Ohio’s Research Initiative for Locals
Request for Proposals

RFP Solicitation Number: 2019-ORIL1

Research Title: Analysis of Aramid Synthetic Fibers in Asphalt Mixes on Local Roads

Problem Statement
Local and state entities pay a premium price for polymer-modified asphalt cement (AC) designed to enhance performance with regards to rutting and crack resistance. The polymer-modified AC is used in high-traffic areas that experience heavy traffic loads. The polymer-modified AC can only be placed when ambient and surface temperatures are above 50° F. These temperature restrictions limit the time asphalt can be placed during the asphalt construction season resulting in an increased unpredictability to construction schedules, which can result in additional costs to bid items associated with polymer-modified asphalt placement.

When resurfacing pavements, some local transportation agencies will place a stress absorbing membrane interlayer (SAMI) between the distressed pavements and a hot mix overlay to seal existing cracks and slow reflective cracking. This results in additional costs and lengthens the duration of the project as it requires more time for application and curing.

Over the years, advances in technology have produced new materials that may have beneficial applications to the transportation industry. One of those is aramid fibers, a heat-resistant, strong synthetic fiber. Claims have been made that incorporating aramid fibers into asphalt mixes can enhance the performance of the asphalt and eliminate the need for a SAMI. Over the past three years, one Ohio city has spent an average of $857,000 annually on SAMI applications in their resurfacing program. It has been estimated that an alternative to SAMI, such as aramid fiber-reinforced asphalt, could potentially save the city approximately $675,000 annually. However, limited information is available on the actual performance of aramid fiber-reinforced asphalt on local roadways. Research that evaluates the effective use of aramid synthetic fibers in asphalt mixes on local roadways is needed.

Goals and Objective
The primary goal of this research is to compare the performance of polymer-modified asphalt mixes to non-polymer-modified aramid fiber-reinforced asphalt mixes for resurfacing applications to control rutting and cracking. The secondary goal of this research is to compare the performance of non-polymer-modified fiber-reinforced asphalt mixes without the use of SAMI to non-fiber-reinforced mixes (both polymer-modified and non-polymer-modified) with the use of SAMI to control reflective cracking. The objective is to identify the optimal aramid fiber dosage and mix design methodology for utilizing non-polymer-modified fiber-reinforced asphalt that reduces cracking and rutting on local roadways.

Proposed Research
This research is expected to include (at a minimum) the activities listed below. Additional activities may be included at the researcher’s discretion in order to achieve the stated goals and objective of the study. This research will be performed in two phases. Researchers are expected to submit proposals inclusive of both phases.

Phase 1 is to be comprised of a feasibility study of aramid fibers in asphalt mixes on municipal and county roadways. At a minimum, the analysis should include the following:

- A comprehensive literature review of active and completed aramid fiber research and advancements in technology. The literature review should include information on other pertinent fibers that have been utilized with the intent to reduce cracking and rutting on roadways.
- Develop a laboratory testing protocol for evaluating the performance of aramid fiber reinforced asphalt mixes versus non-aramid fiber reinforced asphalt mixes. The mix designs to be utilized for initial laboratory testing shall be Marshall Mix designs using the following proposed binder grades: PG58-28, PG64-22 and PG70-22M. Key elements of performance testing must include rutting and crack resistance.
  - Laboratory testing protocol and findings from the literature review must be presented to the TAC for approval by no later than two months following the project start date. Initial laboratory testing
shall not begin until the protocol has been approved by the TAC.

- The City of Columbus currently has a test site, constructed in 2016, that includes one lane resurfaced with a fiber-reinforced PG70-22M asphalt mix without SAMI and one lane resurfaced with a non-fiber-reinforced PG70-22M asphalt mix with the use of SAMI. Data and access to these locations can be made available to the selected researcher for inclusion into the study as appropriate.
  
  - Perform a projected life-cycle cost-benefit analysis of tested mixes and pavement resurfacing treatment combinations and compare results to that of conventional pavement resurfacing treatments and mixes mentioned above. Benefit is to be identified in terms of the cracking and rutting control observed in each of the treatments. Include comparably aged asphalt in the life cycle cost analysis.

- Design a study for in-field evaluation and laboratory testing of field and plant samples of proposed mixes and pavement resurfacing treatment combinations. It is intended that field sites may be located within the Cities of Columbus and Kettering (specific sites yet to be determined) during Phase 2. Therefore, the researcher may conduct laboratory testing as necessary to develop/verify mix design parameters for inclusion in project bid documents. The identified mixes proposed for field testing are expected to be incorporated into the 2019 resurfacing programs for the Cities of Columbus and Kettering. In order to be included in the 2019 resurfacing program, all information necessary for inclusion in bid documents must be finalized by **March 2019**. This date should be taken into consideration as proposals and subsequent laboratory testing protocols are developed.

