TACK COATS: PAST, PRESENT, & FUTURE

24 February 2016

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By a "show of hands," which are true?

1. Tack coat is an important crack prevention measure (for both top down or reflective).
2. Tack coat is an important influence on pavement fatigue life of layered pavements
   a. … by decreasing interface shear stresses.
3. Proven lab methods exist for determing tack coat formulation & application rates.
4. Correlations between lab bond tests & field tack performance are well-established.

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OUTLINE

1. Factors Affecting "Bonding"
2. Current Tack Coat Tests
3. Lab & Field Tests of Tack Coat "Bonding"
4. Results of Pine Shear Test at Ingevity
5. Results of the New IBT Method at Ingevity
6. Conclusions
7. Future Work

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Factors to Consider in Bond Strength

1. Process conditions
   a. Base material temperature & texture
   b. Overlay mixture temperature & thickness
   c. Wind, air temperature, %Rh, solar flux (night v. day)
   d. Compaction effort on overlay

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Factors to Consider in Bond Strength

1. Process conditions
   a. Base material temperature & texture
   b. Overlay mixture temperature & thickness
   c. Wind, air temperature, %Rh, solar flux (night v. day)
   d. Compaction effort on overlay
2. Formulation variables
   a. Base material composition: asphalt or PCC
   b. Base surface dust content
   c. Stiffness of aged binder in base material
   d. Overlay material: asphalt mixture density/workability (compaction), temperature
   e. Tack coat binder type & content, application rate, cure rate (see 1.c.)

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Factors to Consider in Bond Strength (in the LAB)

1. Process variables
   a. Base temperature & texture
   b. Overlay temperature & thickness
   c. Wind, air temperature, %Rh, solar flux
   d. Compaction of overlay
2. Formulation variables
   a. Base composition: asphalt or PCC
   b. Surface dust content
   c. Aged binder adhesivity in base
   d. Overlay density/workability, temperature
   e. Tack %NV, binder PG, application rate, cure rate
3. Testing conditions
   a. Initial bonding pressure
   b. Test temperature
   c. Test geometry: shear, tension, bend, torque

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Lab Test Methods Currently Used

1. **Shear Mode: e.g., NCAT Bond Test & Florida Bond**
2. **Tension mode: e.g., UTEP pull-off & Swiss pull-off tests**
3. **Torque Mode: e.g., Instrotek A-tracker**
4. **Peal or Wedge Mode: e.g., Nottingham impulse hammer & Buttlar Interface Bond Test (IBT)**

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Lab Test Methods Currently Used

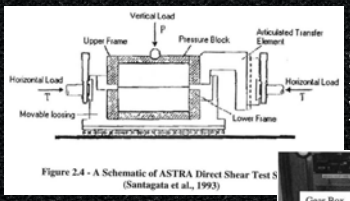


Figure 2.4 - A Schematic of ASTRA Direct Shear Test S (Santagata et al., 1993)

Santagata, E., Canestrari, F., and Santagata, F. A. (**1993**), "Laboratory Shear Testing of Tack Coat Tack coats," **1st WORLD CONGRESS ON TACK COAT**, Paris.

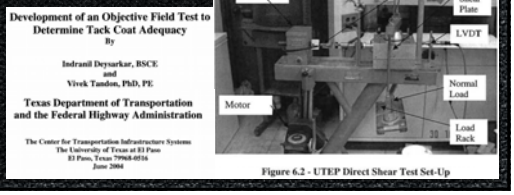
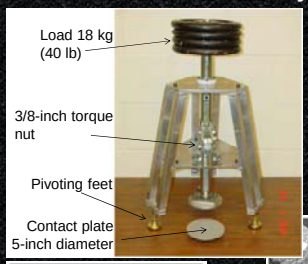


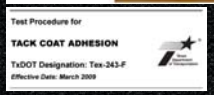
Figure 6.2 - UTEP Direct Shear Test Set-Up

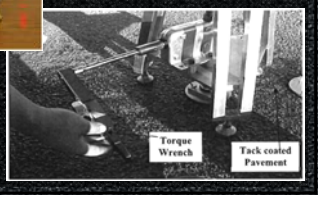
Lab Test Methods Currently Used



Bond Strength = C x Torque

(C is a calibration coefficient)





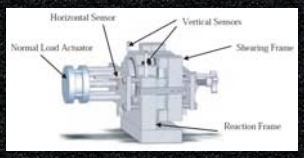
Lab Test Methods Currently Used

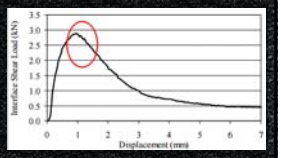
2 PG bitumen + 5 application rates (0 to 0.2 gal/yd²) at 25°C & 55°C.

Mohammad, L.N., et.al., "Influence of Asphalt Tack Coat Materials on Interface Shear Strength", TRB Record 1789, Washington, D.C., 56-65, **2002**.

Lab Test Methods: LISST

LISST = Louisiana Interlayer Shear Strength Tester





www.seaupg.org/PDF/2013/Thursday/5.%20Tack_Coats_LSU_LMohammad.pdf . See, also, NCHRP Report 712, 2012.

