

NEW ENGLAND TRANSPORTATION CONSORTIUM

2019 RESEARCH PROBLEM STATEMENT SOLICITATION

Submit Research Problem Statements to: MassDOT Research Section
[Nicholas Zavolas, Nicholas.Zavolas@state.ma.us] by January 18, 2019

I. PROBLEM TITLE

Characterizing Asphalt Binders with Warm Mix Asphalt Technologies for use in New England

II. RESEARCH PROBLEM STATEMENT

Some New England states have used Warm Mix Asphalt (WMA) additives in paving mixtures since 2005. WMA additives allow for the production and placement of asphalt mixtures at much lower temperatures than a conventional Hot Mix Asphalt (HMA). These lower temperatures are achieved by various WMA technologies including organic (wax-based) additives, foaming agents, and chemical additives.

There are numerous benefits for the low temperatures associated with WMA such as: lowered emissions in the plant and field, extension of the construction season into colder weather, better conditions for the health of the people in the field, and energy savings in producing the mixture. Due to the lower production/placement temperatures, it has been documented in the literature that such mixtures should have better fatigue life (cracking). Furthermore, WMA additives help improve the workability of asphalt mixtures. However, the literature has also suggested that WMA mixtures perform poorly in terms of moisture damage tests conducted in the laboratory.

The purpose of this study is to evaluate the effect of the WMA additives being used in the New England states on overall asphalt binder performance. Neat asphalt binders used in New England are now being formulated to meet specific performance grades (PG) through a variety of different processes. Not all asphalt binders with the same PG grade will perform the same due to these differences in formulation, thus adding another variable like a WMA technology may also have a significant effect on overall asphalt binder performance. Testing and evaluation is needed to better understand the effect of WMA on the asphalt binders used in New England in terms of fatigue, moisture damage and adhesion performance at a minimum.

III. RESEARCH OBJECTIVES

- 1. Identify the WMA additives previously utilized for New England paving projects. The NEAUPG Qualified Warm Mix Asphalt (WMA) Technologies should be used as a starting point. Also identify the WMA additives of interest for future New England paving projects*
- 2. Identify potential asphalt binder tests to measure the performance of an asphalt binder with WMA in terms of fatigue, moisture damage and adhesion at a minimum. Other tests may be identified which are necessary to evaluate the performance of the WMA additive in an asphalt binder.*
- 3. Obtain typical PG binders specified for New England paving projects.*

Who Directs Submitter?

4. Research/document proper dosage and method of incorporation for each type of WMA identified in 1 and 2.
5. Prepare binder samples incorporating each WMA at the appropriate dosage and using the appropriate method.
6. Perform asphalt binder performance testing on the prepared samples. The Lubricity Test (workability), Linear Amplitude Sweep per AASHTO TP 101 (fatigue), Multiple Stress Creep Recovery (rutting) and Asphalt Bond Strength test per AASHTO T361 (adhesion) have been identified as preliminary performance tests for consideration.
7. Document and identify the performance of each binder incorporating WMA.
8. Suggest criteria for selecting the WMA additives utilizing the aforementioned tests. Provide suggestions to revise the paving specifications and WMA qualification process.

IV. COST ESTIMATE

\$250,000

V. RESEARCH PERIOD

24 Months

VI. URGENCY AND PAYOFF POTENTIAL

WMA technologies are currently being utilized in New England with a rather limited history of field performance, as the first trial projects were placed around 2005. The NEAUPG Qualified Warm Mix Asphalt (WMA) Technologies list currently has twenty different WMA technologies that are approved for use. More research is needed to understand the potential performance implications of using these technologies with the asphalt binders currently being specified. These "neat" binders themselves are being modified in a variety of ways to meet specific performance grades, thus it is unknown how adding another technology like WMA will affect the overall performance of the binder. This gap in knowledge needs to be addressed when qualifying WMA technologies.

