ENGINEERING BRIEF NO. 51

Date: OCTOBER 21, 1994

Subject: INFORMATION: Engineering Brief No. 51
Polymer Modified Asphalt

From: Manager, Engineering and Specifications Division, AAS-200

To: All Regions
ATTN: Manager, Airports Division and AMA-600

Engineering Brief No. 51 provides information and guidance for the use of polymer modified asphalt cement.

The purpose of engineering briefs is to keep Airports' field offices informed of construction materials and methods which are being tried, but which are not necessarily known to the Regions and ADO's. In accordance with Order 5300.1E, Approval Level for Modification of Agency Airport Design and Construction Standards, AAS-1 should be notified if this material is used on an AIP project.

The engineering brief on Land and Hold-Short Lighting Systems, issued as No. 50, was meant for comment purposes only and will be reissued under another number when finalized. The engineering brief entitled, Adjustable
L-828 Extension, also issued as No. 50, remains as such

Any comments you have concerning this brief will be appreciated.

Original Signed by
Richard J. Worch

ENGINEERING BRIEF NO. 51
POLYMER MODIFIED ASPHALT

A joint committee composed of representatives from the American Association of State Highway and Transportation Officials, the Associated General Contractors, and the American Road and Transportation Builders Association (AASHTO-AGC-ARTBA Joint Committee) has developed generic guide specifications for polymer modified asphalts.

There are numerous polymers which can be used to modify asphalt cement properties. The specifications developed by the joint committee describe the characteristics of

certain types of polymer modified asphalt which have been used successfully in the field. The type of polymer modified asphalts was limited to include:

1) those used in practice with success on at least a semi-routine basis.

2) those for which specifications had been written which describe properties of the resulting modified binder in common terms which could be verified by users.

The guide specification describes three types of polymer modified asphalts, each based on different types of commonly used polymers. They are, styrene block copolymers, styrene butadiene rubber latex (SBR) or neoprene latex, and ethylene vinyl acetate or polyethylene. A more desirable performance oriented specification will only be possible as additional field experience is obtained and information being collected under the SHRP program becomes available.

The specifications include several grades of polymer modified asphalt within each type. This was an attempt to describe polymer modified binders which might be usable in different climates. A specification and suggested use for each type of polymer modified asphalt is contained in Appendix 1. The specifications are taken from Task Force 31 Report entitled, "Guide Specifications for Polymer Modified Asphalt."

Richard J. Worch
Civil Engineer

APPENDIX 1
GUIDE SPECIFICATIONS

Type I Polymer Modified Asphalt

Description:

Type I Polymer Modified Asphalt is based on properties of conventional asphalt cements after modification with styrene block copolymers. Most styrene block copolymer modified asphalts which meet this specification have butadiene midblocks and could be diblock or triblock, i.e.; SB or SBS configurations.

		I-A	I-B	I-C	I-D
Penetration, 77 degrees F, 100g, 5 sec	Min	100	75	50	40
	Max	150	100	75	75
Penetration, 39.2 degrees F, 200g, 60 sec	Min	40	30	25	25
Viscosity, 140 degrees F, P	Min	1000	2500	5000	5000

Viscosity, 275 degrees F, cSt	Max	2000	2000	2000	2000
Softening Point, R&B, degrees F	Min	110	120	130	140
Flash Point, degrees F	Min	425	425	450	450
Solubility in TCE, % *	Min	99.0	99.0	99.0	99.0
Separation **, R&B Difference, degrees F	Max	4	4	4	4
RTFOT Residue Elastic Recovery ***, 77 degrees F, %	Min	45	45	45	50
Penetration, 39.2 degrees F, 200g, 60 sec	Min	20	15	13	13

* Solubility of original asphalt by ASTM D 2042
** Method described in Appendix A
*** Method described in Appendix B

Uses:

Type I-A

Binder for use in hot mix asphalt concrete in cold service conditions and in hot applied surface treatment applications and crack filling.

Type I-B

All purpose grade intended for dense or open graded asphalt concrete and hot applied sealing applications in moderate to hot climates.

Type I-C

All purpose grade intended for dense or open graded asphalt concrete and hot applied sealing applications in hotter climates than I-B.

Type I-D

Hot climate applications where asphalt concrete is to be used in high volume traffic areas carrying a large percentage of trucks.

Type II Polymer Modified Asphalt

Description:

Type II Polymer Modified Asphalt is based on properties of conventional asphalt cements after modification with styrene butadiene rubber latex (BR) or neoprene latex.

