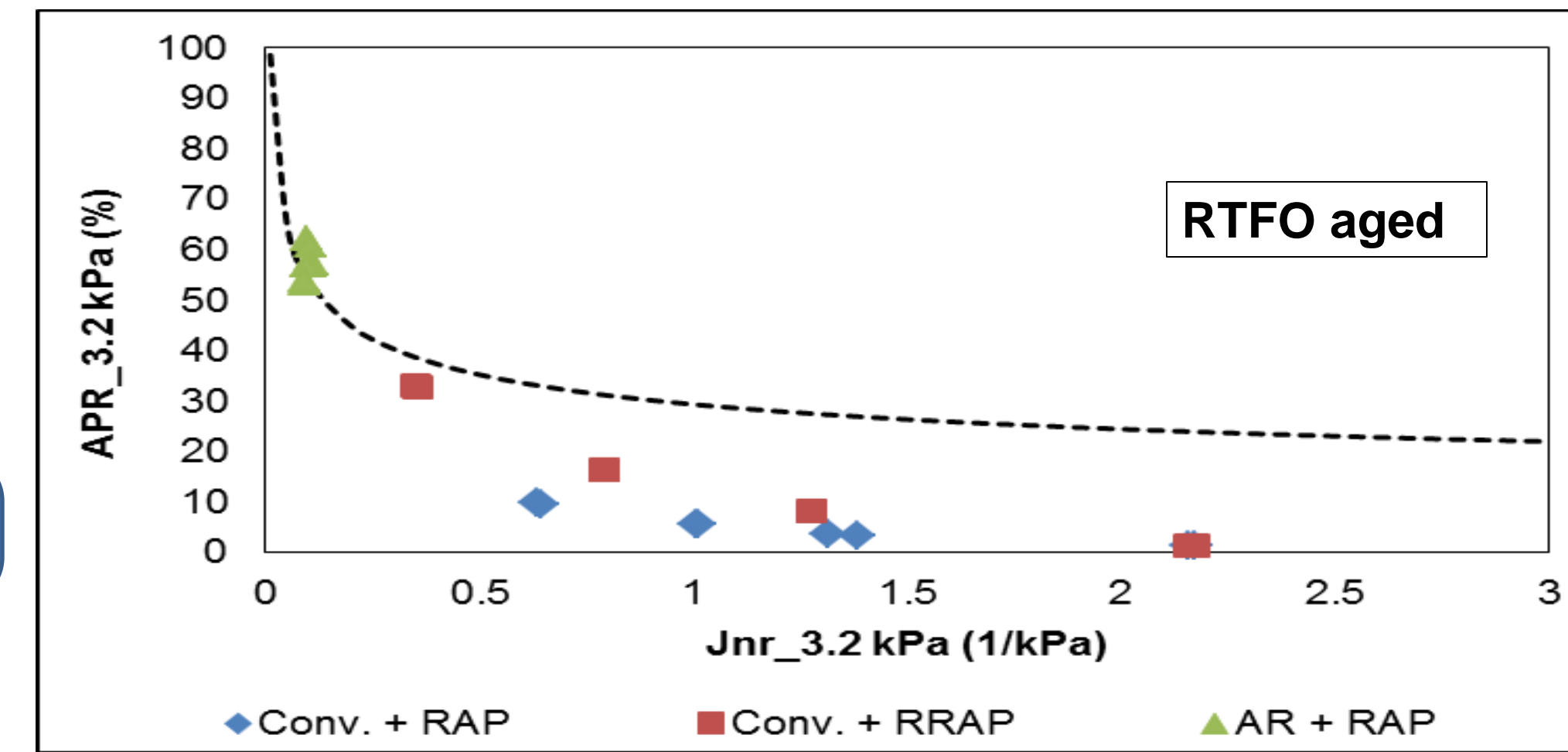


Evaluating the Changes to New Asphalt Binder Rheology When Adding Aged Conventional and Aged Asphalt Rubber Binders

