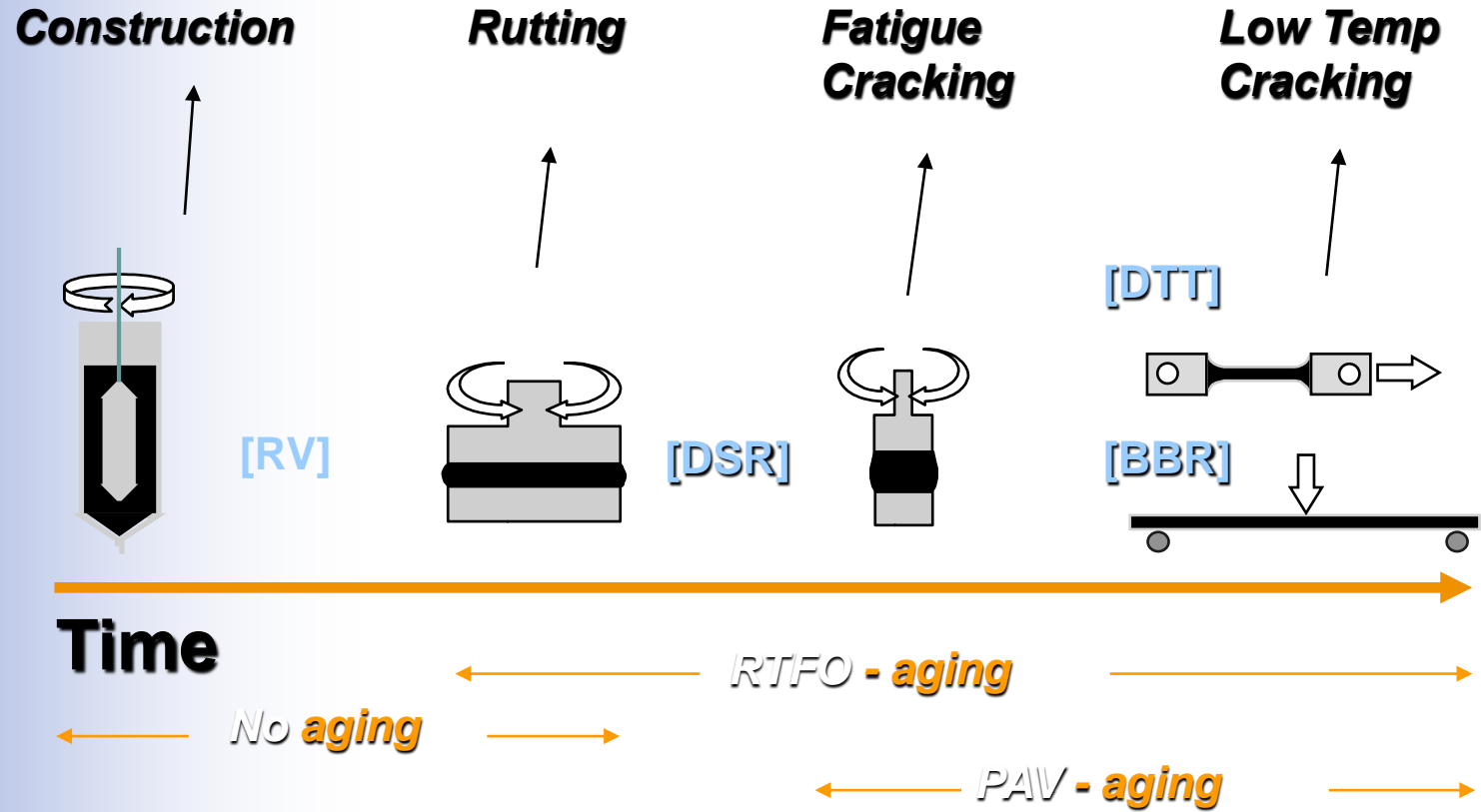# Asphalt Binders and Aging 20Hr or 40Hr PAV

