
LTRC Seminar Series
Emulsion
Design, Construction, and
Performance
DOTD Lessons Learned?


FEELS LIKE
PIONEER SUSPENSION


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Louisiana Highway Facts

- 16,750 total miles of state/federal highways
  - 12,075 miles of Bituminous Surfaces over concrete
  - 3,007 miles of full depth hot mix
- 22,150 miles of non-state bituminous surfaces

Unit Costs / square yard by Application Type

- Chip Seal 2000 2008
  - Single Application (3/8”)……$1.25 $2.00
- Micro Surfacing :
  - Double Application (5/8”) 40 lbs…$2.75 $3.75
- Hot mix (3/4”)
  - “Conventional” OGFC ……$2.75 $5.50
- (1-1/2”)HMAC, ……$3.30 $7.50
- Crack Sealing/ft……..$1.00 $2.00

Expected Life of Bituminous Surfaces

- Chip Seal: 5 - 7 years
- Micro Surfacing: 7 - 10 years
- Thin Overlay (OGFC):8-12 years

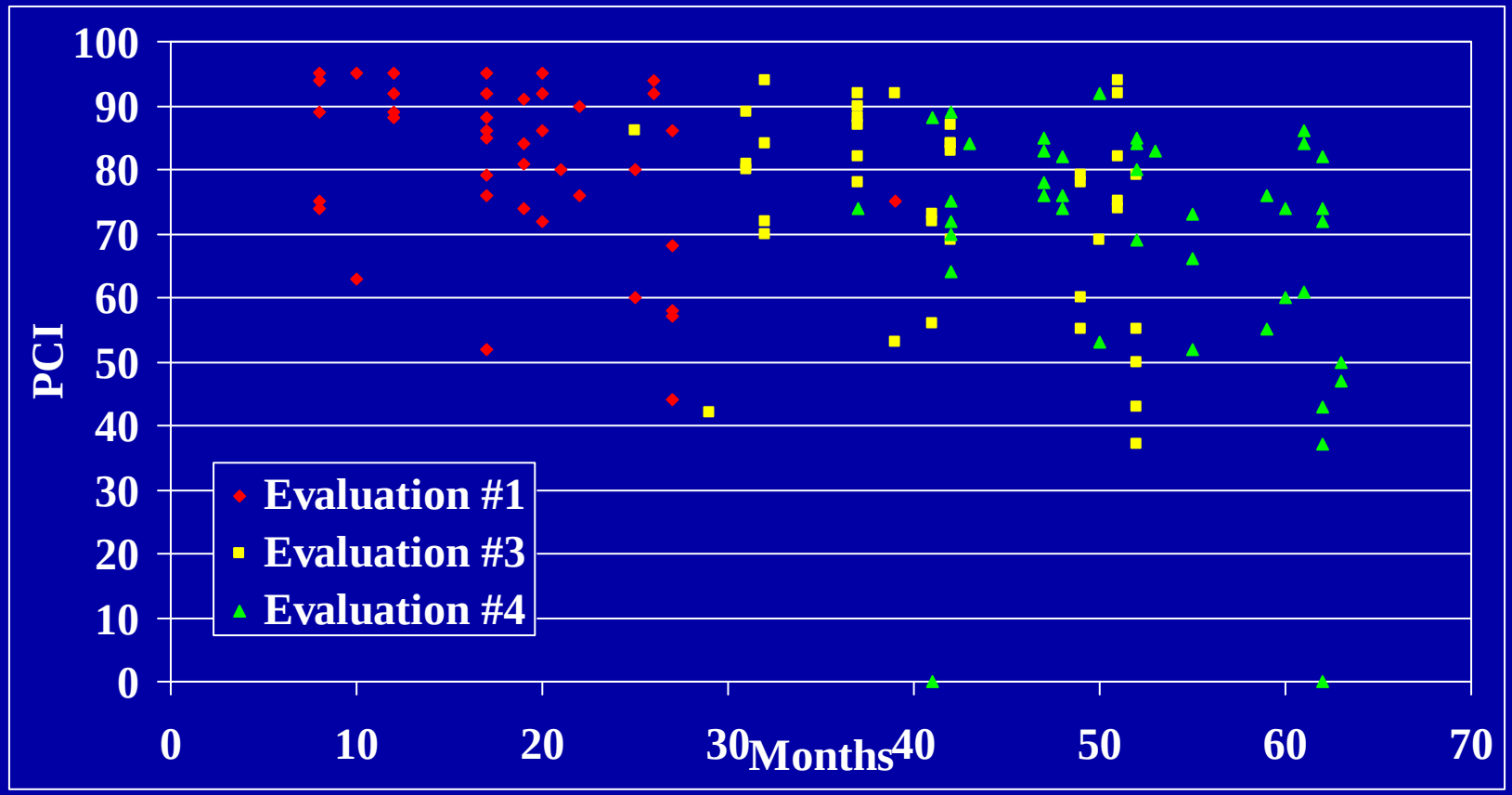
30 year Life Cycle Annual Cost

- Chip seal @ yr 7, 14, 21 and 28 @$2.00
  - Cost of treatment $8.00/ sq yd (5 yrs left)
- Microsurfacing @ yr 10, 20 and 30 @$3.75
  - Cost of treatment $11.75 (10 yrs remaining)
- Thin Overlay @ yr 12 and 24 @ $7.50
  - Cost of treatment $11.00 (6 yrs remaining)

Question : how long will pavement structure last?

