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Fatigue Behavior of Warm Mix Asphalt vs. Hot Mix asphalt

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Abstract

By raising the costs of energy and crude oil, need to reduce costs is very vital. Warm-mix asphalt (WMA) technology allows decreasing the product temperature at which the material is mixed and placed on the road. Reduction of 20 to 50 degrees centigrade has been documented. The reduction in energy consumption is the most obvious benefit of WMA and consequently, reducing the production of CO_2 and other greenhouse gases. In addition, engineering benefits include improving working conditions for production and paving workers due to reduced fumes, emissions and odors, ability to haul longer distances to pave at lower temperature, and allowing longer paving season. All in all, Warm Mix Asphalt is an appropriate option when it is important to reduce the cost of asphalt production.

The long-term performance of pavement is associated with various factors such as pavement structure, materials, traffic loading, and environmental conditions. This study explores the utilization of the conventional fatigue analysis approach (*four-point* bending *beam fatigue testing*) to investigate the fatigue life of the WMA. The fatigue beams were made with two dense gradation with different nominal aggregate size, two WMA additives (RheoFalt ®and Sasobit®), and tested at 25 °C. A total of six mixtures were performed and 24 fatigue beams were tested in this study.

The test results indicated that not only WMA mixture reduced the mixing and compaction temperatures but also effectively extended the long-term performance of pavement when compared with conventional asphalt pavement.

Keywords: Warm Mix Asphalt, Initial flexural stiffness, Fatigue life, Sasobit, RheoFalt

1. INTRODUCTION

One of the most significant distress modes in flexible pavements is called alligator cracking (fatigue cracking) that correlated with repetitive traffic loading. Such cracking is directly related to various engineering properties. The most important factors are aggregate gradation, aggregate-binder interface properties, distribution of void size, and the interconnectivity of voids. As a result, the vast major of studies needs to be conducted to achieve fatigue property of asphalt mixtures.

The fracture resistance ability of an asphalt pavement under the repeated loading condition is vital for designing asphalt mixtures. Several studies have been conducted to predict the occurrence of fatigue damage and how to improve pavement life under repetitive traffic loading. As a result, this field of study is a challenging area in asphalt technology over worldwide, because new materials and additives with more complex properties are being used.

In order to lowering energy consumption and reducing emissions, the warm mix asphalt technology has been introduced in previous years. Based on WMA technology, the mixing and paving temperature has been reduced significantly by using different additives [1], [2]. Additives have been lowered viscosity of bitumen in order to achieve fully coating aggregate surfaces in lower temperatures compared with conventional HMA. Other advantages are the ability to place in lower temperature, haul the mix longer distance, have workability to place and compact, open to traffic in short period and also reducing in worker exposure [3].

Since the first warm asphalt field trail was conducted as recently as 1999, the long-term performance and aging characteristics of the WMA are not yet been identified clearly. One of the long-term performance characteristics for asphalt mixtures is fatigue life. Very few fatigue studies of warm asphalt mixtures have