It is anticipated that the research will provide a current state-of-practice regarding the WMA additives being used in New England including dosage rates and methods of incorporation. Moreover, the study will document the findings of the testing and suggest/recommended criteria for properly selecting the WMA additives to ensure and maximize performance. These criteria may then be utilized by the New England DOTs in their specifications for use in future paving projects. Additionally, these criteria may aid in refining/expanding the process for qualifying WMA technologies on the NEAUPG list.

VII. PRELIMINARY LITERATURE SEARCH

Moisture Damage Characterization of Warm Mix Asphalt Mixtures. Journal of the Association of Asphalt Paving Technologists (AAPT), Vol. 80, 2011, pg. 491-526.

This was a two-part study. The goal of the first part was to undertake an internet survey of materials and construction engineers in each of the fifty state Department of Transportation (DOT) agencies to ascertain if moisture damage related distresses have materialized in WMA field projects placed in the United States. In the second part of the study, laboratory measurements of the resistance of various WMA mixtures to moisture damage were conducted. Moisture susceptibility was evaluated utilizing the Hamburg

Wheel Tracking Device (HWTD); E stiffness ratio (ESR); adhesive bond energy based on surface energy measurements of asphalt binders and aggregates; and fracture characteristics of the mixtures tested under dry and wet conditions. The report focused on evaluating WMA mixtures with respect to moisture damage and not the impact of WMA technologies on asphalt binder properties which is the goal of this study.*

NCHRP Report 691: Mix Design Practices for Warm Mix Asphalt

The objective of this project was to develop a mix design method for WMA in the form of a draft AASHTO recommended practice for use by engineers and technicians in the public and private sectors. This method was (1) to be based on Superpave mix design methodology, (2) to include a suite of performance tests to assess whether a WMA mix design will provide satisfactory field service, and (3) to be applicable to any WMA technology used to lower mixing and compaction temperatures. The report focused on WMA mixture design and not the impact of WMA technologies on asphalt binder properties which is the goal of this study.

Evaluation Ohio Field Trial of Warm Mix Asphalt Technologies: Construction Summary. NCAT Report No. 09-04, Auburn University, Auburn AL, September 2009

The main purpose of this study was to evaluate the field performance of three different WMA technologies. The WMA processes were introduced into existing HMA designs. WMA sections were constructed on in-service roadways along with HMA control sections. Field mixed, laboratory compacted volumetric properties, laboratory performance tests, and field performance data are reported. In addition, the Ohio Department of Transportation (DOT) and asphalt contractors wanted to assess the potential of WMA to reduce the asphalt fumes emitted at both the plant and paving site, reduce the energy consumption at the plant, extend the paving season, and increase the potential haul distance. The report focused on WMA mixture design and testing and not the impact of WMA technologies on asphalt binder properties which is the goal of this study.

VIII. RESEARCH KEY WORDS

Warm Mix Asphalt, WMA Dosage Rates, Binder Performance Testing

TWO DOT ENDORSEMENTS ARE REQUIRED (To be signed by separate individuals.)

IX. ENDORSEMENT BY THE SPONSORING DOT (To be signed by the DOT representative to the NETC Advisory Committee through whom the Problem Statement is submitted.)

By signing the endorsement, the DOT representative is certifying that:

- 1. The Problem Statement follows the required format.*
- 2. The required literature search has been conducted.*
- 3. The Problem Statement addresses a transportation issue of relevance to NETC and does not duplicate another Problem Statement being submitted at this time.*

Nicholas Zavolas
Name

ReCAPIT
DOT

nicholas.zavolas@state.ma.us
Email

857-368-8856
Tel.

[Signature]
Signature

1/25/19
Date

- X. **ENDORSEMENT BY A SECOND EMPLOYEE OF THE SPONSORING DOT**
who agrees to chair the project's technical advisory committee (TAC) if the Problem Statement is selected for funding. (To be signed by a DOT staff person who has technical knowledge of the project topic and is committed to the research outcome.)

DOT Technical Endorsement: *I agree to chair the project's Technical Advisory Committee if this Problem Statement is selected for funding by NETC.*

Bryan Engstrom
Name

MassDOT
DOT

bryan.engstrom@dot.state.ma.us
Email

857-368-3456
Tel.

[Signature]
Signature

1/24/19
Date