1991 Tour of Modified Binder Pavements

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16. ABSTRACT

A pavement tour of modified asphalt binder pavements was conducted in April and May of 1991 by staff from the Construction and Materials sections of the Washington State Department of Transportation. Each section visited is described and the tour participants' comments regarding performance are summarized.

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1991 TOUR OF
MODIFIED BINDER PAVEMENTS

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INTRODUCTION

The 1991 tour of modified binder pavements was conducted on April 29, 30, and May 1. Participants in the tour were Rod Finkle, Bob Gietz, Newton Jackson, and Jim Walter of the Materials Laboratory, Tom Nelson from the Construction Office, and Keith Anderson from the Research Office. Robert Rennie of District 1 and Wes Bogart of the Asphalt Paving Association of Washington accompanied the group to visit the District 1 paving projects on April 29th.

The purpose of the tour was to evaluate the performance of pavements that were constructed with asphalt mixes which had been modified with additives to enhance performance. The short and long term benefits of each of these additives is of interest to the Department which must make decisions on the cost benefits associated with their use. Each of the participants on this tour are involved either directly in making these decisions or indirectly in providing the necessary performance data that supports these decisions.

ASPHALT AND ADDITIVE DESCRIPTIONS

A brief description of each of the additives and their intended function are included below:

AC-5P

A lower viscosity asphalt cement with a polymer additive.

The polymer additive could be a number of different synthetic rubber compounds. AC-5P was developed by the asphalt producers as a substitute for chips seals on the west side of the mountains. The polymer additive adds additional flexibility to the mix to resist fatigue cracking.

AC-5P2

AC-5P2 is a second generation AC-5P and is inclusive in a series of polymer modified asphalts titled AC-5P1, AC-5P2, and AC-5P3. They were developed by the asphalt producers in response to our need for a more flexible asphalt cement to use in thin Class G overlays.

AC-20R

This is an asphalt cement modified with a synthetic rubber polymer used for Class B or Class D mixes. The asphalt cement is a heavier grade and the polymer is generally a styrene-butadiene. The additive is designed to give greater fatigue resistance to the mix and to increase the aggregate-asphalt bond to prevent ravelling, especially in the open-graded Class D pavements.

Asphalt-Rubber

Asphalt-Rubber is a standard asphalt cement such as AR4000W or AR2000W with a crumb rubber additive. The crumb rubber is derived from the recycling of rubber tires. The

crumb rubber is added to the asphalt cement and heated and mixed until the rubber particles are reacted with the asphalt. This reaction results in the absorption of some of the lighter fractions of the asphalt cement into the rubber and also the melting of some of the rubber into the asphalt cement. The additive is designed to give a more flexible pavement that is resistance to fatigue cracking and ravelling similar to the AC-20R.

PlusRide

PlusRide is a proprietary product which contains recycled tire rubber added as an aggregate substitute. The rubber particles are added at the pug mill where they are mixed with the aggregate and asphalt cement for each load of mix. The suppliers of PlusRide say that their product will have greater fatigue resistance due to its higher elasticity, a more skid-resistant and durable surface texture, and a longer service life.

BoniFibers

BoniFibers are polyester fibers approximately 1/2 inch in length which are added to the asphalt mix at the pug mill. They are claimed to increase the pavements' resistance to the formation of cracks, potholes, and ruts.

Carbon Black

Carbon Black, also called lamp black, is an additive used mainly by tire manufacturers. It is added to the asphalt mix at the pug mill similar to BoniFibers and the PlusRide rubber particles. The carbon black is added to reinforce the binder and reduce its temperature susceptibility. The reduced temperature susceptibility should result in less cracking at lower ambient temperatures and greater flushing and rutting resistance at higher ambient temperatures.

PROJECT EVALUATIONS

A recording secretary, Keith Anderson, captured the comments from the various tour participants on a portable PC. The comments were reviewed by the participants for accuracy prior to their inclusion into this report. The comments are recorded below for each of the stops on the tour.

