Measuring the Surface Tackiness of Modified Asphalt Binders and Emulsion Residues using a Dynamic Shear Rheometer

PAVEMENT PRESERVATION & RECYCLING SUMMIT

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Introduction

Tack Coat

Tracking from Conventional Tack Coat

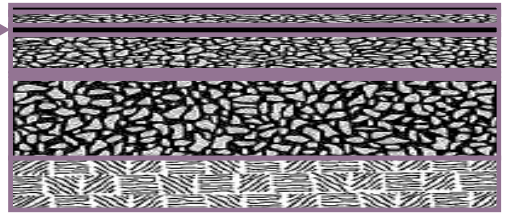
Source: Blacklidge Emulsions

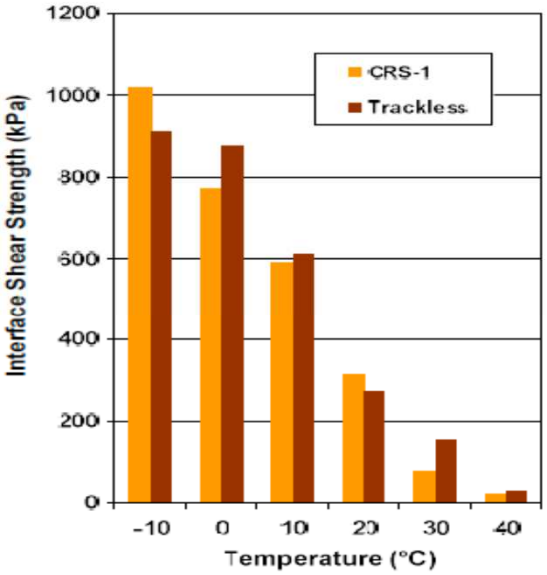
Slippage

Source: NCHRP Report 712

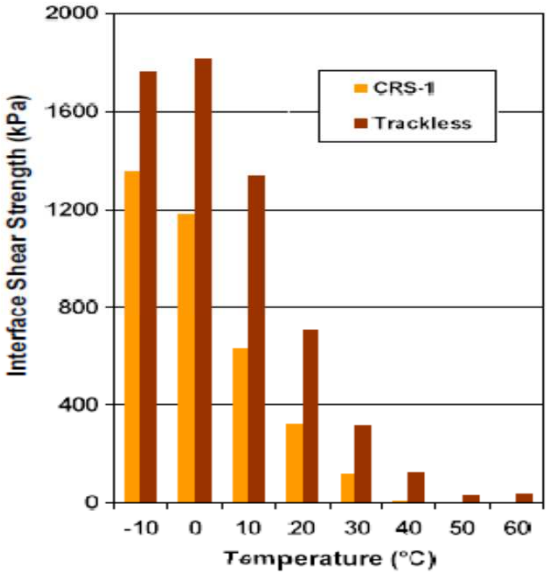
Bond Strength of Trackless Product

Improved shear strength

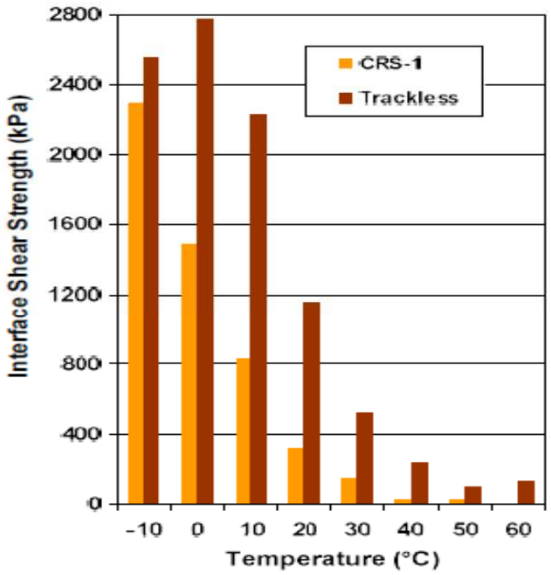




0.14 l/m²



0.28 l/m²



0.70 l/m²

Source: NCHRP Project 9-40

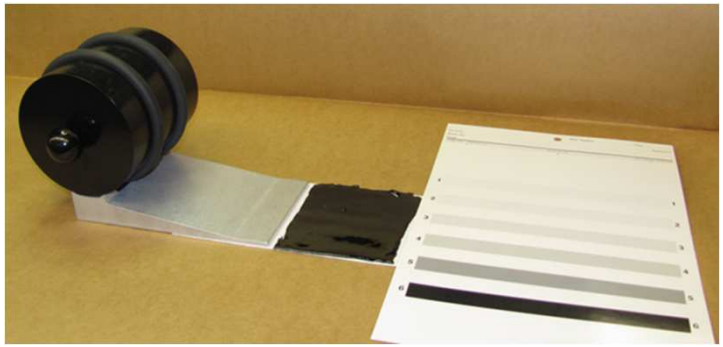
Trackless Emulsions

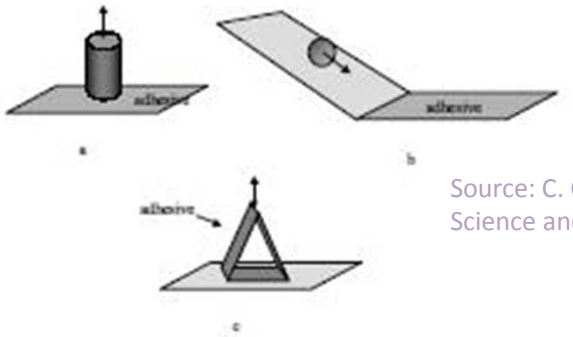
- The residue is non-sticky
  - Use low penetration/ high softening point bitumen
  - Polymer modified systems
  - Other modifiers
- Typical US specifications:
  - <20 pen, softening point >85°C, residue
  - 50% minimum residue content
  - Applied undiluted
- Trackless products can also be hot-applied bitumen

Source: Blacklidge Emulsions

Laboratory test for tracking potential?

