









Evaluating the Influence of Aging on the Chemical and Performance Characteristics of REOB Modified Asphalt Binders & Mixtures

By:

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Questions Prompting Study
What is the minimum and maximum REOB dosage to reach the target low temperature grade? (i.e -28°C).

What is the effect of the maximum dosage on the properties of the asphalt binder after short and long-term aging?

What is the effect of the maximum dosage on the performance of asphalt mixtures both short and long-term?

Questions Prompting Study

Do all REOB sources use the same dosage to reach the target low temperature grade?

Are the REOB samples consistent amongst different samples of the same REOB product obtained from different lots?

How does REOB compare to other products such as Hydrolene that have been used to modify base binders to meet the target low temperature grade?

Objectives

- **1.** Obtain REOB from two different sources, and different batches/lots for each source.
- 2. Determine the consistency among the REOB obtained from the same source but different batches/lots.
- **3.** Obtain a straight run PG64-22 and a PG58-28 from two refineries.
- 4. Obtain a typical PG64-28 that has been used in projects placed within the last 5-7 years.
- 5. Determine the range of dosages of the two REOB sources and Hydrolene required to bump the PG64-22 binder to a PG58-28 binder.

Objectives

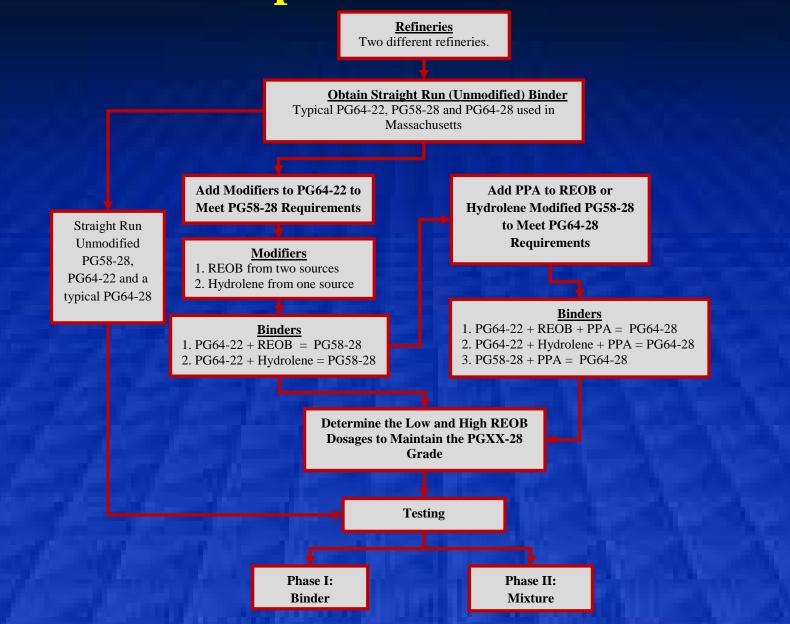
- 6. Measure the performance grade, physical, and rheological properties of the REOB modified PG58-28 binder at different dosages in an attempt to determine at what dosage each REOB will start degrading binder performance.
- 7. Determine the proper dosage of Polyphosphoric Acid (PPA) to bump the REOB modified PG58-28 binder to a PG64-28 binder (1.0% maximum).
- 8. Measure the performance grade, physical, and rheological properties of the REOB and PPA modified PG64-28 at the different dosages. The data will be analyzed to compare the properties of a typical PG64-28 with known field performance.

Objectives

9. Using the REOB modified binders at critical dosages determined during the binder testing phase, conduct mixture performance testing on an approved Massachusetts 12.5mm mixture design.

Mixture performance will be measured in the laboratory in terms of thermal cracking, fatigue cracking, rutting, and moisture damage after short-term and long-term aging.

