to re-use waste materials of such kind in engineering and industrial construction and production projects such as road pavement (Fontes et al., 2010; Ismail et al., 2008). Plastic consumption in Malaysia has grown in recent years. These situation, increasing plastic consumption as well as consumption of other waste materials, have led to pressure on landfill sites to accommodate this waste.

The usage of waste PET granules pellet was conducted as a partial fine aggregate replacement in asphalt mixture. The size of this material is 3mm. The asphalt mixture was produced from 60/70 penetration grade bitumen and 12.5mm aggregate grading. The aggregate and bitumen were mixed between 140 and 180°C and then was compacted using Marshall Hammer with 50 blows on each side. By using Marshall Stability and Flow test, the result shows that the aggregate replacement of 20% fine aggregate (2.36-4.75mm) by volume with PET granulates (5% total weight of the asphalt mixture) was the effective use to get the highest