LTRC RESEARCH PROJECT CAPSULE

OCTOBER 2008

09-1B

TECHNOLOGY TRANSFER PROGRAM

JUST THE FACTS

Start Date:
September 1, 2008

Duration:
10 months

End Date:
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Funding:
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SPECIAL POINTS OF INTEREST:

- Problem Addressed
- Objectives of Research
- Methodology Used
- Implementation Potential

Characterization of HMA Mixtures containing Recycled Asphalt Pavement Modified with Crumb Rubber Asphalt

PROBLEM

Asphalt cement prices, like gasoline and crude oil, are at an all time high with no relief in sight. With hot mix asphalt (HMA) mixtures' prices continuously climbing, highway agencies and owners are continually searching for methods to decrease material costs and maximize their benefits without compromising performance. One such method is to develop innovative technology to incorporate waste and recycled materials such as crumb rubber (CR) from waste tires and recycled asphalt pavement (RAP) in HMA mixtures. RAP is currently allowed for use in limited percentages within HMA layers. As HMA pavements age over time, the asphalt binders become hardened and oxidized causing premature cracking in pavements. Thus, the current limiting factor in increasing the percentages of RAP is the excessive stiffness of the resulting HMA mixture. Rejuvenating additives are often used as an additive in the virgin asphalt cement binder, which is used in the making of a HMA mixture, to soften the RAP asphalt cement binder materials. Therefore, the incorporation of these additives into the HMA mixture will enable the use of higher percentages of RAP in the finished product. The absorption properties of crumb rubber from waste tires may be used to carry those necessary additives to revitalize the properties of the aged binders in lieu of adding rejuvenating additives to the virgin asphalt cement binder. Research is needed to evaluate the performance of HMA mixtures containing crumb rubber with these additives.

OBJECTIVES

The main objective of this study is to characterize the laboratory performance of conventional HMA mixtures and mixtures containing high RAP content and waste tire crumb rubber/additives through their fundamental engineering properties. These mixtures can be used in either wearing or binder course layers.

The second objective is to characterize the laboratory performance of a HMA mixture containing 100 percent RAP and waste tire crumb rubber/additives. A candidate for this type mixture is an Asphalt Treated Base mixture.

METHODOLOGY

A limited comparative laboratory mechanistic performance evaluation of conventional HMA mixtures and mixtures that contain waste tire crumb rubber, additives, and RAP will be conducted. HMA mixture characterization in terms of fatigue cracking, moisture susceptibility, and rutting will be analyzed and evaluated to determine the effects of RAP, CR, and additives on the HMA mixtures' performance.

Superpave 19-mm nominal maximum aggregate size (NMAS) Level 2 HMA mixtures meeting Louisiana Department of Transportation and Development (LADOTD) specifications will be designed and examined in this study. HMA mixtures containing siliceous limestone aggregates, coarse natural sand, and RAP commonly used in Louisiana will be designed. A total of four mixtures will be examined and evaluated in this study. Two conventional mixtures commonly used in Louisiana, one with RAP and one without, each containing a Styrene Butadiene Styrene polymer-modified asphalt cement meeting Louisiana's specifications for performance grade (PG) 76-22M will be studied. The third mixture contains no RAP, 30

mesh CR, and additives blended (wet process) with a PG 64-22 asphalt cement binder, which yields a PG76-22. The last mixture contains a high RAP content (40 percent), 30 mesh CR, and additives blended (dry process) with a PG 64-22 asphalt cement binder. In addition, an asphalt treated base mixture utilizing 100 percent RAP, 30 mesh CR, and additives will be examined and characterized to determine its fundamental engineering properties. The CR and additives (dry process) will be introduced to the mixture at a rate of ten percent by total weight of binder. Mixture performance tests that will be conducted include:

- Simple Performance Tests (Dynamic Modulus, E*, and Flow Number, F_N)
- Semi-Circular Bend (SCB) test
- Dissipated Creep Strain Energy (DCSE) test
- Modified Lottman test

