HSRC
Highway Sustainability Research Center

Innovative Research in Asphalt Pavements

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

By:

Professor Walaa S. Mogawer, P.E., F.ASCE
Highway Sustainability Research Center
UMass Dartmouth

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).**

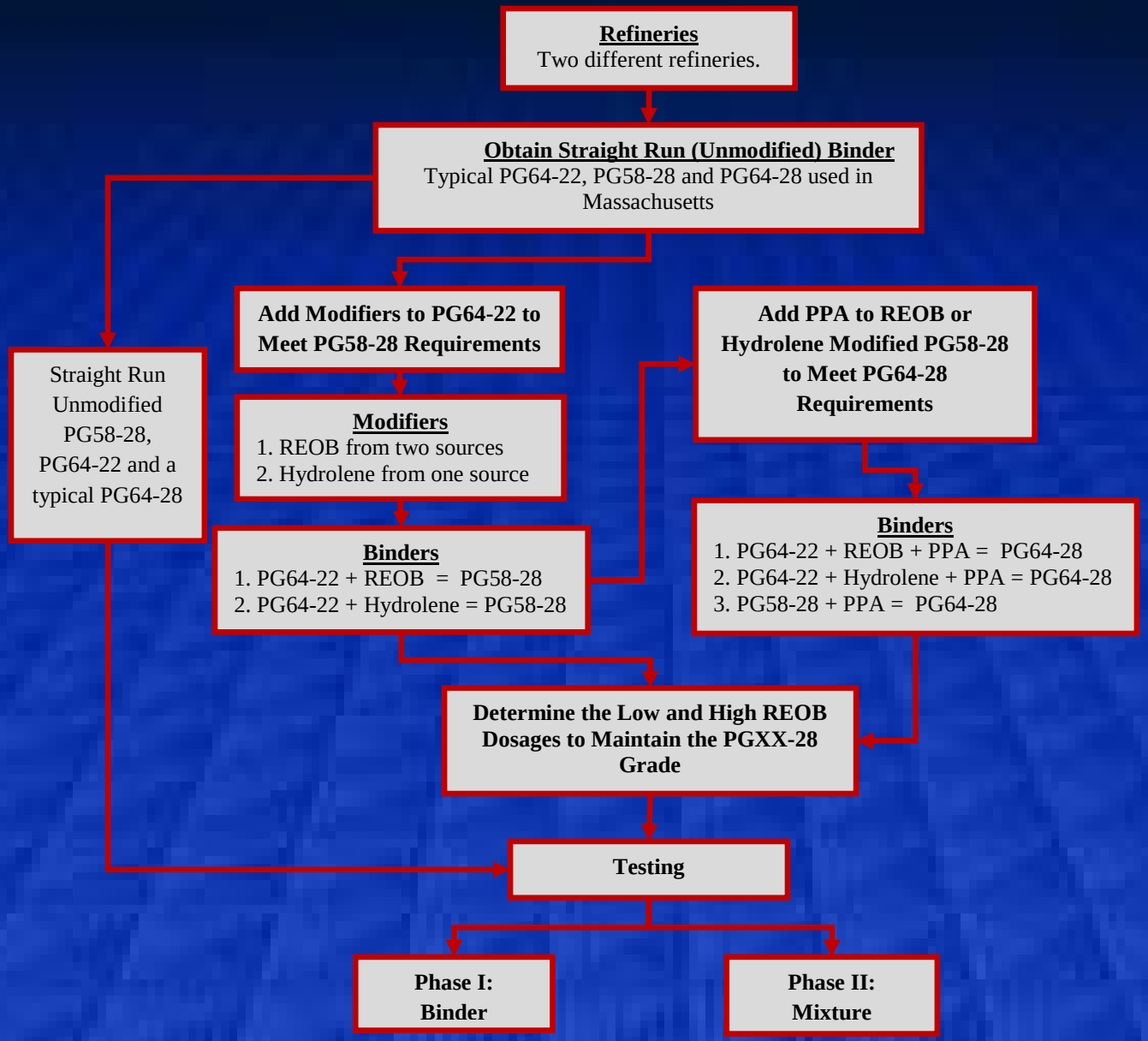
8. **Measure the performance grade, physical, and rheological properties of the REOB and PPA modified PG64-28 at the different dosages. The data will be analyzed to compare the properties of a typical PG64-28 with known field performance.**

