

**ARKANSAS DEPARTMENT OF TRANSPORTATION
SYSTEM INFORMATION AND RESEARCH DIVISION
FISCAL YEAR 2021
REQUEST FOR PROPOSAL
RESEARCH PROJECT NO. TRC2102**

TITLE: Effect of Aggregate-Binder Compatibility on Performance of Asphalt Mixtures in Arkansas

ARDOT POLICY

All proposals shall be submitted electronically per the Proposal section of this Request for Proposal. As of Fiscal Year 2020, all research project contracts will be managed under Info Tech's Doc Express Paperless Contracting platform. All information on the utilization of this platform for research projects can be found at

http://www.ardot.gov/System_Info_and_Research/research.aspx or from the Research Section.

PROBLEM STATEMENT

In recent years, there have been some problems with the use of certain aggregates around the State of Arkansas (e.g., some sources of the northeast and west-central Arkansas aggregates) for asphalt mixtures that caused serious durability and performance issues. In particular, aggregates from some quarries are suspected to be problematic and non-compatible with some asphalt products, including surface asphalt concrete hot-mix (ACHM) that presumably associated with either chemical or bonding compatibility between aggregate and binder. In practice, aggregates are used in asphalt mixture production without knowing their compatibility with asphalt binders, and some aggregates (e.g., sandstone or granite) are highly prone to stripping that can cause significant moisture damage issues (e.g., potholes, moisture-induced interlayer failures, premature cracking, etc.) in the field. Also, the excessive amount of highly absorptive aggregates (e.g., sandstone or novaculite) can potentially result in dry or brittle mixtures that can cause constructability and durability issues such as difficulty in obtaining specified compaction, early oxidation, premature cracking, and stripping.

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These aggregate compatibility and durability related issues can be mitigated by using appropriate asphalt binders in consideration of its chemical properties (e.g., acidic or basic) determined based on crude sources. Acidic aggregate, for example, granite or gravel, is usually more prone to strip than basic aggregate such as limestone. Particular chemical polar compounds of asphalt binder are absorbed by aggregates, and the absorption is aggregate dependent. Some of these polar materials are desorbed by water more easily than others depending on the specific aggregate-binder combination. Therefore, there is a need to investigate the effect of aggregate-binder compatibility on change in durability and performance characteristics of asphalt mixtures in the field based on the comprehensive evaluations that consider multiple factors involved, including a range of aggregate and binder types used in Arkansas. The evaluations will incorporate the effects of anti-stripping agents, air voids, recycled asphalt pavement (RAP), etc., in conjunction with the aggregate-binder compatibility.

AREA OF STUDY

The primary objective of this study is to develop a draft specification including the implementable test protocols that ensure the use of durable and compatible aggregate-binder systems in the mix design phase for enhanced mixture performance in the field. This study requires comprehensive evaluations that take into account multiple critical factors involved, including a range of aggregate and binder types used in Arkansas.

METHOD OF STUDY

The project will include but is not limited to the following tasks that ensure the research objectives are met:

1. Conduct a literature review of ongoing and previous research related to the effect of aggregate-binder compatibility on durability and performance of asphalt mixtures. The review should include a variety of state, national, and international

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- level laboratory and field studies, which help provide a better understanding of the problems and the significance of research needs.
2. Evaluate physical and mechanical properties (e.g., absorption, durability, etc.) of aggregates (e.g., sandstone, limestone, granite, etc.) and their compatibility (chemical/bonding) with asphalt binders from different binder sources used in Arkansas.
 3. Investigate the durability and performance of asphalt mixtures containing different aggregate-binder combinations based on the laboratory mixture performance tests (e.g., APA, IDEAL-CT, moisture susceptibility, etc.) and field performance evaluations. Also, the evaluation will take into account the effects of other factors involved, including anti-stripping agents, air voids, RAP, etc., in conjunction with the aggregate-binder compatibility.
 4. Develop a draft specification including the implementable test protocols and a database of durable and compatible aggregate-binder systems for asphalt mixtures used in Arkansas.

