New Friction/Polishing Test for Asphalt Mixtures

2025 SEAUPG MEETING Charleston, WV

Wade Collins
President
Pavement Technology Inc.

Why is Laboratory Friction Testing Important/Needed?

- Predict Friction Characteristics of Asphalt Mixtures-Build Data Base
- Optimize Hot Mix Asphalt Surface Friction Characteristics
- Determine how different percentages of RAP/Additives affect Friction. Evaluate 100% RAP friction properties-Useful when multiple RAP sources are available.
- Establish initial aggregate blends for friction testing
- Be a part of BMD, Acceptance Testing of HMA Designs, and as a Quality Acceptance Test during Construction
- Ensure Safety for the Travelling Public

Two most common highway-level friction devices is:

- Locked-Wheel Friction Testing
- Sideway-Force Coefficient Routine Investigation Machine (SCRIM)

Example of Locked Wheel Friction Testing

Two most common laboratory friction devices are:

- Dynamic Friction Tester (DFT)
- Three Wheel Polishing Device (TWPD)

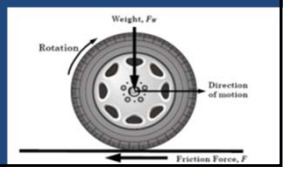
Dynamic Friction Tester (DFT)

Three Wheel Polishing Device

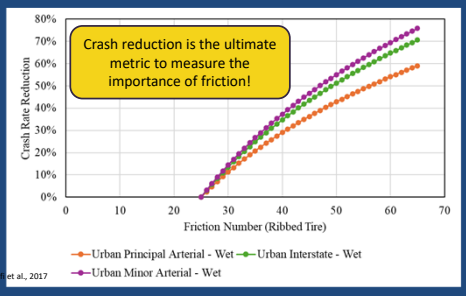
Pavement Friction

- Pavement Friction is defined as "The Force that resists the relative motion between the vehicle tire and Pavement Surface"
- Factors Effecting Friction
  - Vehicle Factors
  - Pavement Surface Factors
  - Pavement Geometry
  - Load Factors
  - Environmental Factors

$$\mu = F/Fw$$



Example of Crash Rate vs. Friction



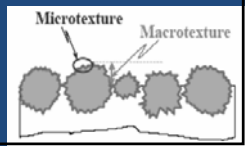
Source: Najafi et al., 2017

Microtexture vs Macrotexture

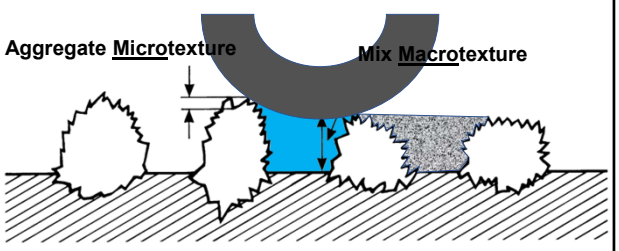
- Pavement Microtexture is the deviation of an aggregate from a true planar surface
- Pavement Macrotexture is the deviation for a pavement surface from a true planar surface

Pavement Texture

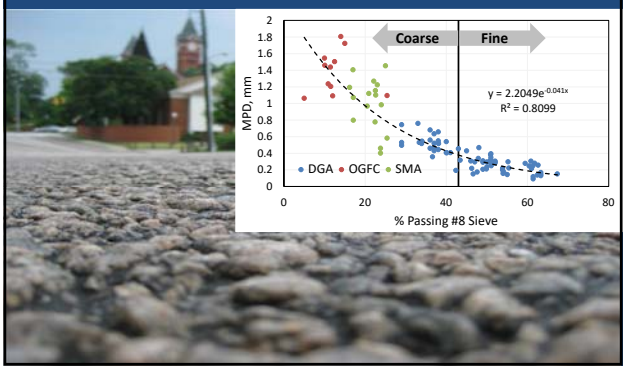
- Irregularities in the pavement surface and the aggregate particles
- Macrotexture depends on size, shape, NMAS and distribution of coarse aggregates
  - Important for water displacement and increasing the exposure of aggregates on the surface
- Microtexture depends on initial roughness on aggregate surface
  - Gives Tires something to "Grip"



