Fort Worth’s Experience with the Use of SBR Latex in Hot Mix
What is the Issue?

Oxidation of Surface Mix 3-6 months after Surface Course Placement

Crack Sealing First Season after Surface Course Placement
What is the Issue?

Seal Coats for Heavy Crack Sealant 3rd Year after Surface Course Placement
What Is The Issue?

- Early oxidation of SBS modified asphalt binder after placement (3-6 months).
- Inclusion of RAP and RAS using highly oxidized asphalt binders (PG82-22 to PG106-22).
- Less than optimum asphalt content resulting in brittle mixes.
- Hamburg tests are not indicative when using modified binders.
Asphalt Emulsions using a Polymer Modified Base

- **Emulsify polymer mod. asphalt**
  - “Pre-modified” emulsion
  - Polymers – SBS, SB-, EVA
  - Higher mod. asphalt viscosity
    - higher asphalt + mill temp.
  - Exit temp. > 100°C
  - Heat exchanger, back press.

- **Polymer inside asphalt droplet**
Asphalt Emulsions using BASF Latex Dispersions

- Add latex external to asphalt
  - Methods
    - soap batching
    - co-milling – asphalt or soap
    - post addition
  - Polymers – SBR, NR latex
  - Lower asphalt viscosity
  - No special mill, handling

- Polymer in water phase
- Continuous polymer film formation on curing
SBR Latex Film Formation
Emulsion Residue

Latex Modified Emulsion

Cured Asphalt Emulsion
Notes of Interest

- Early oxidation of SBS modified asphalt binder after placement (3-6 months).
  - SBS modifier inside asphalt allows asphalt to be exposed to the sun’s UV rays and oxygen resulting in whitening of pavement. SBR coats the asphalt providing additional protection against the UV rays and oxygen keeping the pavement dark longer.

- Inclusion of RAP and RAS using highly oxidized asphalt binders (PG82-22 to PG106-22).
  - These add very hard binders creating very stiff mixes much more susceptible to premature cracking.

- Less than optimum asphalt content resulting in brittle mixes.
  - Not enough binder (glue) to hold the aggregate together and resist cracking.

- Hamburg tests are not indicative when using modified binders.
  - See next slides.
Typical Hamburg Results with Latex
Typical Hamburg Results with Latex and RAP
**District History**

- Started using SBR Latex in surface mixes in the FTW District in the early 1980s.
- SBR Latex added to the mix by injection process at the HMAC plant.
- 3% by weight added to AC-10.
- Stopped this process in September 1994 letting due to institution of QCQA Special Specification and the PG asphalt system (went from AC to PG).
- Have used PG asphalts as modified by the refiners with whatever modifications they wanted to use to achieve the PG grades.
- In the early 2000s, able to push through acceptance of a PG+ Special Provision that allowed the alternatives of SBR Latex, SBS, and Multigrade for a short period of time.
- In 2011, District Maintenance requested options to push back crack sealing from the first year after construction and seal coat application 3 years after construction to a much longer period. District Admin. concurred with using SBR Latex option.
Fresh Mat
Consistent Mix
Latex Balls
Latex Pullouts
IH 35W 2015 (3 Years after Construction)
IH 35W 2015 (3 Years after Construction)
IH 35W 2015 (3 Years after Construction)
IH 35W 2015 (3 Years after Construction)
Pumphrey Street 2015 (7 Years after Construction)
1.5" AC/PCC at Pumphrey Dr., Fort Worth
Reflective Cracking Rate (%) of Main Road- Southbound

- Blue line: Main Road, South bond, outside lane (crumb rubber)
- Red line: Main Road, South bond, inside lane (Latex)
How Do We Require SBR Latex in the Mixes?

- Specifications
- General Notes
- Bid Codes
- Spec. List
- Plan Sheets (Typical Sections and Summary Sheets)
**SS 3001 - Injection of Latex into Asphalt Binder**

1. **DESCRIPTION**
   Inject latex modifier into base asphalt binder immediately before it enters the asphalt concrete mixing plant to produce a final modified binder that meets the specified grade. Use of this method to meet the requirements of the specified binder grade is at the Contractor’s option unless otherwise shown on the plans.

2. **MATERIALS**
   Furnish materials that meet the following requirements:
   **Base Asphalt Binder.** Furnish base asphalt binder of the type, grade, and source used in the binder design and meeting the requirements of Item 300, “Asphalts, Oils, and Emulsions,” and preapproved for use by the Construction Division.
   **Latex Modifier.** Furnish latex additive consisting of an emulsion of styrene-butadiene-styrene rubber (SBR) in water. Provide SBR solids content of the emulsion for each shipment or container of latex modifier.
3. EQUIPMENT

Provide all equipment necessary for metering and blending the latex into the binder and for sampling of the final product.