- Methods for adhesives, paint drying
- Some used on emulsion residue
- Can't distinguish similar samples
- Can't easily control temperature

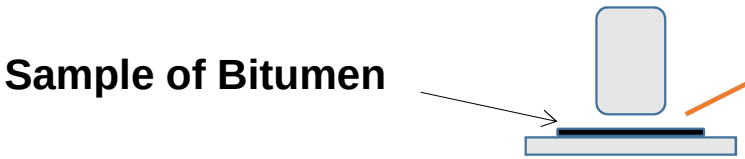




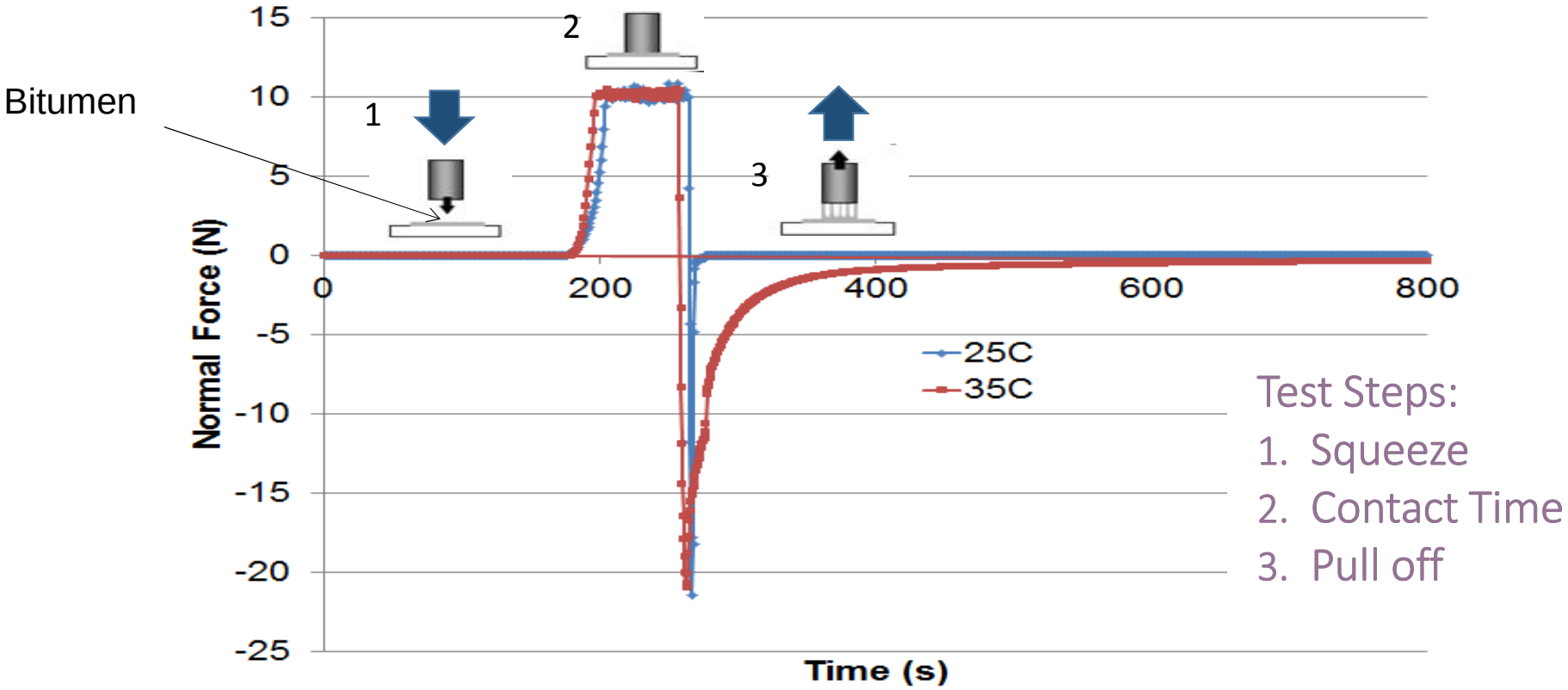
Source: C. Creton, P. Fabre , "Tack" in: Adhesion Science and Engineering, Vol I, Elsevier (2002).

Dynamic Shear Rheometer

- Performance grading
- Pressure sensitive adhesives
- Compression and tension as well as oscillatory, rotational
- Accurate control of temperature



DSR Results in Compression-Tension Mode



Test Steps:

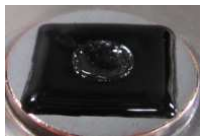
1. Squeeze
2. Contact Time
3. Pull off

Method Development

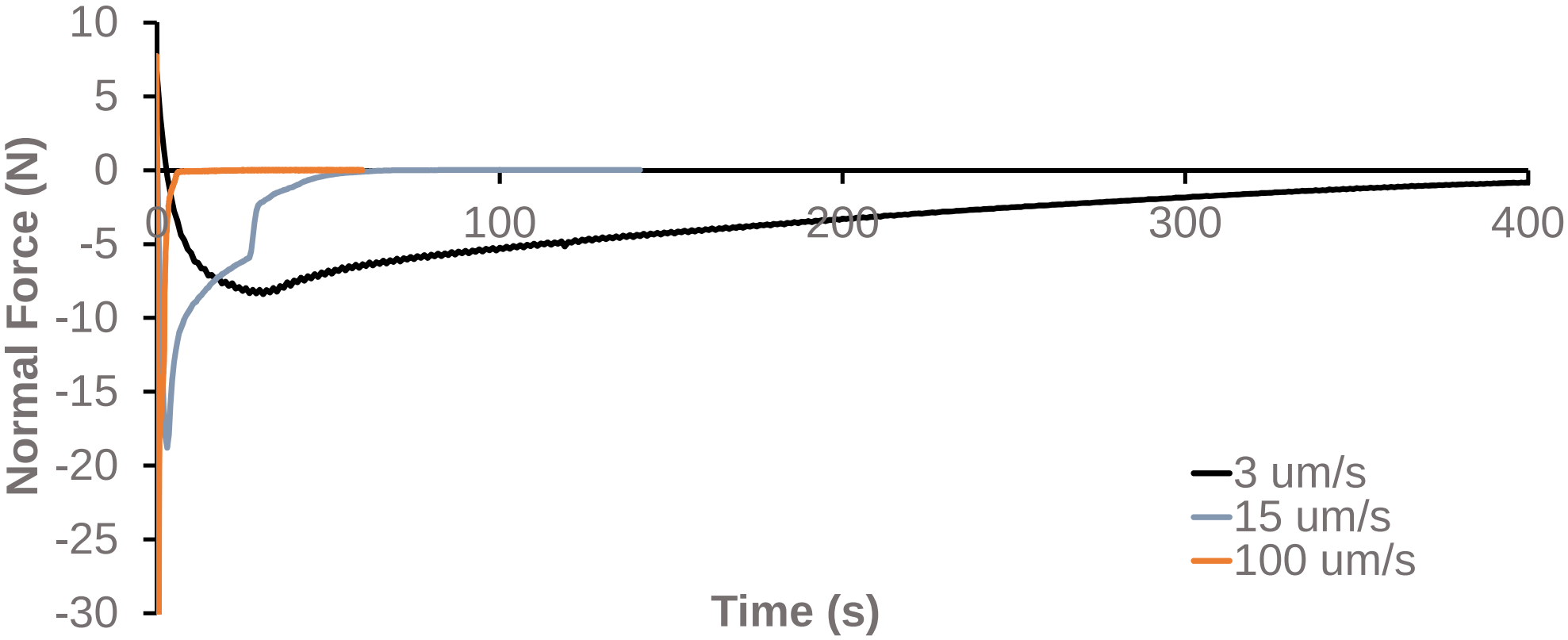
› To get results on previous slide we looked at method parameters: contact time, applied force, speed in tension

- **Goal: Simulate worst case of vehicle stopped on road**
- **Chose method parameters to give resolution between samples; can be can be changed to refine as needed**
- **Sample thickness was important**
- **Both TA Instruments and Anton Paar DSRs**