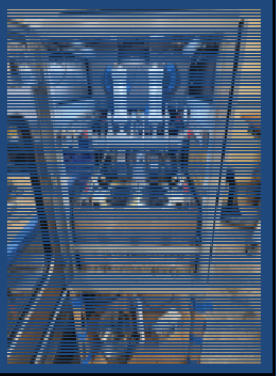
Pavement Surface Friction Basics



Field Measurement Basics



Asphalt Pavement Analyzer-Junior



Friction Test Components


Rubber Pad/Bracket


Force Sensor/Load Cell


Steel Wheel


Gyratory Samples

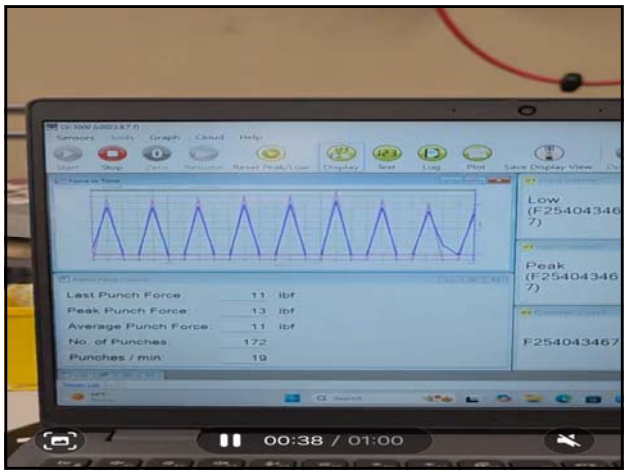
Friction/Polishing Test Method

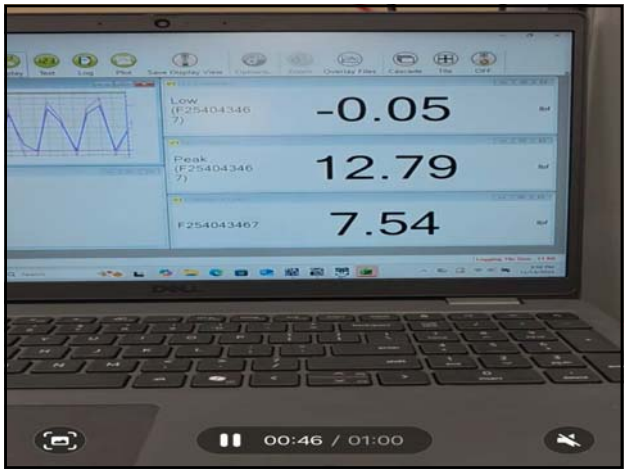
- Utilizes a rubber pad 2" length x 1-3/4" width x ½" thick (durometer 62) mounted on a stainless-steel wheel with stainless clips and screws. Alternative durometers can also be utilized
- Each Wheel is capable of accommodating 4 pads (A user can run 4 different friction tests before changing the rubber pads) on each wheel.
- All loading is one directional for each wheel.
- 30lbs of load for each pad. This can be changed utilizing onboard digital regulators and pneumatic wheel cylinders
- Speed is 19 passes per minute (Speed can be changed utilizing on board frequency drive)
- (2) Water spray nozzles for each wheel.
- Temperature is ambient (Temperature can be increased utilizing on board cabin heaters and circulating fan)

Friction/Polishing Test Method-Cont'd

- 20,000 one directional passes. Can be adjusted as needed.
- Force Sensors/Load Cells-Type-Resistive (Capacity-Up to 55lbs)
- Utilizes Gyratory Samples 62mm in height saw cut and "Butted Together" like the Hamburg AASHTO T324-23 Setup. Field Cores and Slab Samples can also be tested.
- Computer Software tracks numbers of passes versus force (per pass) and displays these measurements in a graphic and numeric format. Software is also capable of measuring passes versus motor amperes and passes versus pad wear
- The displayed amperes are what is required by the motor to pull the rubber pads across the asphalt specimens' surface.
- There is always an increase in friction at the very beginning of Friction/Polishing Test. You are wearing off slick binder and encountering gritty aggregates that have not been polished down yet.
- Goal is to achieve a "Flat Line" Friction/Polishing State. "Flat-Line" Friction/Polishing State indicates a minimum change in force and amperes over a designated number of one directional passes.

Video Friction Test





Ideas for Adjustments/Changes/Improvements that can be made when a mix exhibits low friction

- **Friction is primarily affected by aggregate type**
- **Increasing the proportion of polish-resistant aggregate will improve the results**
- **Hard angular aggregates that are resistant to polishing tend to improve friction.**
- **Determine the effects of different particle sizes on mixture friction (i.e. which sieve size has the largest effect on friction for a given mix type)**
- **Hard sands can improve friction in finer mixes**
- **Coarsening up a blend will help improve the macrotexture and water displacement, but not necessarily microtexture (what people think of when they think about "Grip")**
- **A good resource is the AASHTO Guide for Pavement Friction 2nd Edition.**

Additional Ideas

- Micro-surface, chip seals are a good ways to help with friction issues, not to mention the calcined-bauxite high friction surface treatment (HFST) is now become the fall back in areas where lane departures are prevalent due to friction issues.
- Incorporating Friction into the Mix Design Process
- Build a Data Base on Different Mix Designs
- Try to determine what aggregate type/source drives friction in a mix design
- Test Friction Properties-Lab-Plant-Field
- Correlate Lab Predictions to Field Results
- Develop a Failure Criteria for Individual Mix Types

Contractor Needs

- Quicker adoption of potential aggregates
  - vs 8-10 year evaluation
- Screen potential sources - value for friction
  - Never had an option like this before
- Look at unique material combinations for friction
- Understand not just pass/fail, but how friction can degrade over time

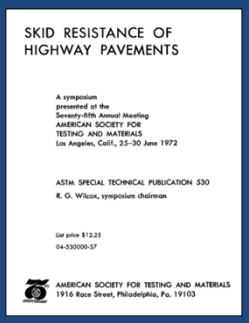
Balanced Mix Designs (BMD)

- If BMD is going to allow roads to perform better and longer, pavement friction becomes even more important due to safety considerations
- Does the Friction Properties have the same “Life” for an HMA pavement as Rutting and Fatigue?

Important Note

- Friction Testing is all very, very early!
- “Higher” friction mixes are much more difficult to achieve than the “Medium” friction mixes.
- This is important and is worth the investment to figure out how to include friction in mix design!

Pavement Surface Friction Basics


SKID RESISTANCE OF HIGHWAY PAVEMENTS

A symposium presented at the Seventy-fifth Annual Meeting AMERICAN SOCIETY FOR TESTING AND MATERIALS Los Angeles, Calif., 25–30 June 1972

ASTM SPECIAL TECHNICAL PUBLICATION 530
R. G. Wilcox, symposium chairman

List price $12.25
04-530000-37

AMERICAN SOCIETY FOR TESTING AND MATERIALS
1916 Race Street, Philadelphia, Pa. 19103

THANK YOU

QUESTIONS?

wadec@pavementtechnology.com