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Superpave Binder Specification

Construction   **Rutting**   **Fatigue Cracking**   **Low Temp Cracking**

[DTT]

[RV]   [DSR]   [BBR]

Time

RTFO - *aging*

No *aging*

PAV - *aging*

Raveling

Fatigue Cracking

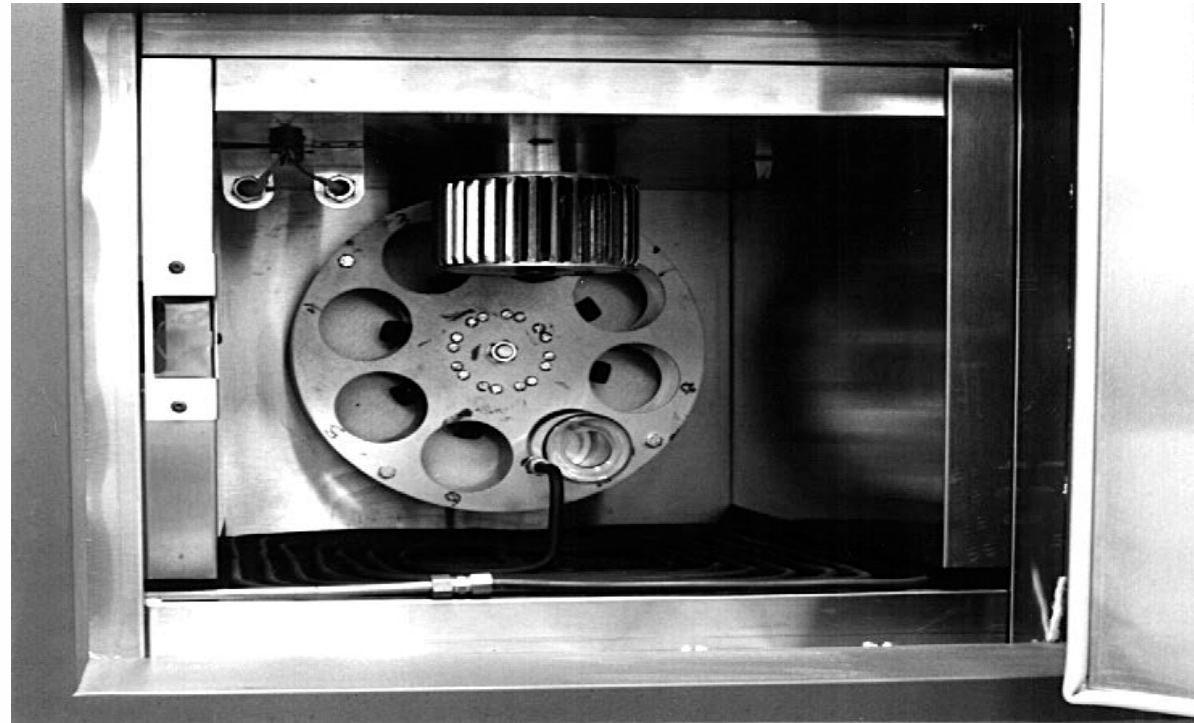# Low Temperature Cracking
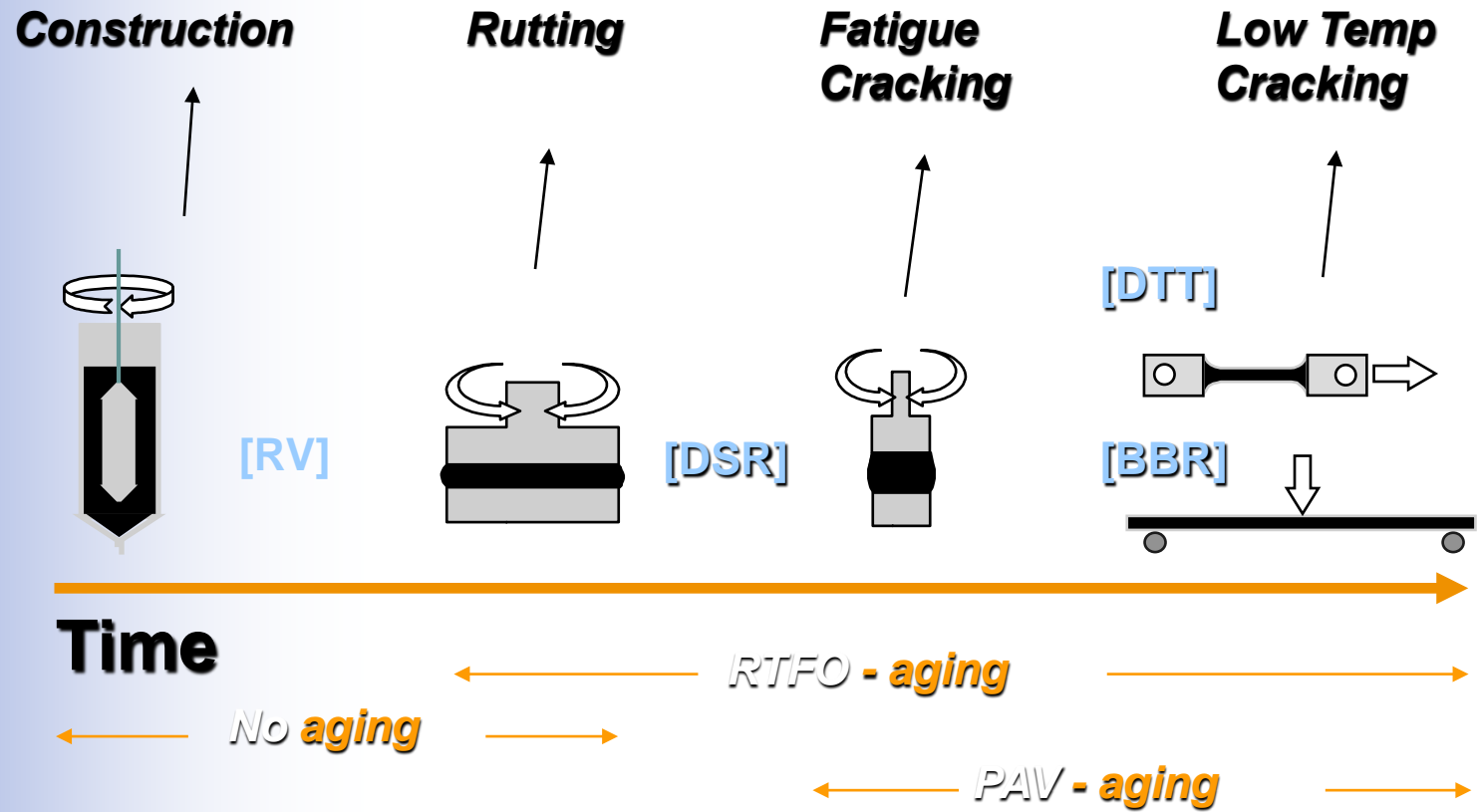
Superpave Conditioning

