



Field Investigation of Polyphosphoric Acid Modified Binders at MnROAD

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*Polyphosphoric Acid Workshop
April 8, 2009*

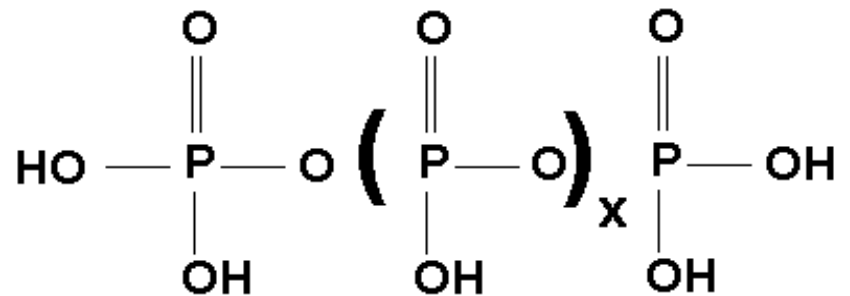
Research Partners

- Mn/DOT
- Federal Highway Administration
- MTE Services, Inc.
- Innophos
- ICL Performance Products
- Marathon Petroleum Company
- Dupont
- Paragon Technical Services
- Western Research Institute



PPA Study Background

- Stiffen asphalt at high temperatures
- No effect at low temps
- More cost-effective than polymers
- FHWA lab studies
- Field validation needed





Low Volume Road

Interstate 94

Mainline

Test Cell Designs

- PPA Only
- PPA + SBS
- SBS Only
- PPA + Elvaloy

-
- Level 3 Superpave
 - PG 58-34 Binder
 - No RAP
 - Limited Limestone
 - Hydrated Lime
 - Liquid Antistrip

77	78	79	33	34	35
4" 58-34 Elvaloy + PPA	4" 58-34 Elvaloy + PPA	4" 58-34 Elvaloy + PPA	4" 58-34 PPA	4" 58-34 SBS +PPA	4" 58-34 SBS
8" Full Depth Reclam.	8" Class 6	8" Full Depth Reclam. + Fly Ash	12" Class 6	12" Class 6	12" Class 6
Clay	Clay	Clay	Clay	Clay	Clay

Challenges Encountered



1904

Extra and Force Account Work

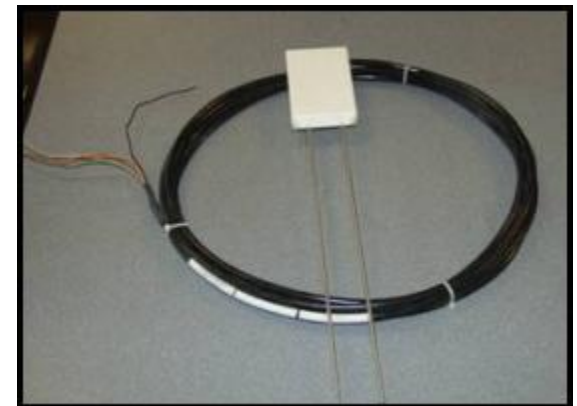
Extra Work performed in accordance with 1403 will be paid for on a negotiated or Force Account basis. The Contractor shall accept the following compensation provisions as payment in full for Extra and Force Account Work.

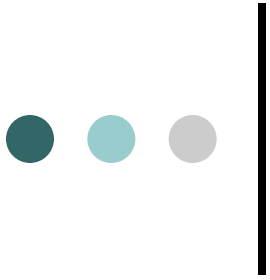
If an agreement cannot be reached to pay for the Extra Work on a unit price or lump sum basis, or if those methods are impracticable, the



Instrumentation

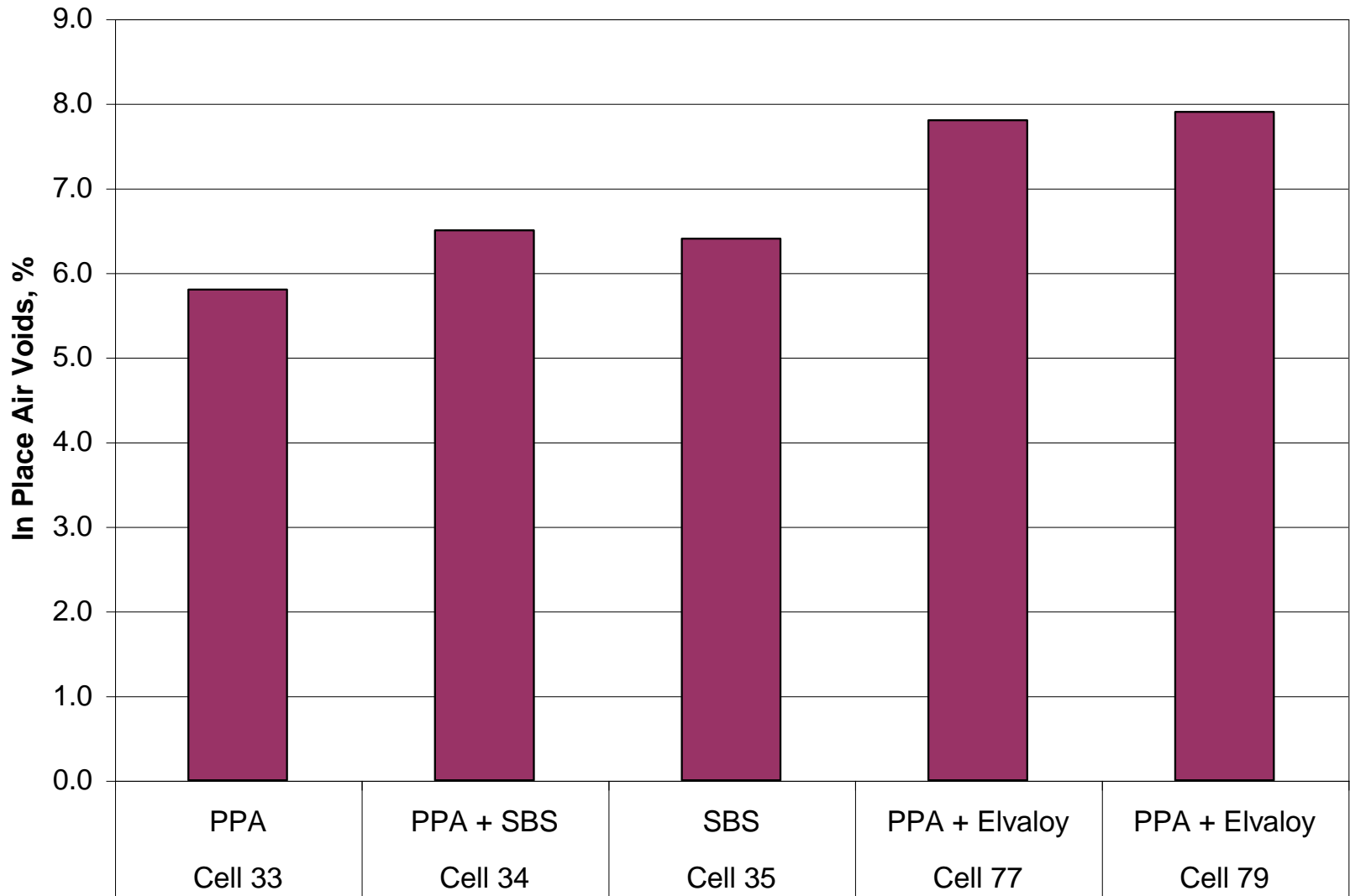
- Thermocouple
- ECH2O-TE
- Time Domain Reflectometer
- Lysimeter
- Loop Detector
- Soil Compression Gauge
- Dynamic Pressure Gauge
- Asphalt Dynamic Strain Gauge





