

Assessment of Compatibility of Mineral Aggregates and Binders Used in Highway Construction and Maintenance Projects

Project Number:
19BASU02

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Lead Institution:
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Funds Requested to UTC:
\$51,000

Funding Source(s):
Tran-SET
Arkansas State University
Atlas Asphalt

Total Project Cost:
\$102,013

Developing a database for compatible aggregate and binder systems with the aim to reduce the cost of asphalt pavement construction

The Arkansas Department of Transportation (ARDOT) has raised some issues with the use of certain aggregates in asphalt concrete projects (both new and maintenance) as these aggregates pose some serious durability and performance issues. In particular, aggregates originating from some quarries are suspected to be problematic and non-compatible with some asphalt products (e.g., hot mix asphalt and chip seals). The non-compatibility issues of these aggregates can be mitigated by selecting appropriate asphalt binder(s) as they can be acidic or basic based on their crude sources. The proposed study will seek to identify the problematic aggregates and their compatible asphalt binders through mechanistic and science-based approaches. Physical and mechanical properties of aggregates will be evaluated in the laboratory. The compatibility of these aggregates with different binder sources will be determined by measuring their surface free energy (SFE) and adhesion forces by using an Optical Contact Angle (OCA) Analyzer and an Atomic Force Microscope (AFM), respectively. A comprehensive database of compatible aggregate-binder systems will be developed, and it can be followed by asphalt contractors to choose the best compatible system to build longer lasting roadways.

Arabian and Canadian crude). The proposed study will seek to identify the problematic aggregates and their compatible asphalt binders through mechanistic and science-based approaches. Physical (e.g., absorption) and mechanical properties (e.g., abrasion resistance and sulfate resistance) of aggregates will be evaluated in the laboratory. The compatibility of these aggregates with different binder sources will be determined by measuring their surface free energies adhesion forces by using an Optical Contact Angle (OCA) Analyzer and an Atomic Force Microscope (AFM), respectively. A comprehensive database of compatible aggregate-binder systems will be developed. The developed compatibility database can be followed by asphalt contractors to choose the best compatible system for building longer lasting roadways.

Objectives

The primary objective of this proposed research project is to assess the durability of selected aggregates throughout Arkansas and their compatibility with asphalt binders from different crude sources. Specific objectives of this study are: (i) evaluate physical and mechanical properties (e.g., absorption and durability) of aggregates; (ii) determine surface free energies and adhesion properties of binders and aggregates; (iii) recommend suitable test method(s) to screen incompatible aggregates, and (iv) develop a database of compatible aggregate-binder systems.

Intended Implementation of Research

Workforce Development: This will be achieved directly by training graduate, undergraduate, and high school students interested in pursuing a career in STEM or Transportation Engineering career.

Problem Statement

In a recent ARDOT Research Roundtable meeting, the Maintenance Division Engineers raised some issues with the use of certain northeast Arkansas aggregates in asphalt concrete and maintenance projects as these aggregates pose serious durability and performance issues. In particular, aggregates originating from some quarries (e.g., APAC-Central-Preston Quarry at Van Buren and Capital Quarries at Pocahontas, both in AR, and Vulcan Materials Grand Rivers Quarry at Gilbertsville in KY) are suspected to be problematic and suspected to be non-compatible with some asphalt products (e.g., hot mix asphalt and chip seals). The non-compatibility issues of these aggregates can be mitigated by selecting appropriate binder sources as they can be acidic or basic based on their crude sources (e.g.,



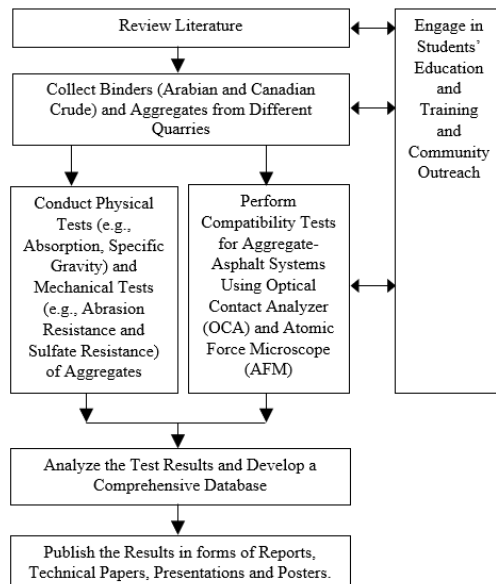


Figure 1. Flow chart of important tasks for the proposed research.

Education: This task supports the federal initiative to build the next generation of transportation professionals to meet the demands of the rapidly changing the 21st-century transportation system. The PI currently supports and mentors five graduate students and three undergraduate students from external grants. The proposed study will help the PI to recruit and train more graduate and undergraduate students in transportation research.

Outreach: Technical articles, posters, and presentations will be delivered at national and local conferences and symposia such as ASCE, Transportation Research Board, ARDOT, Tran-SET, and Create@STATE. Also, a Create@State radio (KASU) podcast will be prepared.

Anticipated Impacts/Benefits of Implementation

The goal of this project is to find a more robust solution to pay for sidewalk repairs without the burden to inspect and contract out repairs being placed on homeowners and to address equity concerns. A more sustainable and equitable sidewalk financing model will not only help bring sidewalks up to ADA standards, increasing mobility for the disabled, but will also provide higher quality infrastructure that encourages walking and its many benefits.

Web links

- [TranSET's website \(https://transet.lsu.edu/research-in-progress/\)](https://transet.lsu.edu/research-in-progress/)
- [TRB's Research in Progress \(RIP\) database \(https://rip.trb.org/View/1642169\)](https://rip.trb.org/View/1642169)

Tran-SET

Tran-SET is Region 6's University Transportation Center. It is a collaborative partnership between 11 institutions (see below) across 5 states (AR, LA, NM, OK, and TX). Tran-SET is led by Louisiana State University. It was established in late November 2016 "to address the accelerated deterioration of transportation infrastructure through the development, evaluation, and implementation of cutting-edge technologies, novel materials, and innovative construction management processes".

Learn More

For more information about Tran-SET, please visit [our website](#), LinkedIn, Twitter, Facebook, and YouTube pages. Also, please feel free to contact Mr. Christopher Melson (Tran-SET Program Manager) directly at transet@lsu.edu.

