Minnesota Department of Transportation

Memo

Office of Materials
1400 Gervais Avenue, Mail Stop 645
Maplewood, MN 55109

Office Tel: 651/366-5596
Fax: 651/366-5461

TO: File: Research on Longitudinal Joint Deterioration

FROM: Mark Watson, PE
Research Engineer

DATE: 10 March, 2011

SUBJECT: TH 10 Longitudinal Joint Treatment and Testing

Introduction:
This memo describes the longitudinal joint fog seal, joint adhesive treatment and the subsequent testing of the centerline joint cores for density and permeability.

Joint Stabilization (JointBond®) and Joint Adhesive Treatments Applied:
Joint Stabilization (Joint Bond®) is a polymerized maltene emulsion designed to penetrate into the longitudinal joint. This is a "rejuvenator" treatment that is advertised to improve the properties of the longitudinal construction joint. This product can be applied 1.0 to 1.5' on either side of the longitudinal construction joint of Hot Mixed Asphalt (HMA) pavements. This treatment, according to the manufacturer, works best when applied right after paving, or within 12 months, and has the purported benefits of 'fortifying' the longitudinal joint and making the pavement impervious to water and salt brine.

Joint Adhesive is a thick (1/8" 3 mm), or rubberized joint sealer (similar to crack seal). The material is designed to provide a better bond between HMA passes and produce a better, more durable longitudinal joint.

Application on T.H. 10 (SP 7102-120):
October 2010 on T.H. 10 WB:

- Joint Bond plus Joint Adhesive was applied on TH 10 WB: RP 209 – 209.99.
- Joint Bond only was applied on TH 10 WB: RP – 210 – 210.99.
- Field Personnel noted a visible reduction in pavement marking retro-reflectivity after joint bond was placed over interim pavement markings (The inspector noted that, if he were to do the project again, he would have required the contractor to re-apply the interim pavement markings)
- Permanent Pavement Markings were applied over the Joint Bond Product

Observations:

- 2 miles on a state highway project is the largest application of Joint Bond

Laboratory Testing and Evaluation:
Cores were extracted over the centerline construction joint in accordance with Mn/DOT specifications, which require the edge of the core barrel to be 6" away from the joint in each of the test sections. An additional set of cores were taken directly over the visible seam of the longitudinal joint. Note that the control section only had one core extracted from directly over the joint and did not have a core extracted 6" away. These cores were tested for in-place voids and later for permeability.

Permeability testing was accomplished using the laboratory Permeameter (Figure 1), also known as the Karol-Warner flexible wall permeameter. The coefficient of water permeability, k was found using the relationship described in Figure 1.

The coefficient of permeability provides an indication of the ease with which water can pass through the specimen, higher values indicate that it's easier for water to flow through the specimen and lower values indicate that it's more difficult for water to flow through the specimen.

$$k = \frac{al}{At} \ln\left(\frac{h_1}{h_2}\right).$$

Where:

k	coefficient of permeability, cm/sec
a	inside cross-sectional area of standpipe, cm^2
l	thickness of test specimen, cm
A	cross-sectional area of specimen, cm^2
h_1	hydraulic head on specimen at time, t_1
h_2	hydraulic head on specimen at time, t_2

Figure 1. Laboratory Permeameter (Left) and Permeability Calculation (Right)

The permeability testing results of TH 10 cores specimens are shown in Figure 2, the boxed numbers are the measured air voids, percent from the cores. As expected, the control section (no treatment) had the greatest permeability value at 0.007 cm/sec; however this section also had the highest air void content at 16.9% followed by the Joint Adhesive section at 16.7%. The lower densities measured on cores extracted 6" away from the CL appear to have less permeability than cores extracted directly over the centerline with higher air voids. For cores extracted 6" away; the adhesive section had the lowest permeability; the jointbond + adhesive, and the jointbond sections had roughly the same permeability at 0.0006 cm/sec.

