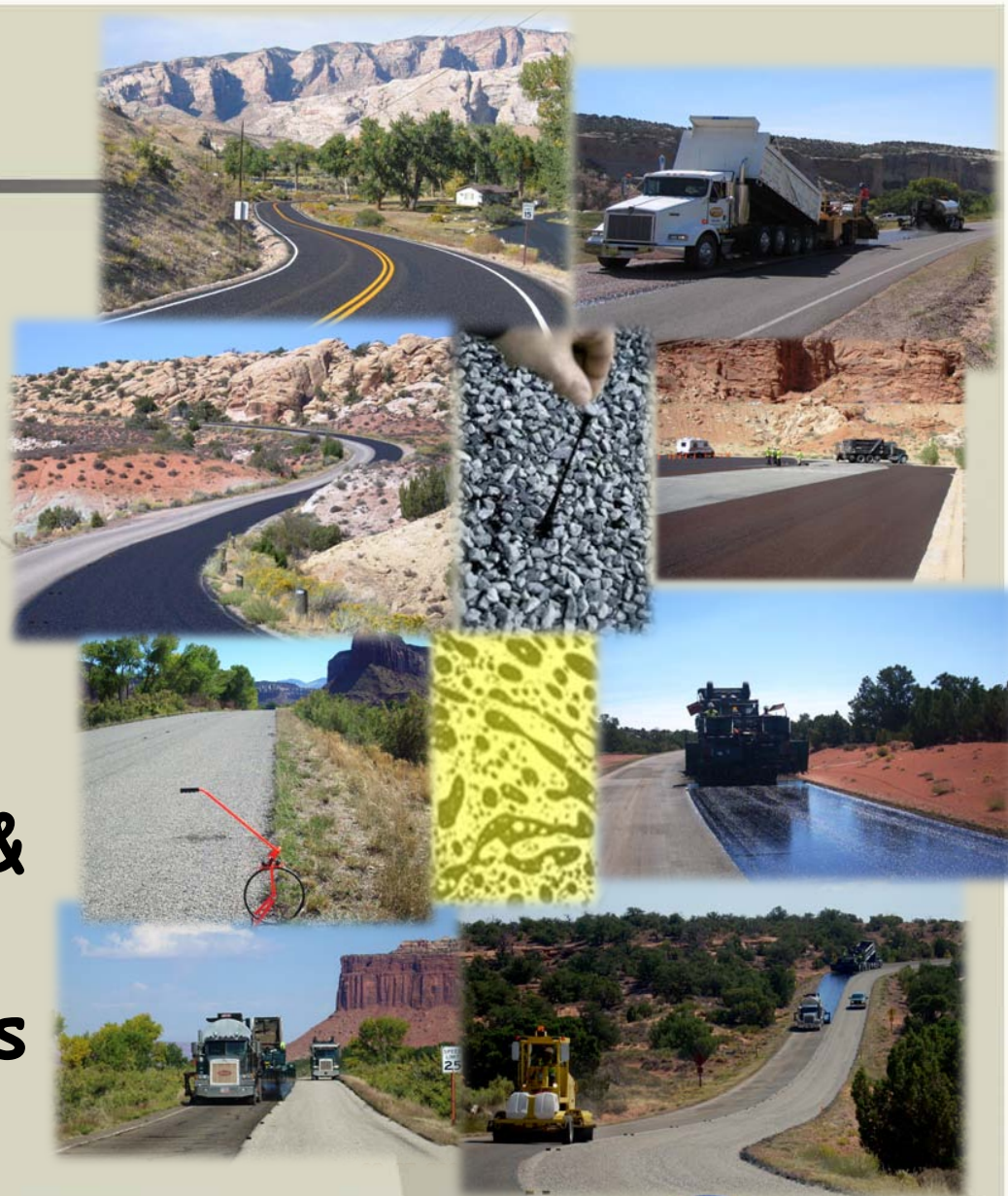




POLYMER MODIFIED ASPHALT EMULSIONS

Composition, Uses & Specifications for Surface Treatments





The Polymer Modified Emulsion (PME) Study

Acknowledgements

■ Sponsored by:

- Central Federal Highway Lands Division
Federal Highway Administration
 - Mike Voth, James Sorenson

■ Investigators:

- National Center for Pavement Preservation
 - Larry Galehouse, John Johnston
 - GHK, Inc.
 - Gayle King, Helen King
 - Industry volunteers
 - BASF, PRI, Paragon, SemMaterials, UW, others



The Problem

- ✓ **Experience:** polymer modification results in better short- and long-term performance
- ✓ **No definitive guide**
 - For selecting, specifying & using polymer emulsions
- ✓ **Areas of interest**
 - Use of PMEs vs. conventional emulsions
 - Optimal % polymer
 - Use on non-roadway applications (parking lots, trails, bike paths)

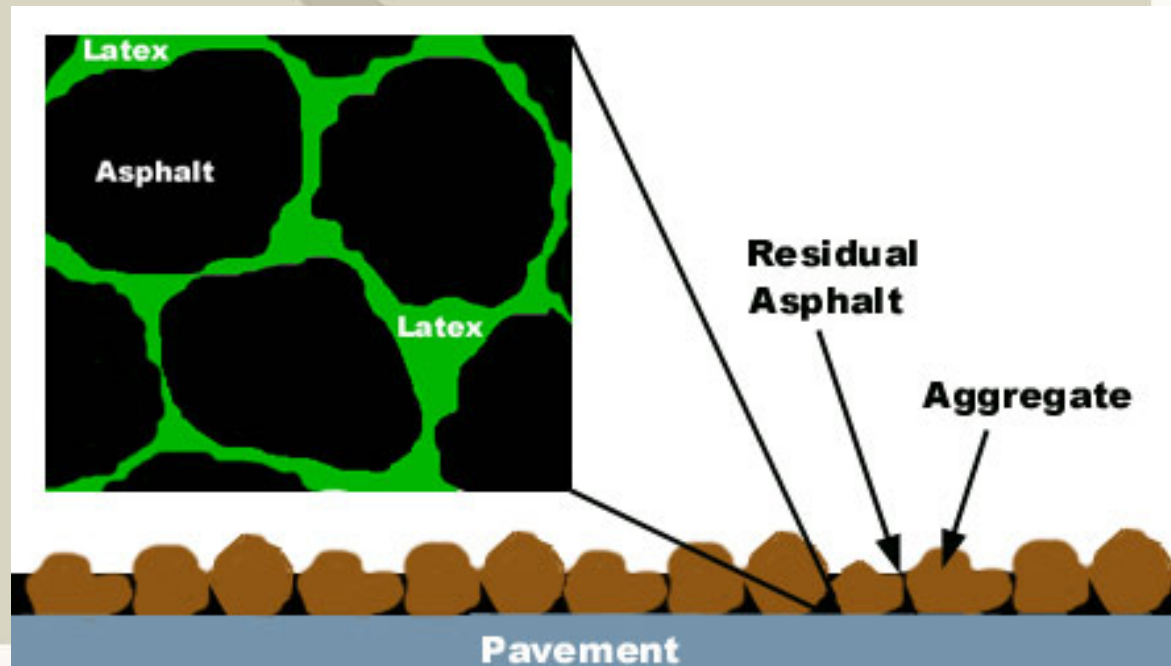
The Project

- Literature review & knowledge gathering sessions
 - Industry, academic, federal & local government agencies
 - On-line user/ producer survey
 - Presentations & input: AEMA/ARRA/ISSA, TRB, ETGs, AASHTO
- Draft performance spec
- Field trials
- Field guide

Findings - What Are PME's?

- ✓ Water based, emulsified asphalt & polymer
- ✓ Performance depends on:
 - Type of polymer
 - Compatibility of polymer & asphalt

PME Chip Seal



Findings - What Are PME's?