BENEFITS

A detailed cost-benefit analysis shall be included in the proposal. The analysis must include but is not limited to the following:

1. Detailed cost analysis on savings to the Department with full implementation of the projects findings.
2. Any anticipated benefit not foreseen as a cost savings.

TIME AND FUNDING OF STUDY

Work will begin no earlier than July 1, 2020, contingent upon acceptance of the proposal and availability of research funds. The length of the project shall be 24 months. A final report is to be drafted and presented to the Research Subcommittee no later than the last day of the project. Up to 25% of the estimated project costs will be

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withheld pending final acceptance of the final report. Failure to deliver the required Final Report at the end of the project will result in the cancellation of the project and 25% of the total project cost will be retained by the Department.

REPORTS

All reports must be in accordance with the 2019 Research Manual (available at http://www.ardot.gov/System_Info_and_Research/research.aspx or from the Research Section). All reports are required to be submitted through the appropriate Doc Express process. An Implementation Report which details the recommended means/techniques for using the project results shall be submitted to the Department six (6) months prior to the research project's Final Report. All Final Reports are required to be reviewed by a technical editor before submission to the Department. An oral report to the Transportation Research Committee may be required. In addition to reports and publications, the Department shall be furnished one (1) copy of any master's thesis or doctoral dissertation which is a result of any investigation or study on this project. The submitting of any report to be published by an outside publication or presentation on this project before its completion; shall be submitted for the Department's approval before submission.

PROJECT DELIVERABLES

The proposed research will provide ARDOT with the project deliverables that will include, but are not limited to:

1. A draft literature review submitted three (3) months following the initiation of the project.
2. Quarterly progress reports, benchmark reports, and implementation report.
3. A final report outlining the results of the study.
4. A draft specification including the implementable test protocols to provide guidance to ARDOT and contractors that ensure the use of durable and compatible

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aggregate-binder systems in the mix design phase for enhanced mixture performance in the field.

5. A database of durable and compatible aggregate-binder systems for asphalt mixtures used in Arkansas that will lead to cost savings due to increased longevity and constructability and reduced premature failures.
6. Recommendations for changes in applicable sections of the ARDOT Standard Specifications for Highway Construction.
7. An implementation plan that shows ARDOT how to incorporate the results of this study into the current specification being used by the Department. Make sure that an implementation plan with a methodology on determining benefit-cost associated with future use of the project deliverables is included.

AUTHORIZATION TO BEGIN WORK

A letter separate from the contracting documents authorizing the beginning of work will be transmitted through Doc Express initiating the project. Any cost incurred before the authorization letter is received, will not be eligible for reimbursement. The project will begin work no earlier than July 1, 2020.

EQUIPMENT

A complete physical verification of all software and equipment purchased or built for use on this project and the actual location of the equipment will be made each year. An Equipment Capitalization Notice is available from the Research Section for the reporting of software or equipment purchased during the project. All software developed on the project will be completed in open source format and ARDOT shall be provided a copy of the source code. If non-expendable or special equipment is purchased with project funds, the equipment is owned by ARDOT and disposition of the equipment will be determined by ARDOT at the project's closeout session.

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All rental rates shall be approved by ARDOT before the approval of the proposals. Should a subcontract be part of the proposal, ARDOT will not approve the purchase of any equipment in the subcontract. Any equipment purchased through ARDOT's Transportation-Related Research Grant Program is not eligible for rental rate charges.

All equipment shall be purchased in accordance with the State of Arkansas purchasing laws.

PROPOSALS

Proposals shall be submitted in two separate electronic formats, a word document and a pdf, to Research@ardot.gov no later than the end of business on April 3, 2020. This is a firm deadline. All procedures shall be in accordance with the 2019 Research Manual and Federal Aid Policy Guide (FAPG). In the event of policy contradiction, the FAPG shall govern.

Upon approval of the electronic version of the Proposal by the Research Subcommittee the Project Manager will initiate the process within Doc Express to acquire the appropriate electronic signatures from all parties.