**Inline Mixer.** Provide a mixer in the asphalt line downstream of the latex injection point with internal baffles and sufficient length to disperse the latex modifier into the binder.

**Sampling Port.** Provide a sampling port in an accessible location downstream of the inline mixer. Ensure that the sampling port meets the requirements of AASHTO T40 for sampling from pipelines.

**Metering Equipment.** Provide continuously recording meters for both the base asphalt and the latex modifier that meet the requirements of Item 520, “Weighing and Measuring Equipment.”
4. BINDER DESIGN

Perform a binder design that demonstrates that the final product meets the requirements of the grade of performance graded (PG) binder shown on the plans, in accordance with Item 300, “Asphalts, Oils, and Emulsions.” Furnish the Engineer with representative samples of all materials used in the binder design and a split sample of the proposed final binder. The Engineer will verify the design. If the design cannot be verified, the Engineer may reject the design.

Provide the Engineer with a binder design report that includes the following items:

- the source and grade or product name of each material used;
- a test report showing passing results for all specified tests;
- the SBR solids content of the latex modifier;
- the percentage of each material used, including the percentage of SBR solids in the final binder;
- a brief description of the mixing procedure used;
- the name and contact information of the laboratory that did the design; and
- the date the design was performed.
5. PRODUCTION OPERATIONS

Provide the Engineer with a daily report of metering records, showing the calculated percentages of each component material used. Provide with this report a balance sheet of component material inventories. Stop production any time metering records indicate that the amount of latex solids falls below the amount determined in the binder design. Resume production only when the Engineer is satisfied that any measurement problems have been corrected.

Obtain one sample of the binder, witnessed by the Engineer, from the sampling port in accordance with Tex-500-C for each day of production and submit it to the Engineer. The Engineer will test these samples to establish consistency of the material and may reduce sampling rates once consistency has been demonstrated. The Engineer may suspend production if tests results indicate that the binder is not consistent.

Perform a new binder design if the source or grade of any of the component materials is to be changed. If the new binder design is not completed before the new materials are to be used, stop production until the new binder design is approved.
Item 341. Dense-Graded Hot-Mix Asphalt

Provide a PG 70-22 asphalt for the surface course and/or levelup course. Provide the PG 70-22 asphalt with either of the following modification alternatives:

* PG 64-22 modified with SBR Latex at the Hot Mix Plant.
* AC-10 modified with SBR Latex at the Hot Mix Plant.

When the asphalt is modified at the Hot Mix Plant, provide the PG 64-22 or AC-10 refinery certification.

The additive rate for the SBR Latex will be based upon the quantity needed blended with the asphalt to produce the required asphalt grade shown above.

Grade Substitution per Table 5 is not allowed.

RAP and RAS are not permitted in any surface and levelup mixes on this project.

For Table 10, the Minimum Number of Passes required for the High-Temperature Binder Grade of PG70-22 is waived for the surface mix.
<table>
<thead>
<tr>
<th>Bid Code</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>341 6259</td>
<td>D-GR HMA TY C SAC-B PG70-22 (LATEX ADD)</td>
<td>TON</td>
</tr>
<tr>
<td>341 6261</td>
<td>D-GR HMA TY C PG70-22 (LEV-UP) (LATEX ADD)</td>
<td>TON</td>
</tr>
</tbody>
</table>
SPECIAL SPECIFICATIONS:

SS 3001      INJECTION OF LATEX INTO ASPHALT BINDER
Technical Considerations

- Safety – Darker pavements allow striping and reflectors to enhance the contrast for drivers at night and in less than desirable weather.

- Trying to build mixes that will last 15-20 years. We have already proven that it can be done with surface mixes that lasted 25 years with little to no maintenance.

- The producers don’t want the liability of adding SBR Latex at the plant and being the “refinery”.

- The producers can go down to 1 tank of asphalt and have 3 grades of mix (PG64-22, PG70-22, and PG76-22).

- Can be used in Warm Mix (WMA) and lower temperatures will help the contractors to achieve field density easier and reduce the potential for crushing aggregate.

- Consideration to lower the base asphalt to a PG58-28 (AC-10); keep it flexible.
Conclusion

- Striving for high quality, long performing material.

- Why reject our 25 year history with Latex?

- From the earlier points presented,
  - Use SBR Latex injected at the local hot mix plants,
  - Use virgin aggregate mixes; no RAP nor RAS,
  - Switched from TGC at 97% density to SGC at 35-50 gyrations, and
  - Waive Hamburg requirement.