✓ Typically 1-5% polymer based on asphalt

✓ Polymers

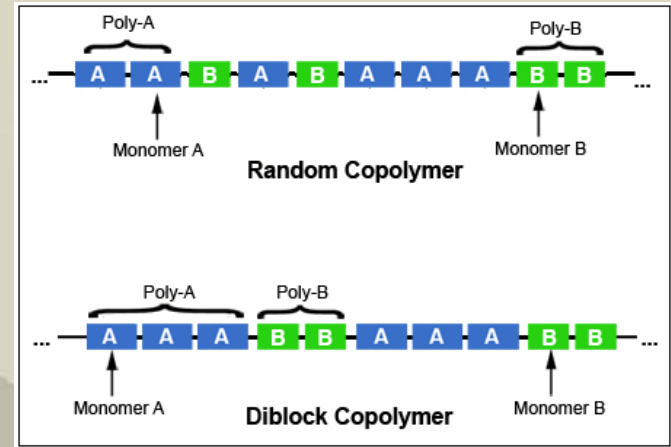
■ Elastomers - elastic

- SBR latex (random)
- SBS block copolymers
- Natural rubber latex

■ Plastomers - high modulus (stiffness)

- EVA

✓ Recommend - preblend prior to emulsifying



Findings - When & Why PME?

✓ PME recommended for all emulsion applications

■ Improve performance

- Stiffer at high temperatures (bleeding, rutting)
- Less brittle at low temperatures (shelling, cracking)
- More adhesive (early chip loss, raveling, delamination)
- Less susceptible to moisture damage
- Less susceptible to oxidative aging (raveling, cracking)
- More elastic - fatigue resistant (chip loss, cracking)



Findings - When & Why PME?

- ✓ **PME recommended for all emulsion applications**
 - **Caution: avoid sealing in moisture**
 - Insufficient drainage
 - Saturated pavement at time of construction
 - Insufficient curing (late season application)





Findings - When & Why PME?

- ✓ Increase service life
 - ✓ Prevent early failures
 - ✓ Cost differentials vs. no polymer
 - Mn/DOT: total project cost \approx 7% higher
 - 2008 study field projects: 4-11% higher
 - Right treatment - Right road - Right time
- www.pavementpreservation.org/toolbox/guidelines.html



Findings - When & Why PME?

✓ Chip seals

- Early & long term stone retention
- Quicker traffic return
- Fewer broken windshields
- Reduced flushing & bleeding
- Greater tolerance for quantities & aggregate embedment factor
- Increased durability
 - Better performance on high volume roads

Findings - When & Why PME?