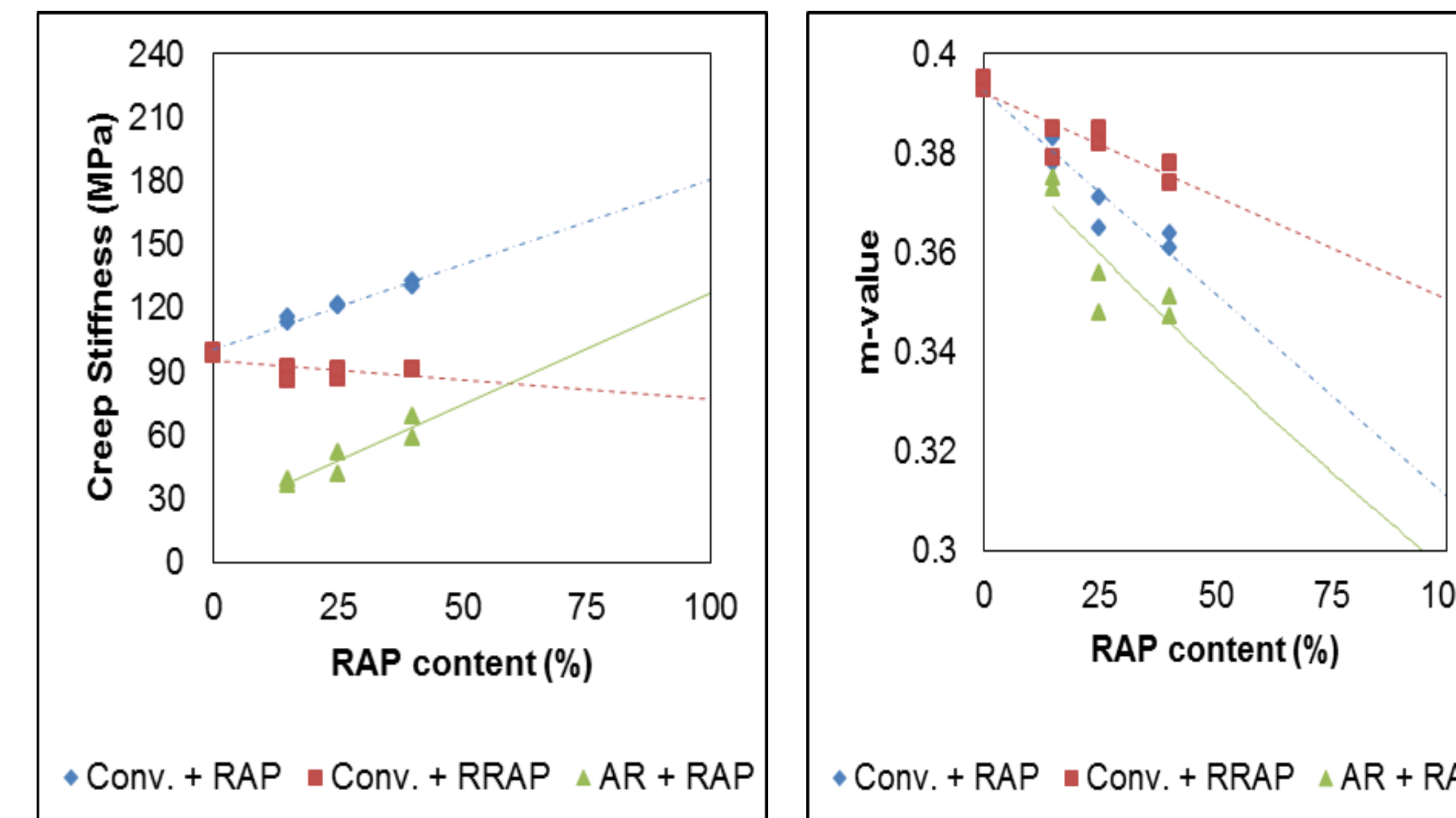
Shawn Hung, Zia Alavi, David Jones, and John Harvey
Paper No. 16-4379