RTFOT – Short term aging

Aging Long Term

- Current PAV 20 hrs at 100 C, 100 psi.
- 20 hr PAV mandates two days for binder classification.

Superpave Binder Specification

Construction   **Rutting**   **Fatigue Cracking**   **Low Temp Cracking**

[DTT]

[RV]   [DSR]   [BBR]

Time

RTFO - aging

No aging

PAV - aging

Current Aging approaches

- Current 20 hour PAV does not represent long enough aging condition to identify critical conditions
  - Extend 20 hour PAV to 40 hour PAV
    - Longer time to grade
  - Use thinner films in the PAV
    - Reduced material for testing
  - Use extremely thin films in an oven.
    - Very small amounts of material special testing 4mm DSR

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Binder Aging

- Longer Aging times being look at to identify embrittlement.
  - Are Longer times needed?
  - Longer time to grade binders
- Can aging ratios identify the same issues?
  - More tests
  - Same time for grading binder

Task Group Goals

- Using an indicator can the 40 hour PAV be estimated from the 20 hour PAV

- This would be used as an indicator not a direct measure.

- If the estimated 40 hour PAV acceptable extended aging not needed.

- If the estimated 40 hour is not acceptable actual 40 hour testing needed.

ΔTc 20 and 40 hour PAV

- Can we determine where the 40hr PAV value we go based on the 20hr PAV?
- Look at the 20hr value and the change from original to 20hr.

ΔTc

- There are clear indications that the 20hr PAV and the change from original provides clear indications if 40 hr PAV will fail.

- Rate of change of RTFOT to 20hr PAV (RTFOT ΔTc – 20hr PAV)/20hr projected to 40hr

Prediction of 40hr ΔTc

To predict 40hr ΔTc determine rate of change RTFOT to 20hr PAV   (ΔTc RTFOT - ΔTc 20hr PAV)/20hr , to predict 40hr ΔTc

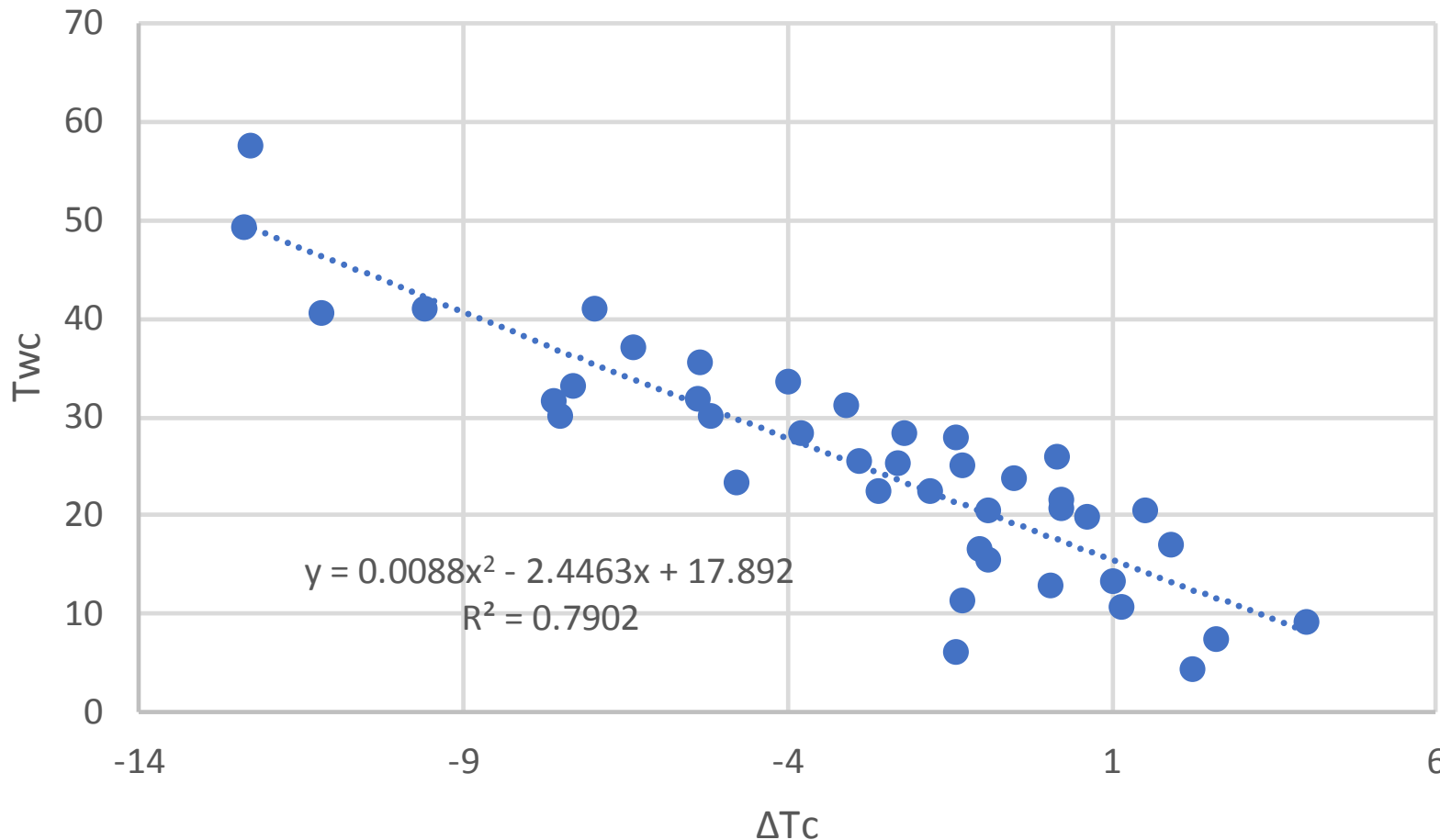| Age	ΔTc,°C													
RTFO	0.5	1.0	-2.6	1.7	2.8	2.3	-1.3	1.3	0.6	1.9	0.4	1.3	1.7	1.6
20 hr. PAV	-3.3	-0.9	-7.0	-1.0	1.7	-0.5	-4.8	-0.9	-2.7	0.8	-3.1	-0.5	-0.7	-2.3
40 hr. PAV	-6.1	-1.4	-12.4	-2.3	0.8	-4.7	-7.6	-2.6	-5.8	-2.6	-8.7	-2.9	-2.2	-8.4
predicted	-7.1	-2.8	-11.4	-3.8	0.6	-3.3	-8.3	-3.0	-6.0	-0.3	-6.6	-2.3	-3.1	-6.2
diff	1.1	1.4	-1.0	1.5	0.2	-1.4	0.7	0.5	0.2	-2.3	-2.1	-0.6	0.9	-2.2

