Tack Coat Strategies: Field Performance and Life Cycle Cost

The Problem

A good bond provided by a tack coat can improve performance of hot mix asphalt (HMA) overlays. Emerging materials and application methods (i.e. trackless tack and spray pavers) help with constructability concerns, however, the long-term benefit of these strategies is unknown. The objective of this research was to assess the performance and cost-effectiveness of conventional and emerging tack coat strategies

What the Researchers Did

Bond performance for several variables was measured. The researchers constructed test sections in the field considering:

- Surface type (new HMA and milled HMA).
- Tack type (SS-1H, trackless, and rubberized).
- Tack rate (0.04 to 0.13 gal/sy).
- Application method (distributor and spray paver).
- Bond age (initial and 8-months later)

The bond performance of cores after construction and 8-months later were tested in the lab with an interface shear strength tester at a rate of 2 in./min. The results were analyzed statistically to identify which variables affected bond performance.

A life-cycle cost analysis was performed for the statistically significant tack coat strategies. This involved two parts:

1. Predicting the long-term performance in terms of reflection cracking, rutting, and fatigue cracking.
2. Estimating initial, long-term maintenance, and rehabilitation costs.

Prediction was done with finite element, multi-layer elastic, and mechanistic-empirical models. The life-cycle cost of the test sections was estimated by summing the initial material costs, routine maintenance costs (based on cracking over time), and rehabilitation costs at failure over 15-years.

What They Found

Tack type and application method, and bond age were found to be statistically significant variables. Trackless tack had the highest bond performance High performance was achieved by SS-1H placed with a distributor, and by no-tack samples. The rubberized tack and SS-1H placed with a spray paver had the lowest bond performance, though the performance doubled after 8-months. The effect of tack rate on the bond was inconclusive. There was no statistical difference between bonding to new and milled HMA surfaces (though significant differences have been noted in other studies).

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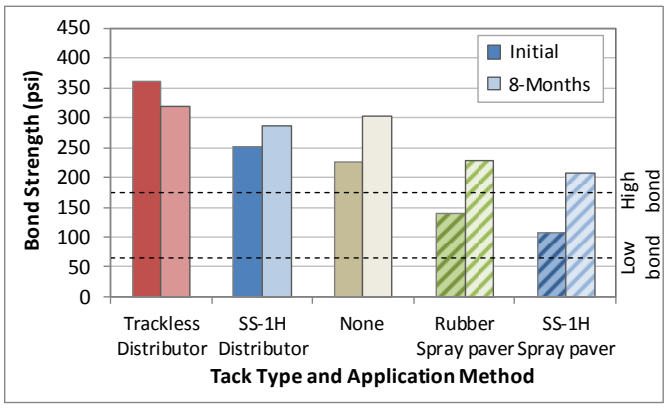

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In the performance predictions, higher bond strength generally resulted in longer service life; however, on the milled HMA sections, the optimal performance was achieved at a partially bonded condition. Poor bond performance was always associated with short overlay service life.

The differences among life-cycle costs for the new HMA test sections were small — $3,000 to $10,000/lane-mile between the least expensive and most expensive section, or about 2 to 6 percent of the overall cost.

What This Means

The researchers recommend using the interface shear strength test for measuring bond quality. Two types of tack coat construction specifications were developed. The method-based specification had few modifications from the existing specification, allowing slightly higher application rates. The performance-based specification moves responsibility for selecting the tack rate to the contractor and requires a minimum bond strength of 70 psi for acceptance.

At this time, the researchers do not recommend enforcing the performance-based specification. Rather, the Department should collect bond and performance data on a variety of projects, and should monitor the long-term performance of the test sections.

The most cost-effective treatment was SS-1H placed with a spray paver, but the savings compared to alternative materials and methods were small. The Department should consider allowing the contractor to choose the tack material, application method, and application rate that is most convenient for their operations, considering they meet minimum application rate and uniformity requirements.

The DOT should be aware that initial bond performance from a spray paver operation is lower than from a distributor application. This is because the water in the tack does not have time to escape the emulsion. The strengths will increase significantly with time, likely within the month. Still, this may be a concern when paving in severe stopping/accelerating traffic conditions, where high bond performance is needed immediately after construction.

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