Test Results/ MSCR at 64°C



Test Results/ BBR at -6°C

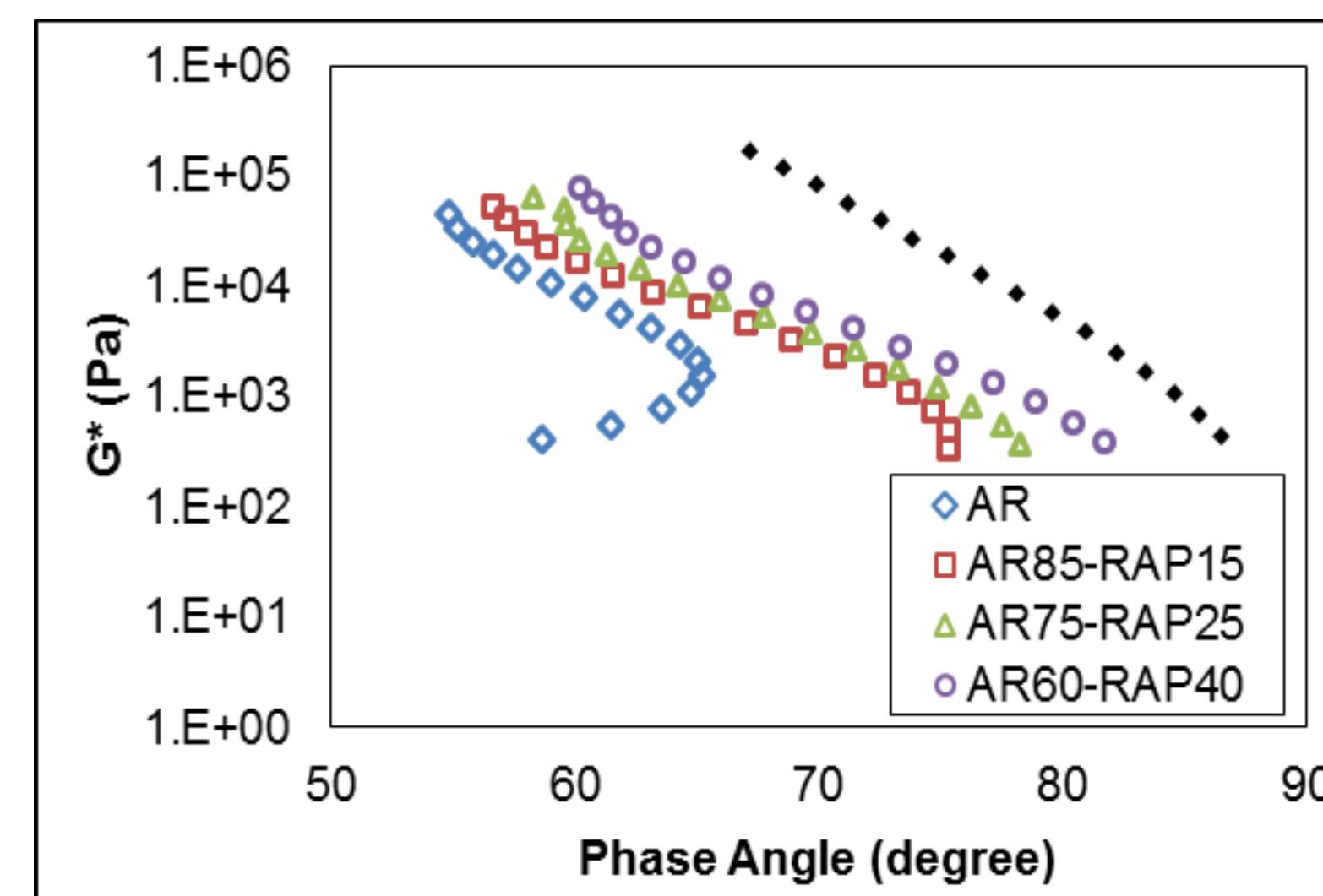