Field Data

As-Constructed Air Voids

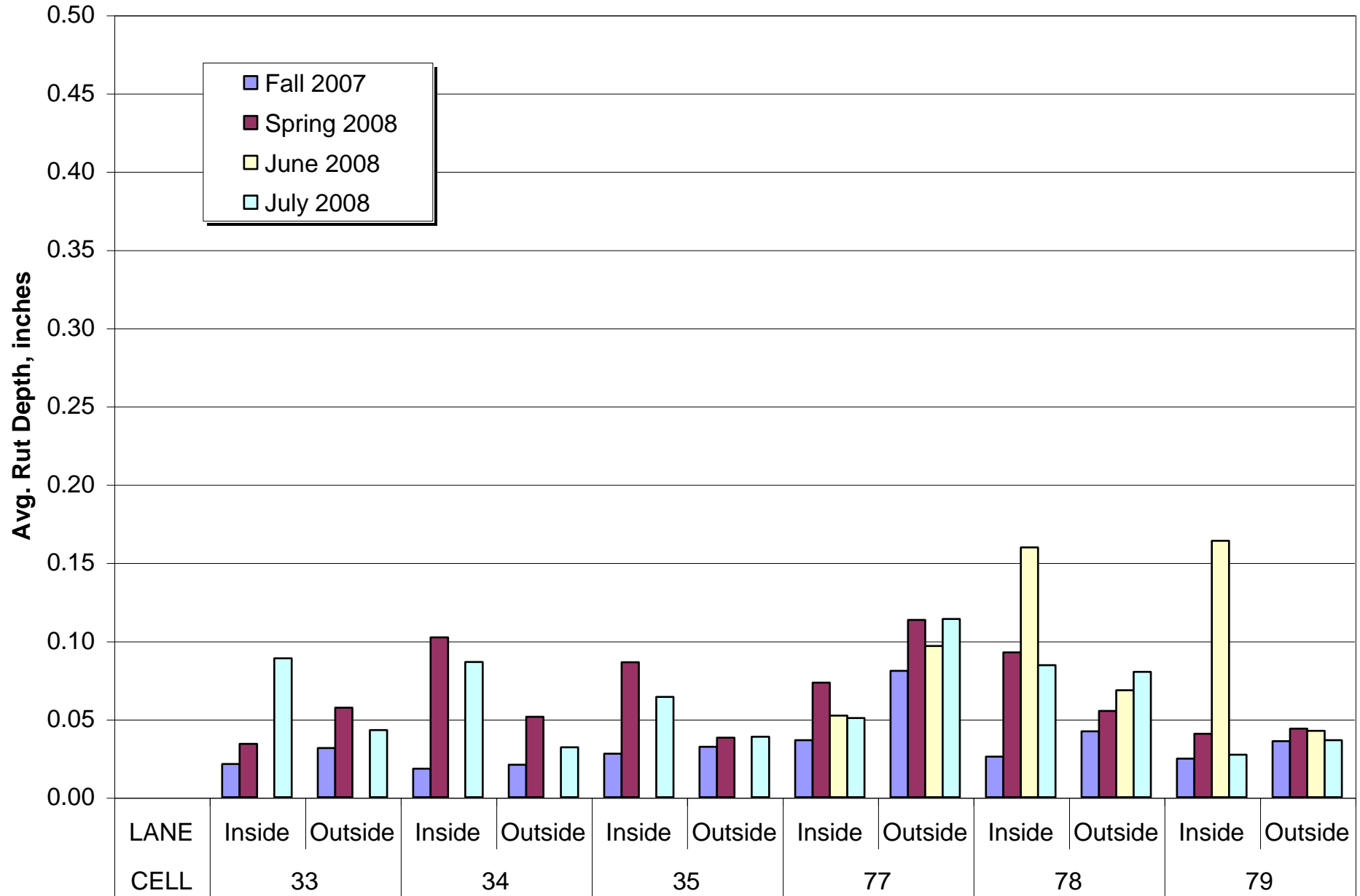




Early FWD Results

		Average Stiffness, MPa	Coefficient of Variation
Cell 33	Subgrade	56.4	15.1%
	Base	147.9	15.1%
	HMA	1331.3	13.7%
Cell 34	Subgrade	52.3	11.2%
	Base	137.4	11.2%
	HMA	1250.8	17.7%
Cell 35	Subgrade	58.5	15.2%
	Base	153.6	15.2%
	HMA	1380.3	12.2%

Rutting Data (PPA Sections)

