Update: PAV Degassing Issues

Task Force on Vacuum Degassing

FHWA Asphalt Binder ETG

Oklahoma City, OK

September 15-16, 2015

Problem Statement – Current Status

- Is vacuum degassing necessary prior to conducting rheological measurements with the BBR or DSR
  - ✓ The requirements for degassing is not an issue with ultimate property measurements
  - ✓ No attempt to remove degassing for ultimate properties measurements
- An ETG task force to investigate the need for degassing was established in 2015
- Report on current status of task force work

Task Force Contacts And Membership

- Ed Trujillo, Colorado DOT
- Mike Anderson, the Asphalt Institute
- Matt Corrigan, FHWA
- Gerry Reinke/Andrew, MTE Services
- Maria Knake, AMRL
- Jim Mahoney, CAP Lab, CT*
- Bruce Morgenstern, WDOT

*Added member

Work to Date and Future Direction

- Work to date
  - ✓ Investigated linearity of pressure release rate
  - ✓ Reviewed previous degassing experiments
  - ✓ Informal survey of RMAUPG workshop attendees
  - ✓ Develop in experiment design
  - ✓ Selected samples for testing
  - ✓ Expanded participants to provide more robust experiment
- Future activities
  - ✓ Perform experimentation
  - ✓ Analyze the data
  - ✓ Present recommendations to ETG spring 2016
  - ✓ Coordinate with ASTM activities

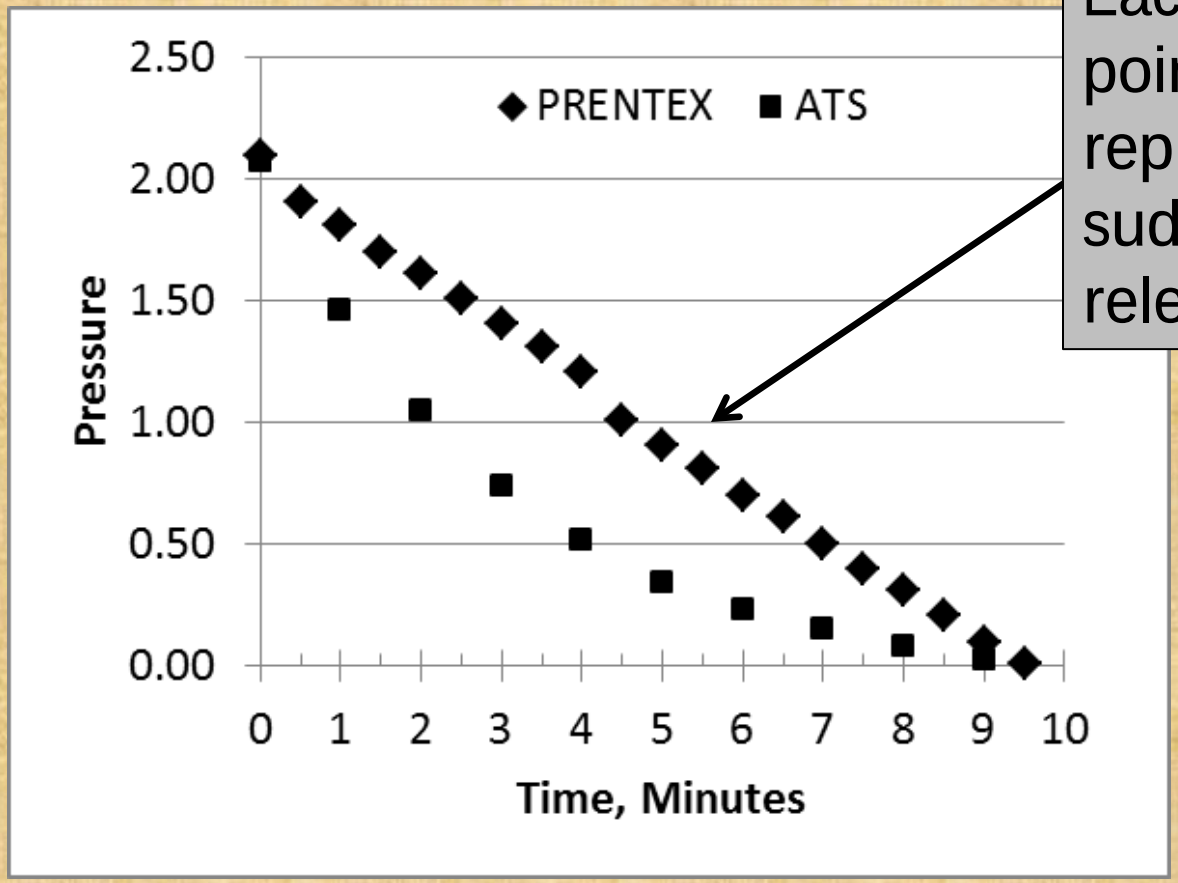
Initial Task Force Efforts and Current Status