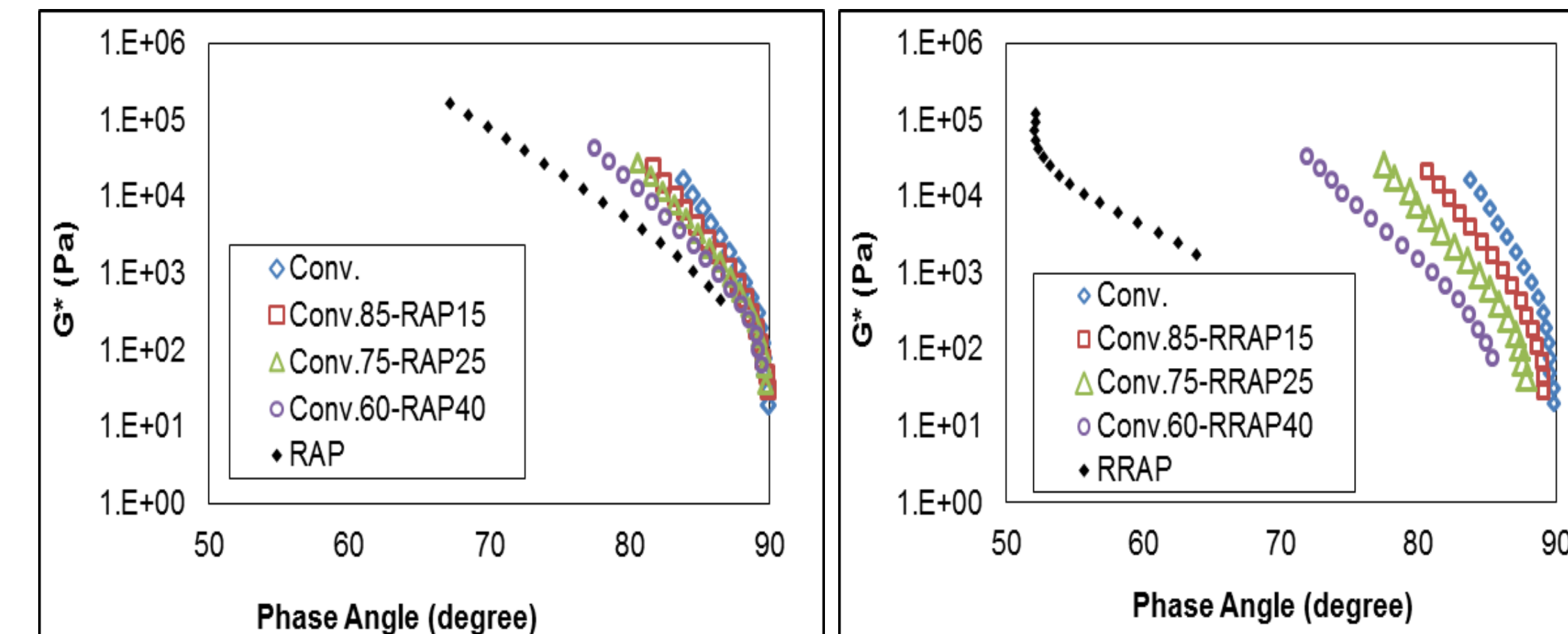
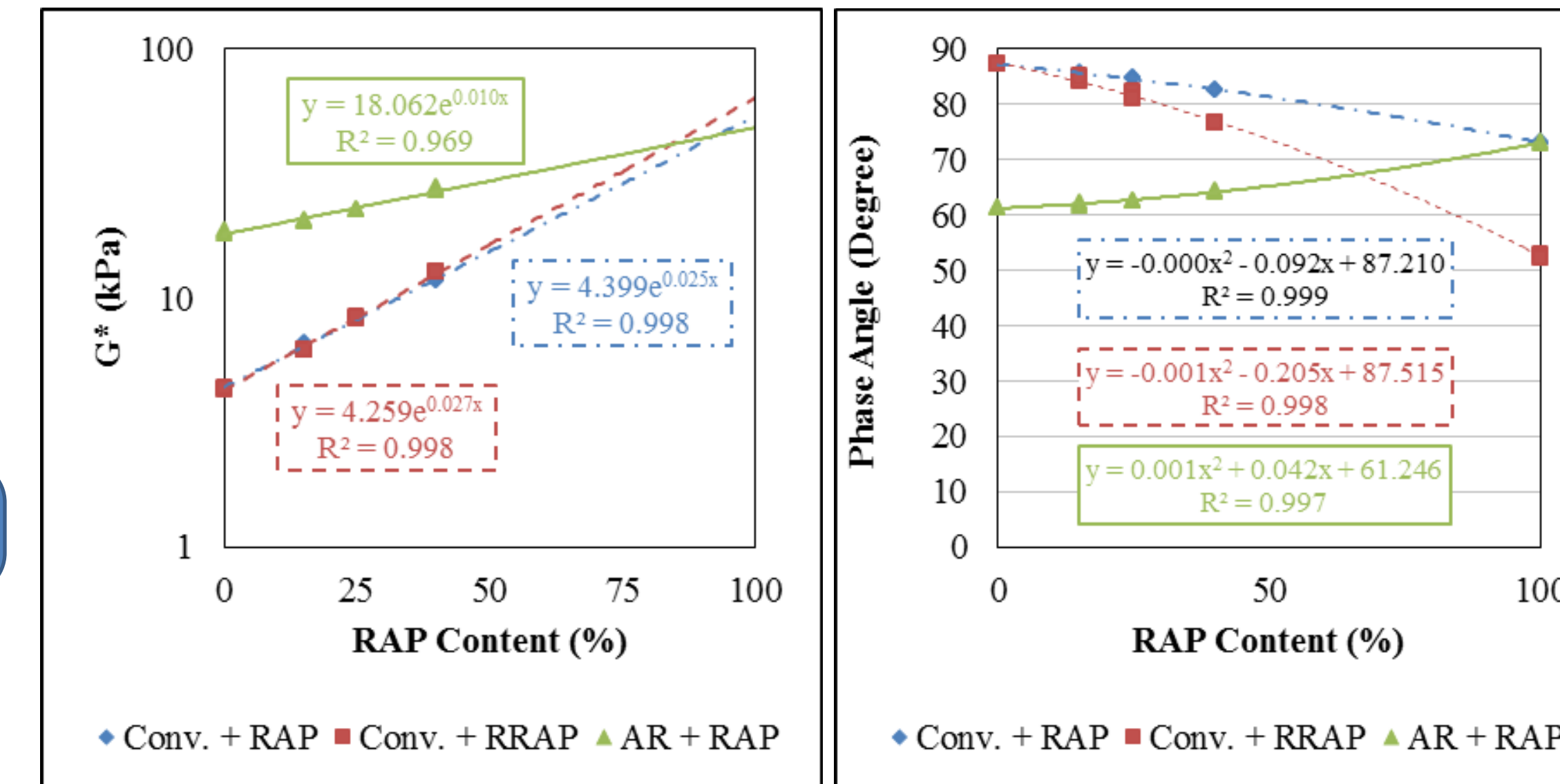


