



Project Summary

Texas Department of Transportation

0-5223: The Effects of Pulverization on Design Procedures

Background

Rehabilitation of highway pavements through full-depth reclamation (FDR) is a cost-effective option that reduces the use of virgin base aggregates. Pulverization of the asphalt layer with base material or base material alone may result in the formation of finer materials during the crushing action of the pulverizer with potentially negative impact on the strength of the material. Typically, a stabilizer (cement or fly ash) is used in the FDR process, which aids in strength gain for the base layer. The optimum stabilizer content is currently determined either based on the previous experience or through a series of laboratory tests that evaluates the strength, stiffness and durability of the base-stabilizer mix. For lab testing, base materials are retrieved from the site before pulverization. The change in gradation due to pulverization can significantly impact the base strength and stiffness.

What the Researchers Did

We established a test protocol to characterize the change in properties of stabilized base materials due to change in gradation after pulverization. We also carefully observed the construction methods and monitored the strength and performance of the FDR projects at six sites.

During this task, the materials were sampled after one to three passes of the pulverizer. We quantified the impact of change in gradation due to pulverization on the moisture-density curve, modulus, unconfined compressive strength, moisture susceptibility and structural design of these sites.

Based on our observations and testing, we developed guidelines and provided recommendations for upgrading the current TxDOT specifications for achieving a high-quality base.

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Category	Definition	Limits as per Item 247	Suggested Value
Gravel	Retained on No. 4 Sieve	35% to 55%	45%
Coarse Sand	Passing No. 4 and Retained on No. 40 Sieves	15% to 40%	30%
Fine Sand	Passing No. 40 and Retained on No. 200 Sieves	Not Available	15%
Fines	Passing No. 200 Sieve		5% to 10%

Recommended Gradation for Base Materials

What They Found

Based on the laboratory and field studies, we made a number of recommendations from the initiation of the project to the completion of construction. Our findings are as follows.

- Pulverization primarily changes the coarse aggregates to fine sands. Most changes in gradation occur after the first pass of the pulverizer. On average, 10% of the coarse aggregates are crushed to fine sands.
- Most change in gradation occurs at sites with coarse aggregates that are soft. A test called the Aggregate Crushing Value can be used to assess the hardness of aggregates.
- Add-rock of coarse gradation and high quality can be added to improve the final quality of the pulverized base.
- Some upfront work is needed to ensure the site is a good candidate for FDR and that representative samples are retrieved from the site for mix design. Pavement evaluation with the FWD and GPR and more rigorous means of sampling the in-place material is recommended.
- Mix design to estimate the type and concentration of additives should be carried out to ensure that adequate strength, modulus and moisture-susceptibility are considered. Ways to accelerate the design process are recommended. Increasing the additive content as a safety factor has many unintended consequences.
- FDR projects require much more attention to quality control during construction as compared to traditional base construction. Adhering to the target moisture content and stabilizer content of the base before compaction is the key element to success of a FDR project.
- Achieving adequate density does not guarantee a high quality base. The strength and stiffness of the material should be monitored. Rapid methods for ensuring quality are recommended.
- Opening to traffic, especially in late season construction, should be based on achieving adequate strength/modulus of the FDR layer to minimize damage.
- Modulus of the completed base is substantially lower than those obtained in the laboratory. The best estimate of the field modulus can be obtained by measuring the laboratory strength/modulus after 24 hours of curing on a counter top.

What This Means

Full-depth reclamation for pavement rehabilitation is quite feasible and would result in tremendous cost savings, provided that an appropriate mix design is carried out and the impact of the change in gradation due to pulverization is considered. However, rigorous pavement evaluation before construction, a mix design to choose the correct type and content of additive, and more rigid quality control during construction are needed. The quality of the final results is highly dependent on good design and quality control during construction.

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