Objectives

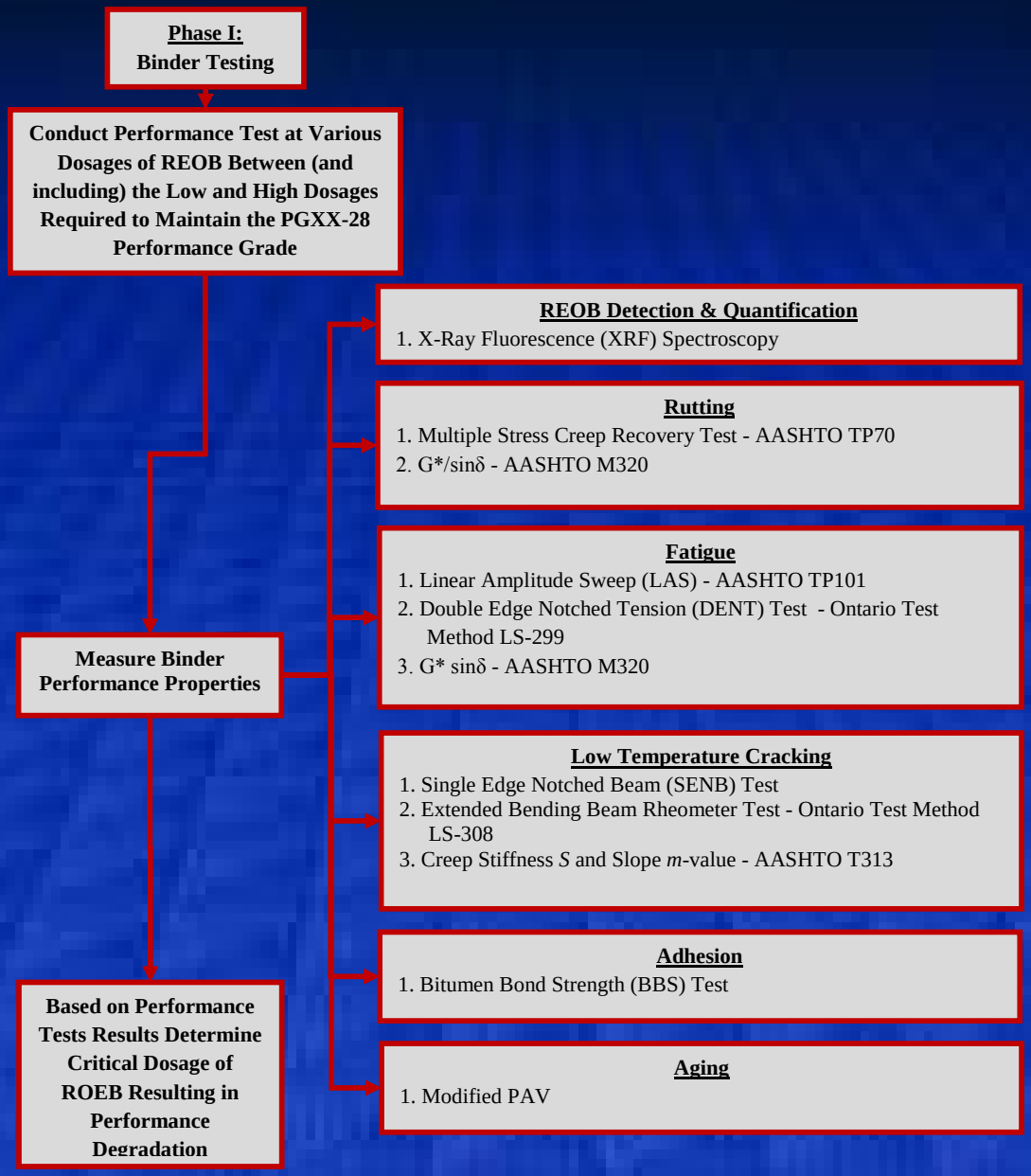
9. **Using the REOB modified binders at critical dosages determined during the binder testing phase, conduct mixture performance testing on an approved Massachusetts 12.5mm mixture design.**

   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.

