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Illinois Asphalt Pavement Association (IAPA)

Scholarship Research Report

Field Tests of Tack Coat Materials

Prepared for the IAPA Scholarship Committee

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Submitted on: January, 2020

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INTRODUCTION

Tack coat (also known as bond coat) is a light application of asphalt, usually asphalt emulsion between hot mix asphalt layers diluted with water. Tack coat is designed to create a strong adhesive bond without slippage, onto an existing relatively non-absorptive pavement surface [2]. It is used to ensure an adequate bond between the pavement being placed and the existing surface. Heavier applications may be used under porous layers or around patches where it also functions as a seal coat. A tack coat provides necessary bonding between pavement layers to ensure that they behave as a single system to withstand traffic and environmental stresses. It may also be applied to the surface of a new hot mix asphalt (HMA) pavement layer before the next layer is placed, such as between an HMA leveling course and an HMA surface course [1].

Without tack coat, the asphalt layers in a roadway may separate which reduces the structural integrity of the road and may also allow water to penetrate the structure [2].
The type of emulsion used for tack coats varies from country to country. Normal practice in the USA is to use a slow-setting emulsion that is diluted with water before application. In many European countries, cationic rapid setting or specially designated low viscosity medium setting emulsions are used, which are applied undiluted [3].

The selection of an optimum tack coat material and application rate are crucial in the development of proper bond strength between pavement layers. In general, the selection of tack coats has been mainly based on experience, convenience, and empirical judgment. In addition, quality-control and quality-assurance testing of the tack coat construction process is rarely conducted, resulting in the possibility of unacceptable performance at the interface and even premature pavement failure.

OBJECTIVE AND SCOPE

The main objective of this project is to understand the purpose and procedure of field-testing of tack coat materials. This involves the summary of professional reports, books, thesis, journals, and researches related to the tack coat.

AVAILABLE IN SITU BONDING TESTS

This report presents test methods for measuring the quality and performance characteristics of the tack coat in the field. Filed testing is very important to perform to measure the effectiveness of tack coat in order to predict the life expectancy of tack coat, and if possible make possible improvements to improve the quality of tack coat. Field-testing can be considered more important than lab testing because some parameters can change in the lab that can be only found on the site. Weather is a good example that is hard to duplicate in lab testing making the sample not an “exact” sample. Table 1 describes interface bond strength and tack coat film test devices used in the field to characterize tack coat application and performance. In this report, the available in situ bond test includes; UTEP pull-off test, torque bond test, in-situ shear stiffness, traction test and instrotek ATACKER™ test.

Table 1. **Available in situ bonding tests**

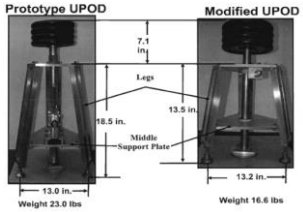
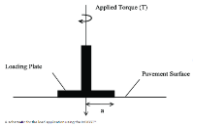
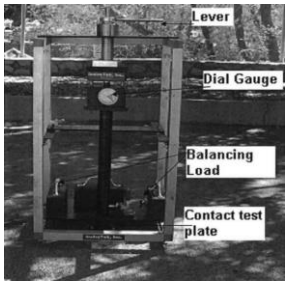
TEST NAME	APPARATUS/ PICTURE	BRIEF DESCRIPTION ABOUT THE EQUIPMENT	TEST PROCEDURE	TEST SPECIFICATION	LIMITATION
University of Texas El Paso (UTEP) Pull-off Test (UPOD)	UPOD 	UPOD developed at the University of Texas at El Paso. Measures the tensile strength of the tack coat before a new overlay is applied. the instrument weighs about 10.4kg (23lb) and it is leveled by adjusting the pivoting feet, as can be seen in picture provided [3]	A torque force is applied to detach the back-coated plates or detach the contact plate and tack-coated pavement [1]	After the Tack coat is applied on the pavement, it is allowed to set for 30 minutes. Thereafter, the device is placed on the tack-coated surface. A 18kg (40lb) load is placed on the weight key at the top of the device for 10 minutes prior to testing. In order to set the contact plate the load is then removed and the torque wrench is rotated in the conterclockwise direction to deatach the contact plate from the tack-coated pavement[3]	The measured tensile strength is only the adhesion property at the time of testing and cannot be used to predict for other temperatures and environmental conditions. The tests are neither force nor displaced controlled, and there is no temperature control Stress Vs Strain. Curves cannot be obtained for further analysis[4]
Torque Bond	Torque Bonding Test 	The torque bond test has been used as an in-situ test to determine bond strength of HMA layers; however it can also be performed in the lab on core specimens[2]	A torque force is applied to core sample from pavement with a torque wrench to failure. Torque force at failure is measure to evaluate the in-place bond effectiveness of wearing course system[1]	1. Clamp specimen 2. Set the torque device 3. Apply torque to specimen to failure (Steady rate of torque should be applied to the specimen)	For the Site test method, coring must be made to a depth of 0.787in below the surface. Also surface must be dry and clean in order to use the bonding material for the plate. In addition torque wrench must sweep at a 90° angle[2]
In-Situ Shear Stiffness	InSiSST 	A trailer-mounted testing equipment developed at Carleton University to evaluate the in-situ shear properties of AC mixes. The shear strength is measured to evaluate the shear properties of asphalt concrete pavements in the field. Shear properties of pavement relate to the performance of the pavement[5]	A rotational force is applied to the pavement through a test plate, meanwhile a normal weight is provided by the test equipment[1]	The testing facility applies a force angular displacement to a circular area on the pavement surface through forcing a steel plate bonded to the pavement to rotate about an axis normal to the surface. The following picture is a schematic for the load application during in-situ testing[5] 	Angular displacement is calculated assuming constant strain rate. However, further investigation has shown that depending on the condition of the AC mixture, the actual strain rate might not be constant[5]

