RESEARCH
PROJECT CAPSULE [22-1B]

June 2023

TECHNOLOGY TRANSFER PROGRAM

Evaluation of Saturates/Aromatics/Resins/ Asphaltenes (SARA) Fractionation of Asphalt Binders in Louisiana

JUST THE FACTS:

Start Date:
June 1, 2022

Duration:
24 months

End Date:
May 31, 2024

Funding:
TT-Fed/TT-Reg-5

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Sponsored jointly by the Louisiana Department of Transportation and Development and Louisiana State University

POINTS OF INTEREST:

Problem Addressed / Objective of Research / Methodology Used / Implementation Potential

PROBLEM

The Department of Transportation and Development (DOTD) has implemented different characterization methods to evaluate asphalt binder parameters for several years. While these evaluation methods are mainly concentrated on physical and rheological properties, limited qualification has been performed on the chemistry side of asphalt binders and how it relates to the physical properties of asphalt binder.

The primary chemical characterization that is currently performed on asphalt binder in the state of Louisiana is the Gel Permeation Chromatography (GPC). This test evaluates the asphalt binder particles by sieving them into different molecule sizes. While chromatography analysis of the asphalt binder has significant developments in the characterization of asphalt binders, this method lacks the accuracy in determining the different particles present in the asphalt binder. A conventional asphalt binder usually consists of saturates, aromatics, resins, asphaltenes, and polymers. While the chemical properties of each molecule type are different, each category can have a range of molecule sizes; in other words, large molecule sizes are generally assumed to be asphaltene and polymers. This assumption is not entirely correct because maltenes (saturates, aromatics, and resins) can also have large molecule sizes. A more accurate way of distinguishing these particles from each other is to use their chemical properties in the form of solubility in different solvents. This method, called the TLC/FID test, separates the binder fractions by using hexane and toluene as solvents. The fractions are separated based on their solubility or insolubility in these solvents. Once the chemical analysis of the asphalt binder is complete, the chemical properties can be correlated to physical and mechanical properties of asphalt binders and mixtures, respectively. This approach can help improve the quality of the binder that is utilized on the roadways.

OBJECTIVE

The objective of this research is to evaluate the characterization of asphalt binder through TLC/FID testing and SARA grouping. The results will be further analyzed and compared with the available GPC results and other available characterizations of the asphalt binders. Furthermore, the results will be correlated with performance.

METHODOLOGY

To achieve the objective of this study, the research team will conduct the following tasks.

1. Conduct a literature review. Researchers will conduct an extensive literature search of all published materials and ongoing research projects to obtain the latest information on the new methods currently used or being developed on binder chemical testing and characterization.
2. Identify asphalt binder sources used in Louisiana. DOTD will request asphalt binders from major state suppliers. These binders will be tested in comparison with the modified binders from contractors with SBR, crumb rubber, and other commonly used modifiers.
3. Conduct laboratory SARA testing methods in-house. SARA tests will be performed on the collected binders. In addition to SARA grouping, phosphorus and sulfur components will be detected.

4. Conduct mixture testing. Testing of asphalt mixtures will be conducted to determine relationships and links amongst various asphalt binders' chemical properties from SARA analysis to their mechanistic mixture responses. Results will help to develop an understanding between asphalt binder chemical fractions and durability performances of the mixtures.
5. Perform data analyses and comparison. The accuracy of SARA results in determining the components of asphalt binder will be compared with available GPC data. Statistical analysis will determine the accuracy and effectiveness of the SARA test method by considering the deviations between multiple replicates and other suitable statistical methods.
6. Prepare final report and technical summary. A final report and technical summary will be prepared to summarize and document all the findings, experiments, results, conclusions, and problems encountered during the project period. Recommendations on future research needs may also be included.

IMPLEMENTATION POTENTIAL

With the completion of this research, LTRC will provide recommendations on benefits of SARA grouping application. LTRC will report possible advantages and disadvantages of current GPC method and SARA grouping method.

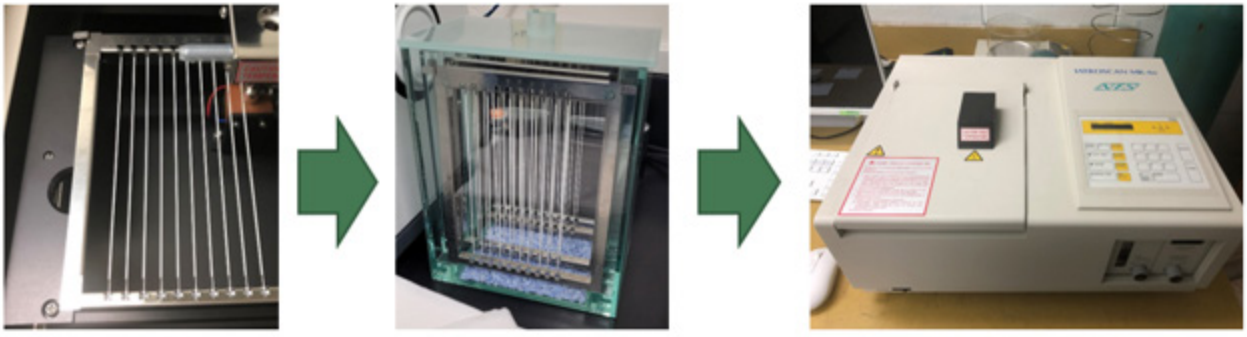

Figure 1. SARA Grouping process with Iatroscan