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Laboratory Evaluation of Asphalt Tack Coat Materials

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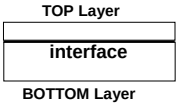
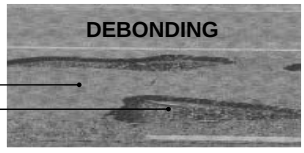
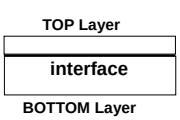
What is a Tack Coat?

- **A light application of asphalt, usually asphalt diluted with water. It is used to ensure a *bond* between the surface being paved and the overlying course**

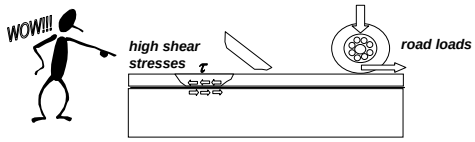


What is NOT A BOND?





Loss of ADHESION and/or INTERLOCK at the interface:



Long term pavement performance and durability can be affected by Debonding as well as Rutting and Cracking.

DEBONDING happens where high shear stresses occur:

- ***on heavily trafficked roads***
- ***on small radius curves***
- ***at traffic lights, or stop signs***
- ***on roads with steep gradients***
- ***on bridges***

Common Tack Coat Materials

- **Hot AC (AC-20, AC-30, …)**
- **Emulsified Asphalts (SS-1, SS-1h, CRS-2, CSS-1h, …)**
- **Cutback Asphalts (RC-70, RC-250, …)**

The Question Is?

1. **What Material Should Be Used?**
2. **What should be the optimum residual application rates?**

Objective

- Evaluate the influence of tack coat types, application rates, and test temperatures on interface shear strength

Scope

- 19 mm Mix
-

Tack Coat Materials	
Emulsions	CRS-2P
	SS-1
	CSS-1
	SS-1h
Asphalt Cements	PG 64-22
	PG 76-22M

-

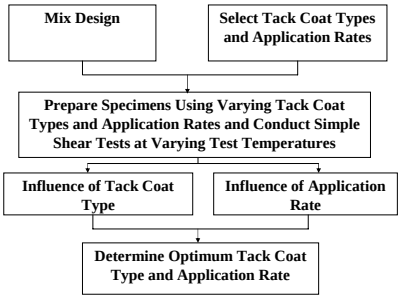
Application Rates	
l/m²	gal/yd²
0.00	0.00
0.09	0.02
0.23	0.05
0.45	0.10
0.90	0.20

-

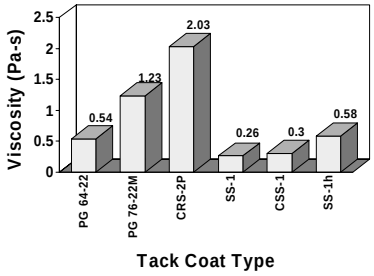
Test Temperatures	
°C	°F
25	77
55	131

- Triplicate samples
- 156 samples

Methodology



Viscosities of Tack Coats at 135°C



Specimen Preparation

- Determine Tack Coat Amount
- Estimate Minimum Curing Period of Emulsions
- Compact Specimen
- Condition Specimen

Minimum Curing Period

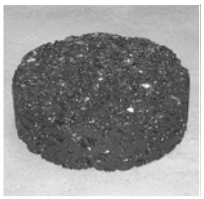
Emulsified Asphalt	Minimum Curing Period Minutes
CRS-2P	5
SS-1	20
SS-1h	15
CSS-1	20

Specimen Preparation

- Specimen with interface
- Specimen Size: 150mm Diameter and 112mm High
- Compact Specimen in Two Halves
- Compact Bottom Half to 56mm Height First
- Accept Specimens with Air Void Content 6 ± 0.5%
- Apply Tack Coat on the Surface and Cure
- Compact Loose Mix on the Tack Coated Surface
- Check Air Void Content of the Complete Specimen
- Specimen with no interface

Compact Loose Mix to 56mm Height Bottom Half

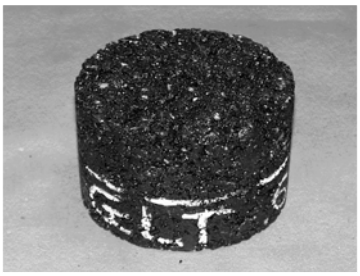




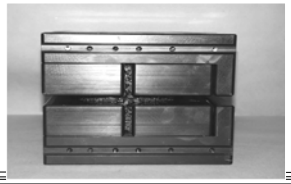
Apply Tack Coat, and Place in the Compaction Mold