Lab Test Methods Currently Used

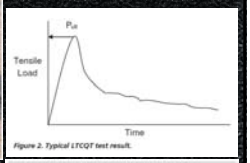


Figure 2. Typical LTCQT test result.

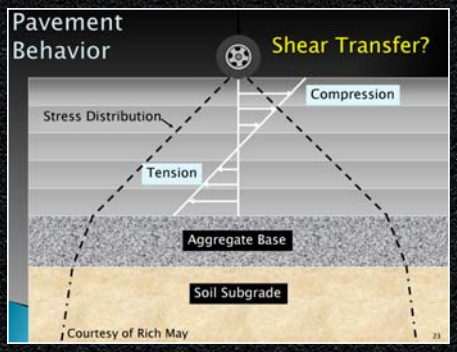
Proposed Standard Method of Test for

DETERMINING THE TACK COAT QUALITY OF ASPHALT PAVEMENT IN THE FIELD OR LABORATORY

AASHTO Designation: TP XX-XX

Proposed test method under review before submitting to AASHTO Subcommittee on Materials

Load Stresses & the Need for Tack Coats



http://ltap.okstate.edu/OK_Tack_Coat.pdf Gerhart, D. & Dietz, J.

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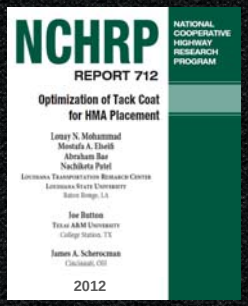
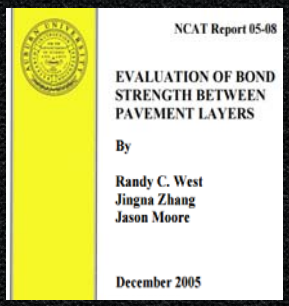
For Thorough Overviews of Tack Bond Tests:





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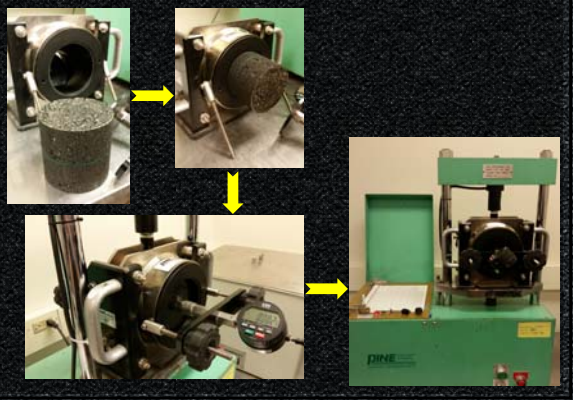
Lab Test Methods: Pine Shear Tester at Ingevity



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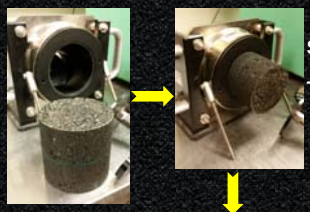
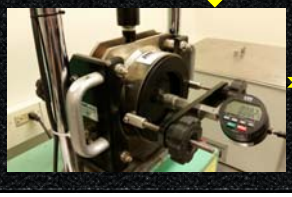


Shear Rate: 50.8 mm/min

Temperature: 25°C



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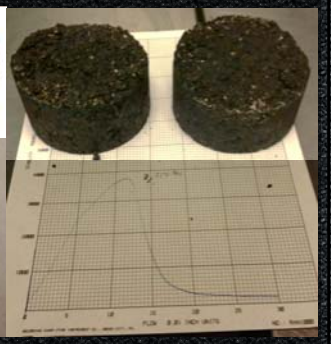

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Lab Test Method: Pine Shear Tester at Ingevity

CUSTOMER 1
3650 lb-f Peak Load

CUSTOMER 1
3750 lb-f Peak Load

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Lab Test Methods: Interface Bond Test (IBT)

Evaluation of Bonding between HMA Layers Produced with Different Tack Coat Application Rates using Shear-type and Tension-type Tests

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Revised: November 15, 2011

Submitted for consideration of presentation and publication at the 2012 Annual Meeting of the Transportation Research Board

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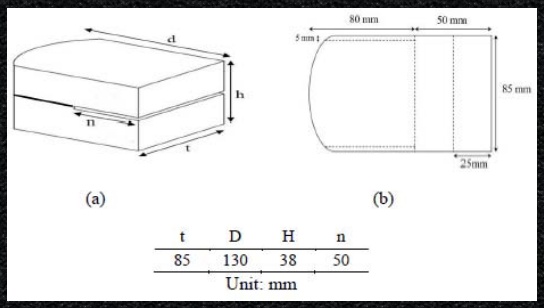
Lab Test Methods: IBT Tester at Ingevity



t	D	H	n
85	130	38	50

Unit: mm

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Lab Test Methods: IBT

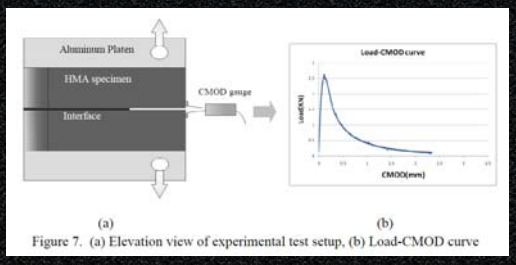

Figure 7. (a) Elevation view of experimental test setup, (b) Load-CMOD curve

Shear Rate: 0.5 mm / min

Temperature: 0 to -40°C

Hakimzadeh, S., Buttlar, W., et.al. "TRB 2012."

