Update: PAV Degassing Issues

Task Force on Vacuum Degassing

FHWA Asphalt Binder ETG

Salt Lake City, UT

April 27-28, 2016

Problem Statement – Current Status

- Is vacuum degassing necessary prior to conducting rheological measurements with the BBR or DSR?
  - ✓ Degassing shown to be necessary with ultimate property measurements
  - ✓ No known initiative underway to remove degassing from ultimate property measurements
- Evidence for retaining the post PAV degassing step prior to DSR/BBR testing is inconclusive
- An ETG task force to investigate the need for degassing was established in 2015
  - ✓ Laboratory work underway but not complete

Task Force Collaboartors - Contacts

- Ed Trujillo, Colorado DOT
- Mike Anderson, The Asphalt Institute
- Matt Corrigan, FHWA
- Tina Conticelli, Nevada DOT
- Andrew Hanz/Gerry Reinke, MTE Services
- Maria Knake, AMRL
- Jim Mahoney, CAP Lab, Connecticut
- Bruce Morgenstern, Wyoming, DOT

Now have 8 participating laboratories

Variables Considered in the Experiment

- Four asphalt binders supplied by Colorado DOT
  - ✓ Samples from 2015 production
  - ✓ Binder type – plain, modified, heavily modified
- Release rate
  - ✓ ATS (non-linear), Prentex (Burst), manual (linear)
- Laboratory elevation
- Measurements (Replicate)
  - ✓ DSR after RTFO and prior to degassing
  - ✓ BBR and DSR after degassing
- Careful monitoring of technique

Laboratories and Test Variables

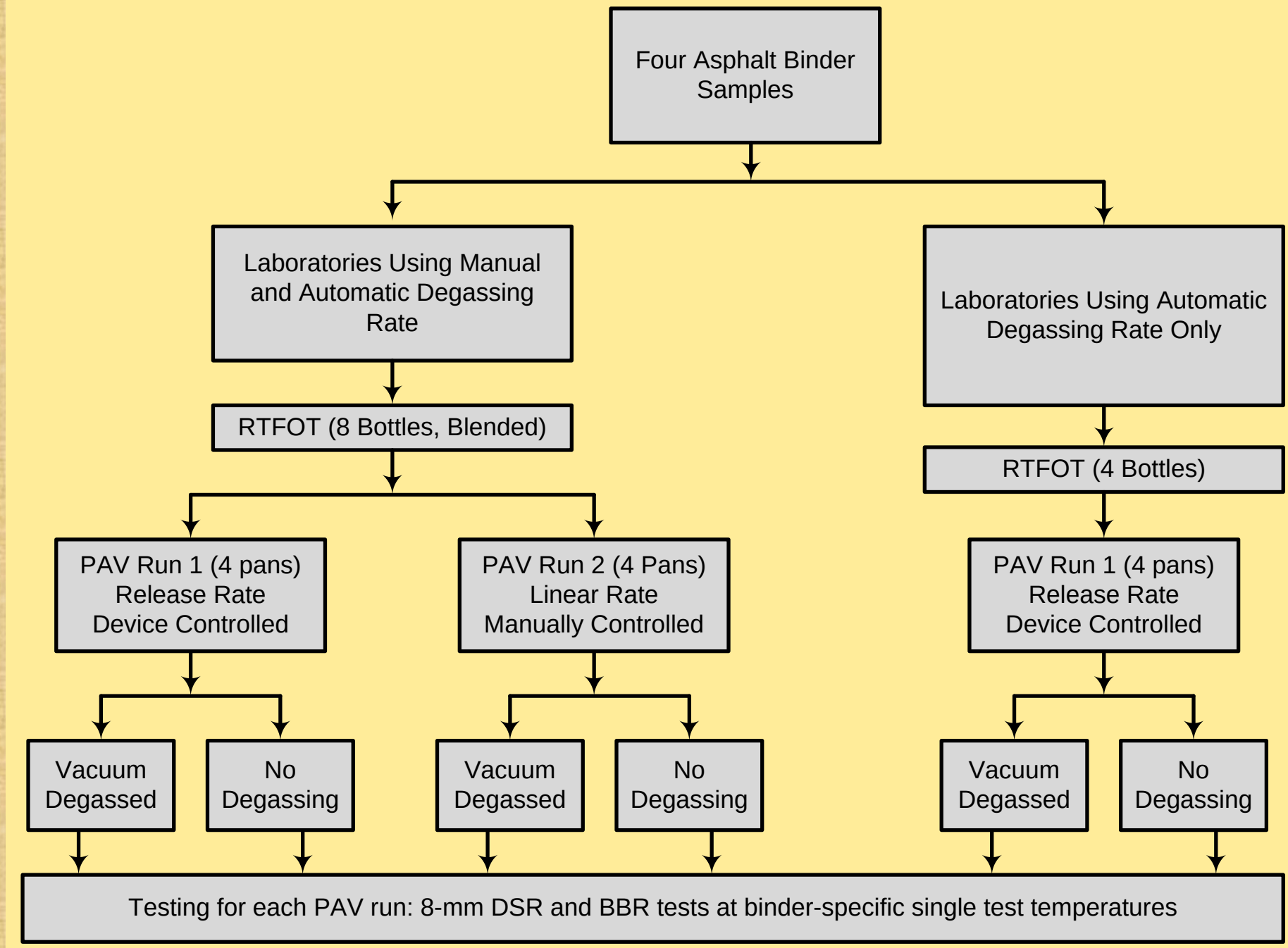
Table 1. Assignment of Degassing Test Variables [(A)].