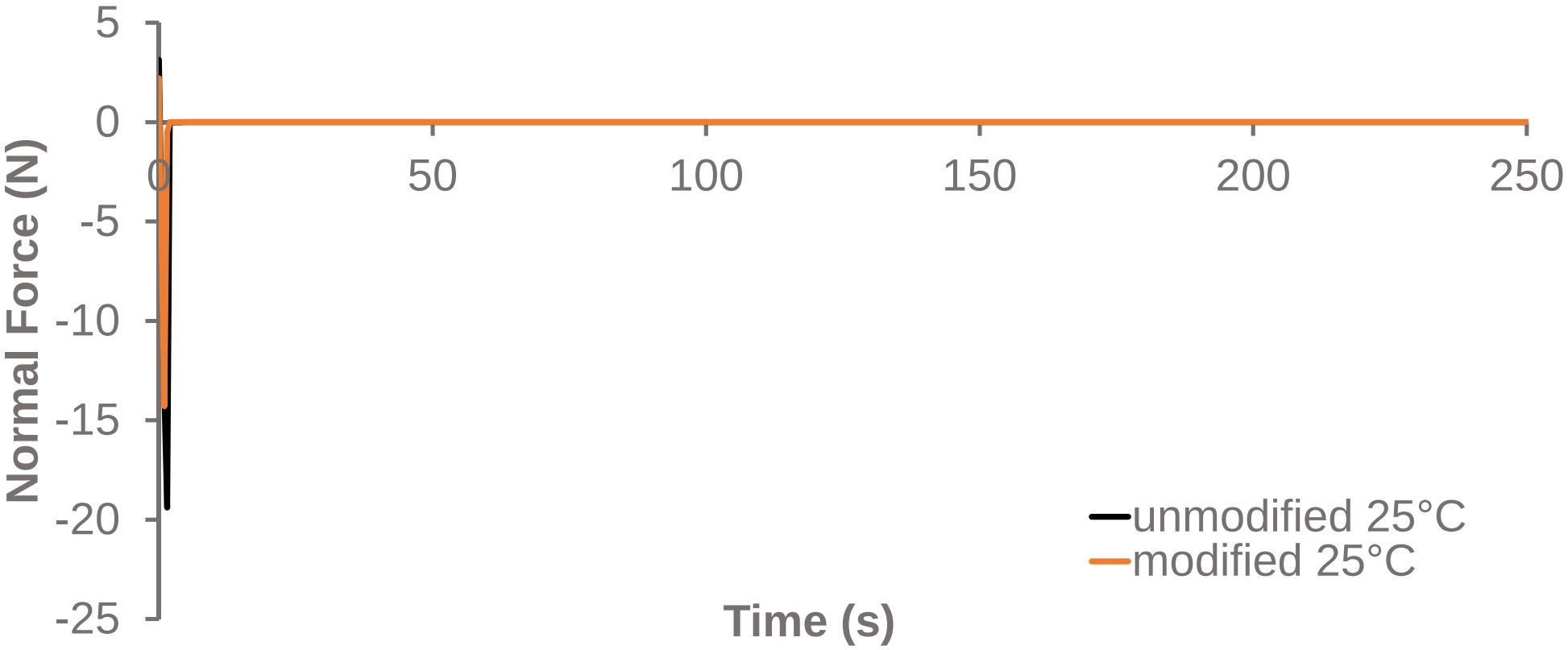
Source: NCHRP Report 712



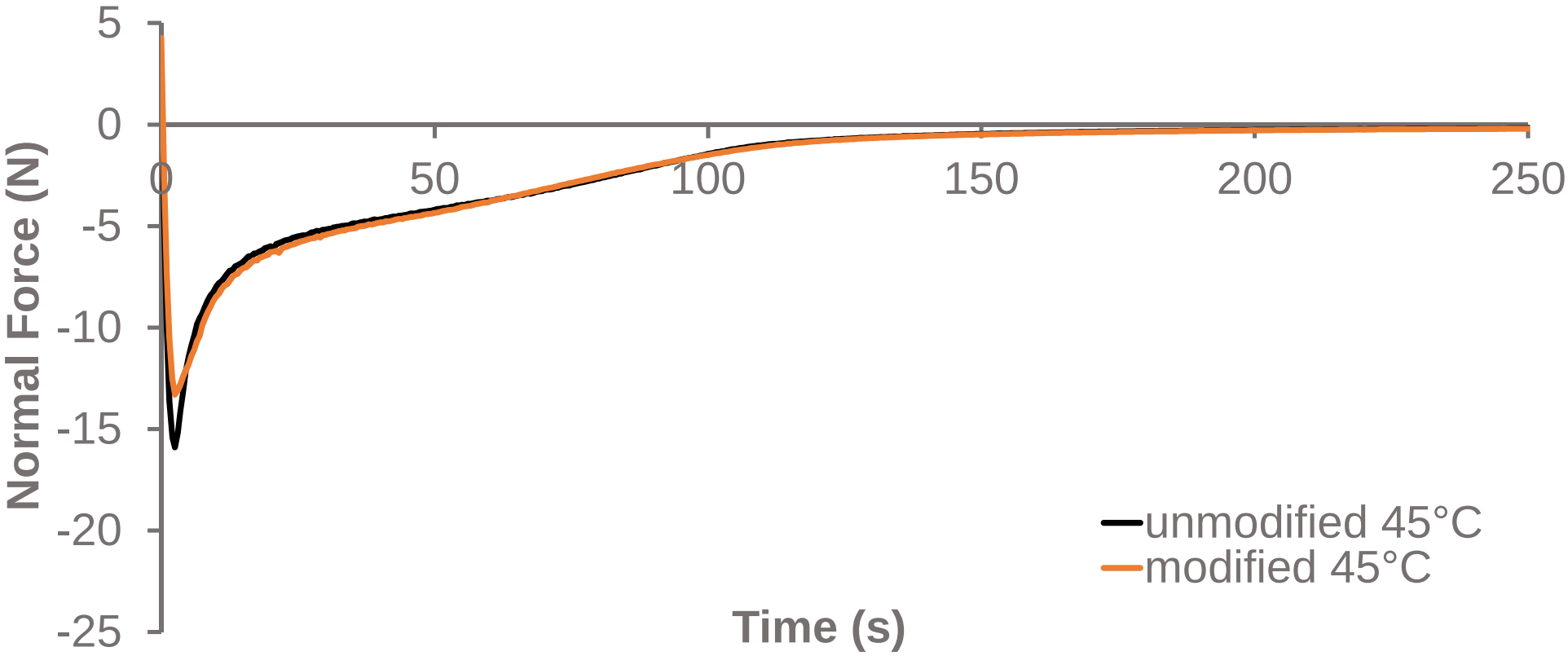
Method Development: Effect of Speed in Tension



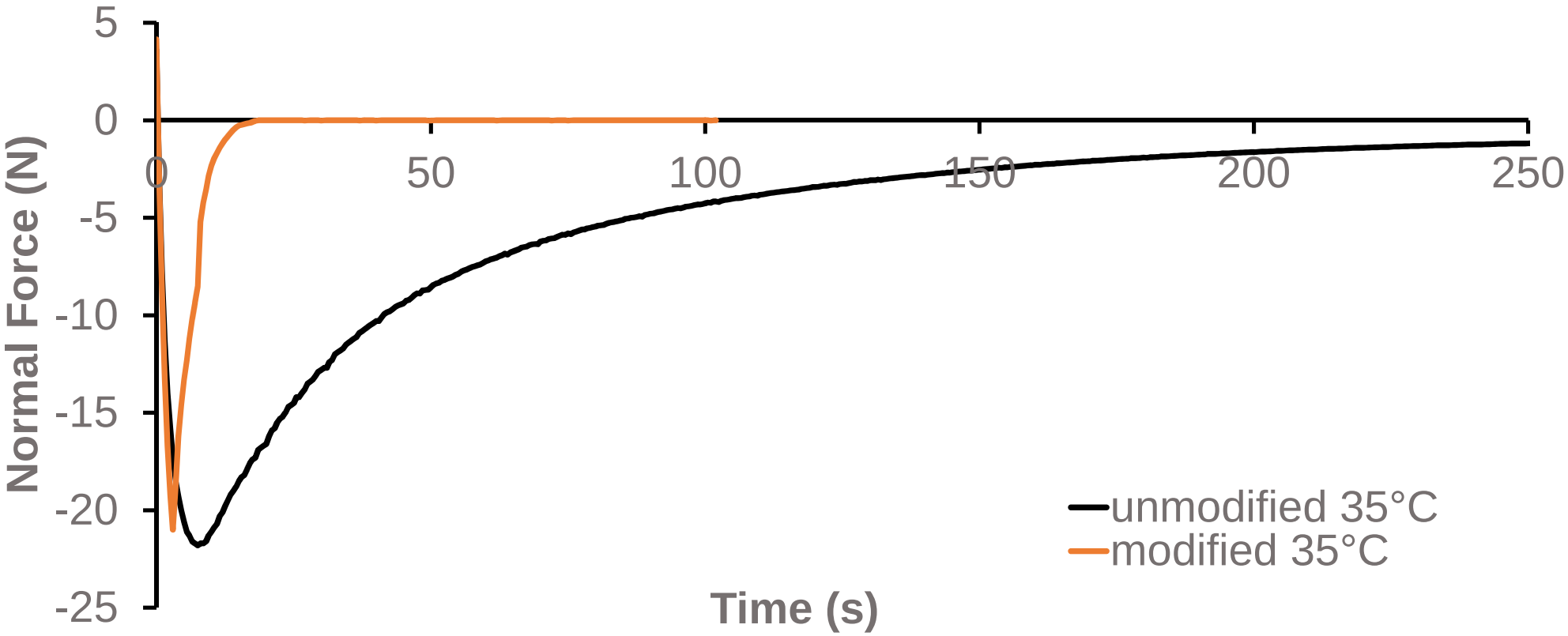
Effect of Temperature: 25°C, *both non-tacky*



