TECHSUMMARY August 2013

State Project No. 736-99-1358 / LTRC Project No. 05-1B

Evaluation of Superpave Mixtures Containing Hydrated Lime

INTRODUCTION

In the mid-1990s the Louisiana Department of Transportation and Development (LADOTD) revised its hot-mix asphalt (HMA) mixture specifications. Some of those major changes included requiring larger nominal maximum aggregate size in its aggregate structure and significantly reducing the amount of fine aggregates used in HMA mixtures. Later, in 2003, LADOTD implemented the Superpave mixture design method. Mixtures under the Superpave system are encouraged to use coarse gradations that pass below the maximum density line, which eventually led to a reduction in the amount of fine aggregate materials from the aggregate structure. This lower fine aggregate content in combination with relatively high in-place air voids and high Voids in Mineral Aggregate resulted in Superpave mixtures with high permeability, less resistance to age hardening, and poor rut resistance. The addition of quality filler materials can be a possible solution to rutting, fatigue cracking, and moisture damage in asphalt concrete mixtures.

This study evaluated the influence of hydrated lime on the fundamental engineering properties of HMA mixtures produced with the LADOTD Superpave specifications. In addition, the effects of the method (i.e., slurry or dry) in which hydrated lime was introduced to the HMA mixture were also evaluated.

OBJECTIVE

The primary objective of this study was to compare the fundamental engineering properties of HMA mixtures containing hydrated lime with the conventional mixtures designed to meet the Louisiana Superpave specifications. A secondary objective was to evaluate the influence of the method of the addition of hydrated lime on mechanical properties of the resulting HMA mixtures. The third objective was to compare the laboratory performance of hydrated lime treated mixtures containing a lower "high temperature PG graded" asphalt binder with the conventional mixtures containing a relatively higher "high temperature PG graded" asphalt binder.

SCOPE

This study investigated the effect of the addition of hydrated lime on the mechanistic properties of Superpave HMA mixtures. A suite of laboratory tests were conducted to evaluate the laboratory performance of both asphalt binders and HMA mixtures included in this study. Using a typical siliceous limestone aggregate and three different asphalt cements (a neat PG 64-22 and two SB polymer modified PG 70-22M and PG 76-22M), nine 19.0-mm Level 2 HMA mixtures were designed and examined. Among those nine mixtures, three were conventional mixtures, three mixtures were treated with a hydrated lime in paste (slurry) method, and the remaining three mixtures were treated with a hydrated lime in no-paste (dry) method.

METHODOLOGY

An experimental program was performed to investigate the potential benefits of hydrated lime to improve the permanent deformation and fatigue performance for the aforementioned HMA mixtures. Indirect tensile strength test (ITS), loaded wheel tracking (LWT), simple performance tests (dynamic modulus and flow number), semi circular bend test, and dissipated creep strain energy test were conducted. Triplicate samples were used for each test except for the LWT test where two specimens

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PRINCIPAL INVESTIGATOR:
Louay Mohammad, Ph.D.

LTRC CONTACT:
Bill King, P.E.
225-767-9129

Louisiana Transportation Research Center

4101 Gourrier Ave
Baton Rouge, LA 70808-4443

www.ltrc.lsu.edu

were tested. The dynamic modulus test was used to determine the permanent deformation and viscoelastic properties of the mixtures. Flow number tests were used to evaluate the permanent deformation of the mixtures. The indirect tensile strength test, semi circular bend test, and dissipated creep strain energy test were used to examine the fracture properties of asphalt mixtures. Also the LWT test was used to evaluate the rut and moisture susceptibility of the mixtures. The test results were statistically analyzed.