STOP 1. SR 92 MP 3.37 to 5.97, Near Granite Falls

Contract 3596 - District 1 Chip Seal
Roadway Section: 0.06 Class G
Asphalt Type: AC-5P2
Year Paved: 1990

Pavement is in very good condition. A minor amount of transverse cracking was noted in the westbound lane. The section is underlaid by old PCC pavement. Stopped at MP 4.90 and walked the immediate area.

STOP 2. SR 92 MP 5.97 to 8.26, Near Granite Falls

Contract 3249 - SR 532, et al. District Wide Seal - North
Roadway Section: 0.06 Class G
Asphalt Type: AC-5P
Additive Type: Dupont Elvax
Dosage: 2.25% by weight
Year Paved: 1989

The pavement has a more open appearance than the pavement at Stop 1 and more ravelling is apparent. Longitudinal cracking is reflecting through in the left wheel path from the underlying PCC pavement edge. Additional longitudinal cracking not associated with the underlying pavement is also evident in addition to transverse cracking. This indicates a fatigue response from overloading by traffic. Newt Jackson indicated that they were under designed at the 0.06 depth. Potholes and alligator cracking were found in the eastbound outside wheel paths in locations where the roadway was build on soft subgrade with inadequate drainage. The left wheel path in the eastbound direction was also cracked longitudinally.

The pavement structure is apparently not able to support the traffic loads. The inspection team had mixed opinions regarding the cost-benefits of the additive in light of the amount of distress showing after only 2 years of service. The absence of a control section makes it difficult to draw a definite conclusion.

STOP 3. SR 530 MP 30.90 to 31.50, East of Arlington

Contract 3249 - SR 532, et al. District Wide Seal - North
Roadway Section: 0.06 Class G
Asphalt Type: AC-5P
Year Paved: 1989

The pavement looks very good with no defects noted.

STOP 4a. SR 530 MP 3.37 to 3.80, North of Stanwood

Contract: 2937 - Skagit County Line to Dahlgren Road
Roadway Section: 0.12 Rubber Modified ACP (PLUSRIDE)
Additive Type: Crumb Rubber
Dosage: 3% by weight of the total mix
Year Paved: 1985

Some longitudinal cracking has reflected through from the edge of the underlying PCC pavement. Transverse cracking was also noted, but none of them extended across the entire width of the pavement. This is one of the only good looking PlusRide projects we have constructed.

STOP 4b. SR 530 MP 3.80 to 4.23, North of Stanwood

Contract: 2937 - Skagit County Line to Dahlgren Road
Roadway Section: 0.12 Polyester Modified ACP (BONIFIBERS)
Additive Type: Polyester Fibers
Dosage: 5 pounds per ton of mix
Year Paved: 1985

Longitudinal cracking is reflecting through from the edge of the underlying PCC pavement. Minor amounts of transverse cracking are also present. Section is performing on a par with the PlusRide section.

STOP 4c. SR 530 MP 4.23 to 5.10, North of Stanwood

Contract: 2937 - Skagit County Line to Dahlgren Road
Roadway Section: 0.12 Class B (CONTROL SECTION)
Year Paved: 1985

The control section is the most distress free of all three sections. The same longitudinal reflection cracking is present as is the transverse cracking. The inspection team felt that from a cost-benefit standpoint the added expense of the PlusRide and BoniFibers has not been justified from the performance noted.

STOP 5. SR 9 MP 68.00 to 74.50, Acme Vicinity

Contract: 3814 - 1990 Thin Overlays
Roadway Section: 0.06 Class D
Asphalt Type: AC-5P
Year Paved: 1990

A few longitudinal cracks noted but otherwise the pavement looks good. Newt Jackson will recommend to the District that they fog seal this section due to its dry appearance. The cost of this pavement was about equivalent to a two shot chip seal.