Summary and Conclusions

- The concentric cylinder geometry on the DSR was able to effectively capture the changes in the rheological properties of composite binders containing different RAP and RRAP percentages.
- These results provide an initial indication that inclusion of RRAP in conventional mixes will generally produce improved performance at both high and low temperatures.
- The results also provide an initial indication that inclusion of RAP in asphalt rubber mixes will potentially negatively affect low temperature performance and will have limited effect on high temperature performance.
- The use of RAP in new RHMA mixes will effectively reduce the amount of recycled tire rubber used.

Test Results/ G* and Phase angle at 64°C

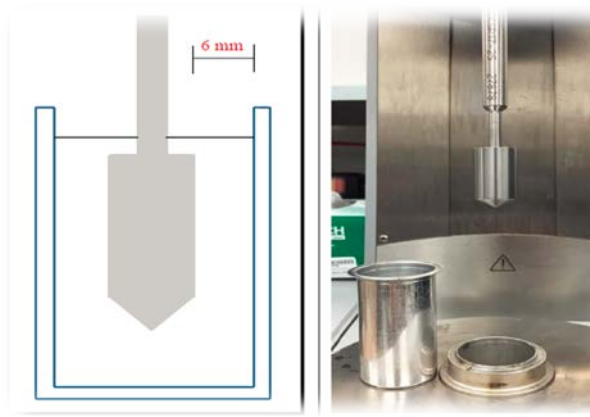
Tests performed on original binders.



