

TECHNICAL MEMORANDUM



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Research Product P1, Updated Construction Specifications (Developing Ultra-Thin Slurry Mixtures and Field Evaluation)

TxDOT Project 5-6615-01: Implementing the Next Generation of Ultra-Thin Slurry Overlays

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STUDY NO. 5-6615-01

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As documented in the project summary report, the existing slurry materials are not recommended for main lane applications because of an unacceptable drop in skid resistance. To address this a new specification is proposed and included in this tech memo. The main change with this test is the use of the 3-wheel polisher and Dynamic Friction Tester to demonstrate that the proposed slurry can retain 90% of its skid value after 10,000 applications of the polisher.

Such a slurry is not currently available and will need additional research by either the company marketing the material or university researcher. Once an acceptable material is found in laboratory testing it will need to be demonstrated in the field using the small-scale testing techniques developed in project 5-6615-01-R1.

Special Specification XXXX

ULTRA-THIN SLURRY SEAL TREATMENT



1. DESCRIPTION

Apply a surface preservation treatment consisting of one or more applications of a single layer of asphaltic and aggregate material.

2. MATERIALS

Furnish materials in accordance with the following:

2.1. Asphalt.

Furnish an emulsified asphalt in accordance with Table 1. Provide water in accordance with Article 204.2., "Materials."

Table 1. Emulsified Asphalt

Property	Test Procedure	Min	Max
Viscosity	T 59	20	100
Particle Charge Test	T 59	Positive	
Sieve, %	T 59	0	0.1
Residue by Distillation, percent	T 59	60	-
Penetration at 77°F, 100 g, 5 sec.	T 49	40	150

Use a quantity of emulsified asphalt in the mixture, expressed as a percentage of total weight, the percentage shown on the plans, or as directed.

2.2. Aggregate. Furnish aggregate meeting Item 302, "Aggregates for Surface Treatments," of the grade shown in Table 2.

Table 2. Aggregates

Physical Properties ¹				
Property	Test Procedure	Min.	Max.	
Water Absorption, %	T 84	-	4	
Micro-Deval, %	D 7428 ²	-	20	
Gradation ³				
Sieve	Standard	Master Grading Band Limits Percent Passing		Target Tolerance
No. 4	C 136	TBD		
No. 8	C 136	TBD		
No. 16	C 136	TBD		
No. 30	C 136	TBD		± 5
No. 60	C 136	10-40		± 5
No. 100	C 136	0-10		± 5
No. 200	C 117	0-5		± 1

1. Perform physical property tests on aggregates that are received before blending into sealer.
2. Micro-Deval on aggregate larger than No. 60 sieve U.S.
3. As the current mixes do not have adequate skid – research is needed to define what mixes will pass the retained friction mix design tests in Section 3.1

2.3. Additives. Add clay, polymers, water, and other additives as required. Use a minimum of 4% polymer by weight. Furnish water free of industrial wastes and other objectionable matter.

or:

Other Additives. Use approved additives as recommended by the Ultra-Thin Slurry manufacturer when necessary to adjust mix time in the field.

3. MIX DESIGN

3.1 Furnish a laboratory mix design meeting the requirements shown in Table 3:

Table 3. Laboratory Mix Design

Test	Test Procedure	Min	Max
Wet-Track Abrasion Loss, 3 day soak, g/m ²	D 3910 ¹	--	80
Asphalt Content by Ignition Method, %	T 308	30	--
Dynamic Friction Test Number, 60 kph	E 1911 ²	0.90	--

1. Use the modified method to account for realistic application depth and fine emulsion mixture.
2. Demonstrate that the proposed Slurry material can withstand 10,000 passes of the 3-wheel polisher and retain 90% of the friction of the unpolished material. Basic details at the end of this spec, Test equipment available at TTI

3.2 Furnish a production or field sample meeting the requirements shown in Table 4:

Table 4. Production or Field Sample

Test	Test Procedure	Min	Max
Solids Content by Evaporation, %	T 59 ¹	48	--
Asphalt Content by Ignition Method, %	T 308 ³	30	--
Rotational Viscosity, 20 rpm, RV spindle, 25°C, cP	D 2196 ²	800	4000
Temperature for storage and application, °F	--	60	130

1. Dry specimens to a state where measurements taken 20 minutes apart do not change.
2. Test samples within 7 days.
3. Reduce sample size to achieve asphalt quantity. It is very important that this test be performed on a completely dry sample.

4. EQUIPMENT

4.1 **Mixing Plant.** Provide a stationary pugmill, weigh-batch, or continuous mixing plant as approved. Equip plants with digital proportioning and metering devices that produce a uniform mixture of asphalt, aggregate and additives in the specified proportions.

4.2 **Distributor.** Provide applicable equipment in accordance with Article 316.3., "Equipment." Furnish the necessary facilities and equipment for determining the temperature of the mixture, regulating the application rate, and securing uniformity at the junction of 2 distributor loads. Furnish a distributor capable of keeping the Ultra-Thin Slurry Treatment in uniform suspension and adequately mixing the asphalt, aggregate and additives.

4.3 **Asphalt Storage and Handling Equipment.** When using storage tanks, furnish a thermometer in each tank to continuously indicate the asphalt temperature. Keep equipment clean and free of leaks. Keep asphalt material free of contamination. Furnish storage tanks capable of keeping the Ultra-Thin Slurry Treatment in uniform suspension and adequately mixing the asphalt, aggregate and additives.