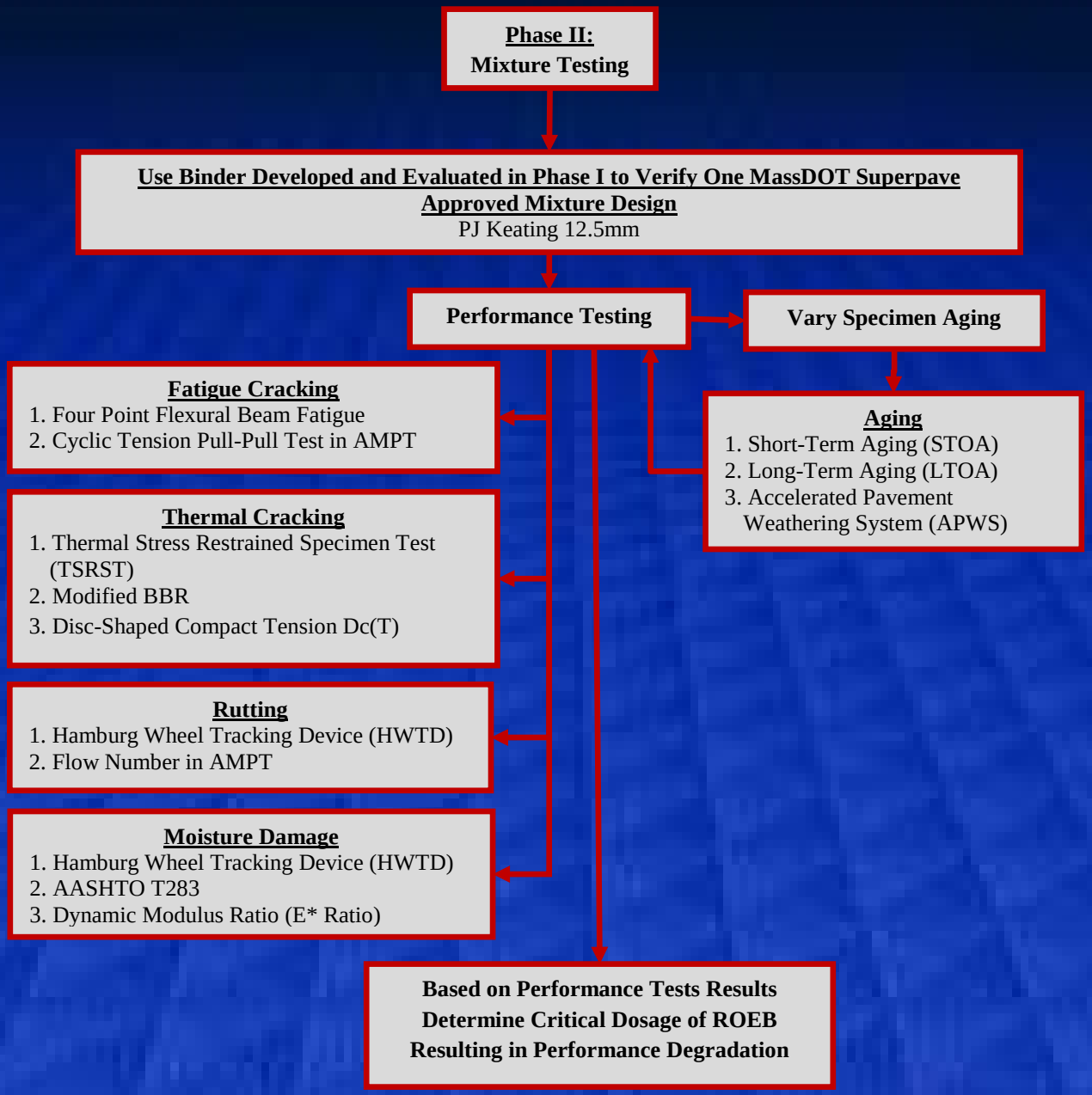
Experimental Plan



Phase I: Binder



Phase 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

Hydrolene

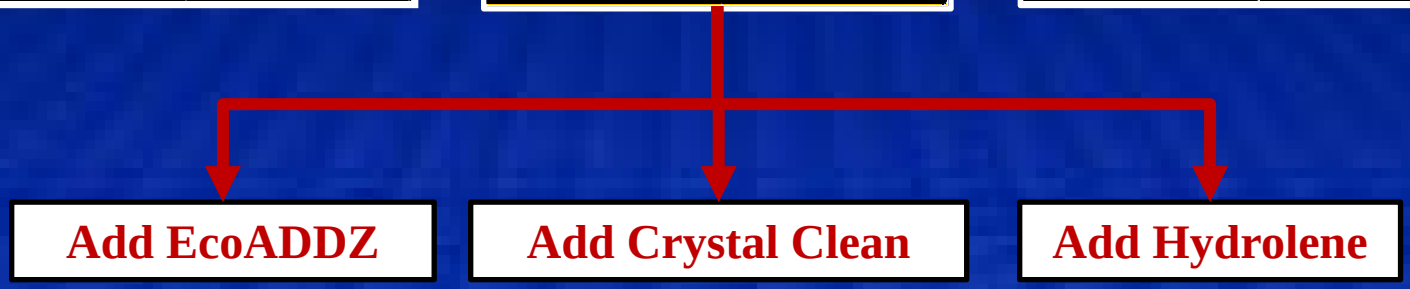
Holly Frontier Corporation H90T

Phase I: Binder

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

