OKLAHOMA Transportation RESEARCH

PROJECT TITLE
IMPLEMENT LONG TERM PAVEMENT PERFORMANCE MONITORING OF SIX LTPP SPS-10 SECTIONS IN OKLAHOMA WITH 3D LASER IMAGING

FINAL REPORT ~
FHWA-OK-19-05
ODOT SP&R 2115

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HIGHLIGHTER

LONG TERM PAVEMENT PERFORMANCE MONITORING OF SIX LTPP SPS-10 SECTIONS IN OKLAHOMA WITH 3D LASER IMAGING

April 2020

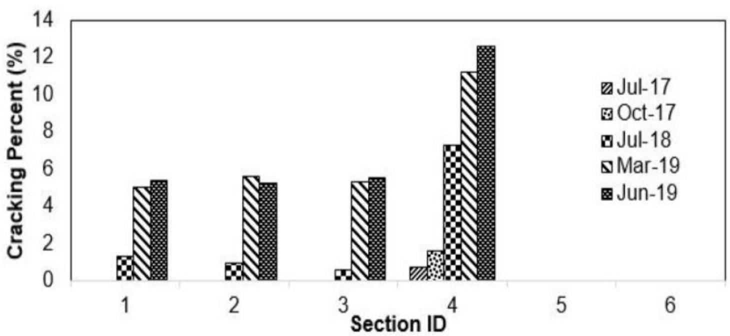
OVERVIEW The use of warm mix asphalt (WMA) technology, which is defined as an asphalt concrete paving material produced and placed at temperatures approximately 50°F cooler than those used for hot mix asphalt (HMA), offers significant benefits, notably, lower energy demand during production and construction, reduced emissions at the plant and the paver, and increased allowable haul distances. As a result, WMA for asphalt pavement construction has dramatically increased in the US over the past decade. At least 30 state departments of transportation (DOTs) have established specifications permitting the use of WMA. Studies have been conducted to evaluate the performance of plant-produced lab-compacted mixtures utilizing various WMA technologies. However, as WMA moves into mainstream use, one primary obstacle of WMA implementation is the uncertainty about how WMA may affect short- and long-term field performance.

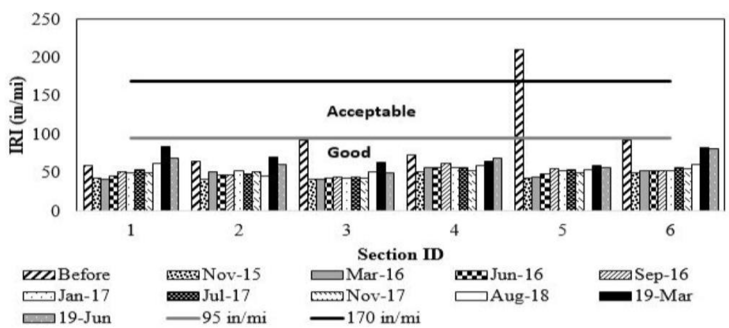
RESULTS The Long Term Pavement Performance (LTPP) Program of Federal Highway Administration (FHWA) recently initiated a new program, Specific Pavement Study 10 (SPS-10), to evaluate the long term performance of WMA mixtures. Within the initiative, this study worked with the Oklahoma Department of Transportation (ODOT) in constructing five warm mix asphalt (WMA) test sections and one hot mix asphalt (HMA) control section, as shown in the following table.

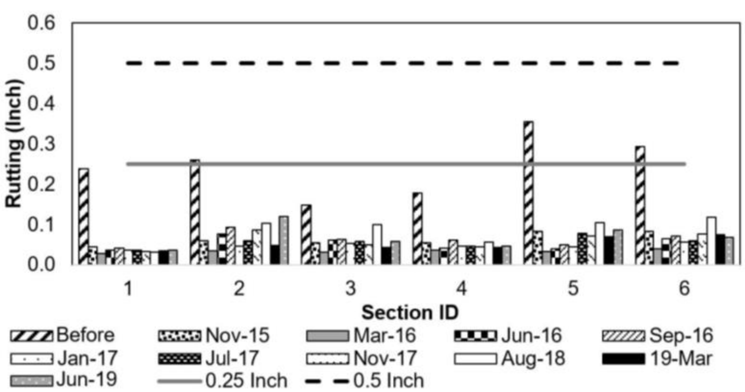
Section	Binder	Mix Description	Aggregate Mix #	AC (%)
1	PG 70-28	HMA with RAP + RAS	1	4.9
2	PG 70-28	WMA Foaming with RAP + RAS	1	4.9
3	PG 70-28	WMA Chemical with RAP + RAS	1	5.0
4	PG 64-22	WMA Chemical with RAP + RAS	1	5.0
5	PG 58-28	WMA Chemical with RAP + RAS	1	5.0
6	PG 70-28	WMA Stone mix with mineral filler	2	6.6
Mainline	PG 70-28	HMA with RAP	3	5.1

