

Iowa's Best Practices for Full Depth Reclamation and Cold In-Place Recycling

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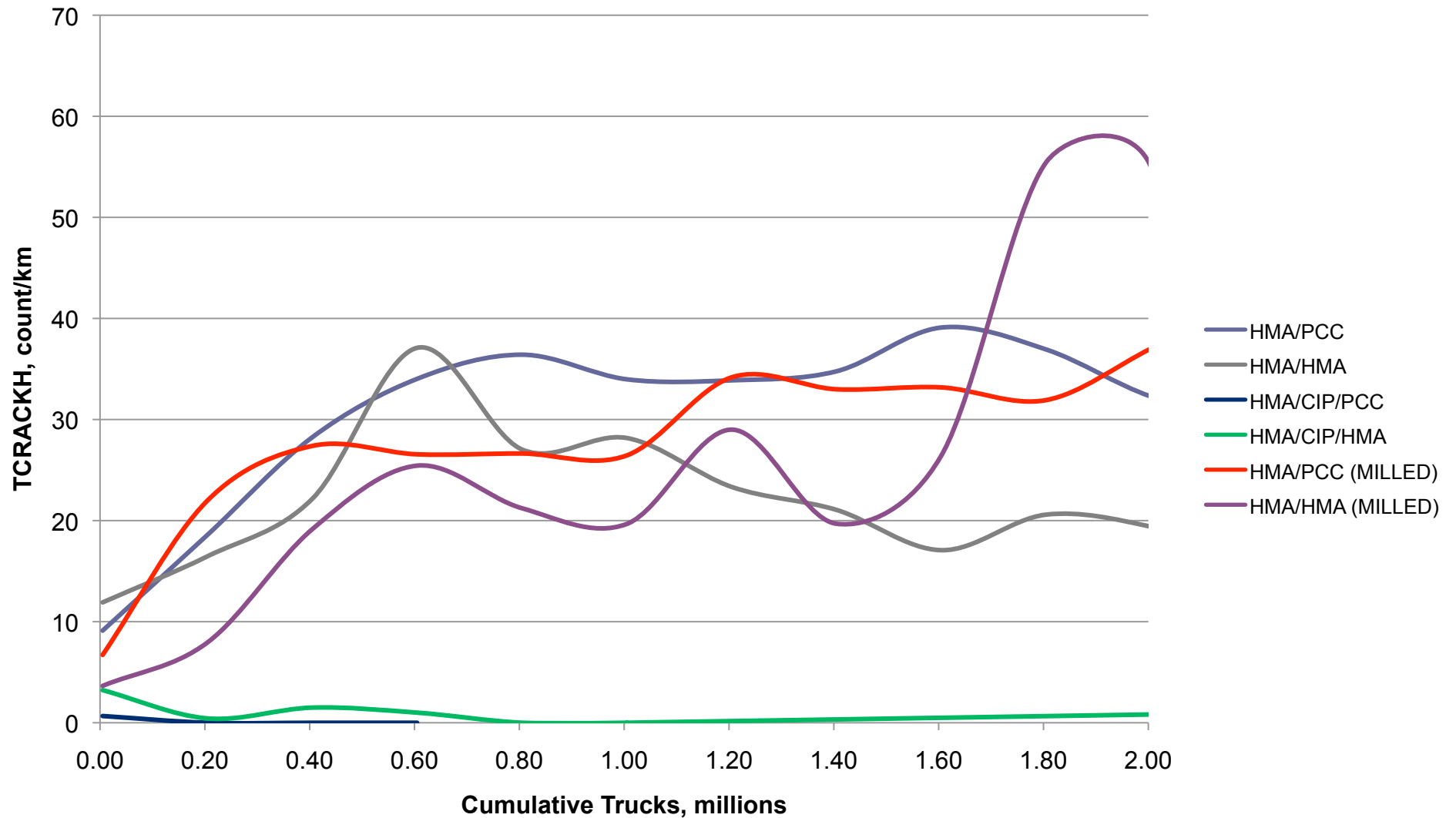


Experience with In-Place Recycling

- Cold-in-place Recycling (foam and emulsion)
 - 5-year Total
 -  53 projects
 -  \$118M
 -  1800 lane-miles
 - Many more local CIR projects
- Full Depth Reclamation (fly ash stabilization)
 - 5-year Total
 -  3 Projects
 -  \$8.6M
 -  100 lane-miles

Iowa Field Performance

**Average High Severity Transverse Cracking
10 Year Span (3-4 inches HMA Surface)**



Why Not More?