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

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



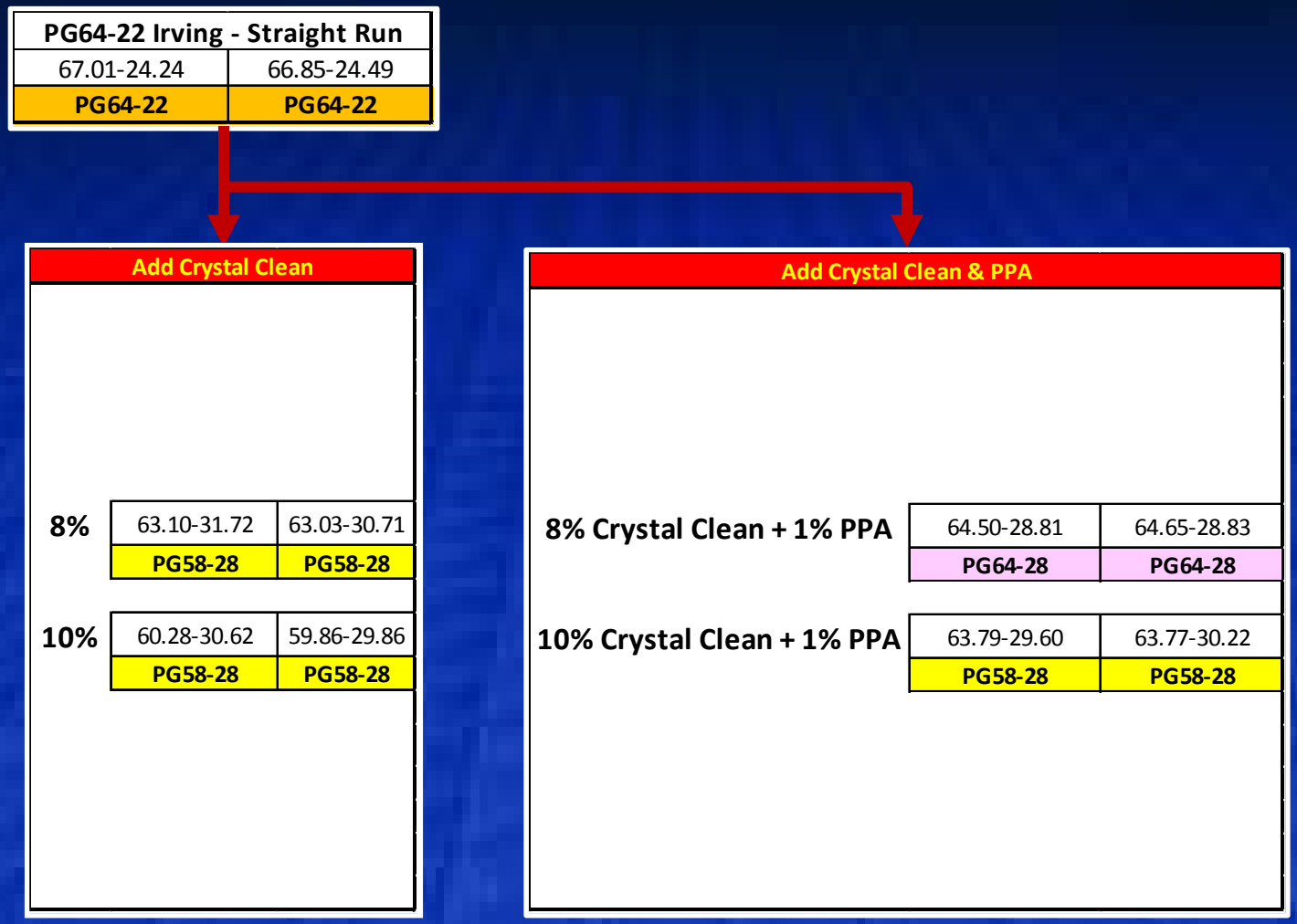
Phase I: Binder Data - EcoADDZ

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