Effect of Temperature: 45°C, *both tacky and tracking*

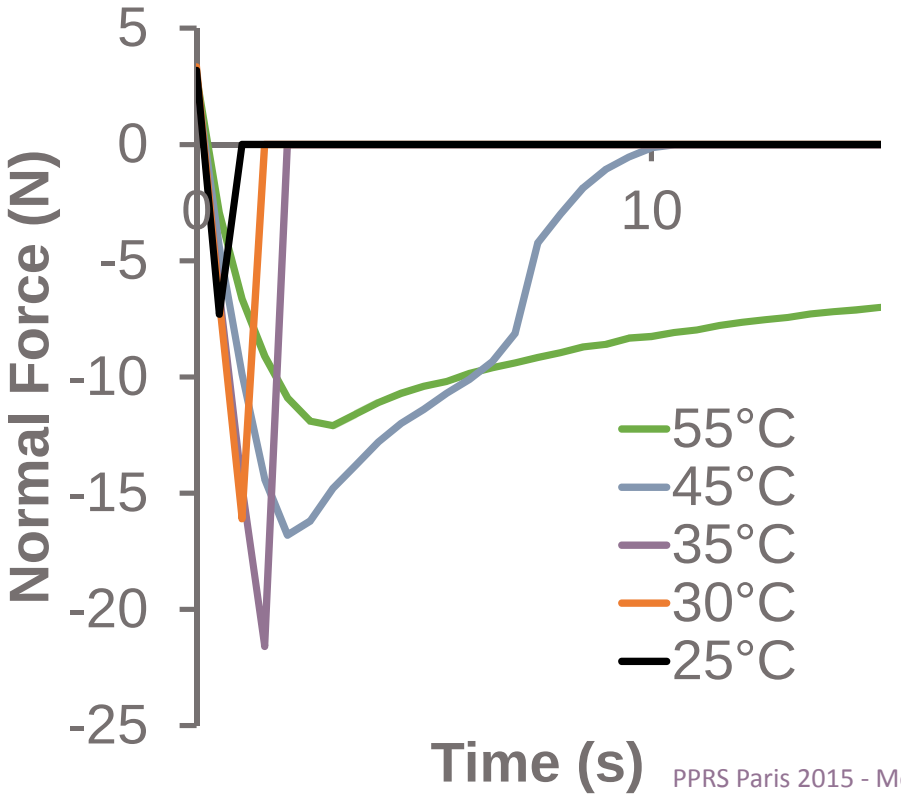


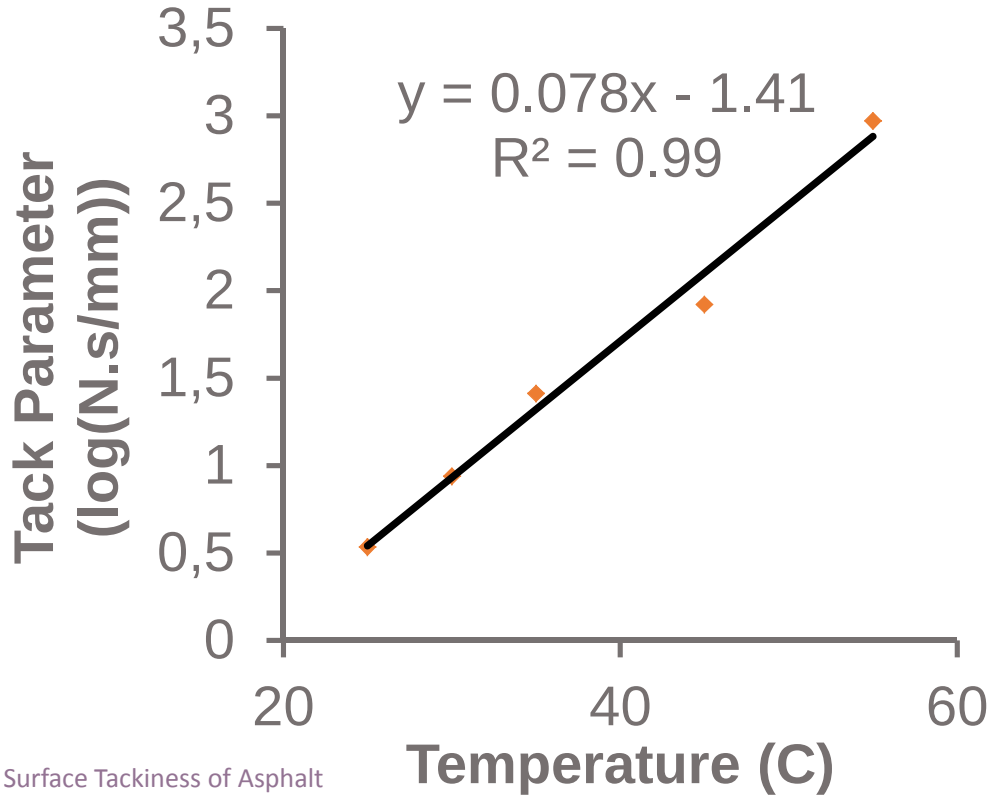
Effect of Temperature: 35°C, *differences resolved*