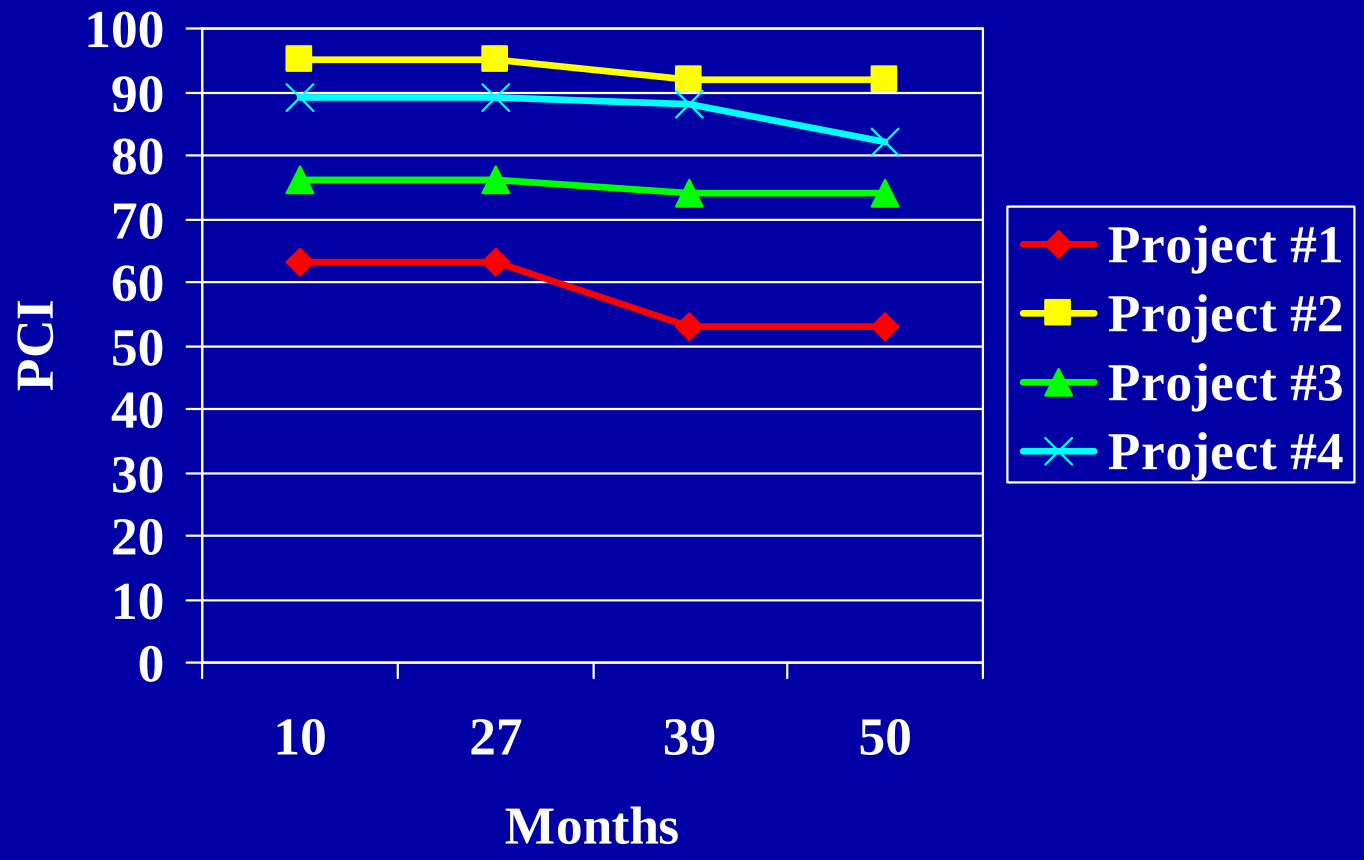

HYPAC

Pavement Condition Index –PCI Chip Seals

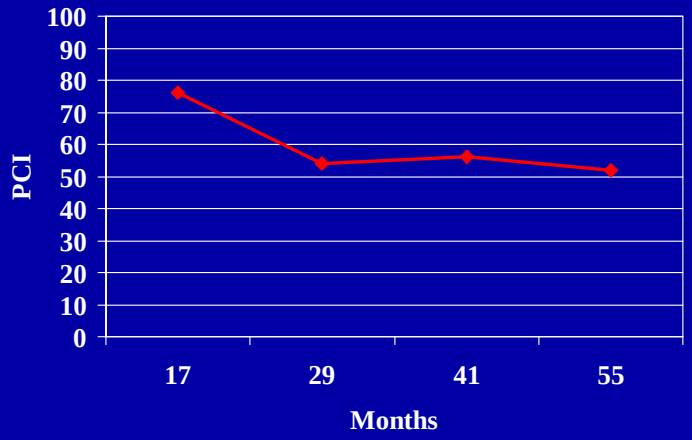


Pavement Condition Index –PCI

Chip Seals



LA 999 Chip Seal

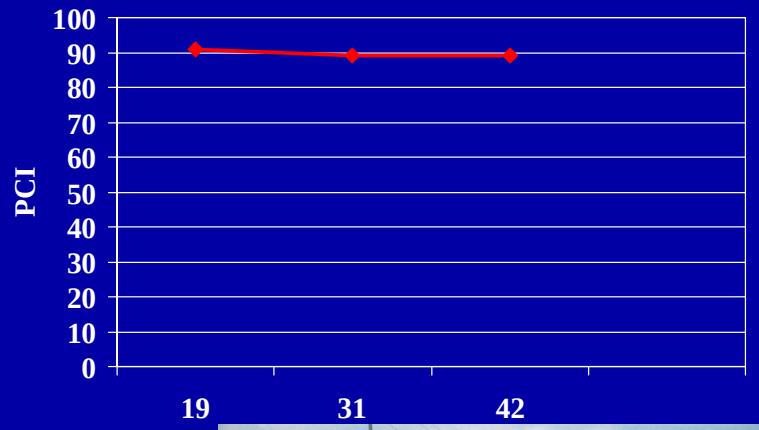


December 1998

February 2001

LA 4 Chip Seal

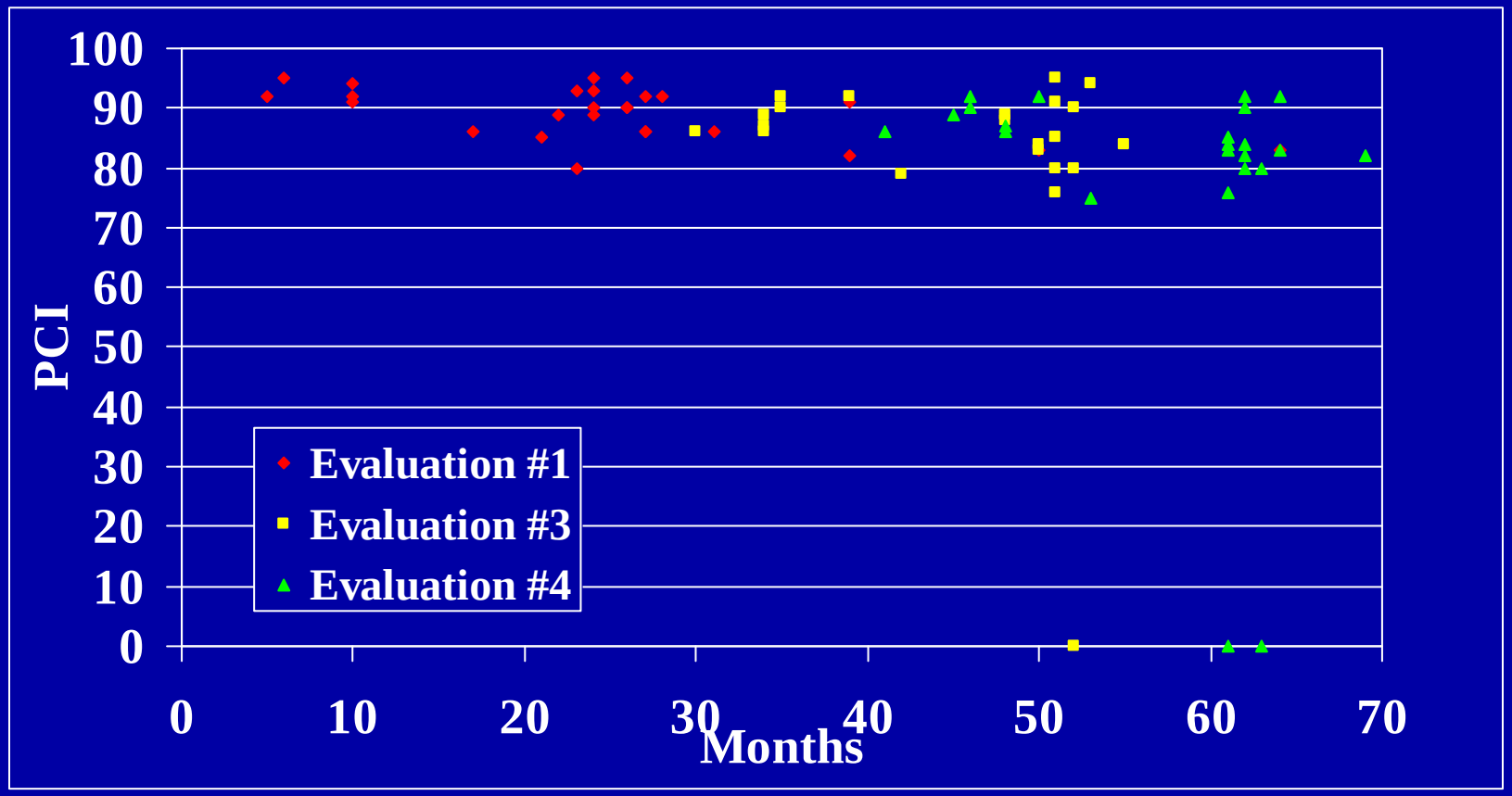
November 1998



February 2001

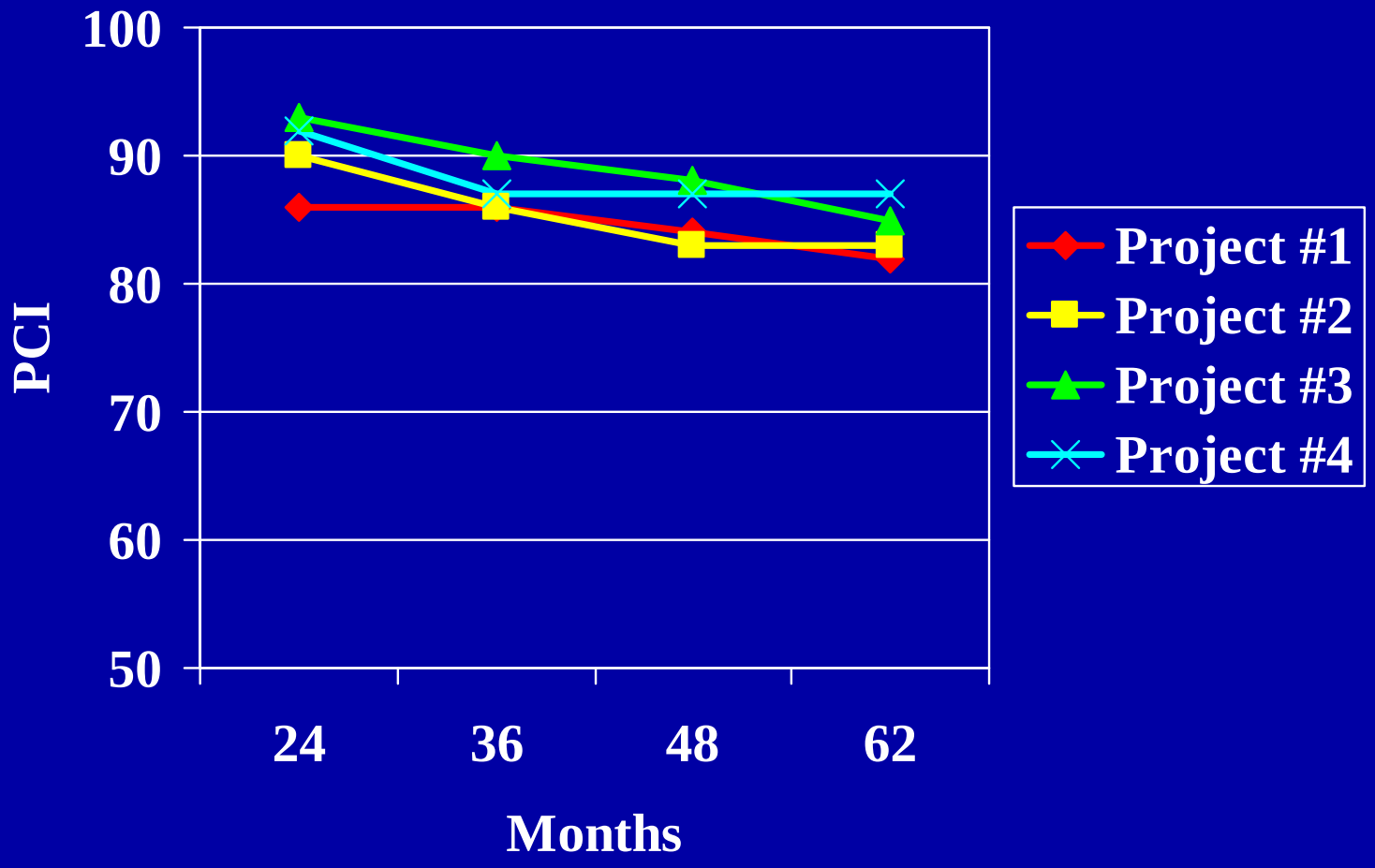

LA 397 --‘96 Microsurfacing

Pavement Condition Index –PCI Micro Surfacing



Pavement Condition Index –PCI

Micro Surfacing



LA 3188 Micro Surfacing

December 1998

February 2001

LA 659 Micro Surfacing, Houma

December 1998

February 2001

5th Year Performance Evaluation

- Avg. PCI of 75 for chip seal
- Avg. PCI of 85 for micro-surface