Experimental Plan



Phase I: Binder

Phase I: Binder Testing

Conduct Performance Test at Various Dosages of REOB Between (and including) the Low and High Dosages Required to Maintain the PGXX-28 Performance Grade

REOB Detection & Quantification

1. X-Ray Fluorescence (XRF) Spectroscopy

Rutting

1. Multiple Stress Creep Recovery Test - AASHTO TP70 2. G*/sinδ - AASHTO M320

Fatigue

- 1. Linear Amplitude Sweep (LAS) AASHTO TP101
- 2. Double Edge Notched Tension (DENT) Test Ontario Test Method LS-299
- 3. G* sinδ AASHTO M320

Low Temperature Cracking

- 1. Single Edge Notched Beam (SENB) Test
- 2. Extended Bending Beam Rheometer Test Ontario Test Method LS-308
- 3. Creep Stiffness S and Slope m-value AASHTO T313

Adhesion

1. Bitumen Bond Strength (BBS) Test

Aging

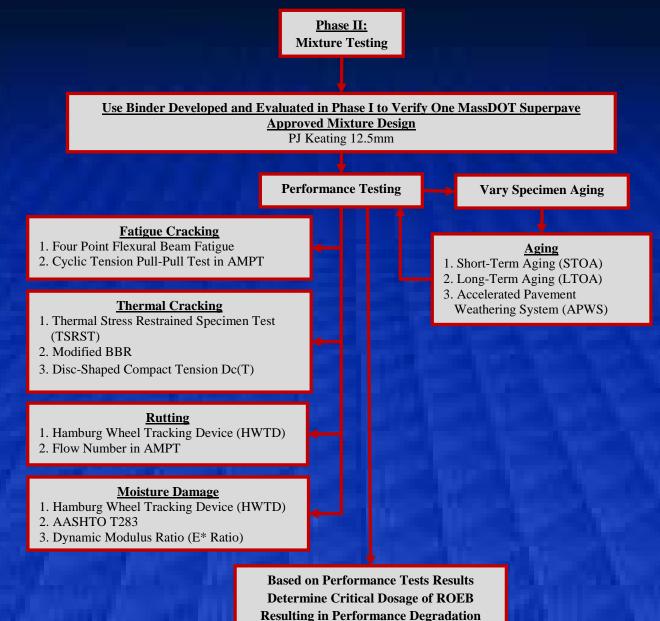
1. Modified PAV

Based on Performance Tests Results Determine Critical Dosage of ROEB Resulting in Performance Degradation

Measure Binder

Performance Properties

Phase II: Mixture



Binder, REOB & Hydrolene Irving & Petróleos de Venezuela, S.A. (PDVSA) PG58-28 & PG64-22 Straight Run REOB **1.Safety-Kleen EcoADDZ** 2. Heritage Crystal Clean VTAE

Holly Frontier Corporation H90T

Hydrolene

Phase I: Binder

					1 1			
58-28 Irving -	1			Straight Run				I Typical
1.07-28.24	61.11-27.92		-24.24	66.85-24.49		65.57-2		65.59-29.26
PG58-28	PG58-22	PGe	54-22	PG64-22		PG64-	-28	PG64-28
	coADDZ		d Const	al Clean	ור	Add	II.	alama
Add E	COADDZ	Au	i Cryst	al Clean		Add]	Hyar	biene

Phase I: Binder Data - EcoADDZ

PG64-22 Irving - Straight Run						
67.01-24.24	66.85-24.49					
PG64-22	PG64-22					

	Add EcoADD	Z	Add EcoADD	Z & PPA	
	-				
2% 🔦	65.48-24.91	65.55-24.94	2% EcoAddz + 1% PPA	72.01-26.1	72.04-27.4
	PG64-22	PG64-22		PG70-22	PG70-22
6% 🔦	63.25-27.74	63.10-27.32	6% EcoAddz + 1% PPA 4	67.70-27.38	67.8-28.49
	PG58-22	PG58-22		PG64-22	PG64-22
	-				
10% 🔦	60.99-28.29	61.02-28.49	10% EcoAddz + 1% PPA	64.42-29.83	64.7-28.91
	PG58-28	PG58-28		PG64-28	PG64-28
	·				
13% 🔦	59.42-29.24	59.54-28.91	13% EcoAddz + 1% PPA	61.62-30.4	61.82-30.29
	PG58-28	PG58-28		PG58-28	PG58-28
	-				
18% 🔦	56.66-30.37	56.65-32.45	18% EcoAddz + 1% PPA	58.88-32.00	58.17-31.69
	PG52-28	PG52-28		PG58-28	PG58-28
18%	56.66-30.37	56.65-32.45	18% EcoAddz + 1% PPA ⁴	58.88-32.00	58.17-3