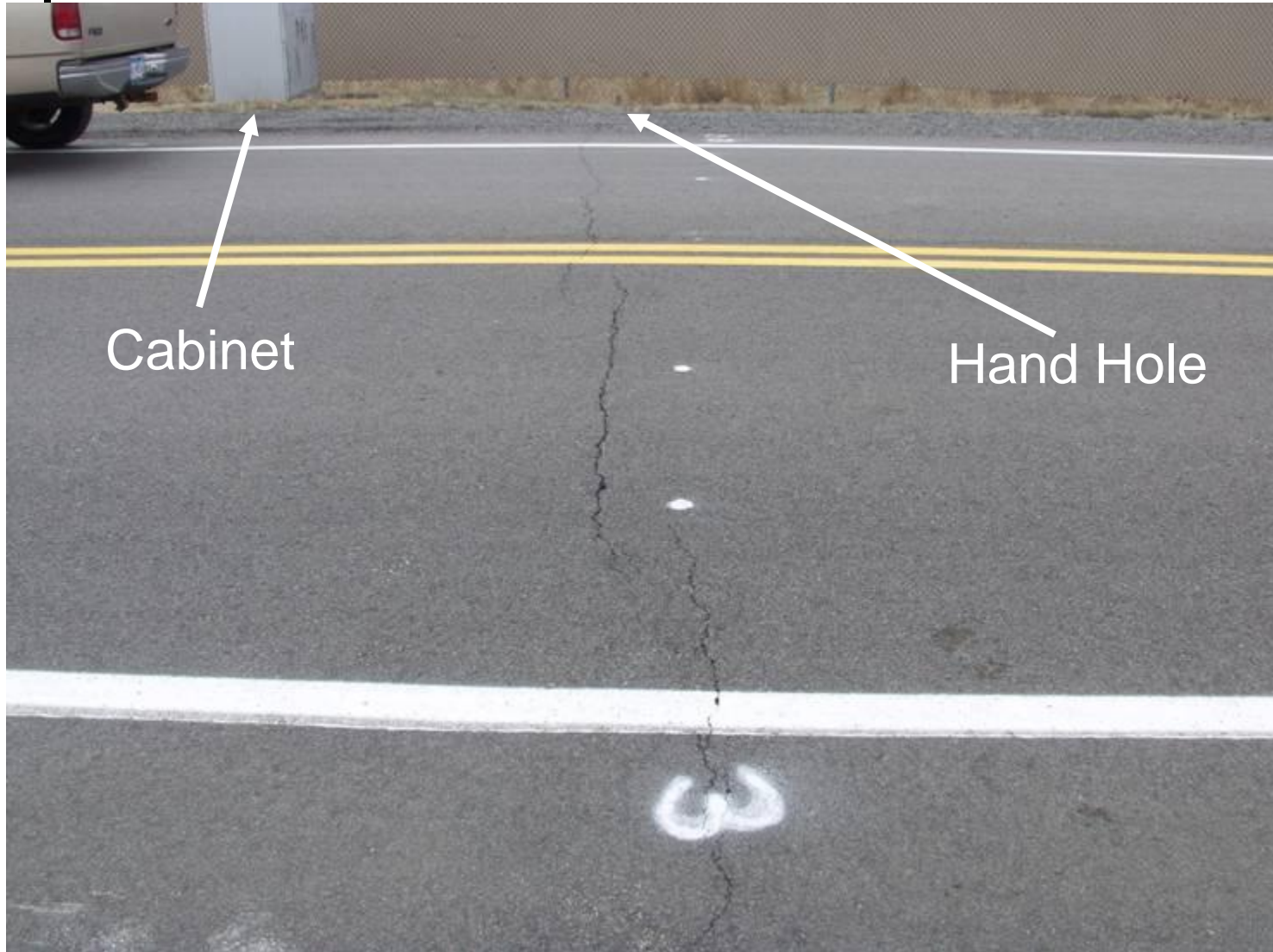


March 2009 Field Inspection

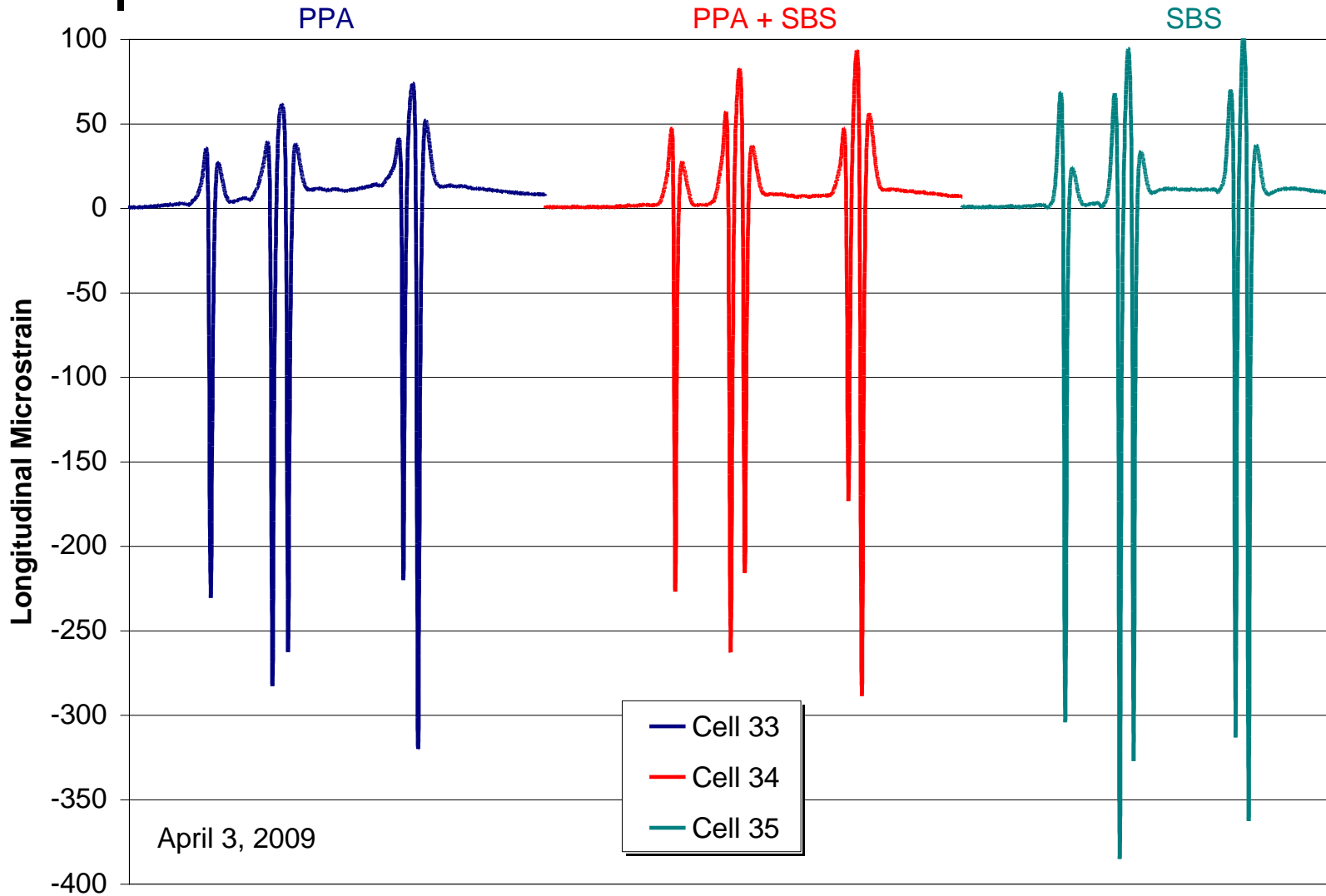


Safety First!