An interim report based on Phase 1 analysis must be submitted within **8 months of the project start date**. The interim report will be a comprehensive accounting of all research activities to date and include the recommendations for Phase 2 field analysis. Based on a review of the findings and life-cycle cost-benefit analysis, the TAC will make a recommendation on whether or not to pursue Phase 2. If Phase 2 is not authorized, the interim report will be treated as the draft final report and the project finalized. The researcher will receive instructions concerning the delivery of all other pertinent deliverables. If Phase 2 is authorized, the interim report will serve as the basis for the final report to be presented at the conclusion of Phase 2. Note that Phase 2 is also contingent upon securing a suitable local site for field testing.

**Phase 2** is to be comprised of construction, evaluation of the mixes and pavement resurfacing treatment combinations identified in Phase 1, along with laboratory testing of field and plant samples. The researcher will be required to coordinate with city personnel and construction contractors to provide clarification during the bid process and oversight in the design and build of the test sections. The researcher will observe and document the construction of the test sites. The researcher will not be required to construct the physical test section as this will be handled by the selected municipality. Therefore, costs associated with construction should not be included in the proposal.

The researcher will develop a methodology for ongoing data collection and testing in order to confirm/validate the performance of the mix and pavement resurfacing treatment combinations. This methodology is expected to be performed by city personnel; therefore the researcher should take into consideration available resources during the design of the methodology. Currently, basic asphalt testing, such as binder content, gradation, compaction density, specific gravity/air voids, and indirect tensile strength are performed by the city. The methodology should include a recommended timeline for data collection and testing as well as a process for performing a life-cycle cost analysis of the test section. The researcher must provide training for city personnel on the methodology.

The researcher will be expected to perform base-line testing of the test sections on behalf of the city.

The researcher will prepare a final report on all aspects of Phase 1 and Phase 2.

**Requirements of the Research Team:**
Due to the nature of this study, the proposed research team must include individual(s) experienced in the design and testing of asphalt mixtures. Previous experience in asphalt concrete research for transportation applications is preferred. The proposal must demonstrate that this requirement is met in the “Qualifications of the Research Team” section as well as in the attached resumes. Contracting requirements of the State of Ohio require the inclusion of an Ohio-based entity on the research team.

**Assistance from Locals**
During the course of this research, the researcher can expect to receive the following assistance from the Technical
Advisory Committee:
- Technical direction
- Review of reports
- Existing data and access to existing test sites containing fibers/SAMI applications as well as various PG mix designs referenced in the Proposed Research Section (as available)
- Participation in meetings
- Site selection for Phase 2 (if authorized)
- Assistance with coordination efforts with construction contractors for Phase 2 (if authorized)
- Coordination of staff for training in Phase 2 (if authorized)

**Project Specific Deliverables**
The researcher must provide the following deliverables (electronically) for **Phase 1** within 8 months of the contract start date:
1. Summary of findings from the literature review and a laboratory testing protocol within 2 months of the contract start date
2. Interim report documenting findings and statistical analysis of the initial laboratory testing
3. Testing protocol for Phase 2

The researcher must provide the following deliverables for **Phase 2** by the completion date of the project:
1. Methodology for ongoing data collection and testing
2. Training of city personnel
3. Baseline data
4. Statistical analysis of the laboratory testing of the field and plant samples

**Research Contract Deliverables**
In addition to the project specific deliverables, the researcher must also provide the following standard deliverables by the completion date of the project:
1. Quarterly progress reports (provided electronically).
2. Electronic copies (MS DOC) of the draft final report and draft executive summary shall be submitted 120 days prior to the contract completion date.
3. Electronic copies (PDF and MS DOC versions) of an approved final report and an approved fact sheet shall be submitted by the contract completion date.
4. Article for the Research newsletter (to be provided upon request).
5. Participation in the following meetings: project start-up, research review session (1 per year), and research results presentation.

**Benefits**
The results of this research will provide local officials with enhanced knowledge along with a laboratory and field-validated assessment of aramid fibers in asphalt mixes. The findings of this research will either validate or disprove the perception that the use of these fibers enhances the performance of the asphalt and reduces or eliminates the need for SAMI applications. This not only provides an opportunity for cost savings, but the identification of a mixture that permits construction at lower ambient/surface temperatures which could also extend the paving season. This information will be of assistance to local decision makers in managing budgets, scheduling projects, and determining the proper utilization of fibers on their prospective projects.

**Potential Application of Research Results**
The findings of this research will be of interest to municipalities, townships and counties within Ohio as well as other states and localities nationwide. Results from this research may be used to justify modifications to paving specifications. Actual implementation of findings will be at the discretion of each Local Public Agency.

**Preliminary Literature Search Results**
A preliminary literature search identified numerous publications pertaining to this topic. Based on a review of the literature, the majority of these studies focus on applications on interstates and highways as opposed to local roadways. A summary of the literature identified is provided below. Researchers are expected to perform a more in-depth literature search to ensure this research does not duplicate existing efforts.

Fiber-Reinforced Hot-Mix Asphalt: Idaho Case Study

**Effect of Polymer Fibers Reinforcement on Selected Properties of Asphalt Mixtures**  

**Fiber Reinforcing Effect on Asphalt Binder under Low Temperature**  

**Duration**  
Total duration of the project is 24 months. Phase 1 analysis and report must be completed within 8 months of the project start date. Draft final report for Phase 2 (if authorized) will be due within 20 months of the contract start date.