CONCLUSIONS

The following conclusions were drawn from this project:

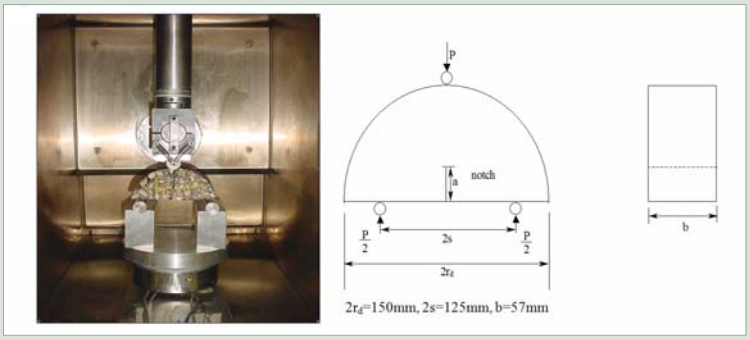
- In general, the addition of hydrated lime to mixtures containing PG 64-22 binder improved the rut resistance with slight improvement in fatigue endurance.
- The addition of hydrated lime to mixtures containing SB polymer modified asphalt PG 70-22M and 76-22M binder improved the rut resistance. However, there was decrease in the measured fatigue properties. It is noted that despite this decrease, these mixtures did meet the minimum required values for fracture resistant mixtures.
- No substantial difference in mixtures' fatigue or rutting laboratory performance was observed when hydrated lime was added either in paste or no-paste method to mixtures containing PG 64-22 binder. However, the paste method resulted in mixtures that performed better in rutting than the no-paste method when PG 70-22M or PG 76-22M was used; whereas, the fatigue resistance for both methods were similar.

RECOMMENDATIONS

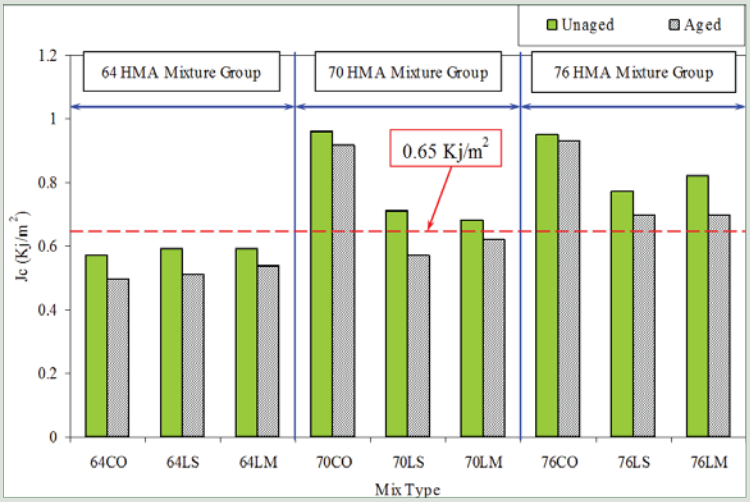
The use of hydrated lime in Hot-Mix Asphalt (HMA) mixtures can reduce permanent deformation, improve fatigue endurance, and reduce moisture sensitivity of asphalt concrete mixtures. In addition, hydrated lime increases the stiffness and fatigue resistance of mixtures. Therefore, based on the results of this study, specifications were developed and added to the LADOTD standard specifications for the HMA mixture and asphalt cement binder to allow the use of the hydrated lime in HMA mixtures. Hydrated lime treatment has shown promise to improve the permanent deformation characteristics HMA pavements. The use of hydrated lime in Louisiana's Superpave mixes should provide for a longer life expectancy of the completed roadway structure.

Specifically, it was recommended that the Louisiana specification for asphalt mixture section 502 be amended to state, "when adding hydrated lime in accordance with standard specifications 503.05 to mixtures containing PG 70-22M, the binder may be substituted for mixtures containing PG 76-22M." The new proposed specifications due for release in late 2013 will require additional LWT testing requirements.

It is further recommended that this specification be promulgated at first regionally to those production facilities that are capable of the addition of hydrated lime to allow for the validation of the laboratory test results obtained from this study.



Semi circular bend test setup and specimen configuration



Semi circular bend test tesults