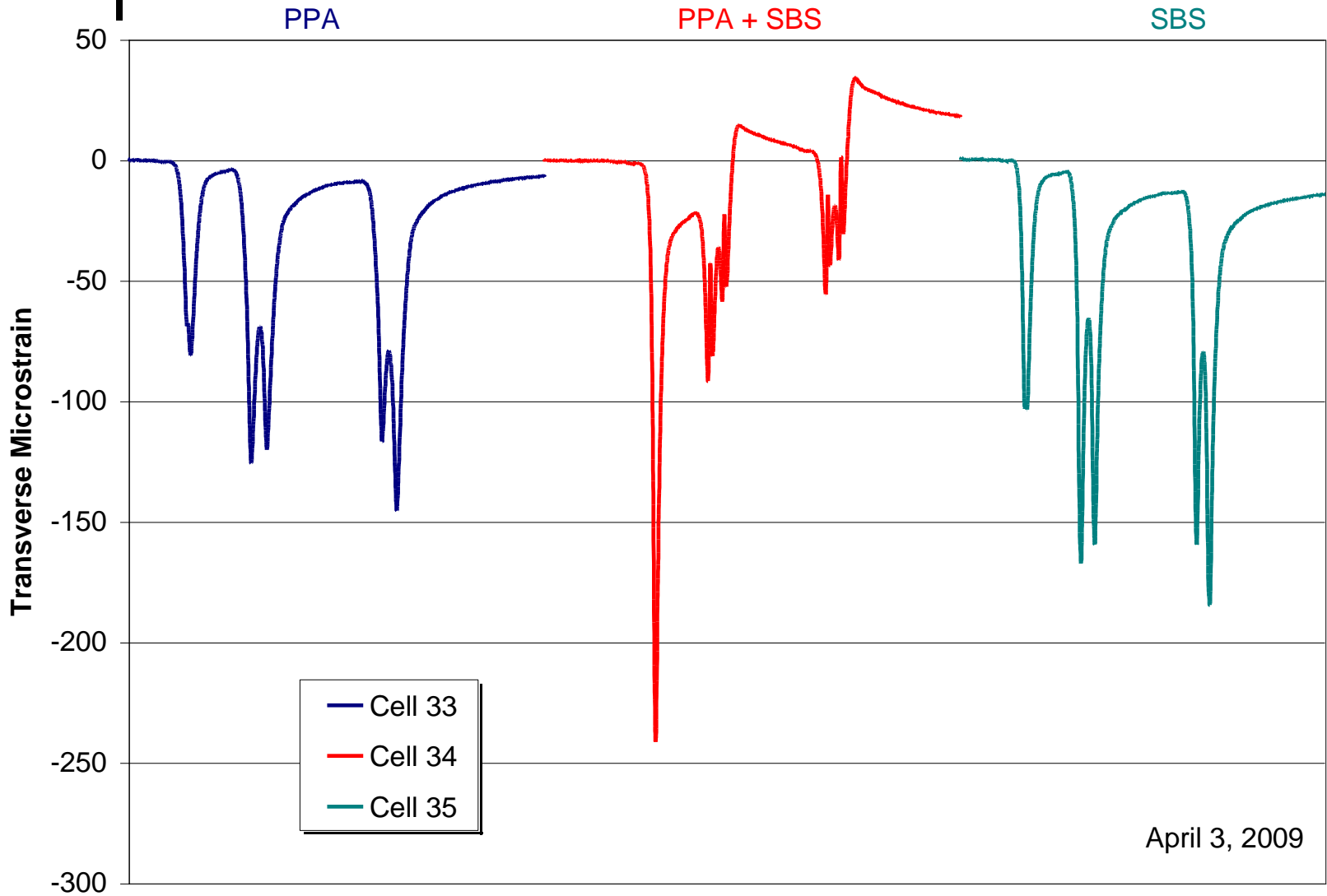
The First Crack – Cell 79



Longitudinal Strain

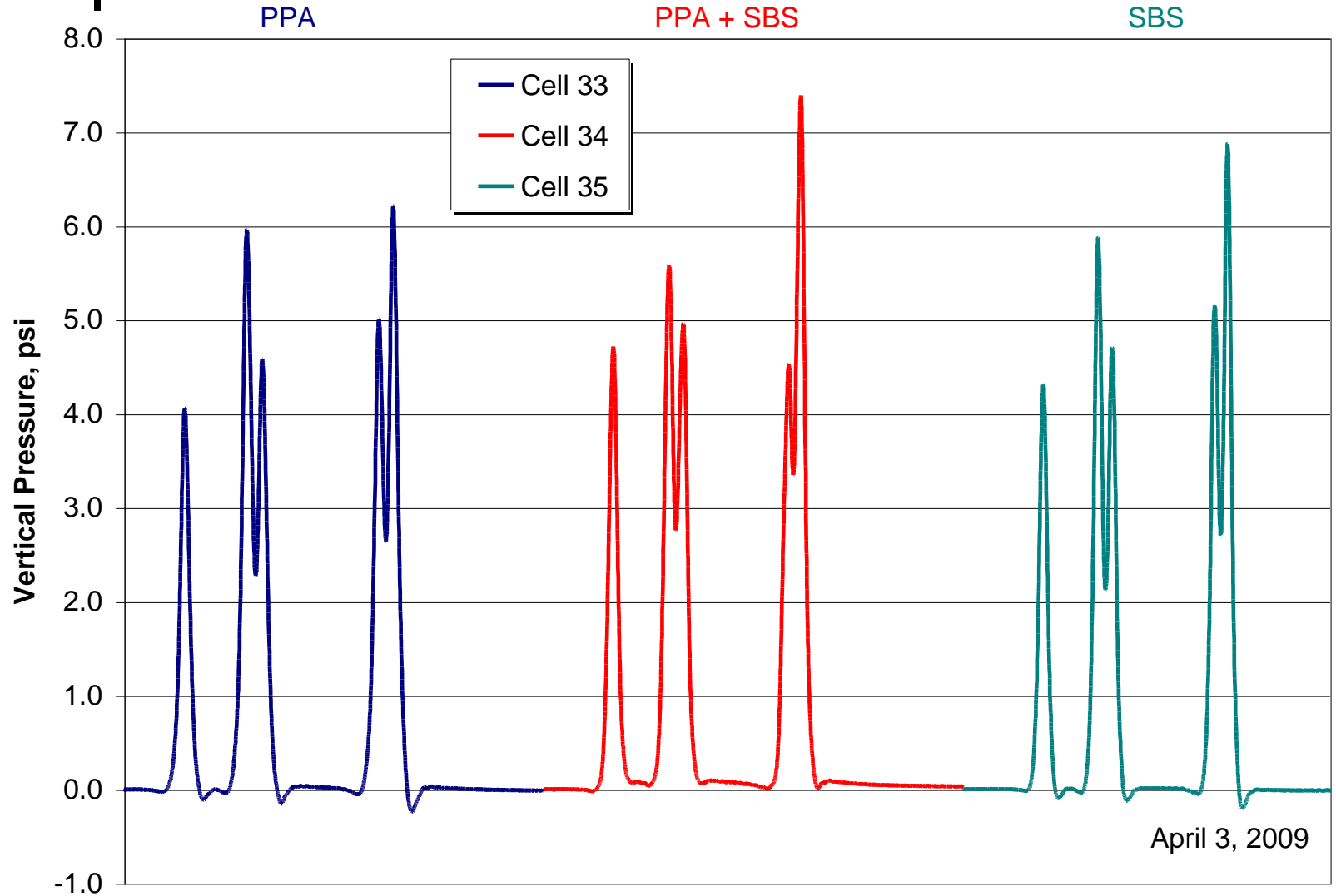


