Polymers in Pavement Preservation Techniques

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Presentation Outline

- Why polymers, and what is used in asphalt
- Why polymers are used in chip seals
- Why polymers are used in micro-surfacing
- Why polymers are used in scrub seal
- Why polymers are used in tack coats
- Conclusions
The Benefits of Polymers

Why polymers, and why in asphalt applications
Polymer Modified Asphalt Emulsions
Practical Benefits

- Overall improvement in performance + durability
- Reduced life cycle cost – preventive maintenance
- Cost-effective (vs. HMA) access to other apps.
  - Surface dressings for high volume roads
  - Micro-surfacing
Polymers used to modify asphalts for Pavement Preservation

- Solid Polymers
  - SBS, EVA
- Latex Polymers
  - SBR, Natural Latex, Neoprene
Polymer Modified Asphalt based Emulsions

- Emulsify polymer modified 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
Pre-Modified Emulsions

- Hot stage micrograph
  - SBS modified residue
  - Sample dried/cured at RT
- Polymer stays inside droplet
- No polymer network formed
  - Spherical, yellow domains
  - App. size of asphalt droplets
Latex Polymer Modified Asphalt Emulsions

- **Add latex external to asphalt**
  - **Methods**
    - soap batching
    - co-milling - asphalt line
    - co-milling - soap line
  - Lower asphalt process T
  - No special mill, handling
  - **Polymer in water phase**
  - **Continuous polymer film formation on curing**
Latex Modified Emulsions

- Hot stage micrograph
  - SBR modified residue
  - Sample dried/cured at RT
- Polymer stays outside droplet
- Continuous film formation
- Fine SBR polymer network
Residue Evaluation - Polymer Modified Asphalt vs. Latex Modified Emulsions

Dried emulsion residues (coalesced asphalt particles)

- **Neat asphalt**
  - Asphalt rheology only

- **Latex modified emulsion**
  - Improved binder properties
    - Improved low temperature fatigue properties
    - Reduced rutting at high temperature
    - Improved early strength development

- **Emulsion of polymer modified asphalt**
Why polymers are used in various pavement preservation techniques?
Chip Seals, Micro-surfacing, Scrub Seals and Tack Coats
Chip Seal - Field Application
Chip Seal Surface Treatment

Near Taos, NM
Latex/Polymer Importance in Chip Seals

- Early Chip retention during break and cure process
  - Traffic control and early sweeping without chip loss (Windshield breakage)

- Long Term Chip Retention
  - Maintain chip retention through life of preservation treatment through increased summer temperatures and winter conditions (snow plow damage)

- Increase life expectancy of surface treatment when compared to unmodified alternatives (cost effective)
Curing of CRS-2LM Emulsion

- Water in asphalt emulsion wicks the aggregate surface.
  - Order of migration = Water, latex particles, asphalt droplets
Early Strength Develop. - CRS-2P
ASTM D7000-04 - Sweep Test

Data Provided by Paragon Technical Services
Sweep Testing - CRS-2 vs CRS-2P
ASTM D7000 - 04
Micro-surfacing Operation

1 min < Mix Time < 3 min

Cohesion Development < 1 hr
Micro-Surfacing Operation
Microsurfacing – High ADT

Paved in Oct. 2001
Photo from Sept. 2003
Latex/Polymer Importance in Micro-surfacing

- Allow for quick traffic curing - minimal traffic damage
  - Less than one hour traffic time
- Long term fatigue resistance
  - Maintain texture and minimal densification “rutting” over the life of the preservation treatment
- Increase life expectancy of surface treatment when compared to unmodified alternatives (cost effective)
Microsurfacing - Polymer Morphology Field Application

Texas State Highway 84
- Near Waco, TX
Cured Latex Polymer Network

Microsurfacing

Latex Foam
Wet Track Abrasion Loss
ISSA TB-100

SBR latex polymer
- 50% reduction in loss
  - one hour soak
- 67% reduction in loss
  - six day soak

Surface of mix
- tougher
- more abrasion res.

Adhesion + water resistance
- improved
Scrub Seal - Field Application

Emulsion Distributer

Emulsion Brooming/Scrubbing
Scrub Seal - Surface
Latex/Polymer Importance in Scrub Seal

- Allow for early chip/sand retention
  - Minimal effect to traffic
- Resistance to rejuvenating oils
  - Be effective at chip retention, while not “swelling” under the effect of the oils
- Increase life expectancy of surface treatment when compared to unmodified alternatives (cost effective)
Tack/Bond Coat Application

Proper Spraying - Even

Uneven or “Stripped”
Latex/Polymer Importance in Tack/Bond Coat

- Allow for construction traffic to pave on surface
  - Reduce tracking of emulsion into traffic lanes
- Create good bond between pavement layers
  - Be an effective glue between layers
- Increase pavement performance by creating a monolithic layer rather than each pavement layer acing separately
Tracking Testing at 60°C (140°F)
PG58-28 Base - Modified & CRS Chemistry

Bond Coat on felt and paper
Tracking Testing at various temperatures
Bond Coat Emulsion with CRS Chemistry

Ambient – 25°C

35°C

50°C

10 Minute
20 Minute
30 Minute
Bond Strength Testing

- Types of Bond strength testing
  - Shear or tensile
    - Shear testing applies a horizontal force to the pavement section to “shear” the specimen
    - Tensile testing “pulls” the top section away from the existing pavement
- How strong do you need a bond to be?
  - Just like gluing or welding two materials together, the strength of the bond needs to be greater than the materials being bonded.
Comments and Conclusions

- Many different polymers are used to meet specifications and performance requirements in pavement preservation.
- Polymers add to performance of the pavement preservation techniques.
- Current performance tests are being developed to utilize the materials used in application to show performance and are not based on just the binder properties.
Thank You

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