Engineering Brief # 39

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Subject: INFORMATION: Engineering Brief No. 39,
Styrene-Butadiene Rubber Latex Modified Asphalt

From: Manager, Engineering and Specifications Division, AAS-200
To: All Regions

ATTN: Manager, Airports Division

Engineering Brief No. 39, Styrene-Butadiene Rubber Latex Modified Asphalt, provides information and guidance for the use of latex modified asphalt in bituminous concrete mixes and seal coats.

The information contained in this brief is not to be construed as general approval by the Office of Airport Standards. use of latex modified asphalt will be on a case-by-case basis and will require prior approval by this office.

Any comments you may wish to offer will be appreciated.

ORIGINAL SIGNED BY
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ENGINEERING BRIEF NUMBER 39

Styrene Butadiene Rubber (SBR) Latex Modified Asphalt

The purpose of this engineering brief is to present information concerning the modification of asphalt cements with SBR latex to produce a bitumen that improves the properties of bituminous concrete pavement and seal coats.

1. RUBBER LATEX. Rubber latices are particles of unvulcanized synthetic virgin rubber in a water emulsion system. The rubber particles are extremely small and uniform when in latex form and when exposed to asphalt during mixing they disperse rapidly and uniformly throughout the material to form a reinforcing network structure. This is due to the heat and agitation of the materials and the swelling effect the oils and resins in the asphalt have with the SBR latex particles. This alters several of the characteristics of the asphalt, each of which can help improve a pavements durability, weatherability, and performance compared to an unmodified asphalt.

2. EFFECT OF LATEX ON ASPHALT PROPERTIES. Paving material modified with SBR latex improves the following properties of asphaltic concrete:

a. Ductility. The low-temperature ductility of asphalt concretes are improved, thereby allowing the pavement to remain more flexible and crack resistent at low temperatures.

b. Elasticity. The viscosity of asphalt cement is increased at high temperatures, thereby reducing shoving and rutting problems. The increased viscosity can also reduce bleeding in a pavement.

c. Adhesion and Cohesion. The adhesive and cohesive properties are improved, thereby helping to keep the aggregate in place and improve the pavements resistance to surface abrasion and wear. Aggregate retention in chip seals can reach 95 percent.

d. Reduced Rate of Oxidation. Due to the elastic characteristics imparted to the asphalt the latex rubber helps to offset hardening and aging problems.

3. MODIFICATION METHODS. The following outlines methods for modifying asphalt cement and asphalt emulsion with latex.

a. Modification of Asphalt Cement. One method for introducing SBR later is to blend it with the asphalt at the refinery. This procedure requires additional equipment and is not economically viable except for projects with large quantities (50,000 tons) of bituminous concrete.

A more practical method for modifying hot mixes is to add the SBR latex directly to the pugmill or dryer drum during the regular mixing cycle. This can be accomplished with only minor modifications to the equipment.

Normally, 3-5 percent of rubber, by weight of asphalt cement is sufficient to improve the physical properties. The additional cost is about 20 percent for hot mixes.

b. Modification of Asphalt Emulsion. Asphalt emulsions may be modified with rubber latex either at the emulsion plant or in the field.

(1) Co-milling process. This method introduces rubber latex into the colloid mill, or emulsifier, together with the soap and stabilizer phase. This process is used for large scale production of modified asphalt emulsions.

(2) Post blending process. This method may be used for producing smaller quantities of modified emulsion or when modification at the emulsion plant is impractical. The process consists of adding S@ latex to finished asphalt emulsions and recirculating to form the blend.

(3) Distributor blending process. This method modifies the asphalt emulsion in the field. Mixing takes place in the distributor, and the process is simply a variation of the post blending system.

(4) Compatibility. Although rubber latices are compatible with most asphalt emulsions the compatibility of the latex and the asphalt emulsion must be verified.

Normally, 2-5 percent of SBR latex is used with asphalt emulsions. The additional cost over unmodified emulsions is about 10-12 percent in-place.

