

PROJECT SUMMARY REPORT

0-7108: Importance of Fine Aggregates in Achieving Adequate Skid Resistance in TxDOT Hot Mix Asphalt Mixtures

Background

Pavement friction is a critical roadway-safety property, particularly under wet conditions, yet it is not routinely evaluated during asphalt mixture design. TxDOT's Balanced Mix Design (BMD) process primarily addresses rutting, and cracking. Consequently, a mixture can satisfy conventional performance requirements yet still lose adequate surface friction as traffic removes the binder film and polishes the exposed aggregate. Project 0-7108 examined how material, mixture design, and construction variables affect long-term friction and sought a practical way to improve friction without unnecessarily redesigning the entire mixture. The research identified aggregate quality, particularly resistance to polishing, as the dominant factor controlling long-term friction. It therefore focused on determining which aggregate size fractions most strongly influence friction and whether premium, polish resistant aggregate could be concentrated in those fractions while preserving conventional BMD performance.

What the Researchers Did

The researchers combined a literature review, controlled laboratory testing, field verification, and laboratory and producer case studies. The controlled program isolated the influence of binder grade, aggregate type, binder content, aggregate gradation, mixture type, the distribution of aggregate sources within individual gradation fractions, and compacted air-void content. Asphalt ring specimens were subjected to accelerated polishing using the Three-Wheel Polishing Device (TWPD), and friction was measured with the Dynamic Friction Tester (DFT) (see Figure 1).

After identifying the most influential variables in the laboratory, the team evaluated available field sections with different binders, aggregate types, gradations, and mixture types. The final phase used case studies to determine whether mixtures with inadequate friction could be improved by strategically replacing or redistributing the low-polishing-resistance aggregate source contributing to the critical size fraction. The modified mixtures were then rechecked for rutting,

cracking, and moisture-damage performance to ensure that friction improvements did not come at the expense of durability.



Figure 1 - Use of the TWPD and DFT to Develop an Asphalt Mixture Friction Deterioration Curve

What They Found

- Aggregate type and polishing resistance were the dominant controls on long-term friction within the materials evaluated. Binder grade, binder content, overall gradation, mixture type, and air-void content produced comparatively small long-term friction differences after the surface binder film was removed, although these variables can still influence early-life texture and conventional BMD performance.

- The intermediate aggregate fraction passing the No.

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4 sieve and retained on the No. 30 sieve (4.75-0.60 mm) was the most influential portion of the gradation evaluated. Within this range, the No. 4-to-No. 16 fraction (4.75-1.18 mm) was especially important. By contrast, replacing only material passing the No. 30 sieve produced little friction benefit (see Figure 2).

- Field comparisons generally supported the laboratory trends: sections containing more polish-resistant aggregate produced higher friction, while differences attributable to binder grade, gradation, or mixture type were relatively small when aggregate quality was similar.

- Targeted aggregate replacement improved friction while limiting premium aggregate use. In producer case studies, terminal DFV increased from 0.21 to 0.28 for SP-C and from 0.25 to 0.32 for SMA-D. The modified mixtures maintained acceptable rutting, cracking, and moisture-damage performance.



Figure 2 - Surface-area illustration of aggregate size fractions. Testing identified the intermediate fraction passing the No. 4 sieve and retained on the No. 30 sieve (4.75-0.60 mm) as the most influential portion of the gradation.

What This Means

The study provides TxDOT and asphalt producers with a focused friction-screening and mixture-optimization framework for BMD. Rather than upgrading an entire aggregate blend, designers can identify the stockpile contributing to the critical intermediate fraction and concentrate polish-resistant aggregate where it is most effective. In the laboratory SP-C example, 40% high-friction sandstone in the critical bin produced a terminal DFV of 0.35 versus 0.40 for 100% sandstone, demonstrating the potential to reduce premium-aggregate use, hauling, cost, and environmental impacts while preserving friction performance.

For implementation, the report recommends a staged approach: identify aggregate sources contributing to the No. 4-to-No. 16 fraction; use TWPD/DFT testing to screen friction; optimize the critical fraction as needed; and reverify volumetrics, rutting, cracking, and moisture-damage requirements. Pilot field sections, repeatability/reproducibility studies, and laboratory-to-field correlation are needed before terminal DFV is used for acceptance.

Implementation note: The approximate 0.30 terminal DFV is a provisional laboratory screening value, not a TxDOT acceptance limit. Field validation is required before it can be adopted for acceptance.

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