Development of a Test Specification

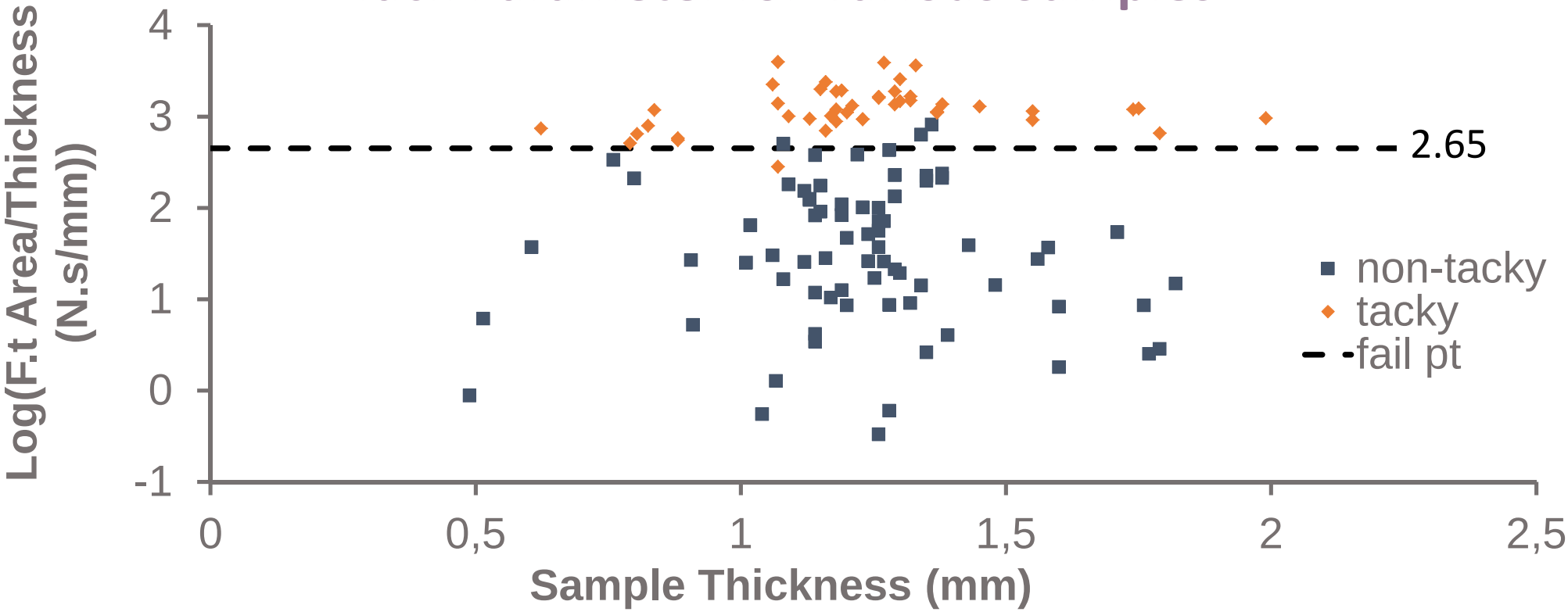
Correlation of Log(Force-Time Area/Thickness) versus Temperature