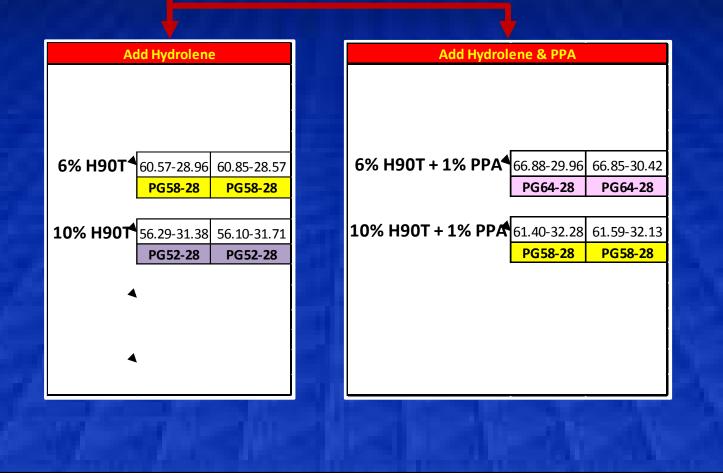
Phase I: Binder Data - Crystal Clean

PG64-22 Irving - Straight Run					
67.01-24.24	66.85-24.49				
PG64-22	PG64-22				

	Add Crystal Cl	ean	Add Crystal C	lean & PPA	
8%	63.10-31.72	63.03-30.71	8% Crystal Clean + 1% PPA	64.50-28.81	64.65-28.83
	PG58-28	PG58-28	L	PG64-28	PG64-28
10%	60.28-30.62	59.86-29.86	10% Crystal Clean + 1% PPA	63.79-29.60	63.77-30.22
	PG58-28	PG58-28		PG58-28	PG58-28

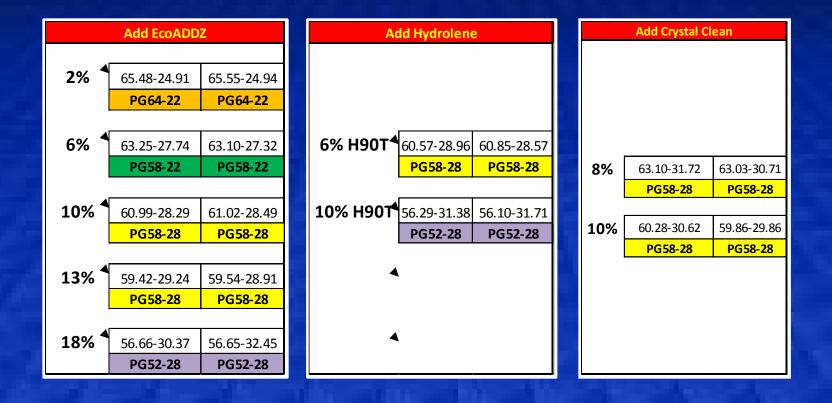
Phase I: Binder Data – Hydrolene H90T

PG64-22 Irving - Straight Run					
67.01-24.24	66.85-24.49				
PG64-22	PG64-22				
PG64-22	PG64-22				



Phase I: Binder Data – Compare

PG58-28 Irving - Straight Run					
61.07-28.24	61.11-27.92				
PG58-28	PG58-22				



Phase I: Binder Data – Compare

PG64-28 AI Typical					
65.57-29.37 65.59-29.26					
PG64-28	PG64-28				

Add EcoADI	DZ & PPA		Add Hydrolene & PPA
2% EcoAddz + 1% PPA	72.01-26.1	72.04-27.4	
	PG70-22	PG70-22	
6% EcoAddz + 1% PPA	67.70-27.38	67.8-28.49	6% H90T + 1% PPA ⁴ 66.88-29.96 66.85-30.42
	PG64-22	PG64-22	PG64-28 PG64-28
10% EcoAddz + 1% PPA	64.42-29.83	64.7-28.91	10% H90T + 1% PPA 61.40-32.28 61.59-32.13
	PG64-28	PG64-28	PG58-28 PG58-28
	F		
13% EcoAddz + 1% PPA	61.62-30.4	61.82-30.29	
	PG58-28	PG58-28	
	F		
18% EcoAddz + 1% PPA	58.88-32.00	58.17-31.69	
	PG58-28	PG58-28	
			and the second second second second

Phase I: Binder Data – Compare

PG64-28 AI Typical					
65.57-29.37 65.59-29.26					
PG64-28	PG64-28				



Thank You