Lab	Device Used in Study	Elevation (Feet)	Vacuum Gage Reading, P_G, in Hg[(A)]	Degassing Procedure		
				Normal	None	Linear
TAI	Prentex	Low (880)	23.8 ± 0.7	Yes	Yes	No
AMRL	ATS	Low (270)	25.2± 0.7	Yes	Yes	Y
CAPLAB	ATS	Low (520)	25.0± 0.7	Yes	Yes	Y
CODOT	Prentex	High (5,270)	20.2± 0.7	Yes	Yes	No
WYDOT	ATS	High (6,180)	18.3 ± 0.7	Yes	Yes	Yes
FHWA	ATS	Low (540)	24.9 ± 0.7	Yes	Yes	Yes
MTE	Prentex	Low (720)	24.8± 0.7	Yes	Yes	No
NMDOT	ATS	High (6,920)	18.6± 0.7	Yes	Yes	No

[(A)] Based on office address. Please change if appropriate.

Variables Considered in the Experiment

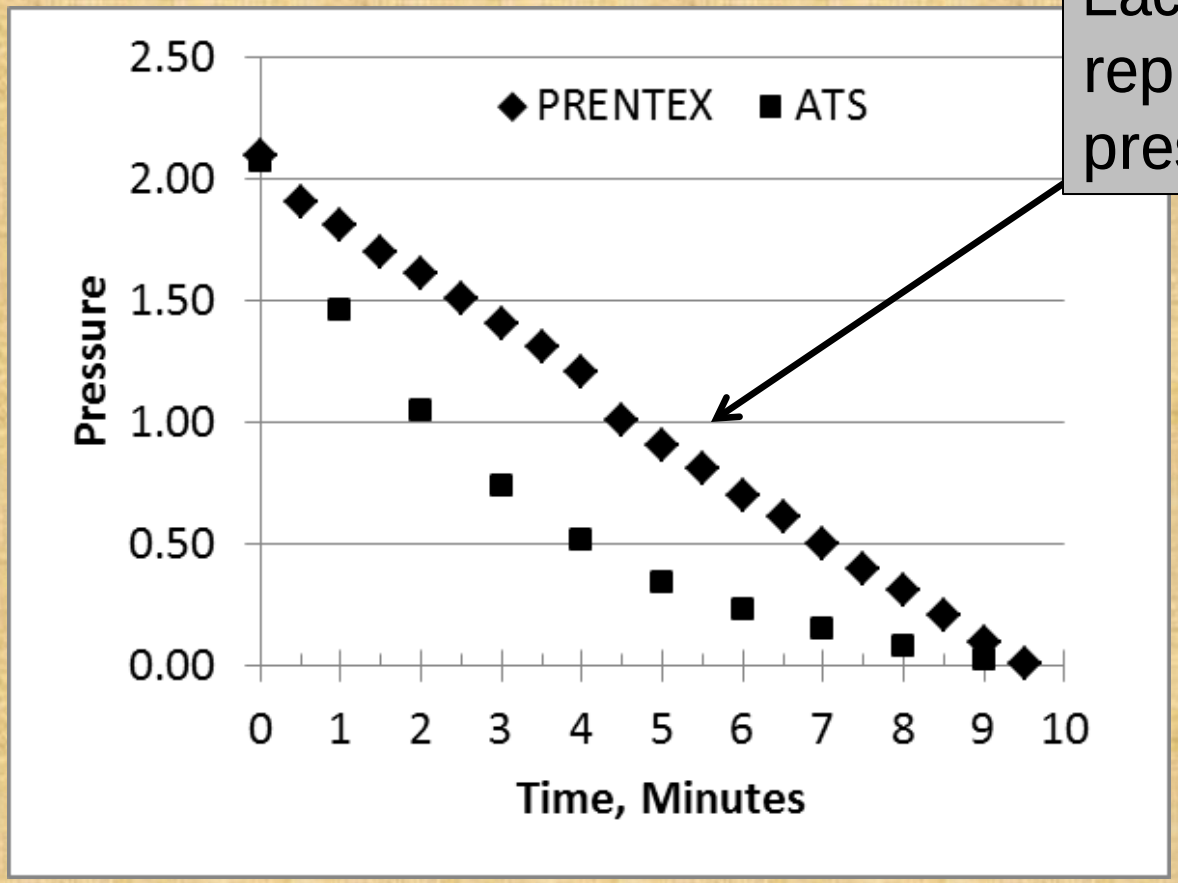
- Pressure release rate
  - ✓ ATS (non-linear), Prentex (Burst), manual (linear)
- Four asphalt binders supplied by Colorado DOT
  - ✓ Four production binders – plain and modified
- Laboratory elevation
  - ✓ Near sea level to just short of 7,000 ft
- Measurements
  - ✓ Limited to DSR and BBR before and after degassing
  - ✓ Will compare before/after ratios of test results
    - Compare ratios with respect to:
      degassing procedure – elevation – binder


Four Asphalt Binder Samples
Laboratories Using Manual and Automatic Degassing Rate
Laboratories Using Automatic Degassing Rate Only
RTFOT (8 Bottles, Blended)
RTFOT (4 Bottles)
PAV Run 1 (4 pans) Release Rate Device Controlled
PAV Run 2 (4 Pans) Linear Rate Manually Controlled
PAV Run 1 (4 pans) Release Rate Device Controlled
Vacuum Degassed
No Degassing
Vacuum Degassed
No Degassing
Vacuum Degassed
No Degassing
Testing for each PAV run: 8-mm DSR and BBR tests at binder-specific single test temperatures

Linearity of Pressure Release Rate

- Reviewed as possible cause of excessive bubbles
- Pressure vs. release rate obtained from several labs
  - ✓ Prentex releases linearly in series of small bursts
  - ✓ ATS releases 50% in first 90 seconds
  - ✓ Neither of them meet original intent of test method
- Above rates verified by data from several laboratories
- Conclusion: Need to include continuous-linear release rate with nonlinear or short bursts
  - ✓ Release rate and uniformity of release rate may need to be addressed in test method

