Asphalt Institute Foundation Research Initiative Proposal
Asphalt Durability

Problem Statement

A critical component in the durability of an asphalt pavement is the asphalt binder. The first-generation Superpave Performance Graded (PG) specifications (AASHTHO M320) were a positive step forward in a science-based approach to asphalt binder evaluation but were defined principally around neat asphalt binders. The second-generation PG specifications (AASHTHO M332) improved the science especially in relationship to polymer modified binders. Additional work is needed to guide future generation specifications to ensure further improvements addressing the long-term (>10 years) durability required of tomorrow's engineered binders in asphalt pavement. The complexity is further increased as such binders may also be included in future pavements as recycled material (e.g. RAP), often of unknown composition and source.

As engineered binders become increasingly complex, the lack of an intuitive and reliable method for assessing the compatibility of various phases, fractions, and additives in the asphalt binder is clearly felt, and has resulted in a number of academic research projects such as the NCHRP 9-60 project, which have attempted to address some of the gaps in current specification. ***A critical research need is to develop methodologies to evaluate the asphalt durability over a much longer time scale, without prior knowledge of composition and ingredients.*** This will lead to a next-generation practical and implementable specification which predicts long-term performance of asphalt binder in pavements.

Background Information

Blenders, brokers, terminal operators, contractors or refineries can engineer asphalt binders to meet specification requirements. These engineered binders have evolved into complex mixes which can contain multiple components such as: polymers, ground tire rubber, compatibilizers, re-refined engine oil bottoms/vacuum tower asphalt extender (REOB/VTAE), polyphosphoric acid (PPA), asphalt rheology modifiers, recycling agents, and various asphalts produced from an array of crude sources. Recent discussions on addition of less controlled additives such as waste plastic further highlights the complexity facing the industry.

State DOT's and other agencies struggle with determining what components are being mixed with the asphalt binder and how it will affect performance in the field. This often leads to development of recipe-type requirements by specifying agencies. In this situation, both accountability by the contractor and the ability to innovate are lost.

Recent research has focused on bulk rheological parameters such as ΔTc and mastercurve/Black Space parameters which, although useful in a known binder system, face challenges for evaluation of complex binders without knowledge of the formulation. Such parameters, although empirically related to compatibility in some cases, often cannot independently and reliably discriminate between the effect of certain polymers and additives, and that of binder compatibility, acid, or aging. For the purpose of this research compatibility is broadly defined as the ability of the components and fractions of the binder to contribute to durable performance, without negative chemical or physical interactions.

Expected Impacts

A comprehensive next-generation specification which addresses long-term durability and compatibility of asphalt binders regardless of any additives, modifiers or other asphalt chemistries, can be used for Quality Assurance (QA), as well as purchase and design specifications. The creation of universal next-generation specifications should be independent of agency, defined solely by geographic location and end-use application.

The Asphalt Institute Foundation Research Committee highly encourages the participation of experts from outside the asphalt industry that can provide a fresh outlook and a paradigm shift on the industries approach to understanding and characterizing complex bitumen chemistry, compatibility, and its relationship to durability.

Project Scope and Deliverables

The final product of this research is expected to be practical and implementable in the industry practice by stakeholders at various levels, while being supported by solid scientific evidence and academic rigor. The project scope may be defined at multiple levels. At the highest level the project will deliver the entire aforementioned comprehensive specification. Alternatively, the project may be defined as to address specific subsets of the specification, for example:

- New approach to characterization and interpretation of the chemistry and compatibility of complex bitumen.
- Practical standard method for defining long term durability of complex binders.
    - Develop a standard test regardless of components that is not simply a pass/fail test.
- Practical standard method for determining long term compatibility of complex bitumen (including bitumen sol-gel phase determination, additive stability and interactions, fractional separation and precipitation).