Temperature and Thermal Equilibrium

Dave Anderson

Asphalt Binder ETG
Bozeman, MT
September 19, 2017
What are the issues?

- How do we define and measure thermal equilibrium?
- How can we ensure that we have reached the target test temperature at low temperatures?
- Do we have adequate measurement techniques?
Some givens

- We need to control temperature to ± 0.1°C and report temperature to the nearest 0.01°C
  - Modern equipment can easily meet these requirements
- We need a better method for measuring specimen temperature
  - An 8 mm silicone wafer with an embedded transducer is not satisfactory for low-temperature 4 mm geometry
  - A satisfactory solution should be available to all instrument manufacturers as an off-the-shelf item
- Action item – Resume this pursuit, particularly for the 4 mm plate at low temperatures, and coordinate with rheometer manufacturers
Pending results to the contrary, it can be assumed that for low temperature measurements Peltier plates alone give insufficient temperature control and must be accompanied by a controlled temperature “oven”.

Further work with low-temperature measurements should be limited to instruments that meet the above criterion.

*Action item* – Combine existing material on sample preparation and fixture compliance with additional information on instrument requirements to provide short-term guidance “White Paper” to the asphalt community.
Detailed procedure for determining time when complex modulus changes minimally with time has been developed as “Determination of Thermal Equilibrium Time”

- Assumes all changes with time of the result of thermal equilibrium

- More detailed evaluation of available data shows that this may not be the case

- Existing and new data needs to be revisited with respect to the design of temperature control systems
Initial work implied time to thermal equilibrium occurs much sooner than the current 10-12 minute wait time.

- More recent studies contradict this finding
  - Work conducted by Pavel Kris as part of ETG study
- Additional data is also now available for 4 mm low temperature measurements

**Action item** -

1. Task Force needs to reevaluate available data and recommended procedure for determining thermal equilibrium
That’s all folks ..............