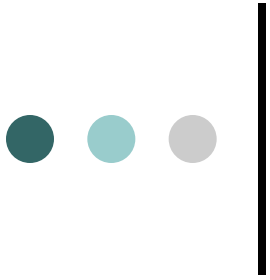
Transverse Strain



April 3, 2009

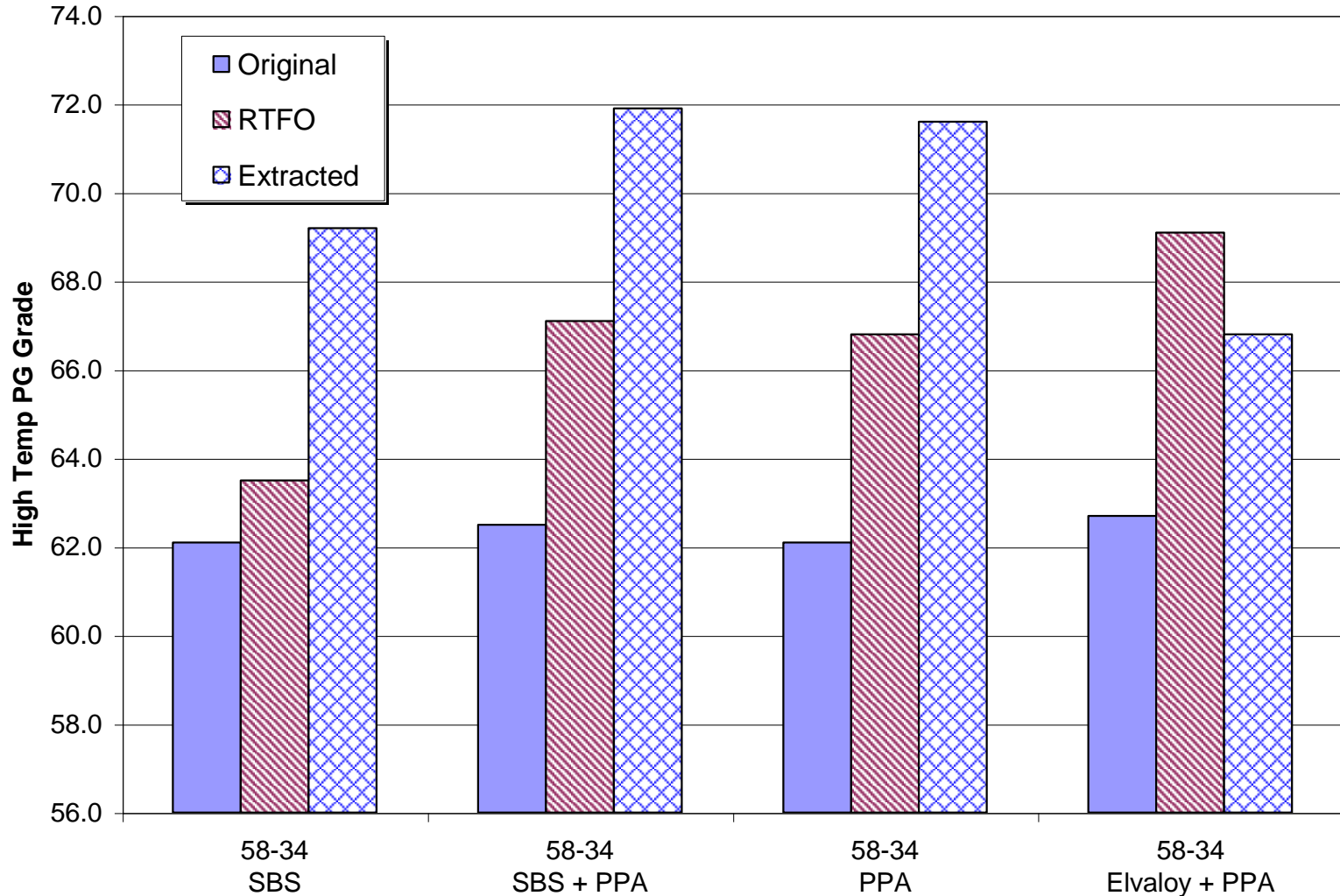
Dynamic Pressure