- Traffic li
- Only wo
- Risk wh
- Overcor

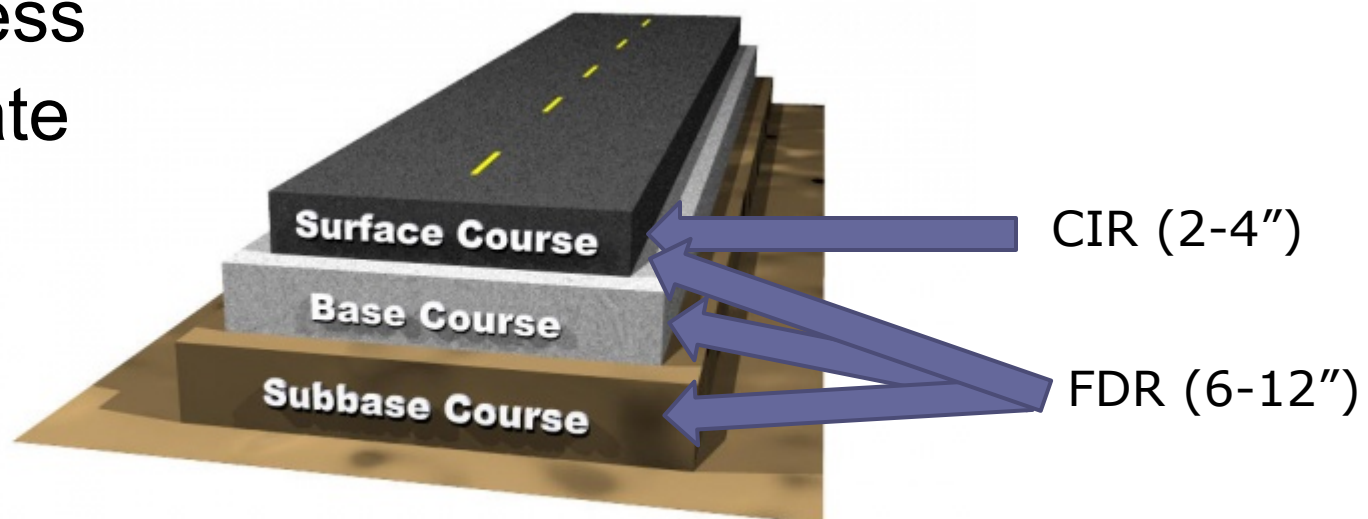


Common Questions

- When CIR?
 - Ideal candidate?
 - Mix Design?
 - Foam or Emulsion?
 - When to overlay?
 - Quality control/Quality assurance?
- When FDR?
 - Ideal candidate?
 - Stabilization?
 - Mix Design?
 - Quality control/Quality assurance?

Project Evaluation

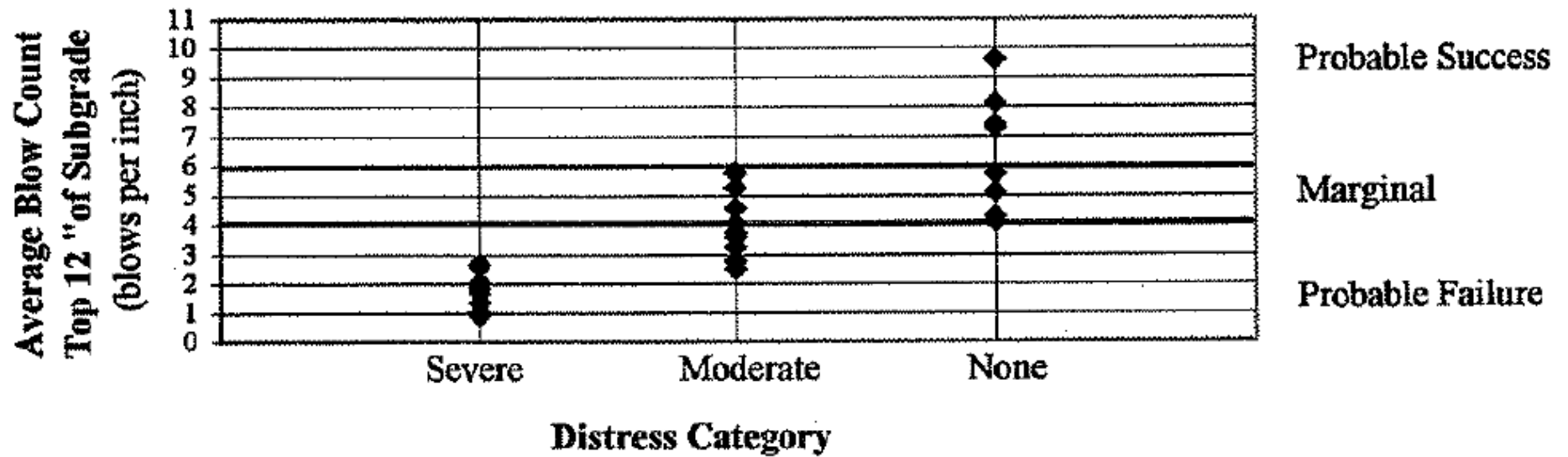
- Traffic
- Structure
- Distress
- Climate