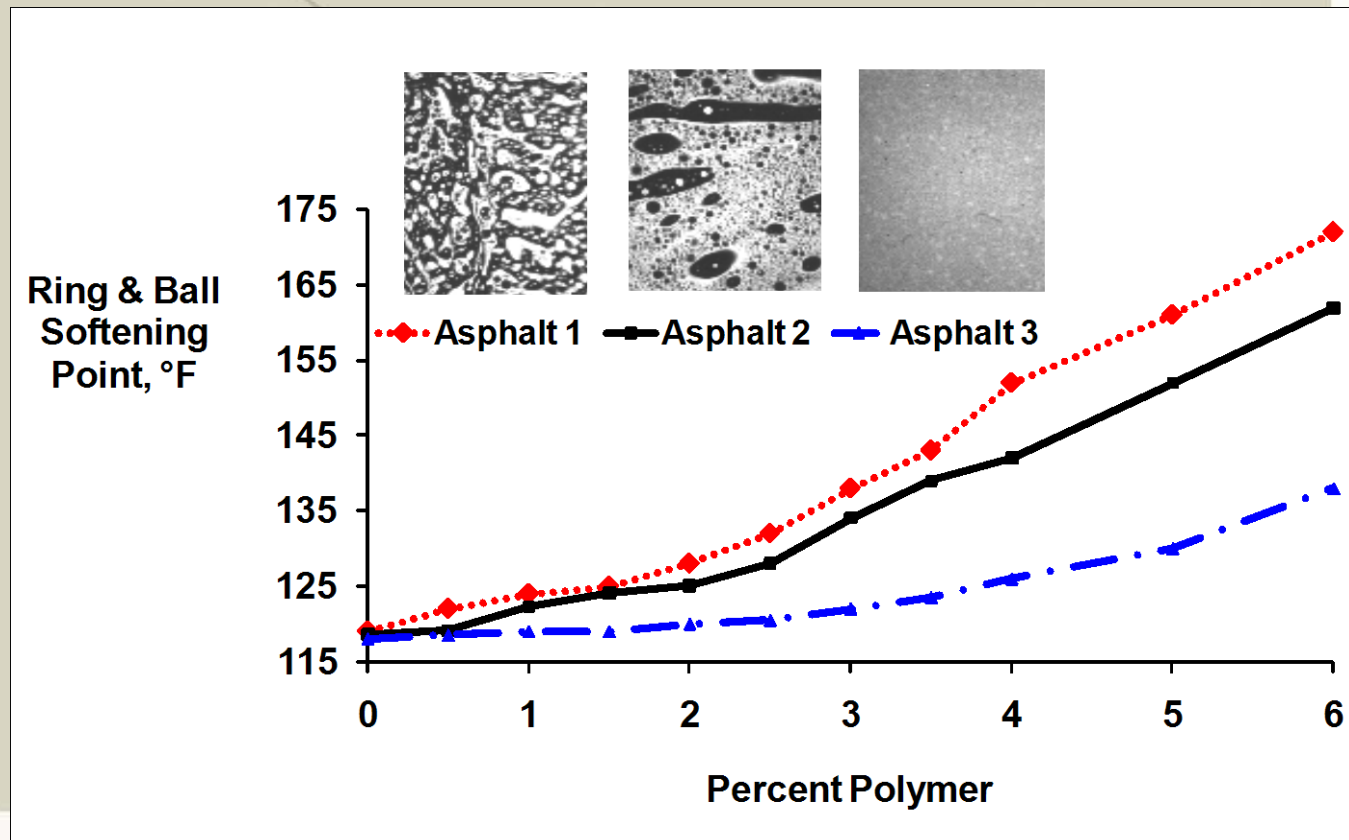
✓ Slurry Seals & Microsurfacing

- Quicker traffic return
- Increased durability
- PME slurry for <1000 ADT
- PME microsurfacing for
 - >1000 ADT
 - Rut filling
 - Minimizing user delay

✓ Non-roadway applications - similar benefits

Findings - How to Specify PME

- ✓ Current specs don't correlate with performance
- ✓ Recommendation: don't specify % polymer



Recommendations:

- Update ASTM D-244 with performance-related tests
 - Low temp residue recovery method
 - Superpave binder tools preferred (rheometry)
 - Sample prep & tests adapted for emulsion treatments
 - Aging procedure for residues
 - Revise emulsion viscosity method
 - Field viscosity test
- Develop Approved Supplier Certification program
 - To prevent shipping & construction delays



