APPLICATIONNOTES

Using LTPPBind V2.1 to Improve Crack Sealing in Asphalt Concrete Pavements

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The Challenge

Repairing cracks in asphalt concrete pavements is essential to insuring pavement performance and reducing life-cycle maintenance and replacement costs. One of the ways to extend pavement life is to include crack-sealing treatments as part of pavement preventive maintenance practice. The effectiveness of these treatments depends on many factors, including the properties of sealant materials, installation methods, temperature extremes, pavement conditions, traffic levels, and crack movements.

Sealants with different properties are needed in different climates. Warm climates require stiff sealants to resist hot summer temperatures. If the sealant is too soft, it may flow or be pulled from the crack by vehicle tires. Softer, more flexible sealants are more appropriate for cold climates in which pavements are prone to large crack movements, especially during the winter. In any given climate, sealant materials must function over the range of temperatures from summer to winter.

Installation methods also vary by climate. Correct installation ensures that the sealant can conform to crack movements in the pavement. The tendency of pavement cracks to widen or move in the winter increases as the distances between existing cracks and variations in winter and summer temperatures increase. If the installation is not correct, cracking or debonding may develop as cracks widen in the winter.

Pavements in good condition that demonstrate transverse thermal cracking, but otherwise have minimal cracking, are best treated with rout and seal procedures. These procedures use very flexible and extensible sealants in widened reservoirs with working cracks that move more than 3 millimeters (mm) throughout the year. For pavements with more extensive cracking, such as longitudinal, block, fatigue, and closely spaced transverse cracks in which crack movement is minimal (less than 3 mm a year), techniques such as crack filling, clean and seal, and overband are appropriate. These techniques use stiffer, more traffic-resistant sealant materials in cracks that generally are not widened.

In the past, highway agencies from across the United States have developed area-specific crack-sealing treatment procedures through a series of test sections, evaluating and investigating sealant types and installation methods by trial and error. Selecting sealant materials for specific climates has been based on approximate descriptions of temperature ranges in hot, moderate, or cold climates, and with some general air temperature highs and lows.

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there will be less pavement crack expansion in Omaha than in Mildred or Fairbanks, and even less expansion in Washington, DC.

Laredo, TX, in contrast, has a high pavement temperature of 65 °C and a low pavement temperature of -4 °C—a 69 °C range. In this climate, crack sealants must tolerate hot pavement temperatures and must remain workable only to -4 °C, which is quite different than the requirements for sealants in Fairbanks, AK.

Table 2. Summary of 98-Percent Reliability Rates from LTPPBind Measured at the Laredo, TX, International Airport Weather Station.

Latitude, degree	27.53	
Depth to surface of layer, mm	0	
Desired reliability, percent	98	
Traffic loading, million ESAL	0	
Traffic speed	Fast	
Method for adjusting for traffic	Strategic Highway Research Program	
Pavement temperature and pavement grade	High	Low
Design air temperature, °C	39.8	-2.7
Design air temperature, standard deviation	.8	2.7
Using HT/LT Model: LTPP/LTPP	High	Low
Design pavement temperature, °C	64.7	-3.7
Adjustment for traffic loading	+0	
Adjustment for traffic speed	+0	
Adjusted pavement temperature, °C	64.7	-3.7
Selected binder grade	70	-10

Using LTPPBind to Select Crack-Sealing Materials

Typical specifications for crack-sealing materials include sealant property evaluations at high, moderate, and low temperatures. The evaluations provide some information on materials characteristics at those temperatures. Using LTPPBind, sealant properties at anticipated high and low temperatures can be evaluated or compared.

Low Temperature Properties

Sealants that meet the American Society for Testing and Materials (ASTM) D6690-Type I (ASTM D1190) are evaluated for low temperature bond at -18 °C using 5 cycles of 50-percent extension. This -18 °C temperature exceeds the -16 °C LTPPBind temperature grade, which indicates that these materials can function at -16 °C. D6690 Type II (ASTM D3405) sealants are tested for bond using 3 cycles of 50-percent extension at -29 °C, which exceeds the -28 °C LTPPBind temperature grade, indicating functioning at -28 °C. ASTM D6690 Type IV (low modulus D3405) sealants are evaluated for bond at -29 °C, but with 200-percent extension. These materials typically will pass 50- or 100-percent bond tests at temperatures as low as -40 °C. These types of sealants are used most often in -34 °C or -40 °C LTPPBind-rated climates.

Flexibility or mandrel bend testing also is performed commonly on materials that are used to treat and fill nonworking cracks. Test procedures vary somewhat, but ASTM D3111 with a 25-mm diameter mandrel and a 10-second bend time is typical. Even though these crack types typically do not move as much as thermal transverse cracks, the selected materials should not become brittle at low temperatures for the climate. Common flexibility test temperatures are -7, -12, -18, -29, and -34 °C. These temperatures are similar to the LTPPBind grades

Table 3. Grade Summary Based on 98-Percent Reliability Rates from LTPPBind Temperatures for Various Climates.

Climate Description	Location	High	Low	Range	Grade
Extreme Cold	Fairbanks, AK	47.3	-48.9	96.2	52–52
Very Cold	Mildred, ND	58.9	-34.8	93.7	64–40
Cold	Omaha, NE	58.3	-24.4	82.7	64–28
Moderate	Washington, DC	59.2	-13.0	72.2	64–16
Hot	Laredo, TX	64.7	-3.7	68.4	70–10
Coastal	San Diego, CA	56.3	0.4	55.9	58–10

98% Pavement Temperatures, °C