5. CONSTRUCTION

5.1 **Adverse Weather Conditions.** Do not place mixture when, in the Engineer's opinion, general weather conditions are unsuitable. Meet the requirements for air and surface temperature shown below.

- 5.1.1 **Standard Temperature Limitations.** Apply mixture when air temperature is above 50°F and rising. Do not apply mixture when air temperature is 60°F and falling. In all cases, do not apply mixture when surface temperature is below 60°F.
- 5.1.2. **Cool Weather Night Air Temperature.** The Engineer reserves the right to review the **National Oceanic and Atmospheric Administration (NOAA)** weather forecast and determine if the nightly air temperature is suitable for mixture placement.
- 5.1.3. **Cold Weather Application.** When mixture application is allowed outside of the above temperature restrictions, the Engineer will approve the mixture and the air and surface temperatures for application. Apply mixture at air and surface temperatures as directed.
- 5.2. **Surface Preparation.** Remove existing raised pavement markers. Repair any damage incurred by removal as directed. Remove dirt, dust, or other harmful material before applying. When shown on the plans, remove vegetation and blade pavement edges.
- 5.3. **Application.** Apply the mixture when the air temperature is at or above 60°F, or above 50°F and rising. Measure the air temperature in the shade away from artificial heat. The Engineer will determine when weather conditions are suitable for application.
- Distribute material at the following rates or as directed:
- First application: TBD* per SY.
 - Second application: TBD per SY.
 - Total application after the second application: TBD per SY minimum.
- * Subject to the mix design which meets the retained frictional requirement
- 5.4. **Edges.** Adjust the shot width so operations do not encroach on traffic or interfere with the traffic control plan, as directed. Use paper or other approved material at the beginning and end of each shot to construct a straight traverse joint. Unless otherwise approved, match longitudinal joints with the lane lines. The Engineer may require a string line if necessary to keep the edge straight. Use sufficient pressure to flare the nozzles fully.
- 5.5. **Workmanship.** Immediately take corrective action if treatment material is exhibiting evidence of poor workmanship, delayed opening to traffic, or surface irregularities, including streaks, uncoated, and blotchy areas. The Engineer may allow placement to continue for no more than one day of production while taking appropriate action. Suspend application if the problem still exists after one day until the problem is corrected to the satisfaction of the Engineer.
- 5.6. **Opening to Traffic.** Open the treated surface to traffic when directed. Furnish and uniformly distribute clean, fine sand on the surface to blot the excess when an excessive quantity of mixture is applied. Maintain ingress and egress as directed by applying sand to freshly treated areas.

6. MEASUREMENT

Ultra-Thin Slurry Treatment will be measured by the ton or by the square yard of the composite Ultra-Thin Slurry Treatment mixture, which includes asphalt emulsion, aggregate, and additives. At the completion of the project, any unused Ultra-Thin Slurry Treatment will be weighed back and deducted from the accepted Ultra-Thin Slurry Treatment quantity delivered.

7. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit bid price per ton or square yard for "Ultra-Thin Slurry Treatment."

This price is full compensation for preparing the existing surface (including removing existing raised pavement markers); furnishing, hauling, preparing, and placing materials; and equipment, labor, tools, and incidentals.

Overview of the Three-wheel Polisher and DFT Testing

NOTE: If TxDOT wants to proceed with the proposed new specification then the slab preparation, polishing equipment and test procedure need to be written up in a standard TxDOT format

Slab Preparation

Slabs shall be made using an asphalt roller compactor to be large enough to accommodate the DFT test equipment. Minimum target slab size is 19 inches by 15 inches by 2 inch thick. The slab should be made of a Dense graded Type D surface mix and the target air void content shall be 7%.

Test Equipment



3-Wheel Polisher



Dynamic Friction Tester

Three Wheel Polishing Devices operated using a 146 lb carriage weight, 56-60 rpm rotational speed, Kenda tire, 35 psi tire inflation, and continuous water flush on the slab surface during polishing. The continuous water flush system is a recirculating system that includes a water reservoir tank, filter screen, pump, and spray bar. One polishing cycle equals one 360-degree revolution of the three-wheel carriage. DFTs are operated as prescribed in the latest ASTM E 1911 standard. The DFT began testing with a new set of rubber sliders for each slab and completed three increments of testing with five replicate friction measurements for a total of 15 drops per set of rubber sliders.

Test Procedure

- 1) The Ultra-Thin Slurry materials need to be made in advance
- 2) The slab will be evenly coated with the Slurry materials
- 3) The slab will be cured for 2 hours at 60C
- 4) The initial friction values shall be measured using the DFT at 40 and 60 km/hr before and polishing using ASTM E 1911
- 5) The slab shall be polished for 10,000 passes of the 2-wheel polisher
- 6) DFT friction measurements will be calculated at 40 and 60 km/hr
- 7) Continue polishing to 25,000 passes and repeat the DFT measurement

Reference:

Heitzman, M, Gu F., and Welderufael, A . "Three Wheel Polishing and Dynamic Friction Tester Accelerated Laboratory Friction testing Repeatability and Reproducibility Study" NCAT Report 19-05, Aug 2019