- 70% of chip seals in good to excellent condition
- 90% of the micro-surface projects in service are in excellent condition
- Severity and length of cracking was low on all projects with good/excellent rating
- Micro-surface Rutting was less than 0.5”

Pavement Preservation – What's new?

- PP Roadmap
  - AFK10 support for TRB RFP - Emulsion Performance Specifications
- Emulsion Task Force
  - Scope
  - Representation
- Research in-progress
- Quest for Performance Specifications

Pavement Preservation Roadmap – Materials Research

- Mechanical Binder Properties to Predict Surface Treatment Performance: $1.5 MM
- Acceptance Criteria for Surface Treatments $600k
- Appropriate Installation Geometry for Crack Treatments: $250 k
- Cost-Effectiveness of Quality Aggregates: $250 k
- Performance Grading System for Asphalt Emulsions: $4.5 MM
- Performance-Graded Aggregate System for Pavement Preservation Surface Treatments: $4 MM
- “Triggers” for the Timing of Surface Treatments: $10 MM

http://www.tsp2.org/roadmap/

National Emulsion Research Programs

- PME Chip Seal Design and Performance
  - North Carolina DOT
  - NC State – Richard Kim
    - Aggregate specs
    - Chip Seal design
    - Advanced Performance test methods
- Using DSR and Rheological Modeling to Characterize Binders at Low Temp
  - FHWA/WRI Fundamental Properties Study
  - WRI – Fred Turner, Mike Harnsberger
    - Replace BBR with DSR for low temp binder testing
    - Use DSR to define “High Float”

Emulsion Research Programs

- Performance specifications for fog seals
  - Funded by Caltrans
  - CA PP Center - Hicks
  - Building on FPP's Spray-Applied Sealer Study
- Microsurfacing Mix Design Method
  - Pooled Fund
  - Fugro - Moulthrop

Emulsion Research Programs

- Optimal Timing of Preventive Maintenance for Addressing Environmental Aging in HMA pavements
  - MnRoad Pavement Preservation Study
  - Pooled Fund Study TPF-5(153)
  - MN, MD, OH, TX, LRRB
  - $375k

Emulsion Research Programs

- Polymer Modified Emulsions (PME) Technology Deployment Study
  - FHWA Bureau of Federal Lands
    - Manager: Mike Voth
  - NCPP – Galehouse, Johnston, King

Polymer Modified Emulsions (PME) Technology Deployment Study

Recommend specifications and use of polymer modified emulsions for:

- Chip Seals
- Microsurfacing/Polymer-modified slurry
- Cape Seals

GO-LIVE in July ’08

- All compliance tests must have ASTM/AASHTO approved or provisional standard
- Use report-only to evaluate new test methods

The PME Survey

- Approved Supplier Certification Program
- Residue Recovery Methods
- Emulsion Specification Tests
- Emulsion Residue Specifications
- Application-Specific Performance Specifications
- Construction/Acceptance

Progress - Federal Lands Study

- Emulsion Survey - Results Reported To:
  - AEMA/ARRA/ISSA – February 22nd
  - Binder Expert Task Group – February 27th
  - Emulsion Task Force – April 10th
- Initiate supplier certification
- Strawman performance specification
  - Define a report-only lab testing plan
    - PME Chip Seal
    - PME Slurry/Microsurfacing

The Framework
Certification

- Approved Emulsion Supplier Certification Program
  - Initial draft from Combined States
  - AEMA/AI represent industry
  - Develop through Emulsion Task Force
- Laboratory Certification Program - AMRL
- Contractor/Individual Certification

Do we need certification for inspection, site selection,etc.

The Framework
Update ASTM D-244

- Residue Recovery Method
- Method for Measuring Emulsion Viscosity
  - Lab: Brookfield or Paddle Method
  - Field Test:
- Methods to Simulate Pavement Aging (PAV)
- Rheological definitions for “High Float”

Emulsion Residue Recovery

- Available methods:
  - Distillation (500F, 400F, 350F)
  - Moisture Content (ASTM)
  - Forced Airflow Drying (48 hour)
    - CEN standards
    - Silicon molds
  - Vacuum Methods
  - Stirred Can method (170 minutes)

Anionic Emulsified Asphalt

	SS-1			SS-1h		
	100	80	50 or remove	100	80	50 or remove
Viscosity, Saybolt Furol @ 25°C, s T59	20-100			20-100		
Residue by Distillation, % by wt T 59	57+	52-56	51-	57+	52-56	51-
Sieve Test (Retained on 850 µm) T 59	0.1-	---		0.1-	---	---
Cement Mixin T 59	2-	---	---	2-	---	---
Settlement, 5-day, % T 59	5.0-	---	---	5.0-	---	---
Tests on Residue by Distillation:						
Penetration, 25°C, 100 g, 5 s, dmm T 49	100-200	88-99	87-	40-90	30-39	29-
		201-212	213+		91-100	101+
Solubility, T 44	97.5+	---	---	97.5+	---	--
Ductility, 25°C,50 mm/min, cm T 51	40+	26-39	25-	40+	26-39	25-

Cationic Emulsified Asphalt (CRS-2, CMS-2)

		CRS-2			CMS-2		
		100	80	50 or remove	100	80	50 or remove
Viscosity, Saybolt Furol @ 50°C, s	T 59	100-400			50-450		
Saybolt Furol @ 25°C, s	T 59	---	---	---	---	---	---
Residue by Distillation, % by wt	T 59	65+	61-64	60-	65+	61-64	60-
Oil Distillate by Volume, %	T 59	3.0-	---	---	12.0-	---	---
Particle Charge	T 59	Pos.	---	Neg.	Pos.	---	Neg.
Sieve Test (Retained on 850 µm), %	T 59	0.1-	---	---	0.1-	---	---
Settlement, 5-days, %	T 59	5.0-	---	---	5.0-	---	---
Tests on Residue by Distillation:							
Penetration, 25°C, 100 g, 5 s, dmm	T 49	100-250	84-99 251-266	83- 267+	100-250	84-99 251-266	83- 267+
Solubility, %	T 44	97.5+	---	---	97.5+	---	---
Ductility, 25°C, 5 cm/min, cm	T 51	80+	66-79	65-	40+	26-39	25-
Viscosity, 135°C, Pa·s	TP 48	0.18+	0.13-0.17	0.12-	---	---	---

Cationic Emulsified Asphalt (CSS-1 and CSS-1h)