STOP 6. SR 9 MP 94.58 to 97.43, Sumas Vicinity

Contract: 3591 - SR 546 to Johnson Creek Bridge 9/360
Roadway Section: 0.06 Class G
Asphalt Type: AC-5P
Year Paved: 1990

Reflection cracking from the underlying PCC pavement is evident in both the longitudinal and transverse directions. The longitudinal cracking is evident mostly in the outside wheel paths. Fatigue cracking is also evident in the outside

wheel path of the southbound lane in addition to the reflective cracking. The southbound lane has more distress than the northbound.

STOP 7. SR 432 MP 2.55 to 4.44, Longview Vicinity

Contract: 3317 - Longview Vicinity Paving
Roadway Section: 0.12 Class B
Asphalt Type: AC-20R
Year Paved: 1988

The pavement looks in excellent condition. Newt Jackson said that Ed Ferguson, then District Administrator, made the decision to use the rubber additive. The pavement has a very tight appearance. A few potholes are showing up in the eastbound lanes near the off ramp just before the I-5 overcrossing bridge. A few potholes were also noted near the west pavement seat of the bridge. The section on the east side of the I-5 overcrossing bridge is in excellent shape. It is one year older in age.

STOP 8. SR 433 MP 0.92 to 1.31, Longview Vicinity

Contract: 3317 - Longview Vicinity Paving
Roadway Section: 0.08 Class G
Asphalt Type: AC-20R
Year Paved: 1988

This section, which lies directly north of the Lewis and Clark Bridge, is showing very good resistance to rutting. Rutting has been a real problem in the past on the approaches to this bridge because of logging truck traffic.

STOP 9. SR 5 MP 0.28 to 2.42, Vancouver Vicinity

Contract: 3044 - Columbia River to 39th Street
Roadway Section: 0.06 Class D
Asphalt Type: Standard and AC-20R
Additive Type: Crumb rubber and styrene-butadiene polymer
Dosage: 1.4% by weight of rubber and 1.2 to 2.0% by weight of polymer
Year Paved: 1986

It is difficult to observe any difference between the control section, the section with crumb rubber and the section with the polymer. They all look excellent. The northbound lanes looks to be in slightly better condition due to the fog seal which was applied during construction. Newt Jackson will recommend that the District fog seal the southbound lanes.

STOP 10. SR 500 MP 0.89 to 5.88, Vancouver Vicinity

Contract: 3829 - St. Johns to NE 112th/Gher Rd.
Roadway Section: 0.15 Class B
Asphalt Type: Standard
Additive Type: None
Year Paved: 1990

District has expressed concern over raveling in the wheel paths. Feeling is that because this was a late season paving project the pavement did not receive the kneading action of traffic which densifies the mat and seals the surface. Consensus was that the raveling will not get any worse. The section that was paved in the rain shows considerably more damage. Small areas are missing aggregate, flushing is evident, and more overall ravelling is apparent. Conclusion was that weather was the overriding factor in the poor performance, and not the mix.

STOP 11. SR 501 MP 0.23 to 5.27, Vancouver Vicinity

Contract: 3724 - SR 5 to Flushing Channel
Roadway Section: 0.15 Class B ACP
Asphalt Type: Standard
Additive Type: None
Year Paved: 1990

This section is flushing to such an extent that it is difficult to find the aggregate in the mat. Gradation tests showed that the aggregate had 45% passing the #10 sieve (specification for Class B calls for 32-48%) and a high natural fines content. The District had a difficult time meeting density requirements and opted to increase the asphalt content. This was a quality assurance project with no mix design.

NOTE: An eastern Washington tour was conducted by Bob Gietz on May 1, 1991. He was accompanied by Russ Shorten and Brent Rasmussen of District 6.

STOP 12. SR 195 MP 22.39 to 29.14, North of Pullman

Contract: 3805 - Armstrong Road to Albion Road
Roadway Section: 0.08 ft. Class D
Asphalt Type: Standard
Additive Type: Crumb rubber
Dosage: 16 to 20% by weight of the total binder
Year Paved: 1990

The pavement has a consistent surface texture which gives the appearance of being somewhat finer and less open then other Class D pavements. Transverse cracking was observed and felt to be the result of reflection from the underlying PCC pavement. Russ Shorten District 6 maintenance indicated that this section is more frost free then other adjacent Class B

pavements. Russ also indicated that the paving operations on this project were of the stop and go variety due to problems with out-of-specification mineral aggregate. Numerous visible night joints attest to this intermittent paving operation.