Table 1. Continued

TEST NAME	APPARATUS/ PICTURE	BRIEF DESCRIPTION ABOUT THE EQUIPMENT	TEST PROCEDURE	TEST SPECIFICATION	LIMITATION
Traction	Traction Test 	Method used to determine the interface bond strength. Used to quantify interface bond strength between layers[1]	A tensile force is applied at constant rate of 54lb/s to a cylindrical sample until failure[1]	Tensile strength of the tack coat interlayer is measured to evaluate the bonding property of tack coat. The bonding property is used to determine the appropriateness of the material for use as tack coat[1]	Limited to a 54lb/s force
Instrotek Atacker(TM)	"The new Pull off Test" / Atacker test 	AtackerTM is an improved device of the Texas Pull-off test developed by Instrotek R, Inc. The development was in accordance to the American Society of Testing and Materials (ASTM) Specificatin D4541. Developed to evaluate the tensile and torque-shear strenght of tack coat materials at various application temperatures, rates, dilutions, and set times[6]	A pull and/or force is applied to detach the tackcoated plates or detach the contact plate and tack coated pavement[1]	Test procedures starts by applying a specified application rate and then a variety of curing times were considered for each of the emulsions. Subsequently a normal pressure was applied to move the loading plate downwards on the tacked surface. The loading plate was then pulled up and the tensile stress or torque required to separate the loading plate from the tacked surface was recorded. Shear on tensile strength of tack coat material are measured to evaluate its bonding propery. The bonding property is used to determine the appropriateness of the material for use as tack coat[6]	Limited ranges of applied normal force, tack coat evaluation device (TCED) for gauge load capacity, and innacurate loading rates were determined to be the major factors reducing test results accuracy and precision[6]

SUMMARY

Tack coat field tests have been conducted to better understand the current state of tack coat practices and to design a corresponding experiment. The primary objective of the field tests is to investigate the current tack coat state of practice related to types of materials used for tack coats. Several field tests have been studied to meet these objectives. Field-testings are studied to facilitate and to improve the bond between the existing pavement and the new seal to be implemented. In total, 5 field tests are described in Table 1 with the hope of having a better understanding of what weak areas to target on tack coat.

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[4] Xiao, Y., van de Ven, M.F.C., Wu, S.P., Woldekidan, M.F., (2016). “Advanced pull test to determine adhesion properties of thin surfaces of pavement.PDF” Advanced pull test to determine adhesion properties of Thin, 2016. www.coursehero.com/file/45035441/Advanced-Pull-Test-to-Determine-Adhesion-Properties-of-Thin-Surfaces-for-Pavementpdf/.

[5] Bekheet, Wael & Halim, A & Easa, Said & Ponniah, Joseph. (2004). “Investigation of shear stiffness and rutting in asphalt concrete mixes.” Canadian Journal of Civil Engineering. 31. 253-262. 10.1139/I03-093.

[6] Mahmoud, Aiman Mustafa H. (2016) “Development of Technologies to Evaluate Hot Mix Asphalt Adhesion through Tack Coat.” *ScholarsArchive@OSU*, Oregon State University, 25 Aug. 2016.