RESEARCH
PROJECT CAPSULE [12-1B]
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TECHNOLOGY TRANSFER PROGRAM

Evaluation of Asphalt Mixtures Containing Recycled Asphalt Shingles

JUST THE FACTS:

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24 months

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POINTS OF INTEREST:

Problem Addressed / Objective of Research / Methodology Used Implementation Potential

PROBLEM

The price of crude oil has more than tripled compared to prices a decade ago. As the price of crude oil rises, the price of asphalt cement, like gasoline and other petroleum based products, has risen to an all-time high without any sign of relief in the near future. Consequently, the cost of asphalt mixtures has increased, forcing highway agencies and owners of roadways to continually search for methods to reduce material costs and maximize their benefits without compromising the performance of pavements. Materials recycling can not only reduce the cost, but also boost the sustainability of pavements by reducing the use of virgin resources and eliminating the need for landfill areas. One of the most recycled materials in pavements is Reclaimed Asphalt Pavement (RAP) because of its high compatibility to the newly produced asphalt mixtures. According to recent statistics reported during the 2011 Annual Meeting of National Asphalt Pavement Association, approximately 91% (or 75 million tons) of collected RAP in 2010 was recycled back into new pavement construction. In the meantime, Reclaimed Asphalt Shingles (RAS), defined by the American Association of State Highways and Transportation Officials (AASHTO) MP 15-09 "Standard Specification for Use of Reclaimed Asphalt Shingles as an Additive in Hot-Mix Asphalt (HMA)" as "any type of waste roofing asphalt shingles that have been processed into a recyclable product," have become another promising candidate for recycling, also because of the high compatibility with paving asphalt mixtures. A critical issue that directly affects the performance of asphalt mixtures containing RAP, RAS, or a combination of both relates to the level of blending that occurs between the aged and virgin asphalt binders. The level of blending not only affects asphalt mixture performance; it also affects the economic competitiveness of the recycling process. Depending on the level of blending that occurs between the aged and virgin asphalt, the result can include increased stiffness, brittleness, and viscosity of the binder and decreased adhesive quality and ductility. To minimize the effects, it is necessary to restore the desirable rheological properties of hardened, recycled binder by incorporating a recycling agent or soft asphalt binder. With no previous experience in Louisiana, a pioneering research effort is necessary to determine any potential issues and benefits associated with this emerging green technology. Furthermore, establishing a reliable standard practice of incorporating RAS and any recycling into asphalt mixtures through research will benefit highway agencies and owners for quicker and safer implementation of this product.

OBJECTIVE

The primary objective of this study is to fundamentally characterize the laboratory performance of asphalt mixtures containing RAS and/or RAP with and without recycling agents as compared to similar asphalt mixtures containing no RAP and/or RAS. Specific objectives are to: ascertain the rheological properties of virgin asphalt cement, extracted asphalt cement from RAS and RAP, and extracted asphalt binders from asphalt mixtures containing recycled materials; characterize the physical and rheological properties of recycling agents; determine the physical properties of RAS and RAP (i.e., specific gravity, gradation, asphalt content); evaluate the high, intermediate, and low temperature performance of asphalt mixtures containing RAP and RAS with and without recycling agents; evaluate the moisture susceptibility of asphalt mixtures containing RAP and RAS with and without recycling agent; determine an appropriate practice of incorporating RAS

and any necessary additives with asphalt mixtures; ascertain the level of RAS content that can be used in asphalt mixtures; and establish general guidelines of optimum RAS content in asphalt mixture that can be used to yield similar performance to asphalt mixtures containing no RAS.

In this proposed study, a 12.5-mm Nominal Maximum Aggregate Size (NMAS) mixture conforming to the Louisiana Superpave Level 2 asphalt mixture specification will be used. The Superpave Level 2 asphalt mixture will serve as the control mixture. In addition, several mixtures with varying percentages of RAP and RAS with and without recycling agents will also be considered. The selection of recycling agents will be based on the literature search and manufacturer's recommendation. It is anticipated that the recycling agent type may be an aromatic extract, naphthenic oil, vegetable derived oils, and/or an asphalt flux oil. A Superpave PG70-22M asphalt binder grade will be targeted as the terminal asphalt grade after mixing with recycled materials and recycling agents. A suite of mechanical tests will be performed to identify the effects of RAS, RAP, and recycling agents on the structural performances of these mixtures in terms of moisture susceptibility, low temperature cracking, fatigue cracking, and permanent deformation.

METHODOLOGY

The proposed study will be conducted according to the following tasks: conduct literature review; conduct laboratory experiments; perform data analysis; prepare standard practice document for the use of RAS in asphalt mixtures; and prepare draft final report.

IMPLEMENTATION POTENTIAL

Results of this proposed study will provide substantial laboratory performance data of RAS contained asphalt mixtures, which are essential to create guidelines for incorporating RAS into asphalt mixtures without compromising the ultimate performance of produced mixtures.

Samples of asphalt mixtures