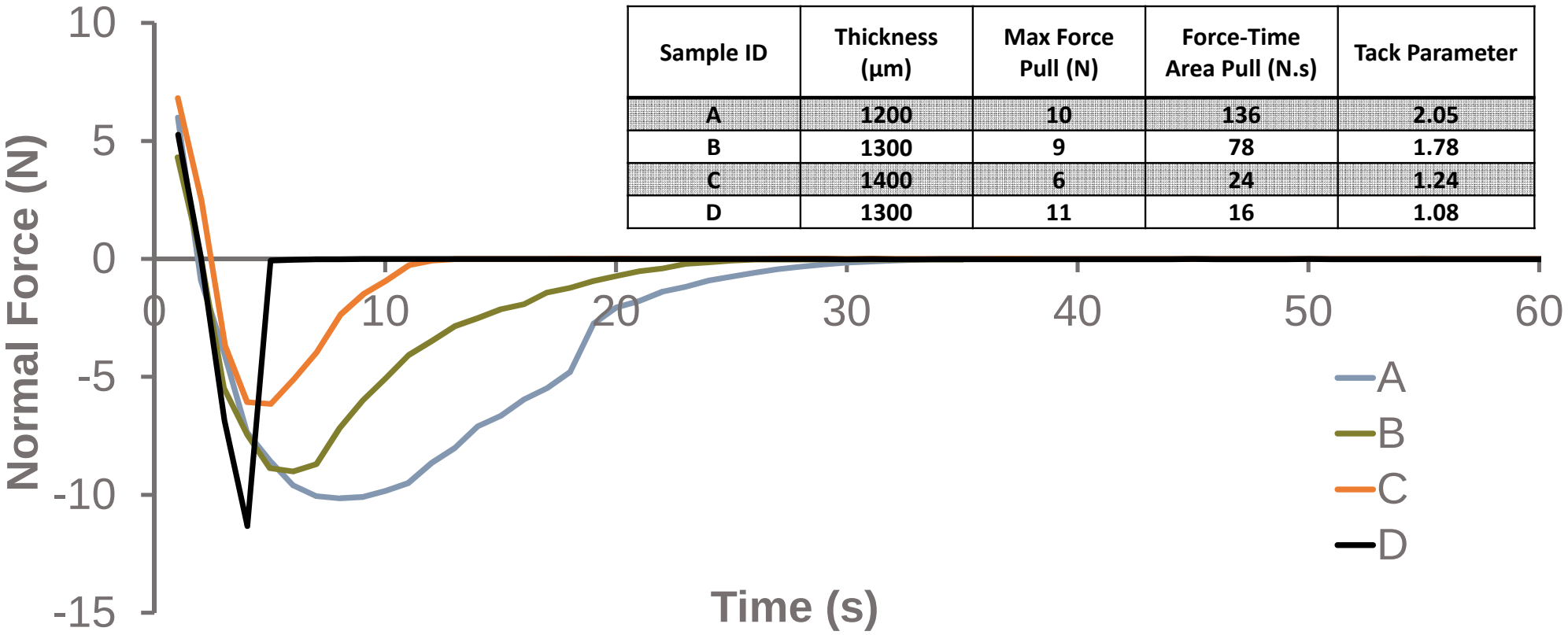
Development of a Test Specification

Tack Parameter for Various Samples

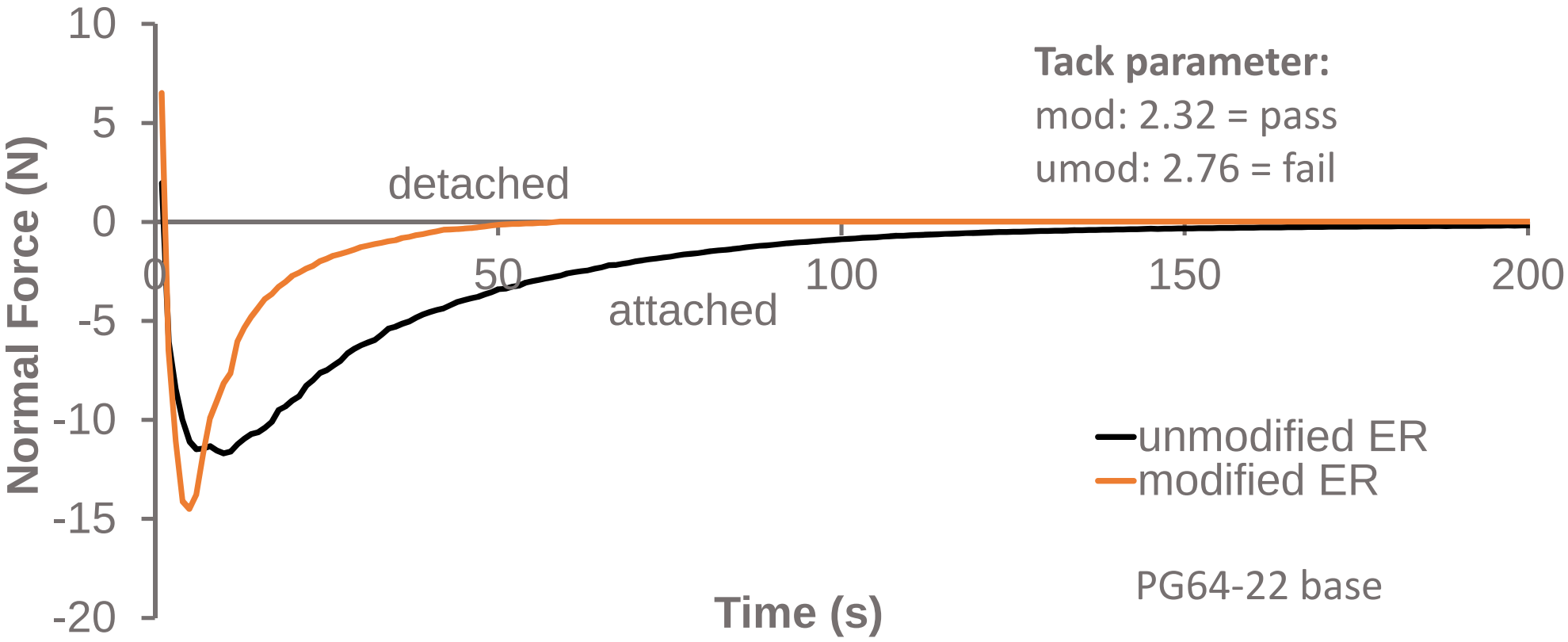


Field Relevant Results: DSR of Modified Bitumens

Sample ID	Thickness (µm)	Max Force Pull (N)	Force-Time Area Pull (N.s)	Tack Parameter
A	1200	10	136	2.05
B	1300	9	78	1.78
C	1400	6	24	1.24
D	1300	11	16	1.08