- Initially envisioned as simple study to validate previous ETG decision that degassing should be optional
- Envisioned experiment with following variables
  - ✓ Rate of pressure release
  - ✓ Laboratory elevation
  - ✓ Binder source to include PMB's
  - ✓ Manufacturer of PAV – degassing rate
- After some reflection decided to do some background work
  - ✓ Initial experiment put on hold while samples were collected
  - ✓ Samples shipped September 2015

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 the all meet original intent of test method
- Above 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 suddend release

Vacuum Degassing - Historical

- Vacuum degassing was adopted to enhance repeatability of direct tension test data (19??)
  - ✓ Not part of original DSR and BBR test protocols
  - ✓ Adopted after bubbles were shown to affect DTT results
  - ✓ Subsequently dropped when DTT was discontinued
- Vacuum degassing protocol was developed based on results of limited laboratory testing program
  - ✓ Conducted by R. Kluttz, Reported early ETG (date ?)
  - ✓ Preheating combined sample at 175°C for 10 ± 1 min
  - ✓ Vacuum at 15 ± 2.5 kPa (Absolute) for 30 ± 1 min
  - ✓ Included stirring and flashing steps
- Concluded that degassing did not affect material (BBR and DSR) properties but was essential for DT

Previous Studies on Degassing
Summarized by G. Reinke, ETG 9/2009

- Asphalt Institute Study (2007)
  1. PG 64-22 (Unmodified)
  2. PG 58-28, (Unmodified)
  3. PG 64-28P (Polymer modified)
  4. PG 70-28P (Polymer modified)

Conclusions:

- **For all 3 responses (BBR S, BBR m-value, PAV DSR) there was no statistical difference between the De-gas "yes" and the De-gas "no" treatments**
- **This was true whether the binders were conventional or PMA materials**
- **No need to continue degassing if not performing DT**

WCTG STUDY (1977)

- Bruce Morgenstern arranged to have WCTG perform BBR & PAV DSR testing on vacuum degassed and non-degassed specimens for 3 binder samples
  - ✓ Tested by the WCTG during 2007
  - ✓ PG 64-22, PG 76-22, PG 70-28
- Reinke conclusion from WCTG (reported to ETG 1999):

  "AT THIS POINT I FEEL ENOUGH DATA HAS BEEN GENERATED TO JUSTIFY THE REQUEST THAT THE ETG RECOMMEND THAT VACUUM DEGASSING IS NOT REQUIRED IF THE BINDER TESTING WILL NOT INCLUDE DIRECT TENSION"

Survey of RMAUPG Workshop Attendees

1. Do you routinely degas PAV residue? Y 5/6
2. Do you feel that PAV spec should give the option to degas? Y 3/6
3. Do you feel that PAV spec should require degassing? Y 4/6
4. Do you stir the residue or flash with a heat gun or torch to remove bubbles? Y 6/6
5. Limited data suggesting difference

