

Emulsion 101

How do you measure the effectiveness?

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Southeast Pavement Preservation Partnership Meeting

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Topics for Discussion

- What is an Asphalt Emulsion – Quick overview?
- Asphalt Emulsion Sampling
- Asphalt Emulsion Testing
- Residue Recovery Methods
- Residue Testing
- Supplier Certification
- What is on the horizon?



Asphalt Emulsion

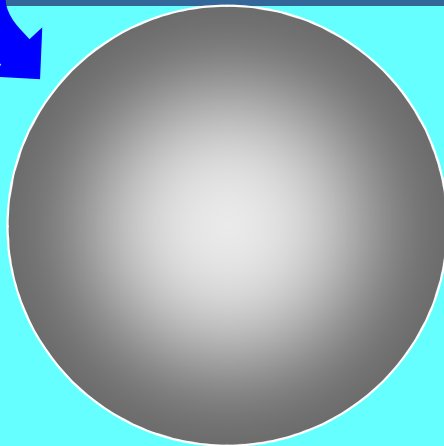
Necessary Components

- **Continuous phase - Water**
 - **Non-continuous phase - Asphalt**
 - **Surfactant - Emulsifying Agent**
 - **Mechanical Energy – Shear**
-
- **The asphalt emulsion is a chemically stabilized system; all components contribute to the stability of the system**

How is an Asphalt Emulsion produced?

Molten asphalt and
emulsifier solution
go in...

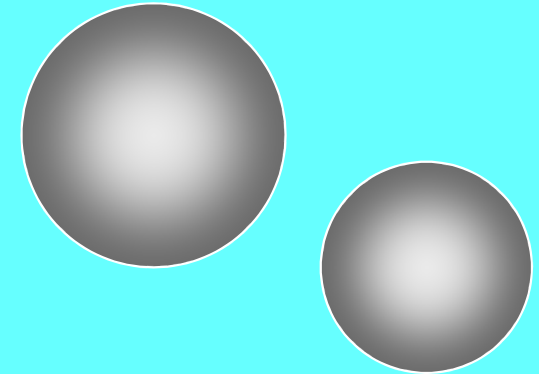
Rotor 



 Time



 Time

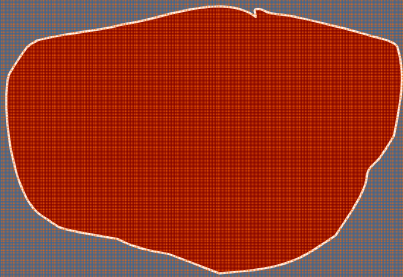


Stator

...and a water based
asphalt emulsion
comes out

Asphalt Emulsion ~

Surface Area of a Latex Modified Emulsion

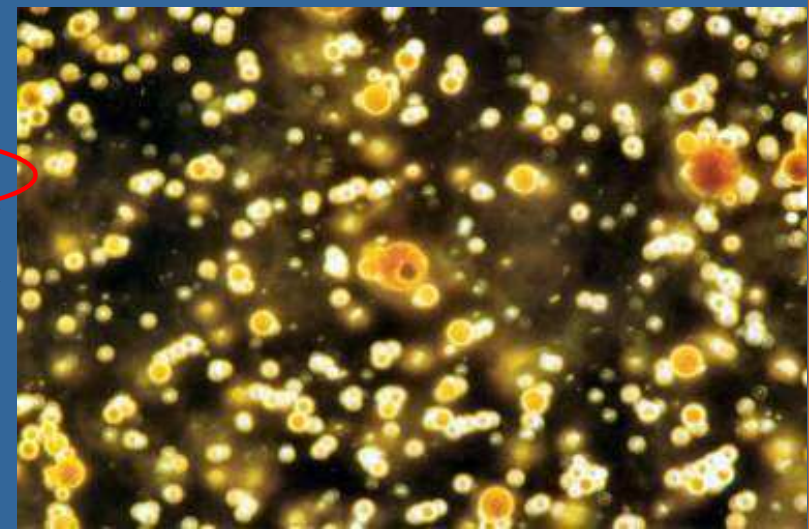


Surface area of asphalt
= 1200cm^2 ($1.2 \times 10^{-1}\text{m}^2$)
(10inch x 20inch)

Material	Weight
Asphalt	2kg
Latex (65% solids)	90g
Cationic emulsifier	4.0g
HCl	3.0g
Water	900g

~ 1 gal emulsion)

Material	No of particles or molecules	Surface Area, m^2	
Asphalt	3.1×10^{13}	600	20x30 m
Latex (3% of asphalt)	4.7×10^{15}	330	20x17 m
Cationic Emulsifier	1.2×10^{22}		
HCl	1.5×10^{22}		
Water	3.0×10^{25}		