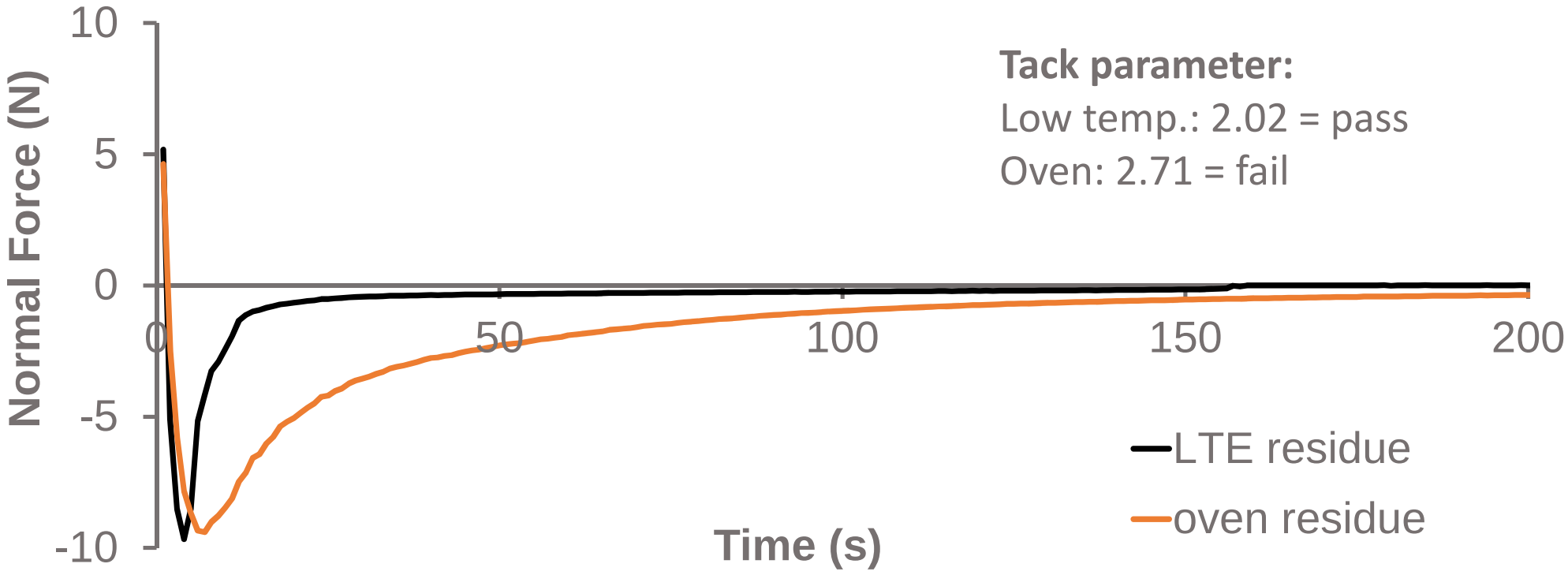


Emulsion Residues: Unmodified and Modified, 25°C

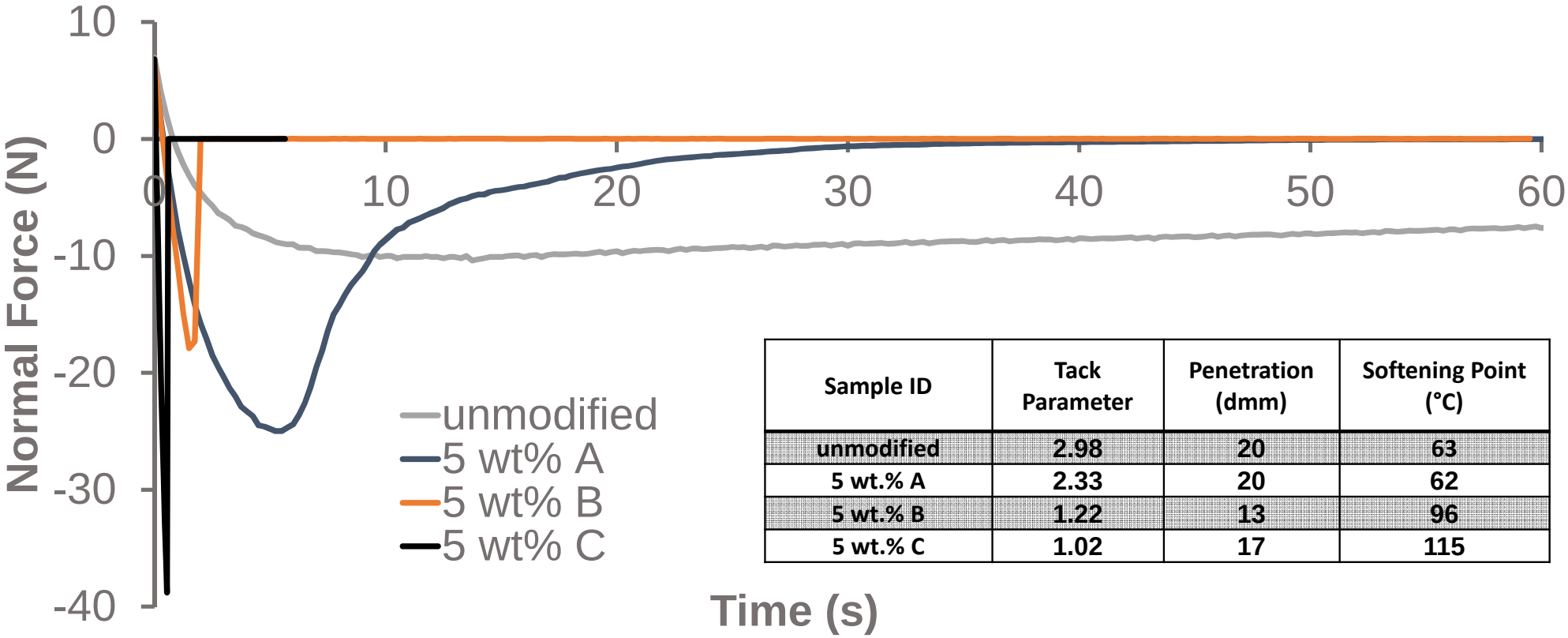


Emulsion Residues:

Recovered by Oven and Low Temperature Evaporation (LTE)



Example with Modifiers



Sample ID	Tack Parameter	Penetration (dmm)	Softening Point (°C)
unmodified	2.98	20	63
5 wt.% A	2.33	20	62
5 wt.% B	1.22	13	96
5 wt.% C	1.02	17	115

Conclusion

- Objective
- Can distinguish similar samples
- Works for different DSR makes
- Proposed spec reliably predicts tracking
- Progress in predicting field performance
- Consistent sample preparation important
- Can evaluate different mechanisms for TT

BETA RESEARCH & DEVELOPMENT

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