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Lab Test Methods: IBT Tester at Ingevity

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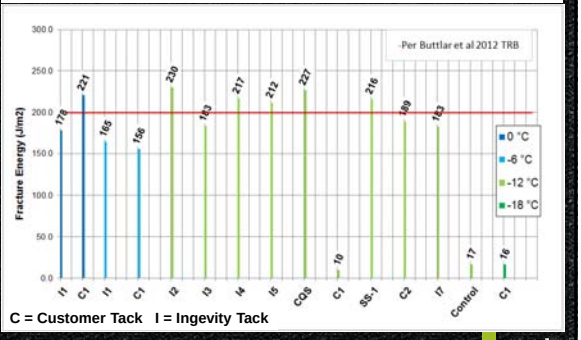
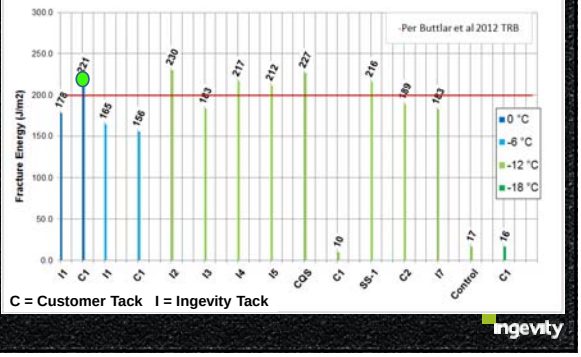
Tack Coat Composite Sample Testing, 0.075 gall Emulsion/sq-yd



C = Customer Tack I = Ingevity Tack

Lab Test Methods: IBT Tester at Ingevity

Tack Coat Composite Sample Testing, 0.075 gall Emulsion/sq-yd



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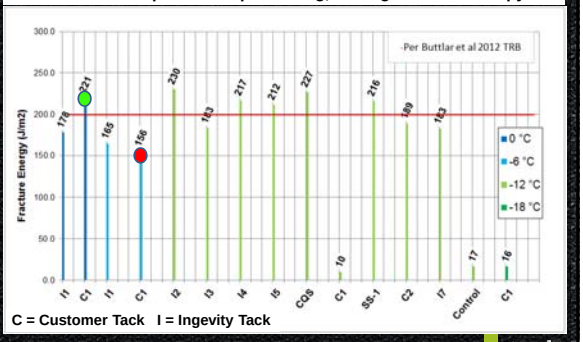

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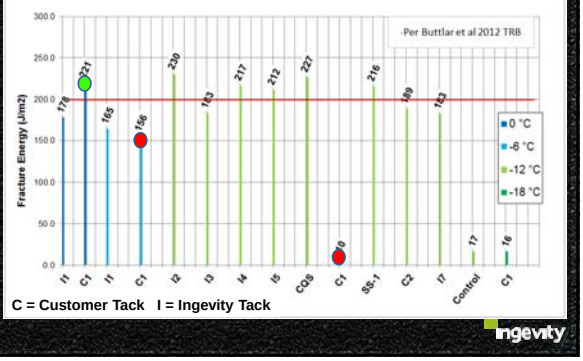

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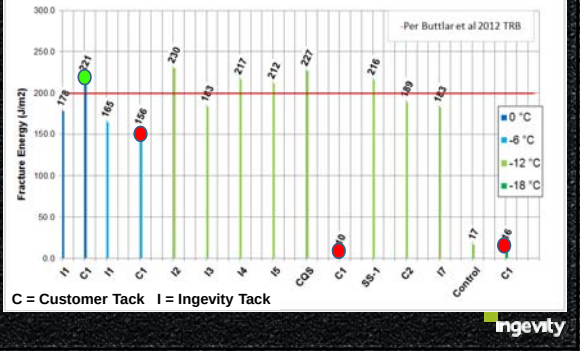

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Conclusions for this Work in Progress

1. Speciment preparation improved: a) platen surface areas maximized to improve bonding; b) eliminated unnecessary specimen cuts; c) a glue-ing fixture was developed.
2. The IBT enables differentiation of tack coat bond strength as a function of temperature
3. As determined in Buttlar's work, IBT provides differentiation as a function of tack coat materials (e.g., PMAE vs CSS-1h vs other)

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Future Work

1. Improvements in sample preparation: a) reduce "play" in the pull pins; b) saw cut jigs being developed to increase productivity and reduce coefficient of variability between samples
2. Other formulation variables to be examined: a) application rates; b) overlay temperature; c) milled HMA & PCC surfaces; d) binder grade.
3. Process variables to be examined: a) shear rate; b) specimen size

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QUESTIONS?

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