		CSS-1			CSS-1h		
		100	80	50 or remove	100	80	50 or remove
Viscosity, Saybolt Furol @ 50°C, s	T 59	---	---	---	---	---	---
Saybolt Furol @ 25°C, s	T 59	20-100			20-100		
Residue by Distillation, % wt.	**T 59**	**57+**	**52-56**	**51-**	**57+**	**52-56**	**51-**
Oil Distillate by Volume, %	T 59	---	---	---	---	---	---
Particle Charge	T 59	Pos.	---	Neg.	Pos.	---	Neg.
Sieve Test (Retained on 850 µm), %	T 59	0.1-	---	---	0.1-	---	---
Settlement, 5-days, %	T 59	5.0-	---	---	5.0-	---	---
Tests on Residue by Distillation:							
Penetration, 25°C, 100 g, 5 s, dmm	T 49	100-200	88-99 201-212	87- 213+	40-90	30-39 91-100	29- 101+
Solubility, %	T 44	97.5+	---	---	97.5+	---	---
Ductility, 25°C, 5 cm/min, cm	T 51	40+	26-39	25	40+	26-39	25-
Viscosity, 135°C, Pa*s	TP 48	---	---	---	---	---	---

Emulsified Polymerized Asphalt (CRS-2P)1

Test Parameter		100	80	50 or remove
Viscosity, Saybolt Furol @ 50°C	T 59	100-400		55-445+
Storage Stability Test, 24 h, %	T 59	1.0-	---	---
Settlement, 5 Day, %	T 59	5.0-	---	---
Classification Test	T 59	Pass	---	Fail
Particle Charge Test	T 59	Pos.	---	Neg.
Sieve Test (Retained on 850 µm), %	T 59	0.1-	---	---
Distillation: Oil Distillate by Vol. of Emulsion, %	T 59	3.0-	---	---
Residue from Distillation, %		65+	61-64	60-
Tests on Residue by Distillation:				
Penetration, 25°C, 100 g, 5 s, dmm	T 49	10-20	8-10 20-22.5	8-23+
Softening Point (Ring & Ball), °C	T 53	38.0+	32.1-37.9 52.1-58.9	32.0-59.0+
Solubility, %	T 44	97.5+	---	---
Tests on Residue by Evaporation[4]:				
Force Ductility Ratio (f_2/f_1, 4°C, 5 cm/min, f_2 at second peak)	T 300	0.30+	0.21-0.29	0.20-
Elastic Recovery, 10°C, 20 cm elongation, %	T 301[5]	58+	51-57	50-

MC Cutback Asphalt

		MC-30			MC-70		
		100	80	50 or remove	100	80	50 or remove
Flash Point, Open Tag, °C	T 79	38+	---	---	38+	---	---
Viscosity, Saybolt Furol @	T 72						
25°C, s		75-150			---	---	---
60°C, s		---	---	---			
Distillation Test, Distillate	T 78						
Percentage by Volume of Total Distillate to 360°C							
to 225°C		0.0-25.0	---	---	0.0-20.0	---	---
to 260°C		40.0-70.0	---	---	20.0-60.0	---	---
to 316°C		75.0-93.0	---	---	65.0-90.0	---	---
Residue from Distillation to 360°C, Volume Percentage of Sample by Difference		50.0+	45.1-49.9	45.0-	55.0+	50.1-54.9	50.0-
Tests on Residue by Distillation:							
Penetration, 25°C, 100 g, 5 s, dmm	T 49	120-250	102-119 251-268	101- 269+	120-250	102-119 251-268	101- 269+
Solubility, %	T 44	99.0+	98.6-98.9	98.5-	99.0+	98.6-98.9	98.5-
Ductility, 25°C, for Residues to 200 Penetration, 5 cm/min, cm	T 51	100+	76-99	75-	100+	76-99	75-
Ductility, 15.5°C, for Residues of 200-300 Penetration, 5 cm/min,	T 51	100+	76-99	75-	100+	76-99	75-

MC 250 Cutback Asphalt

		100	80	50 or remove
Flash Point, Open Tag, °C	T 79	66+	---	---
Viscosity, Saybolt Furol @	T 72			
25°C, s		---	---	---
60°C, s		125-250		
Distillation Test, Distillate Percentage by Volume of Total Distillate to 360°C	T 78		---	---
to 225°C		0.0-10.0	---	---
to 260°C		15.0-55.0	---	---
to 316°C		60.0-87.0		
Residue from Distillation to 360°C, Volume Percentage of Sample by Difference		67.0+	62.1-66.9	62.0-
Tests on Residue by Distillation:			102-119	101-
Penetration, 25°C, 100 g, 5 s, dmm	T 49	120-250	251-268	269+
Solubility, %	T 44	99.0+	98.6-98.9	98.5-
Ductility, 25°C, for Residues to 200 Penetration, 5 cm/min, cm	T 51	100+	76-99	75-
Ductility, 15.5°C, for Residues of 200-300 Penetration, 5 cm/min, cm	T 51	100+	76-99	75-