Testing Method

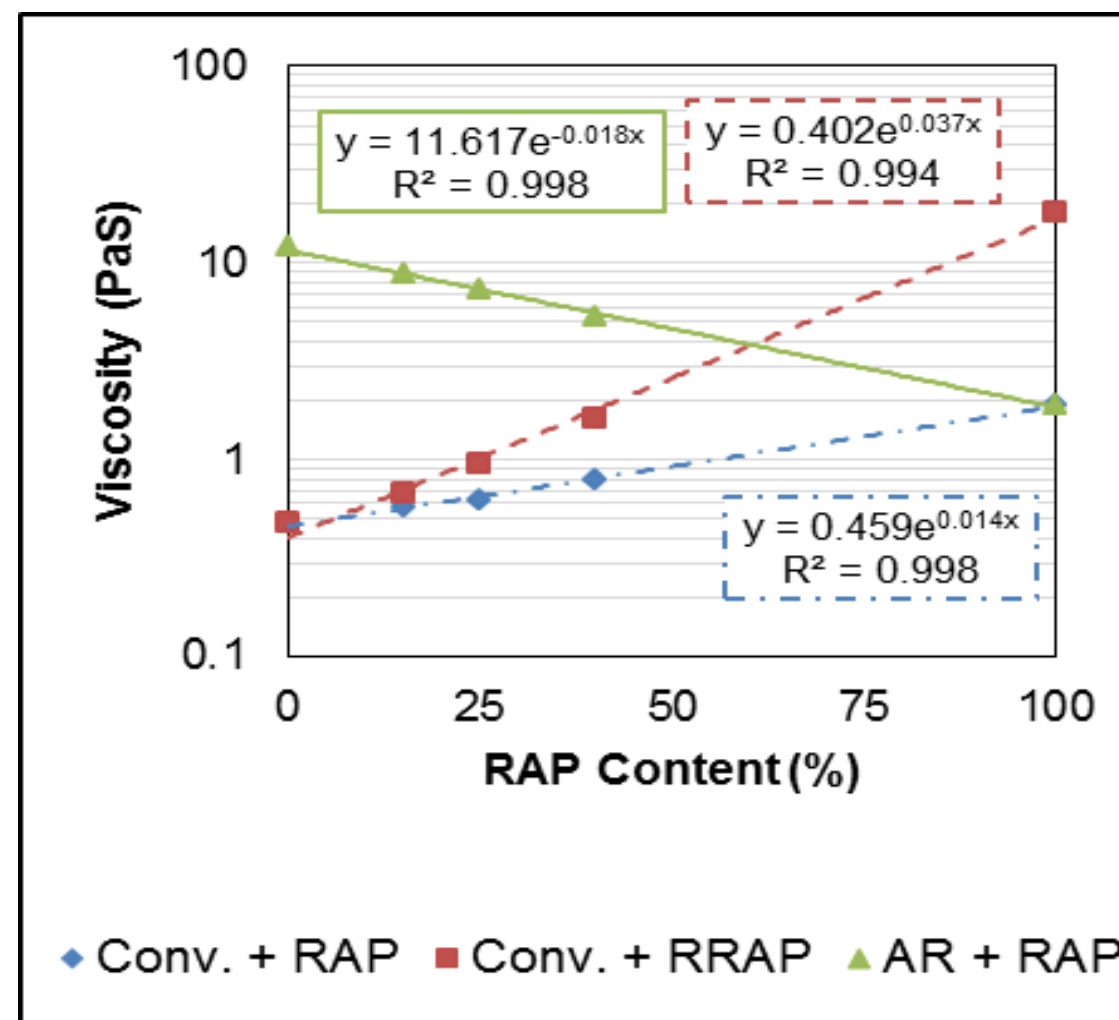
A concentric cylinder testing geometry in a DSR was used to investigate the following binder properties:

- ✓ Viscosity at 135°C
- ✓ High PG limit
- ✓ Rheological properties (G* and phase angle)
- ✓ MSCR



A Bending Beam Rheometer (BBR) was used to investigate low temperature properties