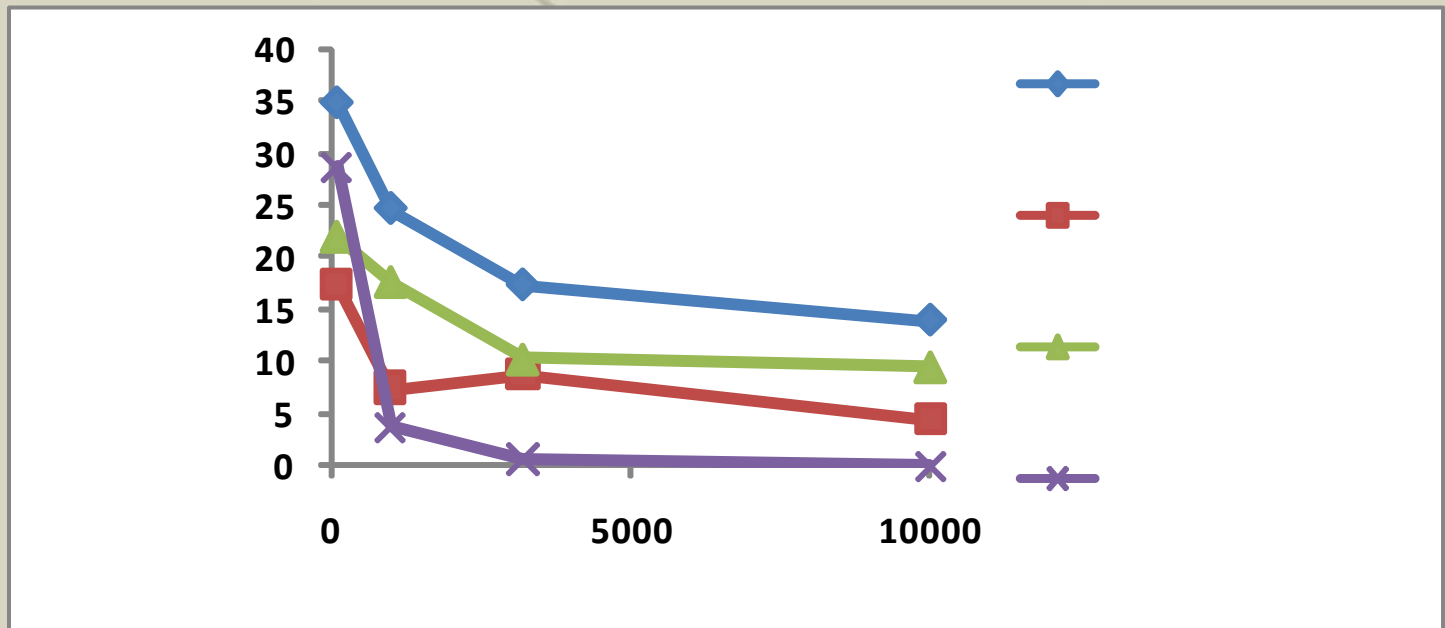
Sample Proposed Performance Tests

| Purpose | Test | Conditions | Report |
|-----------------------------------------------------|----------------------------|-----------------------------------|-------------------------------------|
| Residue Recovery | Forced Draft Oven | 24 hrs @ambient + 24 hrs @60°C | ✓ % Residue |
| Tests on Residue from Forced Draft Oven | | | |
| High Temperature (Rutting/Bleeding) | DSR-MSCR DSR freq sweep | T_h T_h | ✓ J_{nr} ✓ G^* & phase angle |
| Polymer Identifier (Elasticity/Durability) | DSR-MSCR | T_h @3200 Pa | ✓ % Recoverable Strain |
| High Float Identifier (Bleeding) | DSR - non-linearity | T_h | ✓ Test to be developed |
| Tests on PAV after Forced Draft Oven Residue | | | |
| Low Temperature (Aged Brittleness) | DSR freq sweep | 10 & 20° C Model low T | ✓ G^* ✓ Phase Angle |
| Polymer Degradation (Before/After PAV) | DSR-MSCR | T_h @3200 Pa | ✓ Recoverable Strain Ratio |

T_h = high pavement temp; DSR = dynamic shear rheometer
MSCR = multiple stress creep recovery

Field Projects

- ✓ Field projects - 2008 & 2009
- ✓ Tested with proposed performance tests
 - Results currently being analyzed