Pressure Release Rate – Typical Results



Each data point represents sudden pressure release

Vacuum Pressure Gage

Comments on Pressure Gage Readings

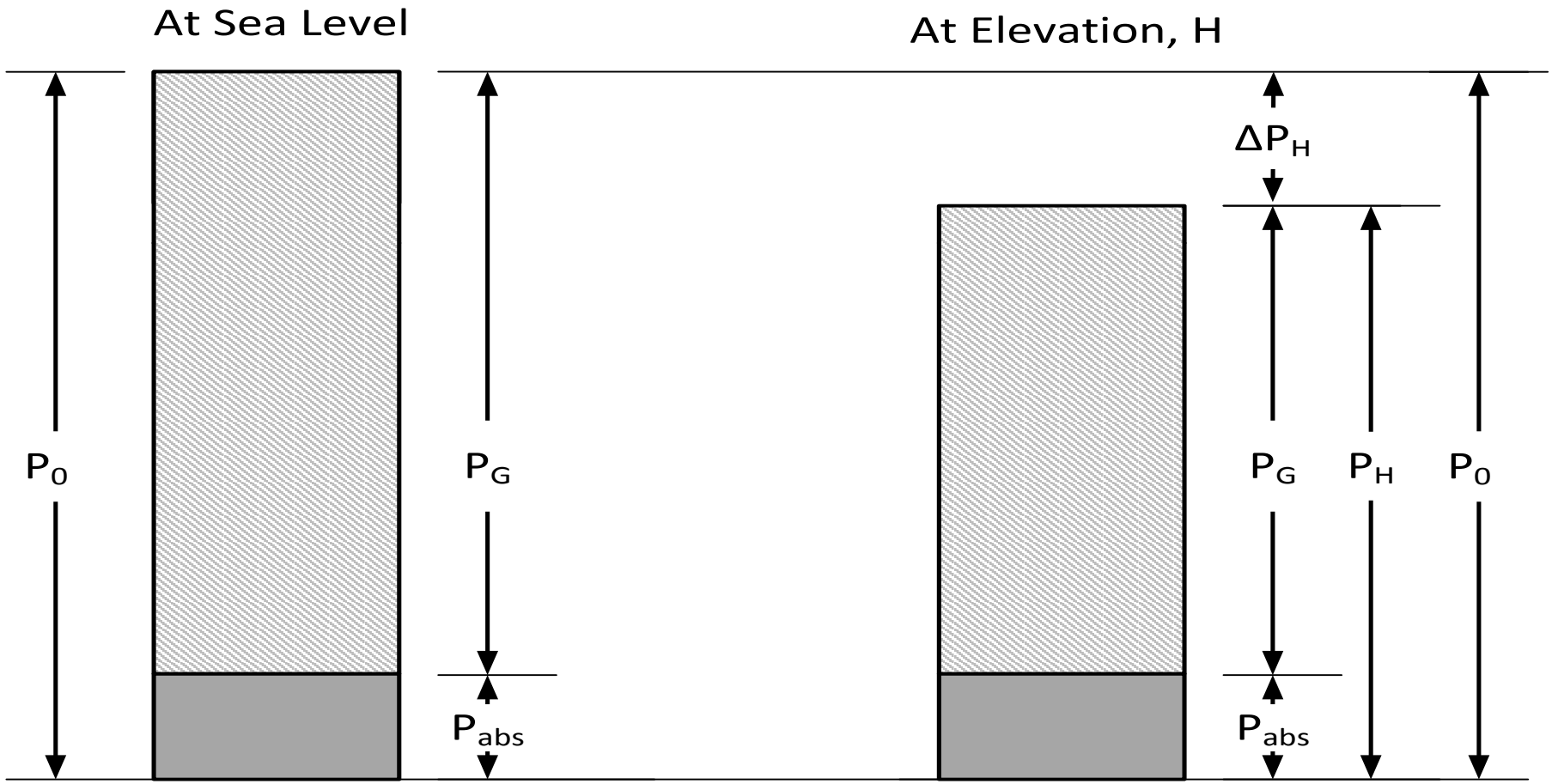
- Seems to be some confusion among field personnel
  - ✓ Information in instruction manuals may be part of problem
  - ✓ Important that vacuum gage readings be properly corrected for elevation
    - Discussed with each laboratory as part of study
- Experience suggests some changes to test method
  - ✓ Specifically state R-28 only source of information
  - ✓ Require calculation of gage pressure with linear equation