4. CONSTRUCTION. Only minimal changes in construction techniques are required when Using latex modified bituminous mixes.

a. Laydown Temperature. The ideal laydown temperature for SBR latex modified bituminous mixes is between 290. and 310. F.

b. Compaction. There is a noticeable difference in compacting latex modified asphaltic concrete. Normally, the breakdown roller must be kept 300-800 feet behind the paving machine. When a latex modified mix is laid, the first roller can work right behind the paving machine.

5. SPECIFICATIONS. Modifications to the specifications when specifying SBR latex modified asphalt or emulsion in Item P-401, Plant Mix Bituminous Materials and Item P-609, Seal Coats and Bituminous Surface treatments, are contained in appendices A and B respectively. Based on successful use on several airport projects we feel that use of SBR latex modified asphalt is acceptable for use in bituminous concrete mixes and chip seal coats. These items may be specified on a case by-case basis so that we may further evaluate their performance on airport pavement.

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APPENDIX A.

Item P-401, Plant Mix Bituminous Materials

The following modifications should be made to Item P-401 when SBR latex modified asphalt is specified:

a. Paragraph 1.1. At the end of the first paragraph add: "The work also includes mixing and placing a SBR latex modified surface course for the top course of the pavement".

b. Section 2 MATERIALS. Add the following paragraph:
2.4 LATEX ADDITIVE The latex additive shall be an approved additive shall be an approved unvulcanized virgin synthetic rubber in the liquid latex form and shall conform to the following specifications:

Type of Latex	Anionic
Monomer Ratio, (Butadiene/Styrene)	76+2/24+2
Solids Content %, min.	67
Solids Content lb/gal, min	5.4
pH of latex	9.5-10.5
Brookfield Viscosity, cps, min (Model RVT, #3 Spindle @ 2O/RPM)	600

The latex modified bituminous surface course shall have a minimum of three percent by weight of latex additive to the asphalt cement.

c. Paragraph 4.2. Add the following after paragraph 4.2(a)(4)(b).
The latex shall be stored where it will be protected from freezing. When stored in drums, the drums shall be thoroughly mixed prior to use. When stored in tanks, the material shall be circulated for at least one hour prior to use.

d. Paragraph 4.7. Insert after the first sentence: "Aggregate for latex modified bituminous material should be heated 25 degrees F above normal aggregate temperatures".

e. Paragraph 4.8. Add the following:
The minimum dry mixing time for bituminous mixes modified with latex shall be ten seconds, followed by a wet mixing time of not less than 50 seconds. The introduction of the latex emulsion shall begin within 5 seconds of the wet mix portion of the mixing cycle, and be continued simultaneously with the asphalt spray operation.

f. Paragraph 4.8. Modify the first sentence to read. "The aggregates, bituminous material, and latex emulsion shall be weighed or metered and introduced into the mixer in the amount specified by the job mix formula".

g. Paragraph 4.9. add the following sentence:
"The latex modified mix shall be placed at a temperature of not less than 290 deg F".

h. Paragraph 6. Under 6.1 add:
Item P-401-6.2 Bituminous Surface Course (latex modified) per ton.

APPENDIX B

Item P-609, Seal Coats and Bituminous Surface Treatments

The following modifications should be made to Item P-609, Seal Coats and Bituminous Surface Treatments, when a SBR latex modified emulsion is specified.

a. Paragraph 609-1.1. Modify as follows.
This item shall consist of a SBR rubber modified bituminous surface treatment as a wearing course composed of single or double applications of modified bituminous material and placed-----.

b. Paragraph 609-1.2 Revise Table 1 as follows:
Table 1- Quantities of Materials

Materials	Amounts
First Application	
Bituminous/Latex Material	0.30 to 0.50 gallons per square yard
Aggregate Material	20 to 35 pounds per square yard
Second Application	
Bituminous Latex Material	0.20 to 0.30 gallons per square yard
Cover Aggregate Material	10 to 20 pounds per square yard

c. Paragraph 609-2.1. Revise Table 2 as follows:
Table 2. Requirements for Gradation of Aggregate

Aggregate for first application

Sieve designations (square openings)	Percentage by Weight Passing Sieves
1/2 inch	100
3/8 inch	95 - 100
#4	10 - 30
#10	0 - 10
#100	0 - 2

Aggregate for Second Application

Sieve designations (square openings)	Percentage by Weight Passing Sieves
1/4 inch	100
#4	70 - 100
#10	10 - 50
#100	0 - 1

d. Paragraph 609-2.2. Revise as follows:
The types, grades controlling specifications, and application temperatures for the bituminous materials are given below. The Engineer shall designate the specific

material to be used.