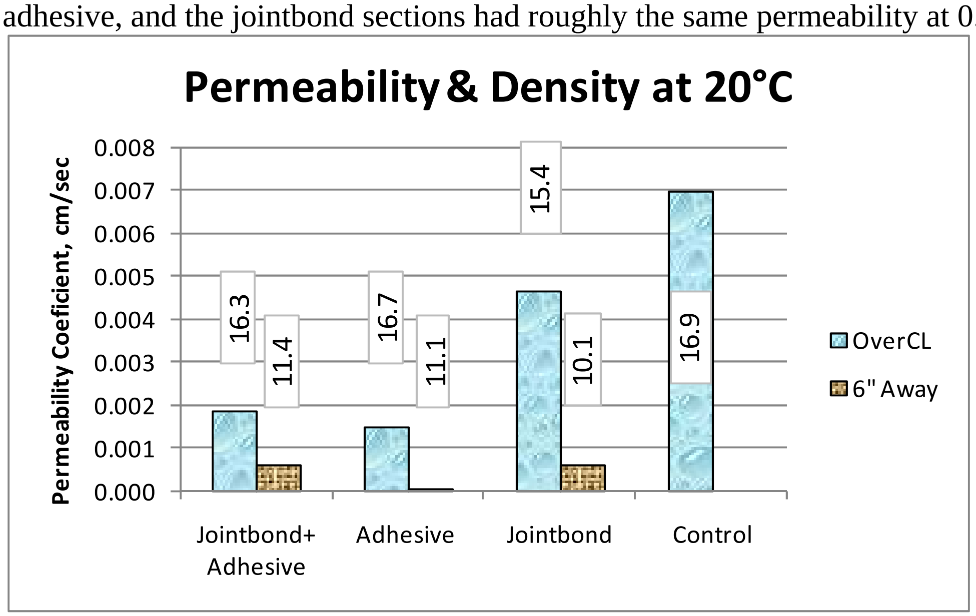

Figure 2. Laboratory Permeameter Results

Discussion:

Cooley, Brown and Maghsoodloo (2001) reported that coarse, dense graded SuperPave mixtures with a nominal maximum aggregate size of 3/4" (19.0 mm) became excessively permeable at approximately 5.5% in-place air voids, which corresponded to a field permeability value of 0.0012 cm/sec. They also observed that permeability appeared to increase exponentially with in-place voids (Figure 3).

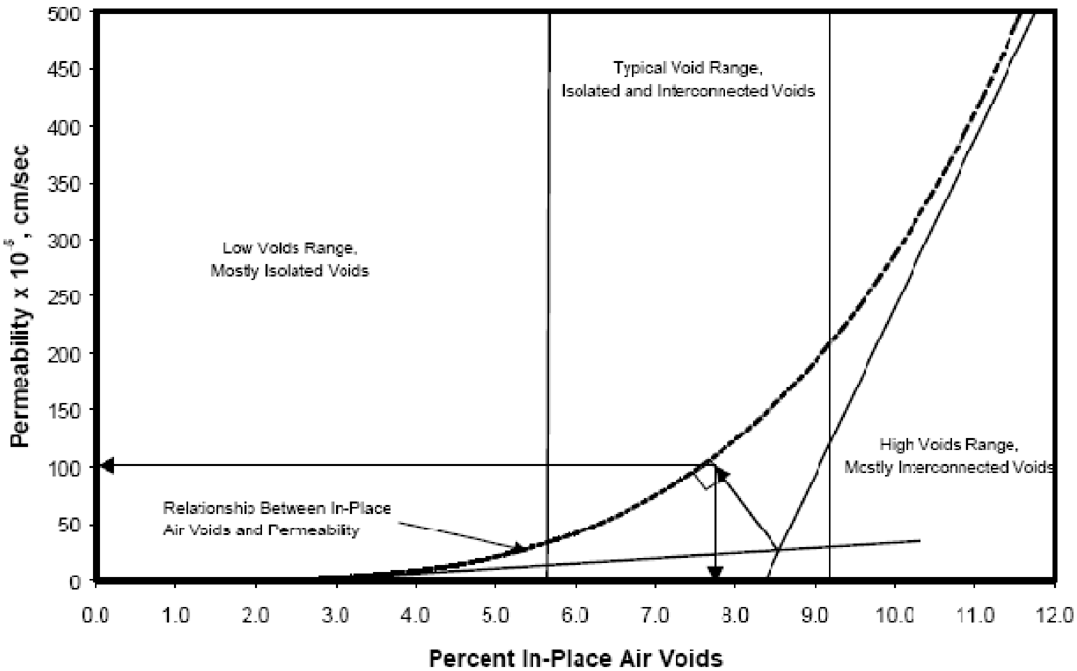

Figure 3. Relationship between permeability and in-place voids (Cooley et. al., 2001)

TH 10 permeability values measured in the laboratory, were 1.3 to 7 times higher than the recommended field permeability threshold of 0.0012 cm/sec for cores extracted directly over the centerline. The permeability values of cores extracted 6" away from the CL were all less than this threshold. However, it is not clear what the relationship between laboratory and field permeabilities are at this high air void content.

At this time it is unclear what impact the longitudinal joint treatments: Joint adhesive and Joint Bond are having on the permeability of the pavement due to the confounding effect of density and the limited number of samples available for testing (only one core was tested). However, the presence of joint adhesive does appear to reduce permeability, but this needs to be verified with additional samples and testing. In addition, JointBond is marketed as a rejuvenator and not as a sealer, permeability does not test rejuvenation. Long term performance has not been determined for any of these products.

There does appear to be a clear difference in permeability and density performance between cores extracted 6" away from the joint and those extracted directly over the centerline joint.