Asphalt Binder Aging

- Are longer aging times needed?

- Binder aging ratios may capture the same issues without longer aging times.

- There are issues with measuring ΔTc on RTFOT material.
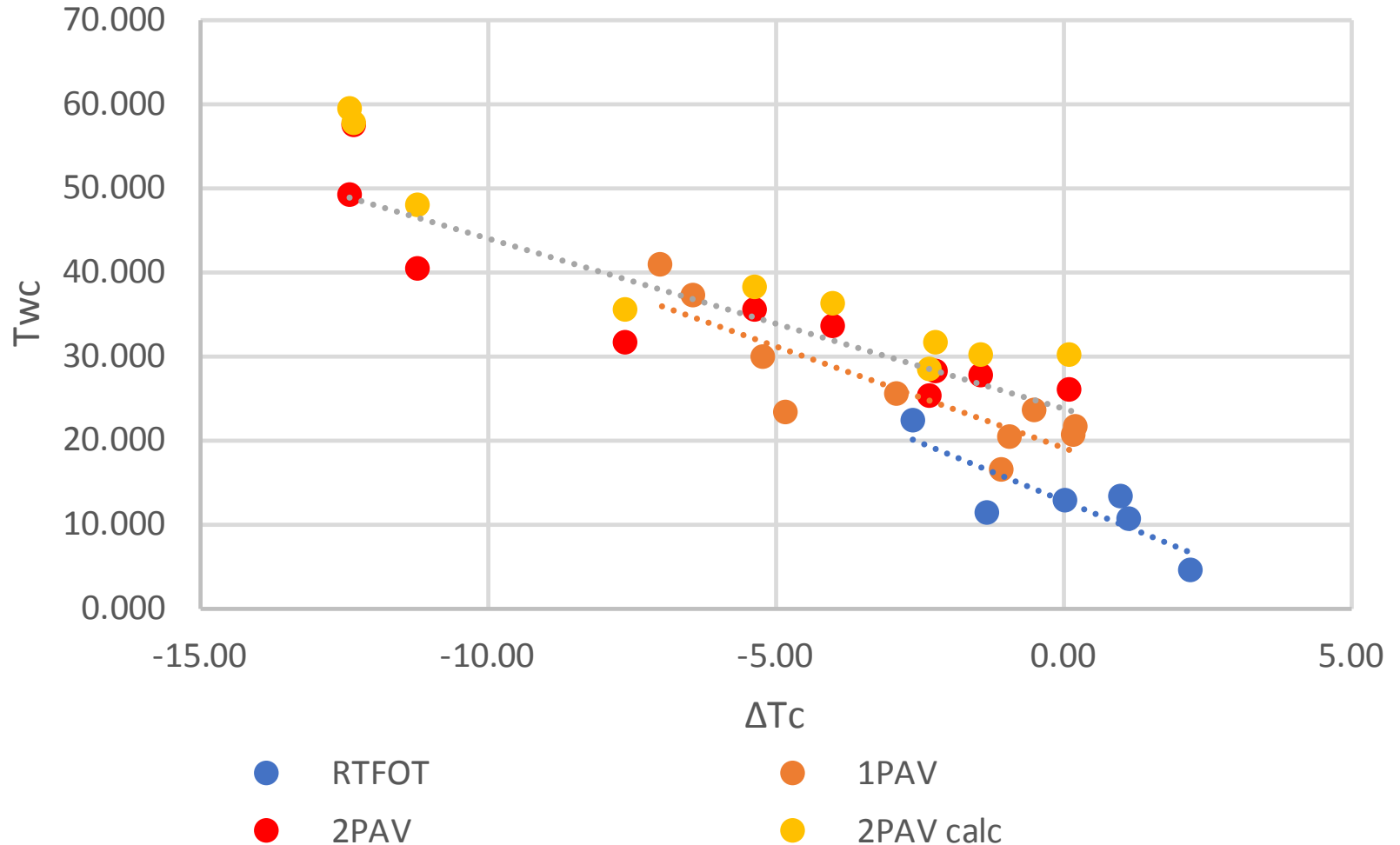
Alternate criteria for evaluation

- Are other criteria that provide similar data to ΔTc?

- The cross over temperature Twc may provide similar information.