Type and Grade	Specification	Temperature
RS-2	ASTM D 977	160-180 deg F
CRS-2	ASTM D 2397	160-180 deg F

e. Add a paragraph 609-2.3 as follows:
609-2.3 LATEX ADDITIVE. The latex additive shall be an approved unvulcanized virgin synthetic rubber in the liquid latex form and shall conform to the following specifications:

Type of Latex	Anionic	Cationic
Monomer Ratio (Butadiene/Styrene)	76+2/24+2	76+2/24+2
solids, minimum,%	67	59
solids, minimum,lbs/gal	5.2	2.8
ph of latex	9.5-10.5	4.0-5.5
Brookfield Viscosity min (Model RVT, #3 spindle @ 20/RPM)	600	600

It is preferred that the latex be added at the refinery or terminal, since mixing is faster and it allows more time for the latex to blend with the asphalt before application. It can be added to the distributor at the job site in the following manner: With the recirculating pump running, add the latex slowly and continue to recirculate for twenty (20) minutes before application. Unless other wise specified, the latex addition should be at the rate of 3.0 gallons per one hundred gallons of emulsion.

f. Add a new paragraph 609-3.10 as follows.
609-3.10 CONTRACTOR'S CERTIFICATION OF LATEX. The Contractor shall furnish the manufacturer@s certification to the Engineer that the latex rubber shipped to the project meets the requirements of the material specified in paragraphs 609-2.3. The manufacturer's certification for the latex rubber shall not Se interpreted as a basis for final acceptance. Any certification received shall be subject to verification by testing samples received for project use.

g. Add a new paragraph 609-3.11 as follows:
609-3.11. TESTING FOR LATEX/EMULSION COMPATIBILITY. Forty five (45) days before the bituminous/latex surface treatment is to be applied, the Contractor shall send a sample of the proposed emulsion, to the latex supplier for compatibility testing. The latex supplier shall notify the Contractor if there are any irregularities with the emulsion. Ten (10) days prior to the surface treatment, the Contractor shall send the latex supplier another emulsion sample for testing. Prior to on site mixing of the emulsion and the latex, a compatibility test shall be performed by the contractor.

The compatibility tests should be run on each lot of latex (lot number is on drum) and each batch of asphalt emulsion.

Compatibility Test:

(1) Filter separately the latex and the emulsion through No. 20 sieve.
(2) Weigh 100 grams of hot asphalt emulsion (160 deg F) in beaker.
(3) Add 10 grams of latex (cationic latex for cationic emulsion and anionic latex for anionic emulsion) to hot latex emulsion.
(4) Mix with a stirring rod by hand for two minutes.
(5) Allow to cool to ambient temperature.
(6) Filter mixture through No. 20 sieve. Note any coagulum.

If the latex-asphalt emulsion is in a smooth liquid state and no coagulum resulted, the materials are compatible.

If coagulum did result, first be sure anionic and cationic systems weren't mixed. Normally, adding little more surfactant in the emulsion formulation will make the system more stable.

Above test should be approximated in the field to check compatibility of latex and asphalt emulsion. The cost of testing is incidental to construction and is not a separate pay item.

h. Revise "Method of Measurement" as follows:
609-4.1 The bituminous/ latex surface treatment will be measured in square yards.

i. Revise "Basis of Payment" as follows:
609-5.1 Payment shall be made at the contract unit price per square yard for latex rubber modified bituminous surface treatment. The price shall be full compensation for furnishing all materials, and for labor, equipment tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-609-5.1	Bituminous/Latex Surface Treatment (first application)-per square yard.
Item P-609-5.2	Bituminous/Latex Surface Treatment (Second application)-per square yard.