		II-A	II-B	II-C
Penetration, 77 degrees F, 100g, 5 sec	Min	100	70	80
Viscosity, 140 degrees F, P	Min	800	1600	1600
Viscosity, 275 degrees F, cSt	Max	2000	2000	2000
Ductility, 39.2 degrees F, 5 cpm, cm	Min	50	50	50
Flash Point, degrees F	Min	450	450	450
Solubility *, %	Min	99.0	99.0	99.0
Toughness, 77 degrees F, 20 ipm, in-lbs	Min	75	110	110
Tenacity, 77 degrees F, 20 ipm, in-lbs	Min	50	75	75
RTFOT or TFOT Residue				
Viscosity, 140 degrees F, P	Max	4000	8000	8000
Ductility, 39.2 degrees F, 5 cpm, cm	Min	25	25	8
Toughness, 77 degrees F, 20 ipm, in-lbs	Min			110
Tenacity, 77 degrees F, 20 ipm, in-lbs	Min			75

* Solubility of original asphalt by ASTM D 2042

Uses:

Type II-A

Binder for use in hot mix asphalt concrete in cold service conditions and in hot applied surface treatment applications and crack filling.

Types II-B and II-C

All purpose grade intended for dense or open graded asphalt concrete and hot applied sealing applications in hot climates.

Type III Polymer Modified Asphalt

Description:

Type III Polymer Modified Asphalt is based on properties on conventional asphalt cements after modification with ethylene vinyl acetate or polyethylene.

		III-A	III-B	III-C	III-D	III-E
Penetration, 77 degrees F, 100g, 5 sec	Min	30	30	30	30	30

	Max	130	130	130	130	130
Penetration, 39.2 degrees F, 200g, 60 sec	Min	48	35	26	18	102
Viscosity, 275 degrees F, cSt	Min	150	150	150	150	150
	Max	1500	1500	1500	1500	1500
Softening Point, R&B, degrees F	Min	125	130	135	140	145
Flash Point, degrees F	Min	425	425	425	425	425
Separation *		Homog	Homog	Homog	Homog	Homog
RTFOT Residue						
Loss, %	Max	1.0	1.0	1.0	1.0	1.0
Penetration, 39.2 degrees F, 200g, 60 sec	Min	24	18	13	9	6

* Method described in Appendix C

Uses:

The Type III asphalts are distinguished by differences in consistency at 39.2 degrees F (4 degrees C) using the penetration test and at high temperatures using the softening point test. As one moves from left to right in the table, as with the other asphalts, the materials become progressively harder or stiffer. The philosophy of Type III is to require the softening point be 40F higher than the normal daily maximum air temperature during the hottest month of service. Low temperature penetration is based on normal daily minimum air temperatures during the coldest month.

APPENDIX A
SEPARATION TEST FOR TYPE I POLYMER MODIFIED ASPHALT

1.0 Scope

1.1 The separation of polymer from asphalt during hot storage is evaluated by comparing the ring and ball softening point of the top and bottom samples taken from a conditioned sealed tube of polymer modified asphalt. The conditioning consists of placing a sealed tube of polymer modified asphalt in a vertical position in a 325 degree F oven for a 48 hour period.

2.0 Referenced documents

2.1 ASTM D32 Softening Point of Bitumen (Ring and Ball Apparatus)
ASTM E11 Specifications for Wire Cloth Sieves for Testing Purposes

3.0 Apparatus

3.1 Aluminum tubes. 1-inch diameter by 5-1/2 inch length blind aluminum tubes. Used to hold the test sample during the conditioning. (Aluminum tubes may be obtained from Sheffield Industries, P.O. Box 351, New London, CT

06320, 203-442-4451. Observations have been reported regarding leakage of asphalt from the bottom of these tubes during the conditioning period. Other tubes may be required if this leakage is significant.)

3.2 Oven. An oven capable of maintaining 325 +/- 10 degrees F.

3.3 Freezer. A freezer capable of maintaining 20 +/- 10 degrees F.

3.4 Rack. A rack capable of supporting the aluminum tubes in a vertical position in the oven and freezer.

3.5 Spatula and Hammer. The spatula must be rigid and sharp to allow cutting of the tube containing the sample when at a low temperature.

4.0 Procedure

4.1 Place the empty tube with sealed end down in the rack.

4.2 Carefully heat the sample until sufficiently fluid to pour. Care should be taken to avoid localized overheating. Strain the melted sample through a No. 50 sieve conforming to ASTM E 11. After thorough stirring, pour 50.0 grams into the vertically held tube. Fold the excess tube over two times and crimp and seal.

4.3 Place the rack containing the sealed tubes in a 325 +/- 10 degrees F oven. Allow the tubes to stand undisturbed in the oven for a period of 48 +/- 1 hour. At the end of the heating period, remove the rack from the oven and immediately place in the freezer at 20 +/- 10 degrees F taking care to keep the tubes in a vertical position at all times. Leave the tubes in the freezer for a minimum of 4 hours to completely solidify the sample.