- The cross over temperature – Temperature measured at 10 radians/s where the phase angle is 45 degrees or tan delta is 1. This is where the Retardation and Relaxation modulus is equal.
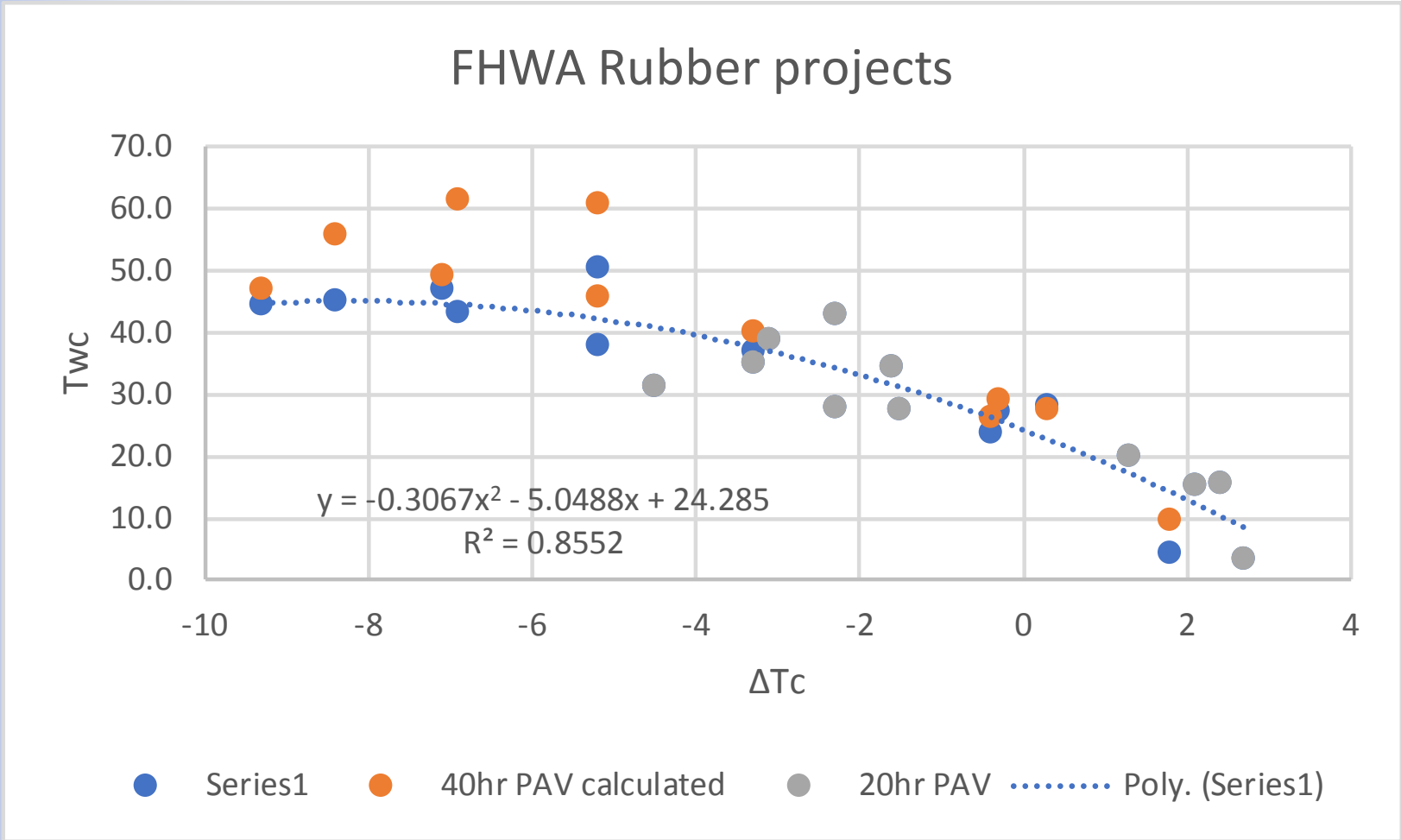
Mathy, Ergon Data RTFOT 1 and 2 PAV comparison.

Chart: Twc vs ΔTc scatter plot with trendline equation $y = 0.0088x^2 - 2.4463x + 17.892$ and $R^2 = 0.7902$.

Mathy, Ergon Data RTFOT 1 and 2 PAV comparison.

FHWA binder many Rubber 20 and 40 hr PAV

FHWA Rubber projects

$y = -0.3067x^2 - 5.0488x + 24.285$
$R^2 = 0.8552$

Series1   40hr PAV calculated   20hr PAV   ······ Poly. (Series1)

Data from Original Anderson Paper.

AAPTP 06-01 Asphalt Binders

$y = -3.6908x + 15.29$
$R^2 = 0.94$

Tc @ $\delta=45°$, C (vertical axis)