Place Loose Mix on Tack Coated Surface and Compact Top Half


Compacted Specimen

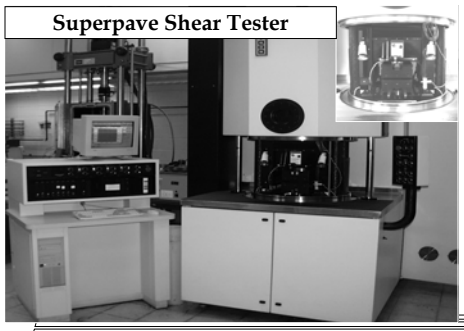


Shearing Mold

Test Equipment

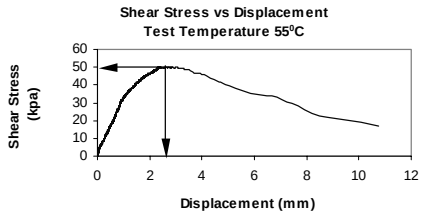
Superpave Shear Tester



Condition Specimen

- For the 25°C tests, the shearing mold assembly was conditioned in the SST environmental chamber for one hour before testing
- For the 55°C tests, specimens were conditioned for 2 hours before fitting in the shearing mold
- Shearing mold assembly was conditioned in the SST environmental chamber for 1.5 hours before testing

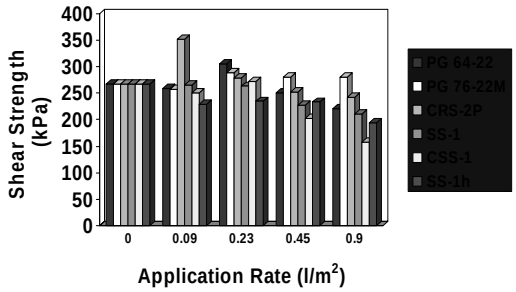
Typical Shear Stress vs. Shear Displacement Plot



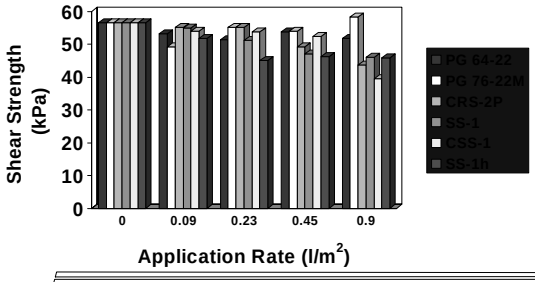
Data Analysis

- A multiple comparison procedure
  - Fisher's Least Significant Difference
  - 95% confidence interval
  - Ranking

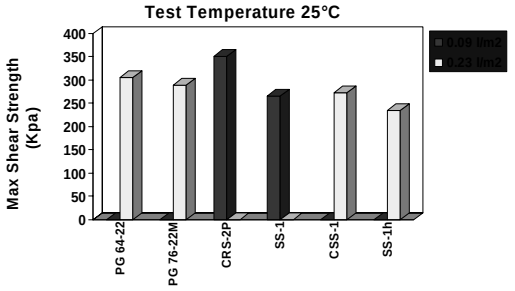
Variation of Shear Strength Versus Application Rate at 25ºC



Variation of Shear Strength Versus Application Rate at 55ºC



Maximum Interface Shear Strength



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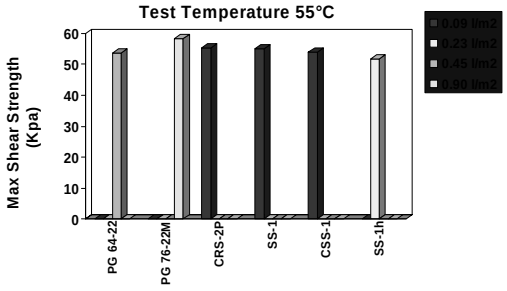
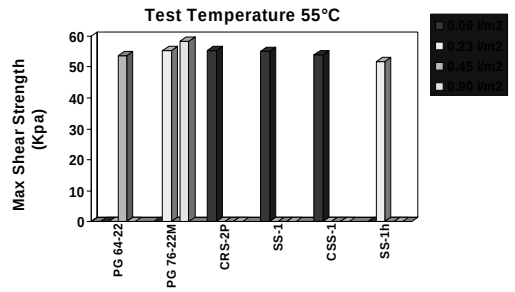


Maximum Interface Shear Strength



Summary and Conclusions

- Controlled laboratory simple shear tests
  - optimum application rate
- The influence of tack coat types, application rates, and test temperatures on the interface shear strength
- Among the six different tack coat materials used, CRS 2P emulsion was identified as the best performer
- Optimum application rate for CRS 2P emulsion was 0.09 l/m^2 (0.02 gal/yd^2)
- At 25C, increasing the tack coats application rates generally resulted in a decrease in interface shear strength
- At 55C, the interface shear strength was not sensitive to the application rate
- CRS 2P at the optimum application rate provided only 83 percent of the monolithic mixture shear strength
- Suggests that the construction of flexible pavements in multiple layers introduces weak zones at these interfaces

Recommendations

Further Research is Recommended to

- Validate laboratory interface strength measurements by conducting similar simple shear tests on field cores;
- Examine the variation of interface strength under fatigue;
- Evaluate the influence of tack coats at interfaces between: an asphalt concrete and a Portland cement concrete layer, and between a new construction surface and an old one; and
- Determine optimum application temperature and curing period for different tack coat types.

NCHRP Project 9-40

Optimization of Tack Coat for HMA Placement

- Determine optimum application methods
- Equipment type and calibration procedures
- Application rates, and
- Asphalt binder materials for the various uses of tack coats

Thank You