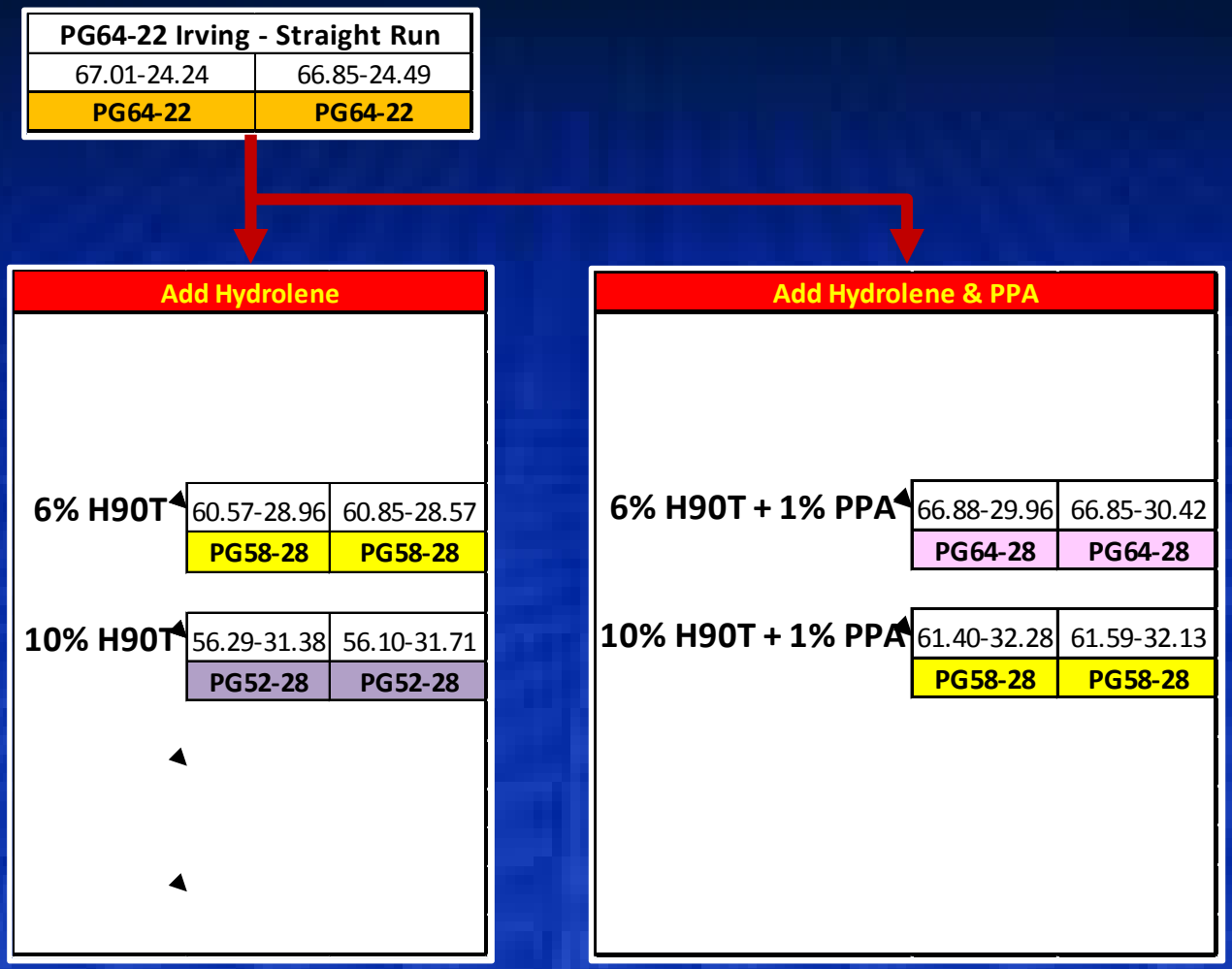
Add EcoADDZ		
2%	65.48-24.91	65.55-24.94
	PG64-22	PG64-22
6%	63.25-27.74	63.10-27.32
	PG58-22	PG58-22
10%	60.99-28.29	61.02-28.49
	PG58-28	PG58-28
13%	59.42-29.24	59.54-28.91
	PG58-28	PG58-28
18%	56.66-30.37	56.65-32.45
	PG52-28	PG52-28