Asphalt Emulsion Sampling

■ Location

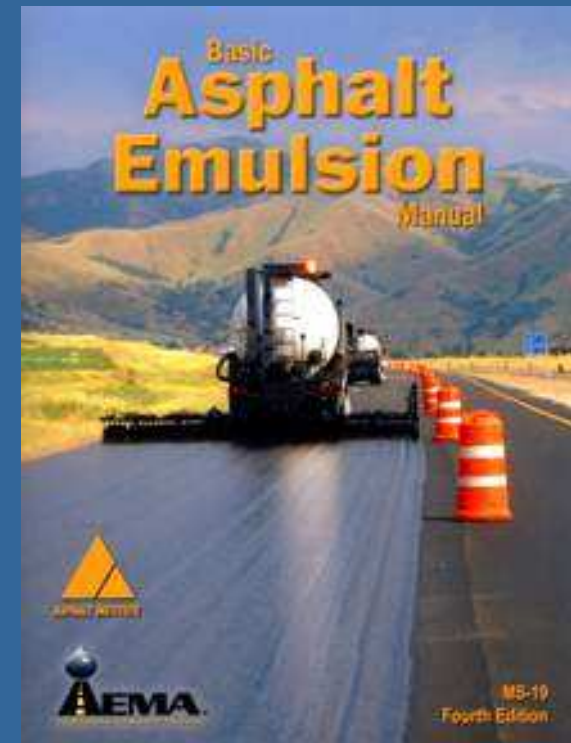
- Supplier tank
- Truck at job site
- Distributer nozzle

■ Containers

- Wide mouth plastic, or plastic lined containers
- Labeled appropriately, to be easily identified
- **No metal containers!**

Asphalt Emulsion Sampling (Continued)

- Shipping to Laboratory
 - Quick as possible, especially with RS grades
 - Avoid Freezing Temperatures
- Time to testing
 - Within two weeks
- See Basic Asphalt Emulsion Manual for additional information



Asphalt Emulsion Testing

■ Characterization

- **Slow, Medium, Rapid or Quick Setting**
- **Cationic, or Anionic/Non-ionic**
- **High Float**

■ Performance

- **Application**
- **Breaking**
- **Mixing**



Asphalt Emulsion Testing Characterization Tests

- Slow Set Emulsions (SS, CSS)
 - Cement Mix Test (ASTM D6935)
- Rapid Setting Emulsions (RS, CRS)
 - Demulsibility (ASTM D6936)
 - Breaking Index
- Medium Setting and Quick Setting (MS, CMS, CQS)
 - Mixture testing with aggregates
 - Ties to performance



Asphalt Emulsion Testing

Characterization Tests – Cont.

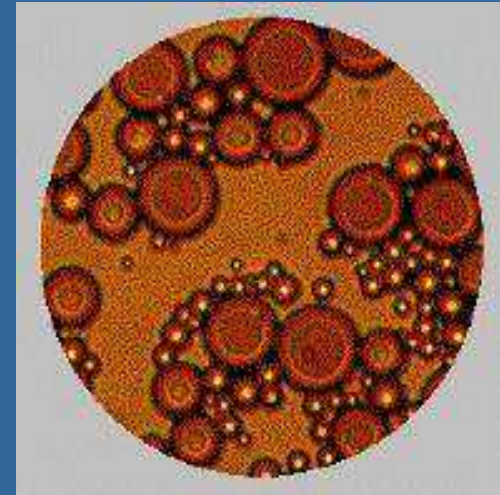
- Cationic or anionic/non-ionic
 - **Particle Charge Test**
 - Identifies cationic emulsions
- High Float Emulsions
 - Discuss in residue properties