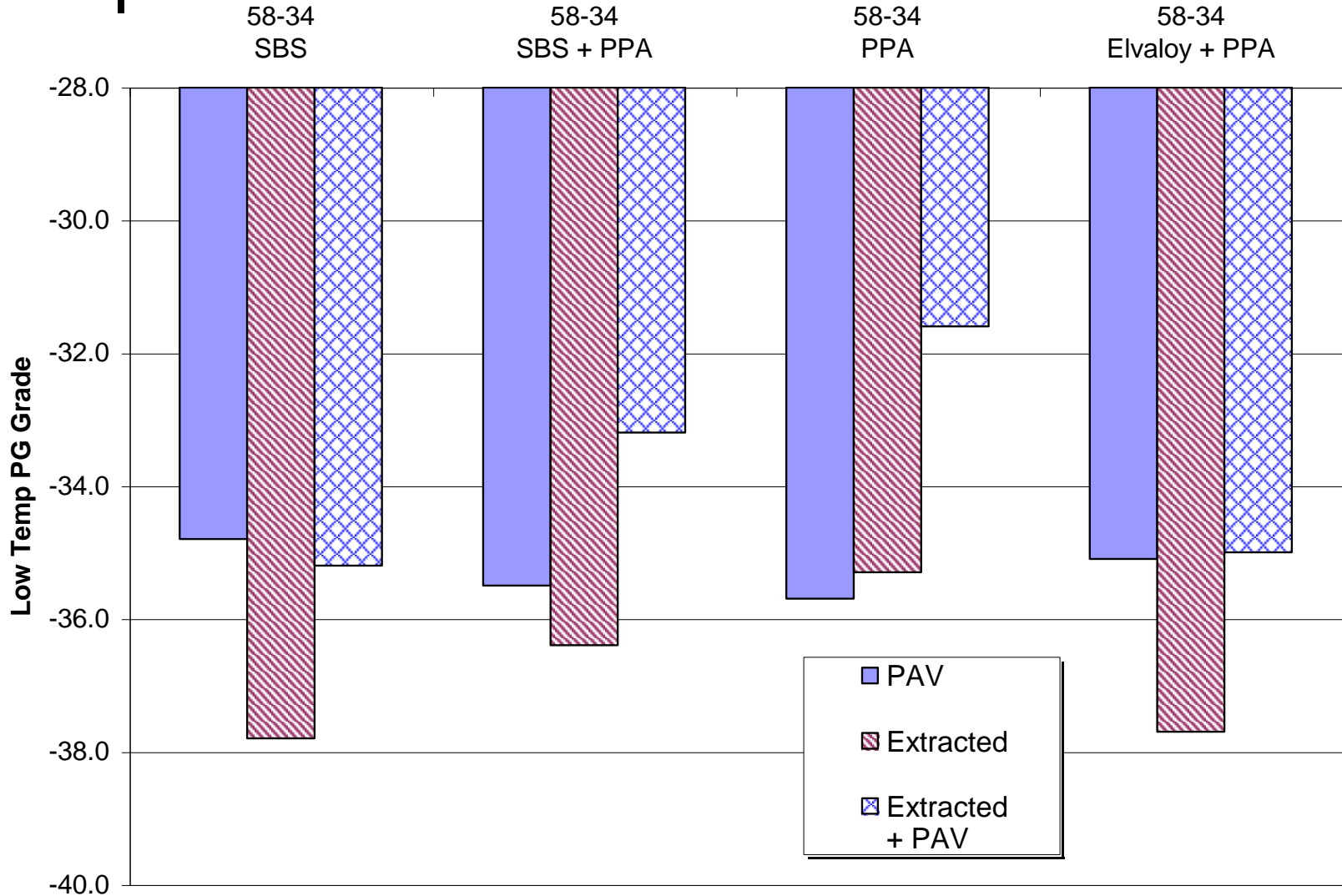


Laboratory Data

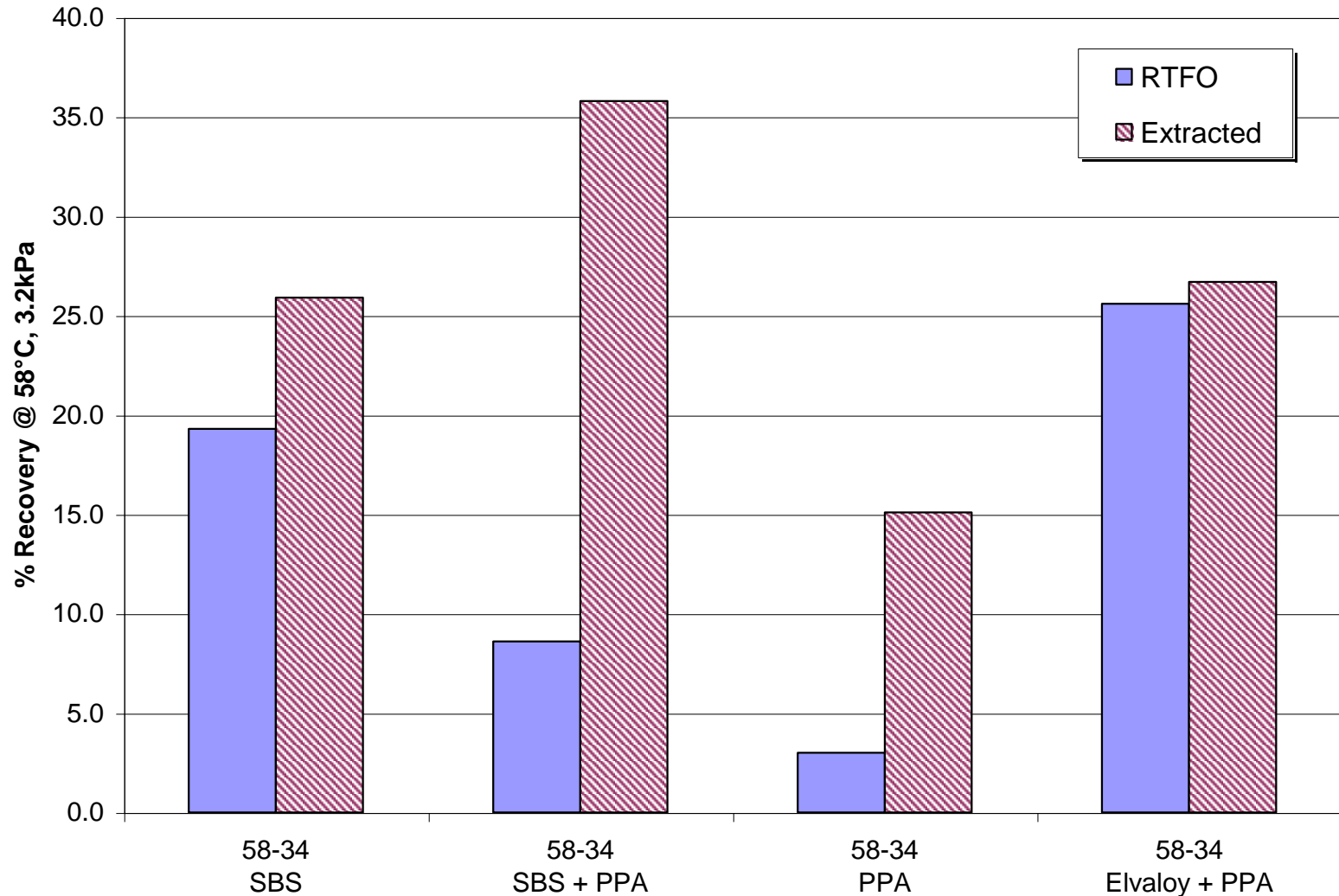
High Temperature PG Grade



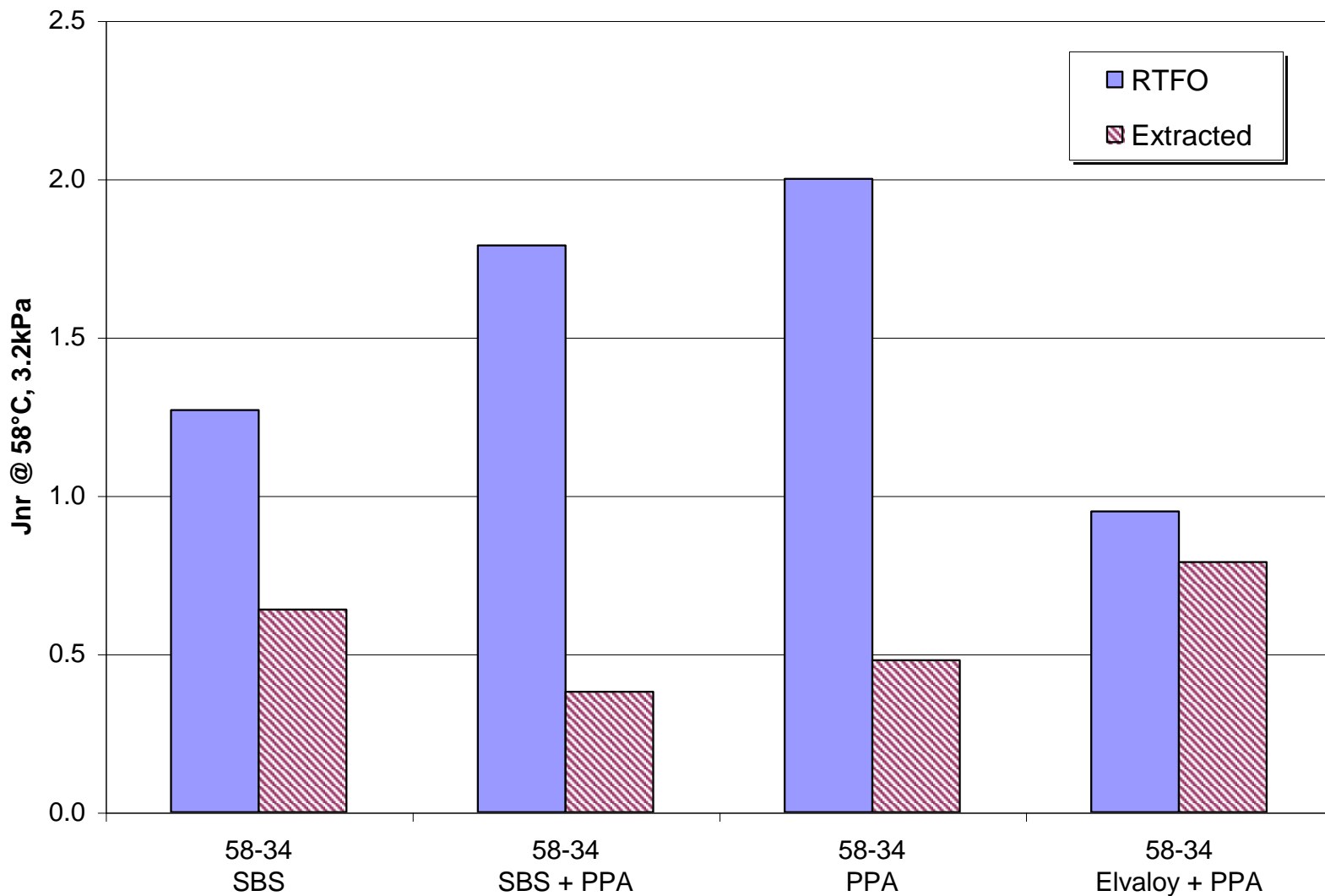