The pavement performance to date is very good, but with only one year of service we would have expected as much.

STOP 13. SR 290 MP 11.69 to 18.38, East of Flora Road

Contract: 3003 - Flora Road to Idaho State Line
Roadway Section: 0.15 ft. Class B
Asphalt Type: Standard
Additive Type: Carbon Black
Dosage: 25 lb. per ton of mix
Year Paved: 1985

The carbon black and control sections show transverse cracking which are believed to be reflective in origin. The surface condition of both sections is excellent with the control section marginally tighter. Some minor rutting was observed in the control section but none in the carbon black section. At this time there appears to be some minor amounts of longitudinal cracking starting to develop in the eastbound outside lane. More longitudinal cracking was found in the control section then the carbon black section. The estimated extent of cracking is 2% in the carbon black and 5% in the control. Some healing of the transverse cracks is occurring from the kneading action of traffic in both sections. It appears that we are just at the starting point of cracking and that in about another year (May of 1992) it would be a prime time to make another cracking survey.

SUMMARY

The following conclusions were provided by Bob Gietz to summarize the modified binder performance observed in the aforementioned projects.

1. We are able to build satisfactory modified binder pavements with no significant construction problems.
2. The use of these materials on roadways needing additional structural improvement makes it difficult to measure whether the modifier improved the performance of the pavement. The construction of control sections of unmodified binder pavement on the same roadways (which in many cases was not possible) would have been provided the side-by-side performance comparison needed to drawn definitive conclusions.
3. We have used modifiers in locations where there was a bonafide need for enhanced performance. We cannot demonstrate that their use was, or was not, cost effective because of the short time that each of the pavements have been in service.

A table summarizing the information from each of the pavement sections is included as Appendix A.

APPENDIX A

PAVEMENT SECTIONS

PAVEMENT SECTIONS

STATE ROUTE	MILEPOST	LOCATION	CONTRACT NUMBER	ROADWAY SECTION	ASPHALT TYPE	ADDITIVE TYPE	YEAR PAVED	PERFORMANCE
92	3.37 to 5.97	Granite Falls	3596	0.06 G	AC-5P2		1990	Very Good
92	5.97 to 8.26	Granite Falls	3249	0.06 G	AC-5P	Dupont Elvax	1989	Fair
530	30.90 to 31.50	Arlington	3249	0.06 G	AC-5P		1989	Very Good
530	3.37 to 3.80	Stanwood	2937	0.12 B	AR4000W	PlusRide	1985	Good
530	3.80 to 4.23	Stanwood	2937	0.12 B	AR4000W	Bonifibers	1985	Good
530	4.23 to 5.10	Stanwood	2937	0.12 B	AR4000W	(Control)	1985	Very Good
9	68.0 to 74.5	Acme	3814	0.06 G	AC-5P		1990	Very Good
432	2.55 to 4.44	Sumas	3591	0.06 G	AC-5P		1990	Fair
433	0.92 to 1.31	Longview	3317	0.08 G	AC-20R	Crumb Rubber	1988	Very Good
5	0.28 to 2.42	Vancouver	3044	0.06 D	AC-20R	Crumb Rubber	1986	Very Good
5	0.28 to 2.42	Vancouver	3044	0.06 D	AC-20P	Polymer	1986	Very Good
5	0.28 to 2.42	Vancouver	3044	0.06 D	AR4000W	(Control)	1986	Very Good
195	22.39 to 29.14	Pullman	3805	0.08 D	AR2000W	Crumb Rubber	1990	Good
290	11.69 to 18.38	Spokane	3003	0.15 B	AR4000W	Carbon	1985	Very Good