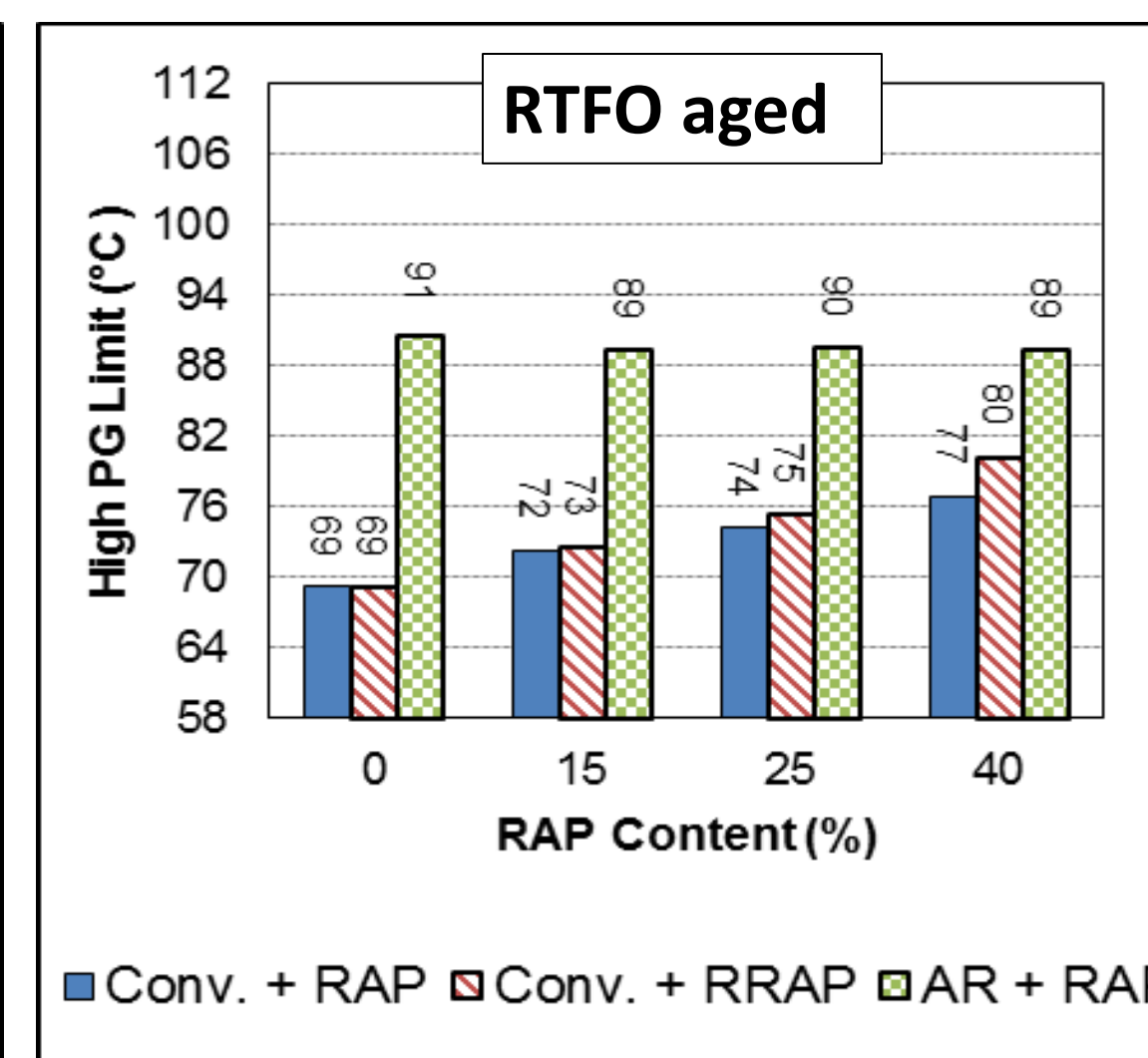
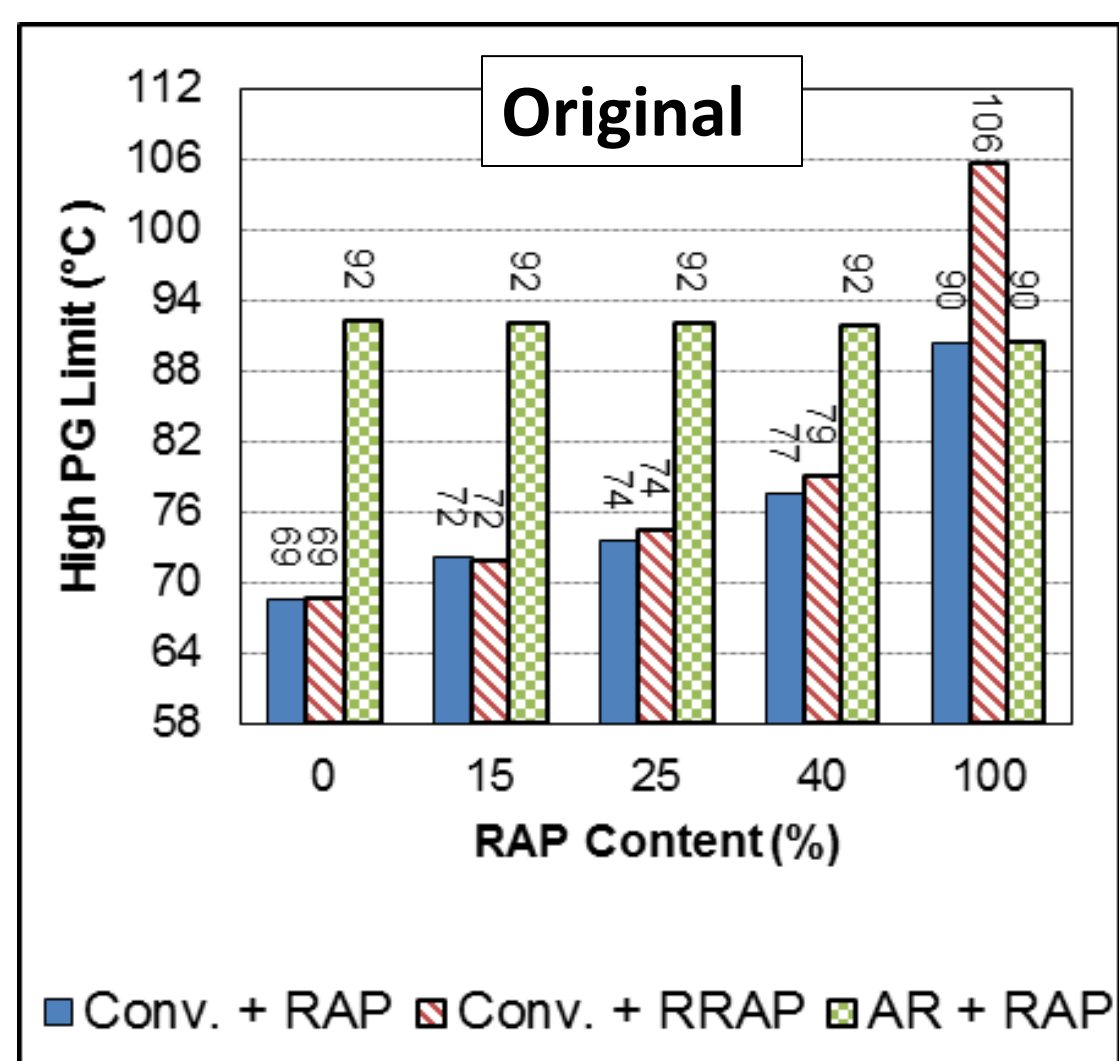
Test Results/ Viscosity at 135°C



