Texas Department of Transportation

PROJECT SUMMARY REPORT

0-7111: Guidelines for Utilization of Field Sands in Superpave Mixtures of Texas

Background

Field sands have been used in hot mix asphalt (HMA) pavements to improve workability since they are readily available and are less expensive than crushed materials. Since field sands are more round compared to crushed aggregates, mixtures containing more field sands can be compacted to a given density at lower binder contents. However, considering their adverse effects on performance, field sands are limited to 10 to 15% of the total aggregates (by weight). The most common feature of field sand that can significantly affect asphalt concrete (AC) performance is the presence of harmful clay particles. Understanding the impact of these clay particles on AC performance was the subject of this research.

The objectives of this project were to determine the upper limit of specific field sand in a mix given the amount of active clay present in it, define the process to determine the clay content, and measure how they affect the performance of the asphalt mixtures. To address these objectives, this study focused on developing and verifying the guidelines for incorporating field sands into Superpave mixtures.

What the Researchers Did

First, a literature review was conducted to compile some of the most recent advancements and findings related to using field sands in the asphalt mixture. Based on the review, the following tasks were selected for evaluation in this study:

1. To establish a limiting clay threshold as a function of its activity, performance tests were carried out on Superpave mixtures prepared with different levels of chemical activity of the fines, or material passing the #200 sieve. The activity level was varied by using a combination of highly active clay (i.e., bentonite) and inactive (i.e., calcium carbonate) fines.

2. To establish limiting thresholds for field sand in a mix considering the activity of the fines. The Hamburg wheel tracking test (HWTT) was carried out on various mixtures with a wide range of combinations of field sands containing different fines with different activity levels.

3. To verify the proposed limiting threshold and guidelines, field sands were incorporated into a Superpave mixture to validate the allowable field sand percentage, given the chemical properties of the aggregate blend fines.

What They Found

This study aimed to develop a guideline on the selection criteria and use of field sand in Superpave mixtures. The focus was on evaluating rutting and moisture damage with respect to field sand properties. The implementable products consist of a procedure to evaluate the amount of harmful clay and limiting values for clay properties. The standard guideline may encourage agencies to use the field sands in their mixtures informed by their effects on the performance of the paving product. The initial task showed that some of the performance parameters did not correlate well with the performance of the asphalt mixtures, and some values were within a certain range for all the mixtures evaluated. One of the few properties of sand, such as methylene blue value (MBV), correlated well with the rutting and moisture susceptibility of the

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mixtures, such as normalized rutting resistance index (NRRI) and stripping inflection point (SIP).

The following tasks were related to using different field sands, binder grades, and lime to determine their impact on the mixture performance and how binder grade and lime improve the performance of the mixture in terms of rutting and moisture susceptibility. Higher binder grade and lime were found to improve the stripping resistance of asphalt mixes, and the mixture performance was found to have demarcation zones of excellent performance, marginal performance, and poor performance based on the MBV and binder grade used to evaluate the asphalt mixtures. This led to developing guidelines for TxDOT and other local agencies to incorporate field sands into asphalt mixtures. These tasks also showed that the NRRI may not be the only parameter to be looked at when evaluating the rutting performance of the asphalt mixtures, especially when field sands are incorporated into the mixture. Stripping inflection points resulted in a much more robust prediction of the failure of a particular mixture.

The final task led to verifying the guidelines developed in the previous tasks. This was achieved by using different percentages of field sands in the asphalt mixture and evaluating their stripping and rutting susceptibility using the Hamburg wheel tracking test. The results showed that the guidelines developed were followed by all the percentages of the field sands, and the higher binder grade improved the stripping resistance of the asphalt mixtures.

What This Means

• MB test is a quick test to understand the expansive characteristics of clay.

• SIP can be a more robust parameter for predicting moisture susceptibility and behavior of asphalt mixtures containing field sand.

• The rutting performance of Superpave mixtures containing field sand can be safeguarded by using a higher PG binder grade, for instance, substituting a PG 64-22 with a PG 70-22. In addition to mitigating moisture damage (stripping), lime can also help to improve the rutting performance of asphalt mixtures with field sand, but this improvement is less effective and needs further verification.

• The field sand content significantly affects rutting and striping performance, especially at 20% by the total weight of the aggregate blend. Still, this should be further investigated as some field sands can be used at a dosage level between 10% and 20% of the aggregate blend.

• The agencies can use the guidelines developed to check which field sand to use in the asphalt mix and how much percentage can be used in the asphalt mixture without compromising the performance of the asphalt mixture.

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