   Without degassing: S = 126, m = 0.371

   With degassing: S = 166, m = 0.316

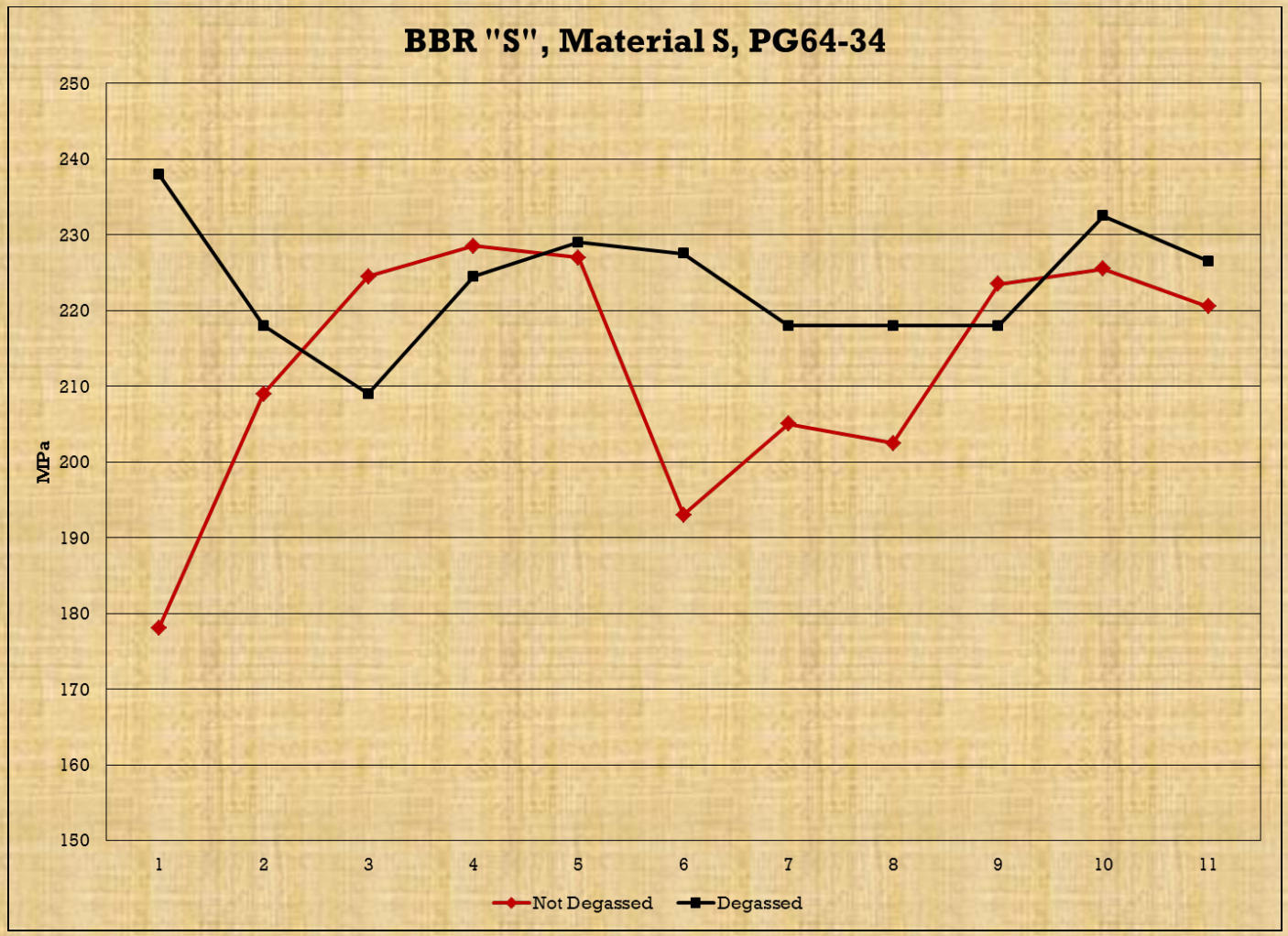
AMRL Proficiency Sampling (2010?)

- Proficiency set 231/232
  - ✓ Degassing practice recorded as part of proficiency round
- Laboratories used one option or the other:
  - 230 laboratories degassed
  - 23 laboratories did not the gas
- Degas or no degas was not replicated in any of the laboratories
- Conclusion: Degassing does not affect BBR or DSR test results
  - ✓ Implies that degassing could be optional

PCCAS PG Round Robin

- Three binders (PG76-48, 64-22, 64-34)
  - ✓ 11 Participants
  - ✓ RTFOT and PAV conditioning
- Summary: PAV – degas or not degas
  - ✓ No significant effect on PAV DSR results for any of the PG binders tested
  - ✓ Significant effect noted on PAV BBR results for Material “S” PG64-34 (see chart)

PCCAS PG Round Robin



No Degassing vs. Degassing - Possible Effects in Both

- No degassing
  - ✓ Is pressure release rate a factor?
  - ✓ Bubbles flashed from pan upon removal?
  - ✓ Residue properly stirred?
  - ✓ Effect of residual bubbles: G*↓, δ **?**, S↓, m**?**
- Degassing
  - ✓ Used in lieu of steps above?
  - ✓ Extra heating: G*↑, δ ↓, S↑, m↓
  - ✓ Improper heating before degassing? G*↓, δ **?**, S↓, m**?**
  - ✓ Can degassing increase variability?
- Is option a good idea?

Some Task Force Findings and Conclusions to Date

- Pressure release rate non-linear for one device
  - ✓ No data to show does or does not contribution to “problem”
- Some labs use vacuum degassing as fall-back for bubble removal whether needed or not
  - ✓ Is this good practice?
- Test methods are inconsistent
  - ✓ Requirement for degassing and linearity issue need to be clarified
- Anecdotal information contradicts previous findings
  - ✓ Practicioners question “no effect” conclusion
  - ✓ Significant number of agencies disagree with current spec

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

What's next?

- Materials, participating laboratories and experiment design are now complete
- Next steps – testing and analysis
  - ✓ See you in 2016!!!!