Add EcoADDZ & 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
	PG64-22	PG64-22
10% EcoAddz + 1% PPA	64.42-29.83	64.7-28.91
	PG64-28	PG64-28
13% EcoAddz + 1% PPA	61.62-30.4	61.82-30.29
	PG58-28	PG58-28
18% EcoAddz + 1% PPA	58.88-32.00	58.17-31.69
	PG58-28	PG58-28

Phase I: Binder Data - Crystal Clean



Phase I: Binder Data – Hydrolene H90T



Phase I: Binder Data – Compare

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

Add EcoADDZ

2%	65.48-24.91	65.55-24.94
	PG64-22	PG64-22
6%	63.25-27.74	63.10-27.32
	PG58-22	PG58-22
10%	60.99-28.29	61.02-28.49
	PG58-28	PG58-28
13%	59.42-29.24	59.54-28.91
	PG58-28	PG58-28
18%	56.66-30.37	56.65-32.45
	PG52-28	PG52-28

Add Hydrolene

6% H90T	60.57-28.96	60.85-28.57
	PG58-28	PG58-28
10% H90T	56.29-31.38	56.10-31.71
	PG52-28	PG52-28

Add Crystal Clean

8%	63.10-31.72	63.03-30.71
	PG58-28	PG58-28
10%	60.28-30.62	59.86-29.86
	PG58-28	PG58-28

Phase I: Binder Data – Compare

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

Add EcoADDZ & 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
	PG64-22	PG64-22
10% EcoAddz + 1% PPA	64.42-29.83	64.7-28.91
	PG64-28	PG64-28
13% EcoAddz + 1% PPA	61.62-30.4	61.82-30.29
	PG58-28	PG58-28
18% EcoAddz + 1% PPA	58.88-32.00	58.17-31.69
	PG58-28	PG58-28

Add Hydrolene & PPA		
6% H90T + 1% PPA	66.88-29.96	66.85-30.42
	PG64-28	PG64-28
10% H90T + 1% PPA	61.40-32.28	61.59-32.13
	PG58-28	PG58-28

Phase I: Binder Data – Compare

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

Add EcoADDZ & 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
	PG64-22	PG64-22
10% EcoAddz + 1% PPA	64.42-29.83	64.7-28.91
	PG64-28	PG64-28
13% EcoAddz + 1% PPA	61.62-30.4	61.82-30.29
	PG58-28	PG58-28
18% EcoAddz + 1% PPA	58.88-32.00	58.17-31.69
	PG58-28	PG58-28

Add Crystal Clean & PPA		
8% Crystal Clean + 1% PPA	64.50-28.81	64.65-28.83
	PG64-28	PG64-28
10% Crystal Clean + 1% PPA	63.79-29.60	63.77-30.22
	PG58-28	PG58-28

Thank You