Utah Parks - Construction

- ✓ 90 miles total 9/6/08 - 10/17/08
 - Arches & Canyonlands Nat'l Parks,
 - Natural Bridges & Hovenweep Nat'l Monuments
- ✓ Chip Seal - 1,140,000 sy (fogged)
 - SBR latex modified CRS-2LM
- ✓ Microsurfacing - 60,000 sy
 - Natural latex modified Ralumac®





Utah Parks - Testing Plan

- ✓ **PRI:** Testing both chip & micro emulsion & aggregates
- ✓ **Paragon:** chip emulsion & aggregates
- ✓ **BASF:** chip emulsion & aggregates
- ✓ **SemMaterials:** micro emulsion
- ✓ **NCHRP study (Shuler):** chip emulsion & aggregates
- ✓ **CFLHD Lab:** acceptance testing only





Death Valley National Park

- ✓ 13 miles - 11/11/08 - 11/14/08
- ✓ Chip seal - 161,400 sy
 - SBR latex modified CRS-LM
- ✓ Test plan:
 - PRI: emulsion & aggregates
 - Paragon: emulsion & aggregates
 - BASF: emulsion & aggregates
 - CFLHD Lab: acceptance testing only





Dinosaur National Monument

- ✓ 11.4 miles - 9/23/08 - 9/30/08
- ✓ Chip seal - 135,000 sy
 - Neoprene modified PASS®
- ✓ Test plan:
 - PRI: emulsion & aggregates
 - CFLHD Lab: acceptance testing only





Crater Lake National Park

- ✓ **23 miles chip seal**
 - Planned for late spring 2009
 - 367,000 sy
- ✓ **Hope: SBS modified CRS-2P**
- ✓ **Testing to be determined**





PME Project Status

- ✓ Preliminary report under review
 - Final report after results of 2009 project
 - Will be posted on NCPP website
- ✓ Field Guide written, published soon
- ✓ Full data available at
www.pavementpreservation.org





Recommendations for Further Study

- ✓ Continue development work on performance specs for emulsions
- ✓ Include testing of unmodified emulsion
- ✓ Continue knowledge sharing of related projects
 - Coordinated by Emulsion Task Force (Pavement Preservation Expert Task Group)



Related Projects

- ✓ **ASTM - Committee D 4.42,**
 - Low temperature recovery of emulsion residue & emulsion viscosity.
- ✓ **Manual for Emulsion-Based Chip Seals for Pavement Preservation (NCHRP 14-17)**
 - Scott Shuler, Colorado State University, and Amy Epps Martin, Texas A&M University.
- ✓ **Emulsion Cold Mix (Asphalt Research Consortium)**
 - Husain Bahia, University of Wisconsin, and Peter Sebaaly, University of Nevada at Reno.
- ✓ **"Chip Seal Design and Performance" North Carolina DOT Project HWY 2004-04**
 - Richard Kim, North Carolina State University.
- ✓ **"Using DSR and Rheological Modeling to Characterize Binders at Low Temp"**
 - Fred Turner and Mike Harnsberger, Western Research Institute.
- ✓ **"Slurry/Micro-Surface Mix Design Procedure" Caltrans Contract 65A0151**
 - Jim Moulthrop, Fugro, and Gary Hicks.



PME Project Status

✓ Envisioned next steps:

- May 14-15, 2009: **ETG/ETF Meeting**
- August 3-7, 2009: **AASHTO SOM** - Study results discussed with emulsion subsection
- September, 2009: **Testing completed**
- October, 2009: **Report finalized**
- November, 2009: **Begin study to develop specification for AASHTO provisional adoption**
- August, 2010: **Provisional specification presented to AASHTO SOM for adoption**
- 2009, 2010, 2012, 2014, 2016: **ongoing performance monitoring of 4 project sites**



Summary

- ✓ **PME should be used for all emulsion applications**
 - <10% increase in cost offset by increased reliability & performance
- ✓ **Field Guide to be published soon**
- ✓ **Current specs need improvement**
 - Efforts underway to develop & implement performance related specs
 - Stay tuned - www.pavementpreservation.org



Thank You.

