Texas A&M Transportation Institute

Texas Department of Transportation

PROJECT SUMMARY REPORT

0-7075: Determine the Influence of Thermal Segregation on Current Asphalt Mixtures

Background

Thermal segregation during asphalt mixture construction can lead to the formation of low-density areas. These low-density areas generally exhibit reduced pavement life. While the general methods for measuring thermal segregation have remained relatively unchanged since their implementation, asphalt mixture types and design methods have undergone significant modifications in the last 10 years. This project evaluated the significance of thermal segregation with current-generation asphalt mixes used in Texas. This project also used thermal profile data to provide guidance on the frequency at which thermal segregation becomes a recurring issue.

What the Researchers Did

Researchers conducted a comprehensive literature review to gather information on thermal segregation in asphalt mixes. Various hardware systems, specifications, and previous research studies were summarized and documented to understand the existing knowledge on the subject.

Additionally, input from stakeholders, including industry experts and agencies, was collected to assess the strengths and weaknesses of the current thermal profiling methods and specifications in use.

To benchmark the level of thermal segregation typically observed in paving operations, the researchers analyzed data from 39 construction projects representing a cross section of 9 different current asphalt mixture types. Field and laboratory testing was also conducted on several paving projects to evaluate how thermal segregation relates to mixture properties with the current-generation asphalt mixes.

What They Found

Current thermal profiling methods are widely accepted, including using 150-ft profile lengths, excluding paver stops, and considering data from the full width of the material. Specifications that include pay implications average incentives at $26.75 and disincentives at $10.67 per profile.

This study highlights differences in preferences for paver-mounted thermal imaging systems and discrepancies in interpreting the meaning of recurring thermal segregation. Current thermal profile specifications offer benefits in terms of placement uniformity, communication, elimination of density profiles, and paving at colder temperatures, but areas for improvement include better training, clearer interpretation, data-processing review, redefined thermal segregation categories, and enhanced stakeholder interaction.

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Benchmarking analysis showed around 5 percent severe thermal segregation in typical paving operations. This percentage corresponds to about two profiles with severe thermal segregation in a typical paving pull. Modifying the thermal profile analysis method to include paver stops increases those numbers to about 14 percent severe thermal segregation, or no more than five profiles with severe thermal segregation in a typical pull.

Demonstration projects showed that lower placement temperatures correlated with increased air voids in the completed mat. Ground-penetrating radar also proved useful for evaluating final in-place density. Thermal segregation-induced air voids could reach 10 percent, but quality control measures helped mitigate effects.

Lab testing mixes from demonstration projects showed a correlation between increasing air voids and decreasing performance characteristics. Texas mechanistic-empirical analyses on various projects suggested that thermal segregation-induced air voids could reduce pavement lifespan by up to 10 years, but their impact varies based on mix properties, density changes, traffic levels, and other factors.

Field evaluations confirmed minimal severe thermal segregation occurred during construction, consistent with benchmarking results. Distresses in the pavement's current condition was associated more with low absolute placement temperatures than temperature differentials, emphasizing the need to update analysis methods to include absolute placement temperature information.

What This Means

The evaluation of thermal segregation in this research has provided valuable insights into its impact on mixture properties and pavement performance. Thermal segregation does induce higher air voids in current asphalt mixes. These higher air voids result in poorer rutting and reduced crack life properties and could potentially reduce pavement life. Findings in this research validate the current 25°F temperature differential as a suitable threshold for defining thermal segregation. Results also show that more than two profiles (or 5 percent) with severe thermal segregation could constitute a recurring issue.

The research also showed the existing temperature differential approach has limitations. The temperature differential does not report cases of uniform but excessively cold mix placement, which can lead to significant areas of poor compaction. The temperature differential approach also does not quantify the impacted area. Future efforts should evaluate and develop improved criteria for quantifying thermal segregation to capture both low absolute temperature and impacted area.

For More Information

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