Asphalt Emulsion Testing Performance Tests

■ Application

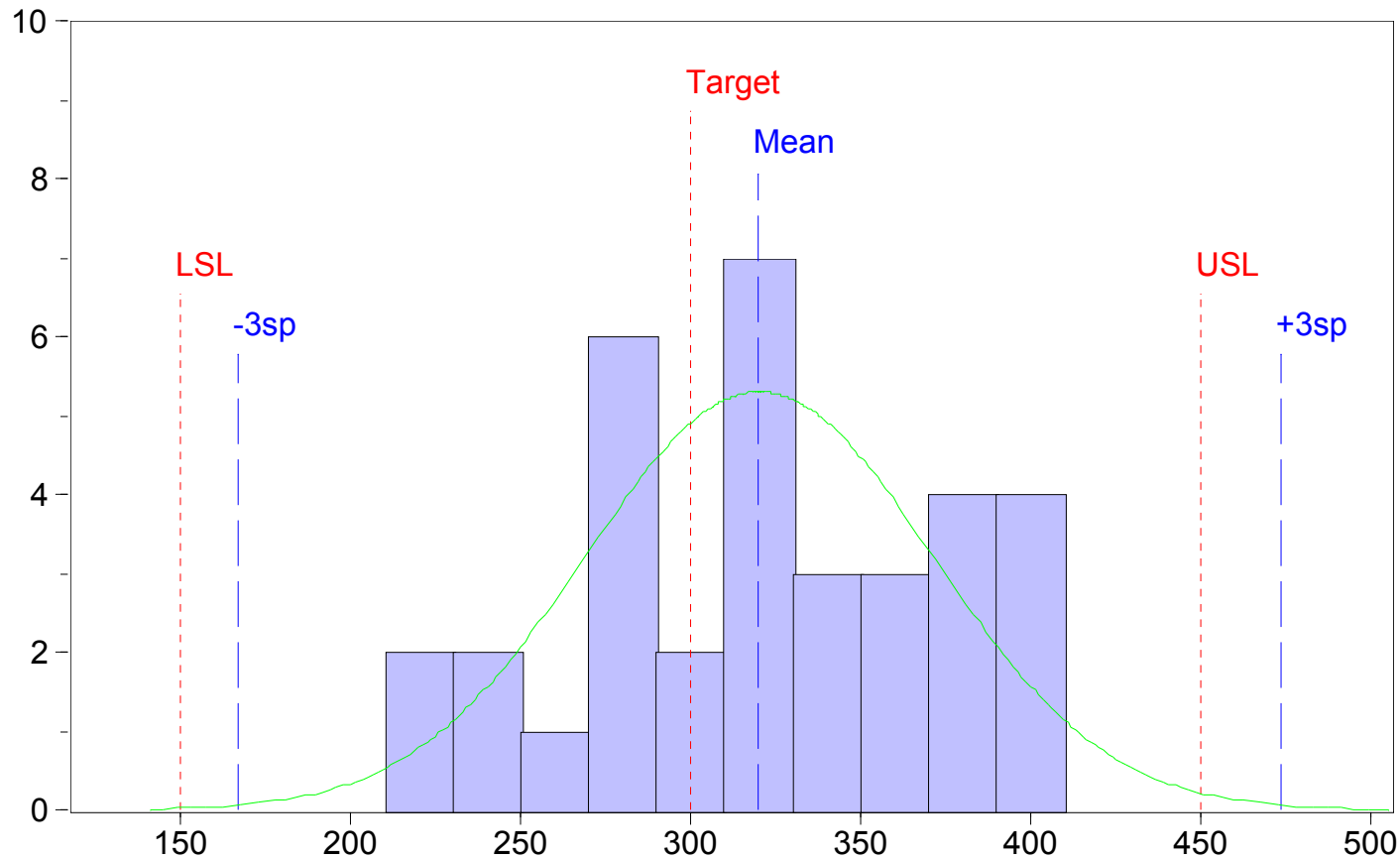
- **Oversize Particles (Sieve) Test**
 - Will it spray through distributor nozzles appropriately
- **Miscibility**
 - Diluteable with water
 - Fog seal or Tack/Bond Coat Emulsions
- **Emulsion Viscosity**
 - Will it coat and make an appropriate mat for the application
 - Most difficult to test over time



Quality Control Charting

Emulsion Viscosity – Plant Production

Data Analysis Results
TK_FINAL



Std Dev:	51.156	Cpk:	.8454	3sp Lim:	(166.8, 473.73)
Samples:	34	Cp:	.9774	Target:	300
Mean:	320.265			Spec Lim:	(150, 450)
Std Dev:	51.156			Est % out:	(.043687, .56052)



Asphalt Emulsion Testing Performance Tests - Continued

■ Application

- **Asphalt Content (Residue)**
 - Amount of asphalt/solids, or non-water component in the emulsion
- **Distillate Content**
 - Amount of petroleum distillate/cutter in the asphalt emulsion
 - Usually used for stockpiled mixes, or mixes with Reclaimed Asphalt Pavement (RAP)



Residue Recovery Methods

■ Distillation

- 177°C or 260°C Temperature
 - ASTM D6997 (modified for polymer systems)
- Are these field conditions?