$P_G = 25.49 - 0.0001001H$ *below 6,000 ft.*

$P_G = P_0 (1 - 0.0065H/T_0)^{5.2561} - P_{abs}$ *above 6,000 ft.*

Gages read to neared 0.5 in Hg

Change limits to 5 ± 0.5 in Hg, 17 ± 2 kPa



P_0 = Barometric pressure = 29.92 in Hg at sea level

P_H = Barometric pressure at elevation H

ΔP_H = Change in Barometric between sea level and elevation H

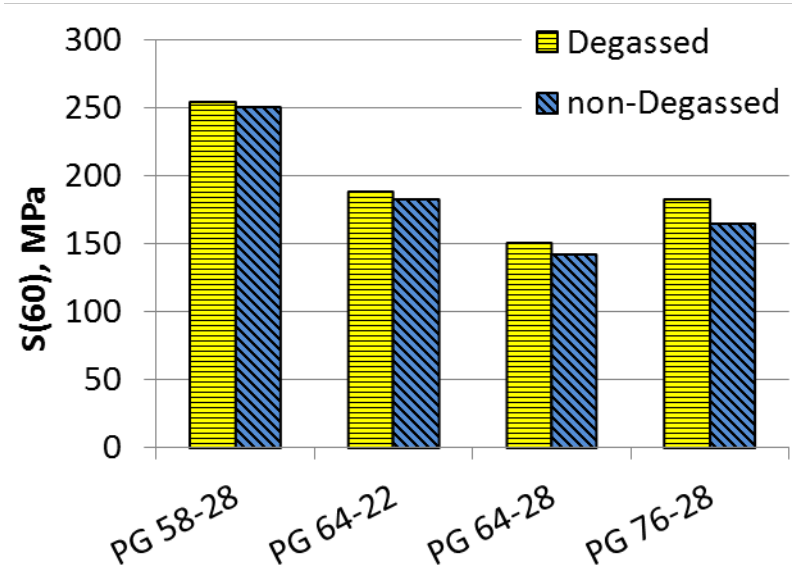
P_G = Vacuum gage reading

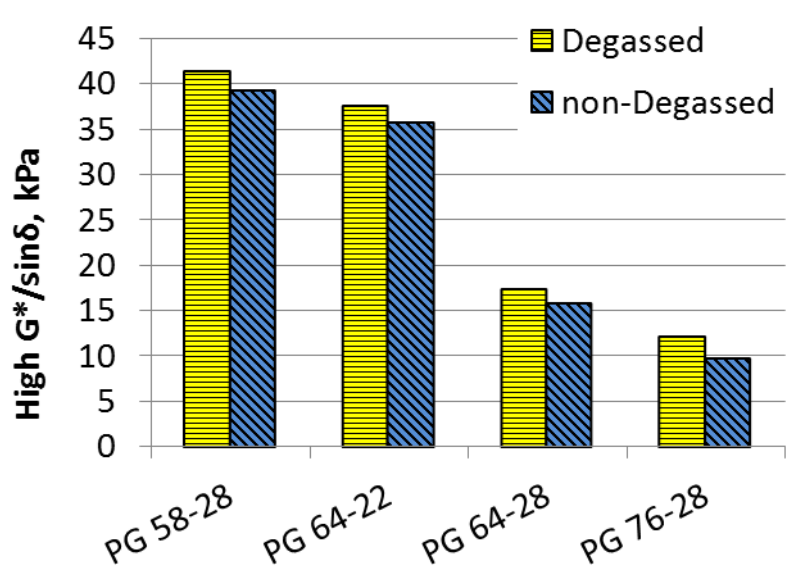
P_{abs} = Absolute pressure gage reading

