A Materials Approach to Improving Asphalt Pavement Longitudinal Joint Performance

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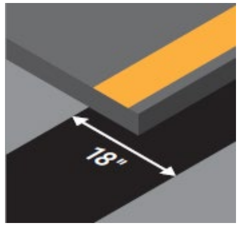
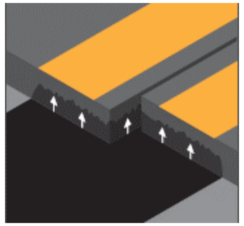
Introduction

- Longitudinal joint performance is key to asphalt pavement performance
- Service life is reduced near the joint up to 36% due to high voids and permeability
- Shortcomings in mechanical methods of improving joint construction led Illinois DOT (IDOT) to the concept of a materials solution: Longitudinal Joint Sealant (LJS)
- Studies of field trials demonstrated the improved performance and life cycle cost benefits, which led to a specification and use of LJS across the highway network

Concept

- A distributor sprays a hot polymer-modified asphalt (not rubber) at a typical width of 18 inches (457 mm) at the planned location of the longitudinal paving joint





- As the hot mix is paved over the LJS and compacted, LJS softens and migrates up into the interconnected voids, making them impermeable to water and air

Original Research

- Bureau of Materials and Physical Research (BMPR) at IDOT reached out to two companies for LJS product
- Goal to fill voids from the bottom-up out to a distance of 9 inches (229 mm) from the joint interface
    - Goal of LJS migration of 50-75% of layer thickness
- Several experimental projects in 2001-2002 were built
- Another goal was to be construction friendly, meaning it could be driven over by construction traffic without picking up
- Projects observed over a decade later

Results of the Research

IL-50, District 1

Control

LJS-1

LJS-2

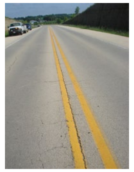
	Control	LJS-1	LJS-2
Permeability* x 10^{-5}, cm/sec	1.5	0	2.5
AC content, %	5.1	7.1	6.7
Air voids, %	10.0	7.9	9.4
Digital image migration, %	-	44	16

IL-26, District 2

Control

LJS-3

LJS-4



	Control	LJS-3	LJS-4
Permeability* x 10^{-5}, cm/sec	372.5	0.2	75.3
AC content, %	5.9	10.3	7.6
Air voids, %	7.6	4.0	6.1
Digital image migration, %	-	65	31
Flexibility Index	0.2	9.0	1.9

US-51, District 7

Control

LJS-5

	Control	LJS-5	LJS-6
Permeability* x 10-5, cm/sec	111	0	0.5
AC content, %	5.1	9.4	10.7
Air voids, %	7.1	3.4	0.4
Digital image migration, %	-	>75	>75
Flexibility Index	0.8	23.3	21.1

Results of the Research, continued

- LJS formulations were adjusted from project to project
- *Permeability was the bottom half of the core

Material Properties and Rates

- Based on the research, a construction and materials specification was developed

Test	Requirement
DSR (unaged) at 88°C – G*/sind ,kPa	1.0
Creep stiffness (unaged) at -18°C Stiffness (S), MPa m-value	 300 max. 0.300 min.
Ash, %	1 – 4
Elastic recovery, 25°C, %	70 min.
Separation of polymer, diff. in R&B, °C	3 max.

- Stiff at high temperatures
- Flexible at low temperatures
- Unaged – No HMA plant; covered by HMA
- Rates are based on 18-inch (457 mm) width with more values in the paper

Overlay thickness	Coarse mix, lb/ft	Fine mix, lb/ft	SMA, lb/ft
1.5 in. (38 mm)	1.47	0.95	1.26
2.0 in. (50 mm)	1.8	0.95	1.51

Life Cycle Cost Analysis

- Illinois calculates based on a 15-year life cycle
- Average awarded LJS price was $2.39 / linear foot (2020)
- Break-even price of $6.46 for one-year added life (year 16)
- Life extension of joint experienced to date is 3 to 5 years