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Influence of Polypropylene Length on Stability and Flow of Fiber-reinforced Asphalt Mixtures

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Abstract

Engineers are constantly trying to improve the performance of the flexible pavements. The main surface distress types which cause maintenance and disruption are rutting and fatigue cracking. For solving these problems, many studies have been carried out until now, ranged from changing gradation to adding polymers and fibers to asphalt mixture. In this study, polypropylene additive was selected as fiber additive because of low costing and having good correlation with asphalt pavement. Three type of polypropylene additive in the length 6, 12 and 19 mm were selected and used at five different percentages in the asphalt concrete mixture. Asphalt specimens were analysed by Marshall Analysis and finally tested by Marshall Stability apparatus. Adding polypropylene increased Marshall Stability (38%), and decreased Flow (39%). These results show that polypropylene can be helpful for increasing pavement life.

Keywords: Polypropylene Fibers; Improvement; Marshall Stability; Flow.

1. Introduction

Scientists and engineers are constantly improving the performance of the flexible pavements. The cost of rehabilitation and maintenance of asphalt concrete pavement is one of the major problems because of improper mix design and/or using improper asphalt either in amount or quality. In order to ensure pavement long-term durability, thus minimizing maintenance cost and conserving resources, proper selection of paving materials together with optimal mix and pavement design are of great importance.

Two important distresses which cause spending for maintenance and rehabilitation are permanent deformation (rutting) and fatigue cracking. In both of them, the aggregate gradation and the percent of asphalt are playing important roles. For solving these problems different efforts have been done like changing gradation to the stone mastic asphalt (SMA) (gap gradation) concluded in higher rutting resistance in SMA compare to dense-graded wearing course mixture [1, 2], increasing coarse aggregate fracture faces showed an increase in rutting resistance, National Cooperative Highway Program 9-35 reports [2]. Changing aggregate gradation to coarser gradation, results in the lower rut problem [3, 14]. Increasing crushed coarse and fine aggregate fractures (instead of rounded aggregate like gravel) increase the shear resistance which result in higher resistance to rutting [5] and also increase Marshall Stability [6, 7]. Using cubical particles can increase internal friction which improves rutting resistance [7, 9, and 10]. Strategic Highway Research Program (SHRP) in summary report on permanent deformation in asphalt concrete indicates that shape of aggregate (rounded to angular) and size (increase in maximum size) will increase rutting resistance [8, 9]. As an utilizing additive for example using hydrated lime in many different studies has been performed like research of Burger & Huege which says that use of hydrated lime contributes to high performance asphalt pavement to mitigate moisture susceptibility, improving rut resistance and reducing fatigue cracking or The National Lime Association has confirmed using hydrated lime in asphalt mixture, make the pavement more resistant to rutting and fatigue cracking [11]. These distresses are common in many countries because of improper mix design and traffic loading and there are

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