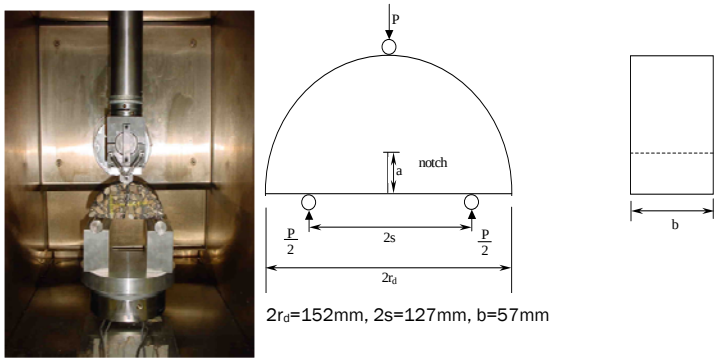

Figure of set-up of SCB test

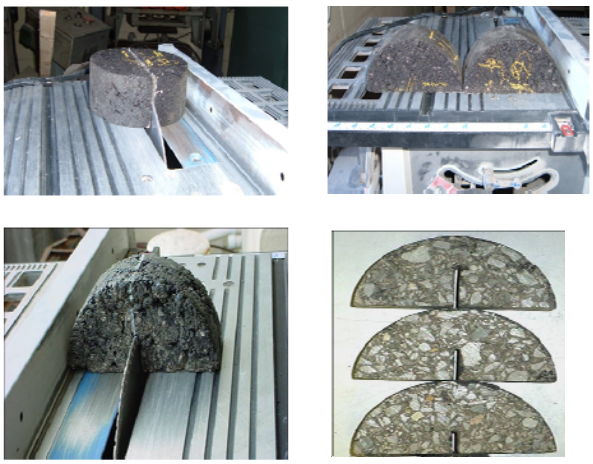

Figure of sample fabrication for SCB test

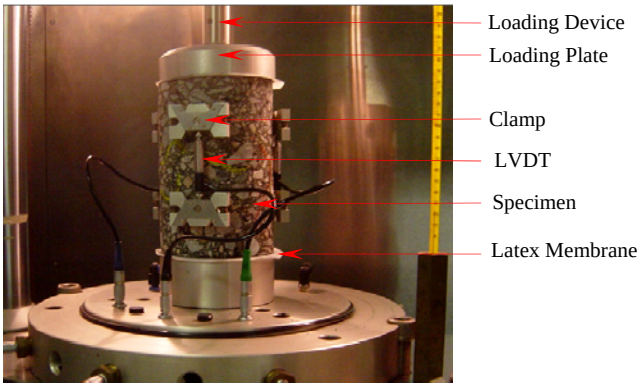

Figure of typical unconfined Dynamic Modulus Test setup

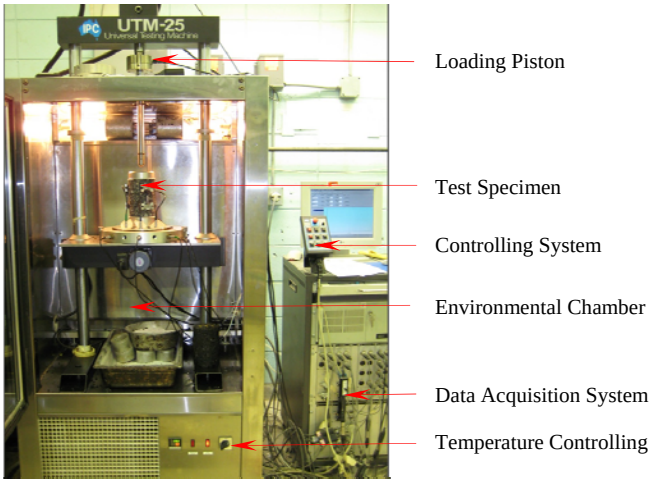

Figure of Universal Testing Machine (UTM) – 25 used for testing Dynamic Modulus

IMPLEMENTATION POTENTIAL

While this study is a limited comparative laboratory study using a single source for siliceous limestone, coarse sand, and RAP, the results of this study will lead into a larger research project that will examine and evaluate HMA mixtures that are designed using various coarse aggregates, coarse sand, RAP, and other asphalt cement binders to determine the effects of high RAP content, CR, and additives on the HMA mixtures' performance characteristics. The results of this study will possible lead to the development of a specification that will allow the use of high RAP content, rejuvenating additives and crumb rubber (added as a dry blend) into HMA mixtures. The use of these materials has the potential of reducing HMA material costs without sacrificing performance, while also maintaining environmental sustainability.

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For more information about LTRC's research program, please visit our Web site. ***www.ltrc.lsu.edu***