Nomenclature:

- “Conv.” → PG64-16 binder
- “AR” → asphalt rubber binder
- “RAP” → simulated RAP binder
- “RRAP” → simulated RRAP binder

Test Results/ High PG limit



Introduction

- State Law: 35% of all asphalt concrete placed in California by Caltrans must contain recycled tire rubber.
- Crumb rubber is added to asphalt binder primarily using the wet-process to produce asphalt rubber binder for use in rubberized hot mix asphalt (RHMA).
- When rubberized asphalt layers reach the end of their design lives, they are being milled off and replaced with new HMA or RHMA.
- The millings are being added to reclaimed asphalt pavement (RAP) stockpiles in unknown quantities and reused in new mixes without consideration of any differences they may cause in performance of the new mix.
- No research was found in the literature specifically addressing the effect of using rubberized RAP (RRAP) in new asphalt mixes and only a limited number of studies have focused on using RAP in RHMA mixes.

Material Collection and Preparation

Materials

- ✓ One conventional binder (PG64-16)
- ✓ One rubberized binder (laboratory blended)

Rubberized binder preparation

- ✓ Base binder: PG 64-16 (same conventional binder)
- ✓ Rubber content: 18% by weight of total binder
- ✓ Grinding type: ambient
- ✓ Extender oil: 4% by weight of base binder
- ✓ Blend in a mixer for 60 minutes at approximately 190°C

Simulated RAP and R-RAP binder preparation

- ✓ Aged in a Pressure Aging Vessel (PAV) for 40 hours at 100°C

Composite binder preparation

- ✓ Unaged binders and age-hardened binders were uniformly hand-blended with a glass rod in three proportions (85:15, 75:25 and 60:40 by total weight of binder).