Low Temperature PG Grade



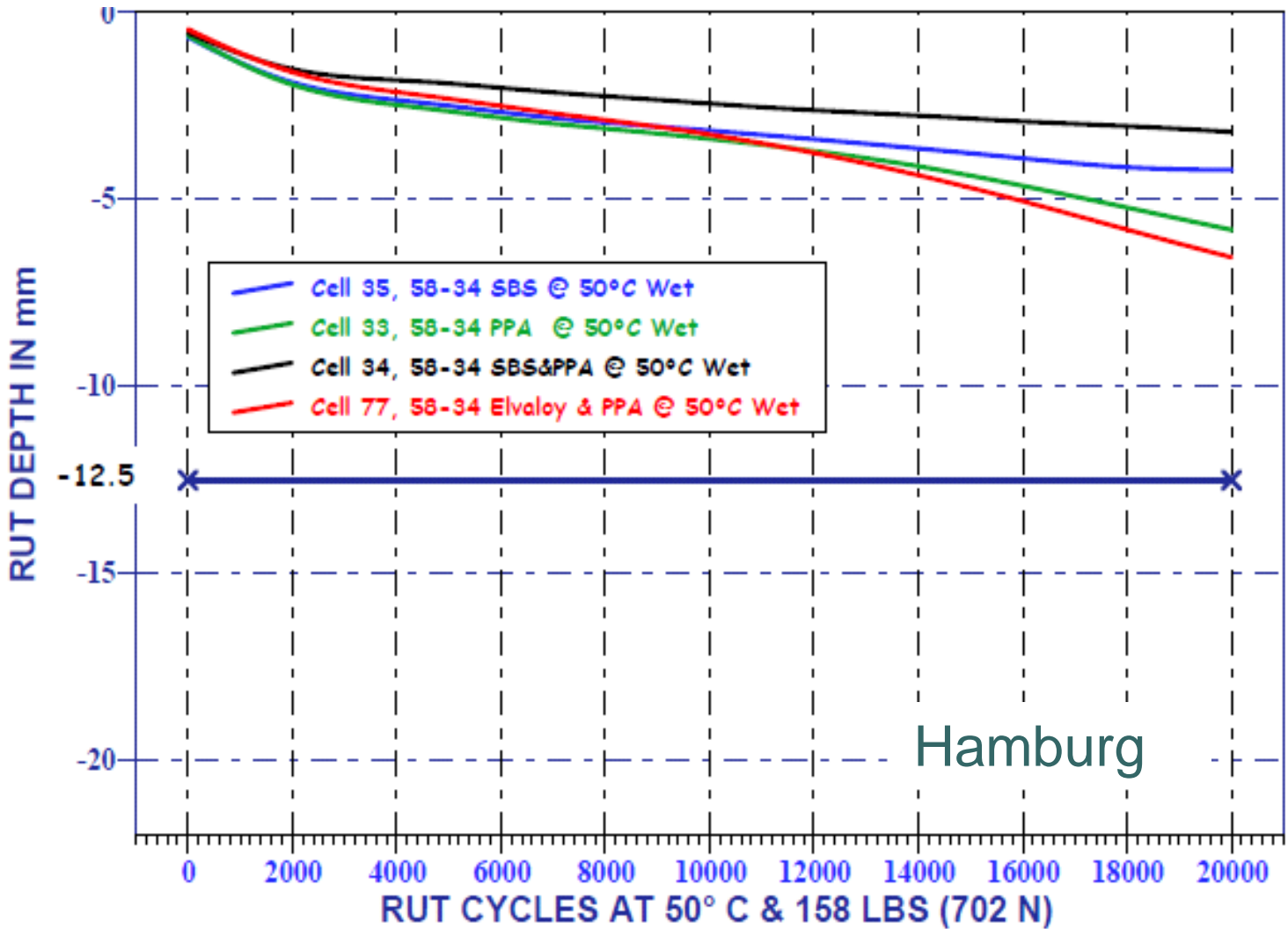
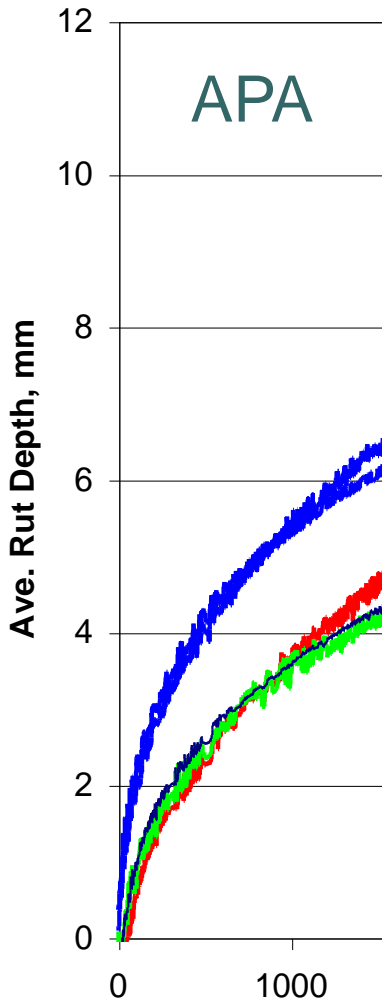
% Recovery @ 58°C, 3.2 kPa