4.4 Upon removing the tube from the freezer, place the tube on a flat surface. With the spatula and hammer, cut the tube into three equal length portions. Place the beakers in a 325 +/- 10 degrees F oven until sufficiently fluid to remove the pieces of aluminum tube.

4.5 After a thorough stirring, pour the top and bottom samples into appropriately marked rings for the ring and ball softening point test. Prepare the rings and apparatus as described in ASTM D 36. (Other physical and chemical residue tests may be run at this time, if desired.)

4.6 The top and bottom sample from the same tube should be tested at the same time in the softening point test.

5.0 Report

5.1 Record the softening point of the top and bottom portions of the sample. Duplicate separation tests should be run.

APPENDIX B
ELASTIC RECOVERY TEST FOR TYPE I POLYMER MODIFIED ASPHALT

1.0 Scope

1.1 The elastic recovery of a polymer modified asphalt cement is evaluated by the percentage of recoverable strain measured after elongation during a conventional ductility test. Unless otherwise specified, the test shall be made at a temperature of 77 +/- 0.9 degrees F (25 +/- 0.5 degrees C) and with a speed of 5 cm/min
+/- 5.0%

2.0 Referenced Documents

2.1 ASTM D 113: Ductility of Bituminous Materials.
ASTM E 11: Specifications for ASTM Thermometers.

3.0 Apparatus

3.1 Mold. The mold shall be similar in design to that described for use in the ductility test (ASTM D 113), Figure 1, except that the sides of the mold assembly, parts a and a' shall have straight sides producing a test specimen with cross-sectional area of 1 square cm.

3.2 Water bath. The water bath shall be maintained at the specified test temperature, varying not more than 0.18 degrees F (0.1 degrees C) from this temperature. The volume of water shall be not less than 10 liters and the specimens shall be immersed to a depth of not less than 10 cm and shall be supported on a perforated shelf not less than 5 cm from the bottom of the bath.

3.3 Testing machine. For pulling the briquette of bituminous material apart, any apparatus may be used which is so constructed that the specimen will be continuously immersed in water as specified while the two clips are pulled apart at a uniform speed without undue vibration.

3.4 Thermometer. An ASTM 63C or 63F thermometer shall be used.

3.5 Scissors. Any type of conventional scissors capable of cutting polymer modified asphalt at the test temperature.

4.0 Procedure

4.1 Prepare test specimen and condition as prescribed by ASTM D 113.

4.2 Elongate the test specimen at the specified rate to a deformation of 10 cm.

4.3 Immediately cut the test specimen into two halves at the midpoint using the scissors. Keep the test specimen in the water bath in an undisturbed condition for a hour.

4.4 After the one hour time period, move the elongated half of the test specimen back into position near the fixed half of the specimen so the two pieces of polymer modified asphalt just touch. Record the length of the test specimen as X.

5.0 Report

5.1 Calculate the percent recovery by the following procedure:

Recovery, % = [(10 - X)/10] x 100

APPENDIX C
SEPARATION TEST FOR TYPE III POLYMER MODIFIED ASPHALT

1.0 Scope

1.1 This test is a simple qualitative test for compatibility of low density polymers in asphalt.

2.0 Apparatus

2.1 Containers. Standard 6 oz. metal sample cups (1.875 inches high by 2.75 inches in diameter)

2.2 Oven. An oven capable of maintaining 275 +/- 10 degrees F.

3.0 Procedure

3.1 After a blend of polymer in asphalt has been prepared and is still at elevated temperature, pour enough of the mix into a clean 6 oz. metal test cup to fill it to the formed roll on the cup (approx. 1/4 inch from top). Place the sample in a controlled temperature oven at 275 degrees F for 15 to 18 hours. Remove carefully from oven without disturbing the surface and observe the sample. After the initial observation, a spatula can be used to gently probe the sample and check consistency of any surface layer and check for sludge on the bottom. These observations and tests should be done while the sample is still hot, within five minutes after removal from the oven.

3.2 Depending on the physical characteristics of the polymer and compatibility of the particular asphalt/polymer system, varying conditions will be noted. These are described and should be reported as follows:

Description	Report
Homogeneous, no skinning or sludge	HOMOGENOUS

Slight polymeric skin at edges of cup	SLIGHT EDGE SKINNING
Thin polymeric skin on entire surface	THIN TOTAL SKINNING
Thick polymeric skin (1/32 inch +) on the entire surface	THICK TOTAL SKINNING
No surface skinning but thin sludge at bottom of container	THIN BOTTOM SLUDGE
No surface skinning but thick (1/4 inch +) sludge at bottom of container	THICK BOTTOM SLUDGE

If these descriptions do not match the particular sample, note the exact phenomena encountered and retain the sample.