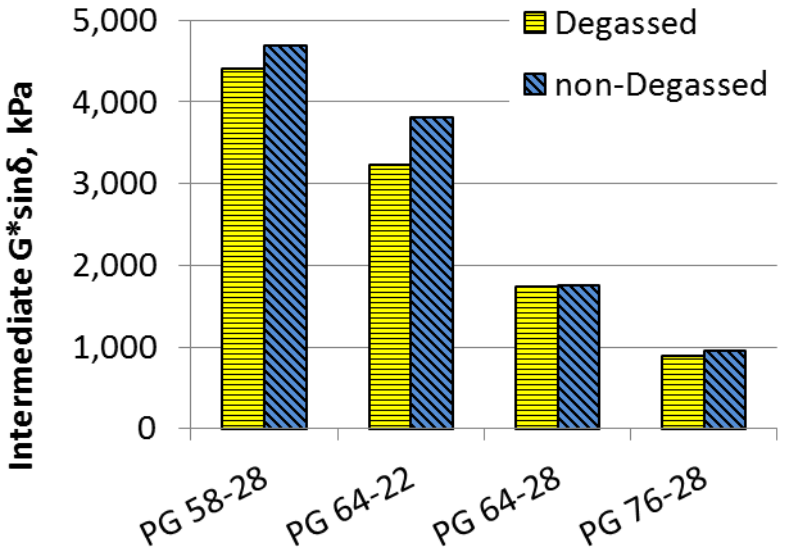
Work to Date and Future Direction

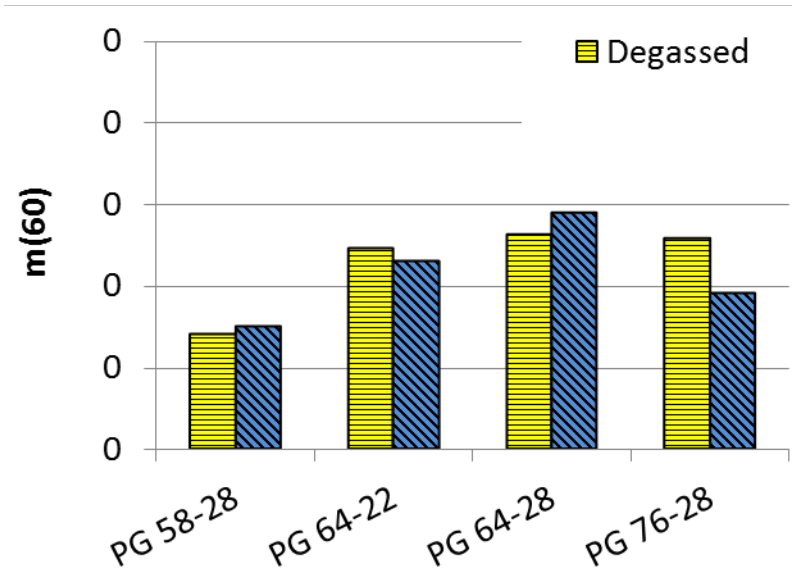
- Work to date
  - ✓ Investigated linearity of pressure release rate
  - ✓ Reviewed previous degassing studies/conclusions
  - ✓ Developed experiment design
  - ✓ Selected samples for testing
  - ✓ Coordinated experiment design with laboratories
  - ✓ Expanded participants to provide more robust experiment
- What is current status?
  - ✓ Laboratory work is underway
  - ✓ One laboratory has completed testing
  - ✓ Waiting for remainder of data
  - ✓ Expect completion with recommendation by Fall ETG Meeting

Preliminary Results from One Laboratory









Some Thoughts

- Specify absolute pressure gage
  - ✓ Use digital gage and closed loop system to release
- Reword instructions for degassing
- Change limits to agree with gage markings

What's next?

- Materials, participating laboratories and experiment design are now complete
- Next steps – testing and analysis

Enjoy the summer

See you in the Fall !!!!