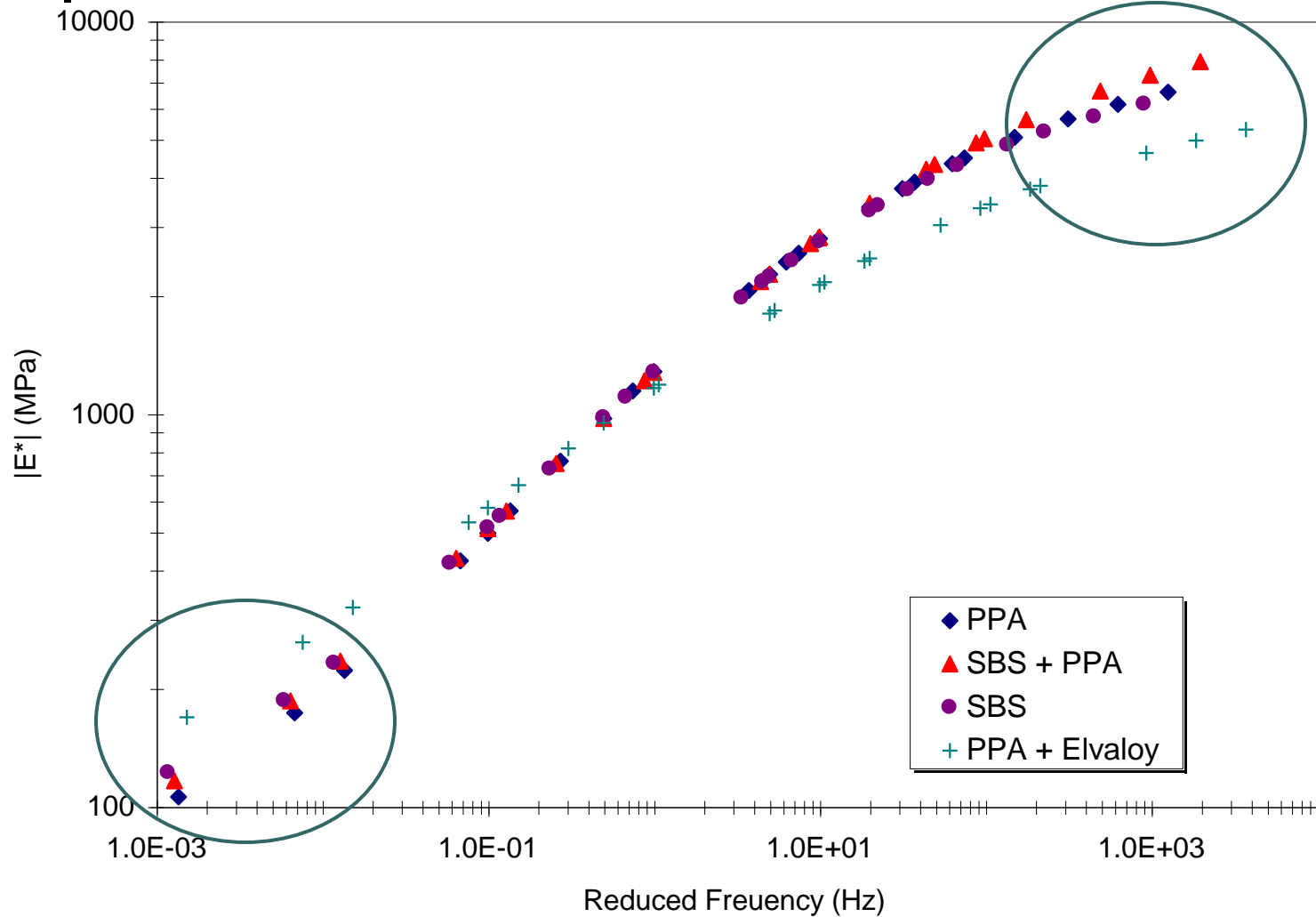
Jnr @ 58°C, 3.2 kPa



Rut Testing



Dynamic Modulus





Summary

- All 4 PPA mixes performing well since 2007
- Field samples showed excellent rutting and stripping performance in lab tests
 - Low Temperature Cracking test results coming soon.
- PPA + Polymer generally performed better than either modifier alone
- Test sections will continue to be monitored for 5 years

Thank You!