■ Evaporation

- ASTM D6934 – High temperature
 - CalTrans variation
- ASTM D7497 - Low temperature

Residue Recovery Methods

Distillation



Residue Recovery Methods (Low Temperature Evaporation)



Asphalt Emulsion Residue Testing (Unmodified)

■ Unmodified

- Penetration
- Absolute Viscosity
- Softening point
- Float Test



Material	% Residue by Distillation (%)	Softening Point (°F)	Absolute Viscosity (Pa*s)	Penetration (dmm)
PGXX-34 Emulsion (no latex)	64.7	93	45.2	304
PG58-28 Emulsion (no latex)	64.4	107	98.8	133
PG64-22 Emulsion (no latex)	65.9	119	261.6	75

Asphalt Emulsion Residue Testing (Modified)

■ Modified

- Elastic Recovery

				CRS-2L	CRS-2P
Sample #				3278	3279
ER 10C SS 20cm 5mn, %	103	T 301	58 min	78.8	78.8
ER 10C SS 20cm 5mn, %	103	T 301	58 min	73.8	77.5
ER 10C SS 20cm 5mn, %	103	T 301	58 min	72.5	78.8
AVG.				73.1	78.1

- Forced Ductility
- Toughness & Tenacity
- Torsional Recovery

Asphalt Emulsion Residue Testing (Modified), Continued

■ Modified

- DSR (Dynamic Shear Rheometer)
 - MSCR (ASTM D7405)

Emulsion	Original DSR Testing on Residue from Evaporation (25°C 24 hour & 60°C 24 hour) @ 10rad/sec @ test temperature								
	% Latex	58°C		64°C		70°C		76°C	
		g*/sin delta	delta	g*/sin delta	delta	g*/sin delta	delta	g*/sin delta	delta
CRS-2	0.00	1.943	84.80	0.900	86.35				
CRS-2P	3.0P	4.526	68.17	2.429	70.33	1.302	73.32	0.7115	76.59
HFRS-2P	3.0P	1.829	77.31	0.9484	79.04				

Multiple Stress Creep Recovery Testing on Residue from Evaporation (25°C 24 hour & 60°C 24 hour)					
Emulsion	% Polymer	58°C		64°C	
		100Pa	3200Pa	100Pa	3200Pa
CRS-2	0.0	-0.650	-0.54		
CRS-2P	3.0P	50.050	35.87	37.72	18.48
HFRS-2P	3.0P	12.53	4.062		

Asphalt Emulsion Certification Emulsion Task Force Update



- Draft document submitted to AEMA board and membership for review and AASHTO for balloting.
- Based on those drafted by north central states and midwest states

Standard Recommended Practice for

Certifying Suppliers of Emulsified Asphalt

AASHTO Designation: X XX-XX (2009)

1. SCOPE

- 1.1 This standard specifies requirements and procedures for a certification system that shall be applicable to all suppliers of emulsified asphalts (EA). The requirements and procedures shall apply to materials that meet the requirements of either AASHTO M 140 or AASHTO M 208/M 316, (Cationic Emulsions/Polymer Modified Cationic Emulsions), which are manufactured at refineries, terminals, in-line blended, or otherwise produced for use in paving applications.
- 1.2. This standard may involve hazardous materials, operations, and equipment. It does not purport to address all of the safety problems associated with this use. The user of this standard shall be responsible for appropriate safety and health practices.

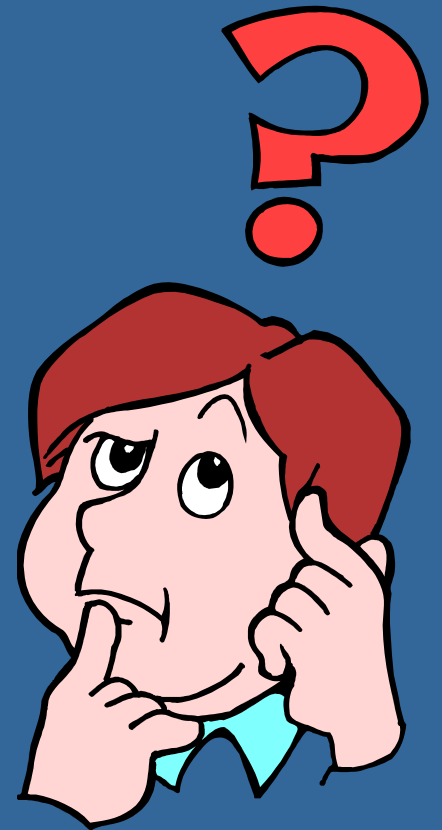
What is on the Horizon?

- Emulsion Task Force
 - Central Federal Lands Report
- Rheological Testing on Residues
 - Data being developed
 - New tests – Strawman Spec.
- Supplier Certification
 - Draft Document for Review
- AEMA - Basic Asphalt Emulsion Manual
 - New revised edition



Thank You!

Questions



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