Cationic Emulsified Petroleum Resin (EPR-1)

		100	80	50 or Remove[2]
Viscosity, Saybolt Furol @ 25°C,s	T 59	15-100		
Residue by Evaporation, % by wt.	T 59	57+	52-56	51-
Particle Charge	T 59	Pos.	---	Neg.
Sieve Test (Retained on 850 µm), %	T 59	0.1-	---	---
Settlement, 5 Days, %	T 59	5.0-		---

AEP Emulsified Asphalt

		100	80	50 or Remove[2]
Viscosity, Saybolt Furol@ 50°C, s	T 59	15-150		
Residue by Evaporation,% by wt.	T 59	50+	46-49	45-
Oil Distillate by Volume, %	T 59	25.0-	---	---
Sieve Test (Retained on 850 µm), %	T 59	0.1-	---	---
Storage Stability, 24 h, %	T 59	1.0-	---	---
Settlement, 5 Days, %	T 59	5.0-	---	---
Test on Residue by Evaporation:				
Penetration, 25°C, 100 g, 5 s, dmm	T 49	250+	---	---
Solubility, %	T 44	97.5+	---	---

Anionic Emulsified Polymer Modified Asphalt

SS-1P

		100	80	50 Or Remove
Viscosity, Saybolt Furol @ 25°C, s	T 59	20-100		
Storage Stability, 24 Hour, %	T 59	1.0-	---	---
Sieve Test, retained on the No. 20, %	T 59	0.1-	---	---
Residue by Evaporation,%	T59	57+	---	56-
Tests On Residue From Evaporation Test:				
Penetration, 25°C, 100g, 5s, dmm	T 49	100-200	88-99 201-212	87-213 +
Solubility, %	T 44	97.5+	---	---
Force Ductility Ratio f_2/f_1, 4°C, 5 cm/min, f_2 @ 30 cm elongation	T 300	0.15+	---	0.14 -
Elastic Recovery [1], 10°C, 20 cm elongation, %	T 301	30+	---	29-

Anionic Emulsified Latex Modified Asphalt

SS-1L

		100	80	50 or Remove
Viscosity, Saybolt Furol @ 25°C, s	T 59	20-100		
Storage Stability, 24Hour, %	T 59	1.0-	---	---
Sieve Test, retained on the No. 20, %	T 59	0.1-	---	---
Residue by Evaporation, %	T 59	57+	---	56-
Tests On Residue From Evaporation Test:				
Penetration, 25°C, 100g, 5s, dmm	T 49	100-200	88-99 201-212	87- 213+
Ductility, 5 cm/min., 4°C	T 51	50+	41-49	40-
Elastic Recovery[1], 10°C, 20 cm elongation, %	T 301	50+	---	49-
Softening Point, Ring & Ball, °C	T 53	50.0+	45.1-49.9	45.0-

Hot Applied Modified Asphalt Cements for Asphalt Surface Treatment1

		Gelled Asphalt		PAC 15	
		100	90 or Remove	100	90 or Remove
Tire Rubber Content, %	---	---	---	5+	---
Penetration @ 25°C, 100 g., 5 s, dmm	T 49	55-100	54-101+	75-125	74-126+
Viscosity, @ 60°C, Pa∽s	T 202	100+	99-	150+	149-
Rotational Viscosity @ 135°C, Pa∽s^2	TP 48	0.7-3.0	0.6-3.1+	3.0-	3.1+
Force Ductility Ratio, f_2/f_1, 4°C, 5cm/min, f_2 @ 30 cm elongation	T 300	---	---	0.30+	0.29-
Softening Point, °C	T 53	53+	52-	45+	44-
Flash Point, °C	T 48	230+	228-	230+	228-
Solubility, %	T 44	99.0+	---	---	---
Separation of Rubber, 163°C, 48 hours difference in R & B from top to bottom sample, °C	DOTD TR 326	---	---	2-	---

Hot Applied Modified Asphalt Cements for Asphalt Surface Treatment1

		Gelled Asphalt		PAC 15	
		100	90 or Remove	100	90 or Remove
Tests on Residue from Rolling Thin Film Oven Test:	T 240				
Elastic Recovery, 25°C, 10 cm elongation, %	T 301[3]	---	---	55+	54-
Penetration Retention 25°C,RTFO/Original	T 49	---	---	0.60+ 1.00-	0.59- 1.01+
Viscosity Ratio, 60°C,RTFO/ Original	T 202	2.5-	2.6+	---	---