Recycling



Project Evaluation



(Pleasant Creek State Park Data) ③

CIR – Mix Design

- Need RAP samples
 - REPRESENTATIVE = DIFFICULT
 - Milling 50' at 3 locations (preferred)
 - Coring or air hammer patching

CIR – Foam Mix Design

1. Determine Optimum Foaming

280-320

1.5% -

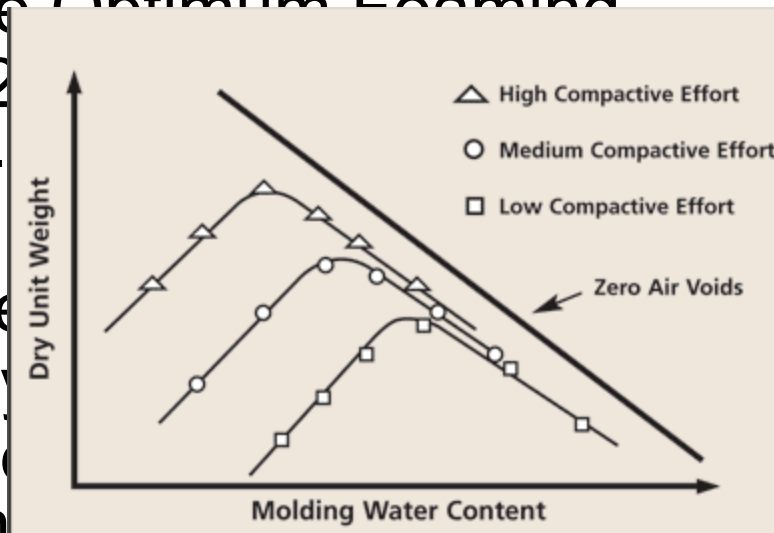
Target

2. Determine

Density

Exper

foaming



PG 46-34)

ratio ~10

sted for

3. Compact specimens @ 4 foamed AC contents

1.5, 2.0, 2.5, 3.0%

N=45 gyrations

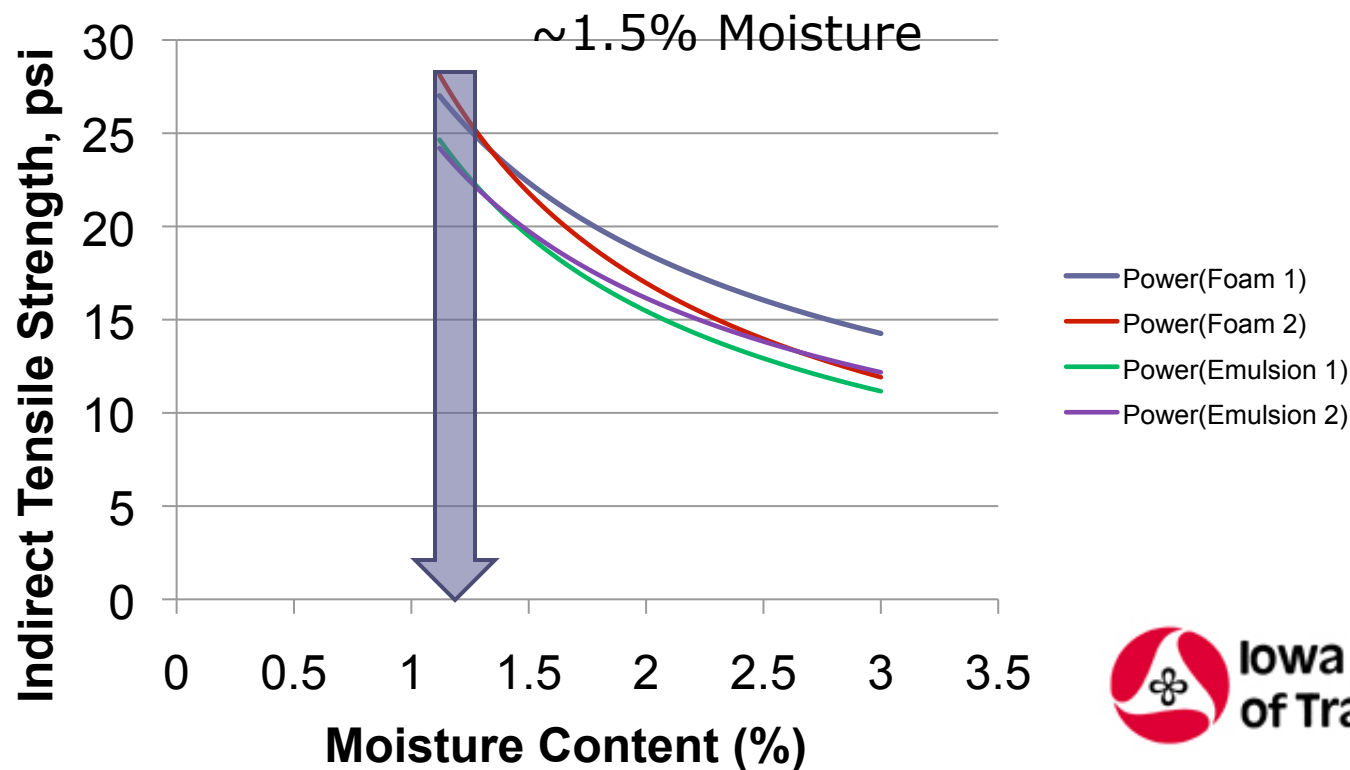
4. Optimize AC foam content from IDT results