ΔTc, degrees (horizontal axis)
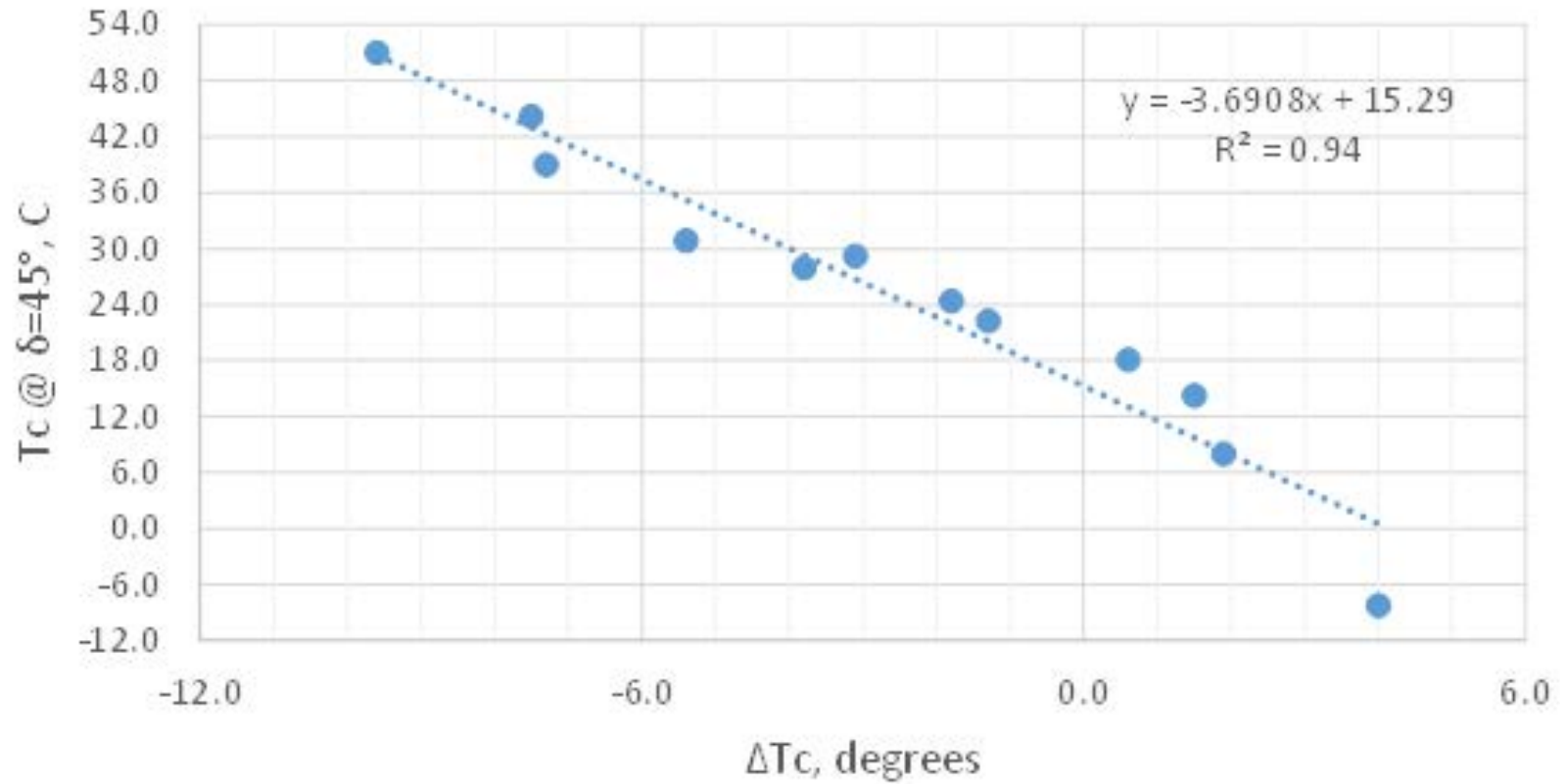
Status

- There is a close relationship between cross over temperature and ΔTc.

- Cross over temperature Twc is easy to measure on RTFOT material.

- ΔTc is difficult to measure on RTFOT material.

Status

- Set limit on ΔTc for 20hr PAV and estimate 40hr PAV using the Twc.

- If ΔTc is bad at 20hr PAV sample fails.

- If ΔTc is very good at 20hr PAV no issue.

- If ΔTc is questionable and 40hr calculated from Twc good no issue

- If ΔTc is questionable and 40hr calculated from Twc need to run 40hr PAV.

Thank You

Discussions