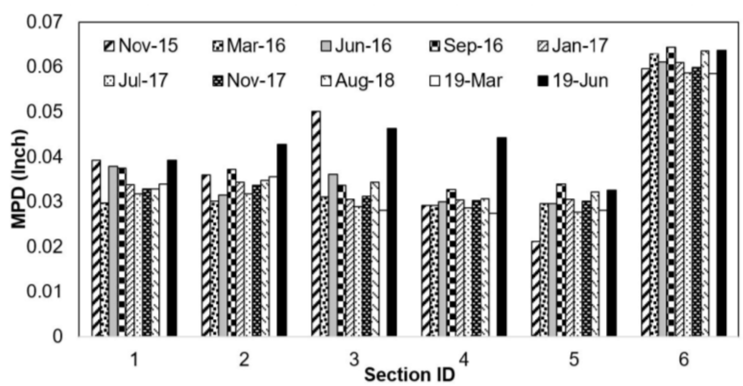
Several state-of-the-art instruments were used to collect a comprehensive array of pavement surface characteristics data: the PaveVision3D system captured pavement images for cracking and rutting analysis, the AMES Profiler collected pavement roughness and macrotexture data, and the Grip Tester measured pavement friction performance. These three devices can perform condition testing at highway speed without interrupting traffic. The data collection was performed biannually for the past five years for long term field performance evaluation.

Results show that four of the five WMA sites exhibit comparable performance as compared to that of the HMA section, in terms of pavement cracking, rutting and roughness (shown in the figures). In addition, aggregate properties and mixture design show impacts on pavement macrotexture and skid resistance properties. WMA Sections 2 and 3, with the same binder grade, content, and gradation as that of the HMA control section (Section 1), achieved comparable performance relative to the conventional HMA in terms of pavement cracking, rutting, roughness, macrotexture, and friction. WMA Section 4 showed much more transverse cracking than the HMA control section because it used PG 64-22 as its binder, one grade higher in the low temperature as compared to PG 70-28 on Section 1. However, WMA Section 4 reached similar performance to that of the control HMA section after 4 years of service in terms of rutting, roughness, macrotexture, and friction. No cracking was observed on WMA Section 5. For other surface characteristics, WMA Section 5 achieved comparable performance as that of the HMA control section. WMA Section 6 had a higher binder content (6.6%) and exhibited no cracking as of June 2019. No difference was observed between WMA Section 6 and the HMA control section regarding rutting and roughness. However, Section 6 with SMA design had larger mean profile depth (MPD) values and was able to maintain higher pavement skid resistance with increasing water film depth.









Recommendations of this study include (1) the continuance of monitoring the ODOT SPS-10 WMA pavement sites to gain greater insight about the intermediate-term and long-term performance of WMA (2) expansion of scope to include friction and safety related implications, and (3) constructing additional WMA sites with high-percentage recycle content, monitoring their field performance, conducting life cycle cost analysis, and developing recommendations and guidelines for the wide adoption of WMA by ODOT.

POTENTIAL BENEFITS Pavement performance should be monitored in a true long-term manner, as evidenced in the national LTPP program and also the findings from this project. The data and their subsequent analysis in the first five-year time-series for this project provides pavement engineers with abundant information on the initial performance of WMA on the six SPS sites. Continued monitoring of the six sites in the next five years will provide a more complete picture of the first 10-years' performance. Even though the advantages of WMA are clear to the ODOT, the justifications of continuing the WMA practice on larger scale in the state will depend on clear evidence that superior performance in the intermediate to long term (10-year) is confirmed.