



Project Summary Report O-4104-S  
Project O-4104: An Evaluation of Factors Affecting Moisture  
Susceptibility of Pavements in Northeast Texas

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## Evaluation of Hot-Mix Pavement Performance in Northeast Texas

In 1995, a joint industry/  
Texas Department of Trans-  
portation (TxDOT) task force  
was established to identify  
issues associated with the  
unsatisfactory performance

of hot-mix asphalt (HMA)  
layers made with siliceous  
river gravels in northeast  
Texas. To address the mois-  
ture susceptibility problem  
the team proposed a series of

recommendations, including  
tighter aggregate specifica-  
tions, use of anti-stripping  
agents, and use of modifiers.

In the late 1990s these  
recommendations were

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a) good-performing core: low deformations and little uncoated aggregate on fracture



b) poorly performing mix: large disintegration and lots of lean aggregate in fractured face

Figure 1. Cores after Hamburg and TSR Testing.



**Table 1. Coarse Aggregate Mineralogy and Additive Type Comparison.**

Coarse Aggregate Mineralogy	Additive	No. of Proj.	Stripping Ratings of Cores		Air Voids of Cores, %	Indirect Tensile Str. 77°F, psi		TSR	Hamburg Rut Depth @ 20,000 Cycles	Average Age, Years	Performance Visual Rating
			Dry	Wet		Dry	Wet				
Gravel	Lime	6	3.9	3.7	5.3	184	167	0.91	2.9	4.7	90
Gravel	Liquid	10	3.1	2.7	3.5	199	165	0.82	29.3	6.5	76
Gravel	None	7	2.7	2.3	4.2	203	198	0.99	18.2	8.7	58
Limestone	Liquid	4	3.6	3.5	6.8	194	166	0.86	7.9	5.5	90
Limestone	None	3	4.4	4.2	2.8	217	213	0.98	27.7	7.3	70

Note: Four of the seven projects using gravel without any anti-stripping additives exhibited failures that required major rehabilitation, including milling. These TSR values reflect data only from the remaining pavement sections.

implemented, on a trial basis, in several paving projects in the Atlanta District. In 1998, 35 sections were identified for study; they included some sections that had adopted the new recommendations and some that had not. These sections were field tested in late 1998 using both visual inspections and laboratory testing of field cores. The results were reported in TxDOT report number DHT-46, *Evaluation of the Factors Affecting Moisture Susceptibility of Pavements in Northeast Texas*. In general this project validated that the original recommendations produced improved HMA performance.

As the sections were very young at the time of the 1998 surveys, a follow-up study was initiated in 2001 to provide a longer-term view of performance.

### What We Did...

In 2001, a detailed visual inspection was conducted of the 35 sections, and several cores were removed from each pavement for laboratory testing. The testing included measurement of the indirect tensile strength both wet and dry, a visual evaluation of the fractured surfaces to identify evidence of stripping, and a Hamburg wheel tracking test in accordance with Test Method Tex 242F. In the Hamburg test the specimen was subjected to repeated loading for 20,000 cycles or until the sample experienced 0.5 inch of rutting.

### What We Found...

Analysis of the data collected during this follow-up study grouped the pavement sections with similar characteristics and evaluated visual stripping ratings, wet-to-dry tensile strength ratio (TSR), and Hamburg results.

Photographs of cores that did well and ones that did poorly in this evaluation are shown in [Figure 1](#).

Numerous correlations and comparisons were made in this study; for example, [Table 1](#) shows the influence of coarse aggregate mineralogy and additive type on performance.

Gravel mixtures with liquid anti-stripping additives performed better than those mixtures with-



out any additives. The TSR value of 0.99 for gravel mixes with no anti-strip is not an accurate representation; this inaccuracy results because four of the seven projects failed and no TSR tests were run on these projects. The 0.99 value represents the three surviving projects.

Limestone mixtures with liquid anti-stripping additives performed better in terms of Hamburg test results and field evaluation than limestone mixtures without any additives. The field condition survey indicated that the three projects containing limestone mixture without any additives exhibited severe cracking and they all required application of seal coat. The four projects with liquid additives did not show any signs of cracking. Two of these four projects exhibited slight rutting.

In summary, limestone mixtures with liquid anti-stripping additive showed less cracking but more rutting than limestone mixtures without any liquid additive.

There were no limestone mixtures in this data set. Therefore, results were not able to show a direct comparison of lime and liquid anti-stripping additives with limestone mixtures. Overall, findings showed:

- Siliceous gravel mixtures containing lime performed very well under a variety of conditions.
- Mixtures containing siliceous gravel screenings and limestone screenings appeared to have similar performance properties as measured in this study.
- Limestone mixtures with liquid anti-stripping additives performed well and better than limestone mixtures without any additives. Limestone mixtures with lime were not evaluated in this study.
- The use of latex improved pavement performance.
- Hamburg test results correlated with visual pavement condition ratings.

## *The Researchers Recommend...*

The findings of this project indicate that many of the recommendations of the task group, which were implemented in the Atlanta District, resulted in improved pavement performance. The researchers recommend that the following findings of the task group be considered for implementation by districts that use siliceous crushed river gravel:

- Require lime additive with siliceous river gravel mixtures.
- Remove the specification requirement prohibiting use of siliceous gravel screenings.
- Consider establishing Hamburg criteria for all mixture types.



## *For More Details . . .*

The research is documented in Report 4104-1, *A Follow-Up Evaluation of Hot-Mix Pavement Performance in Northeast Texas*.

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## *TxDOT Implementation Status November 2003*

The recommendations of this research project have been implemented by TxDOT. The new specification for HMA concrete includes Hamburg Wheel criteria for mix acceptance. The research program is continuing with more fundamental research on aggregate binder compatibility.

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## *Disclaimer*

This research was performed in cooperation with the Texas Department of Transportation (TxDOT) and the Federal Highway Administration (FHWA). The contents of this report reflect the views of the authors, who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of TTI, TxDOT, or FHWA. This report does not constitute a standard, specification, or regulation, nor is it intended for construction, bidding, or permit purposes. Trade names were used solely for information and not for product endorsement. The engineer in charge was Tom Scullion, P.E. #62683.

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