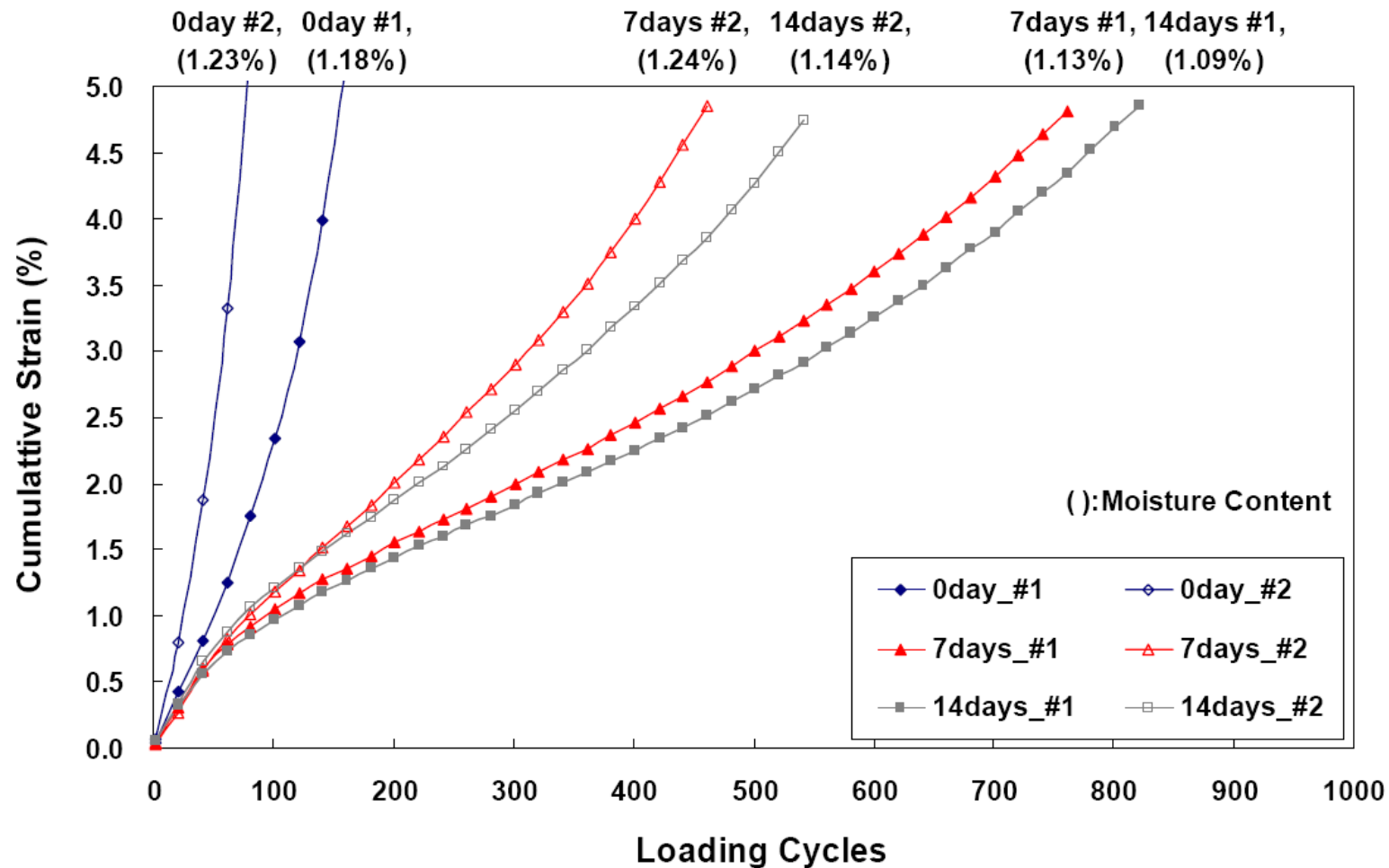
Foam OR Emulsion?

- Does it matter????
-Sometimes....
- Stabilizing agent will impact curing > OVERLAY
- The magnitude of impact is material dependent

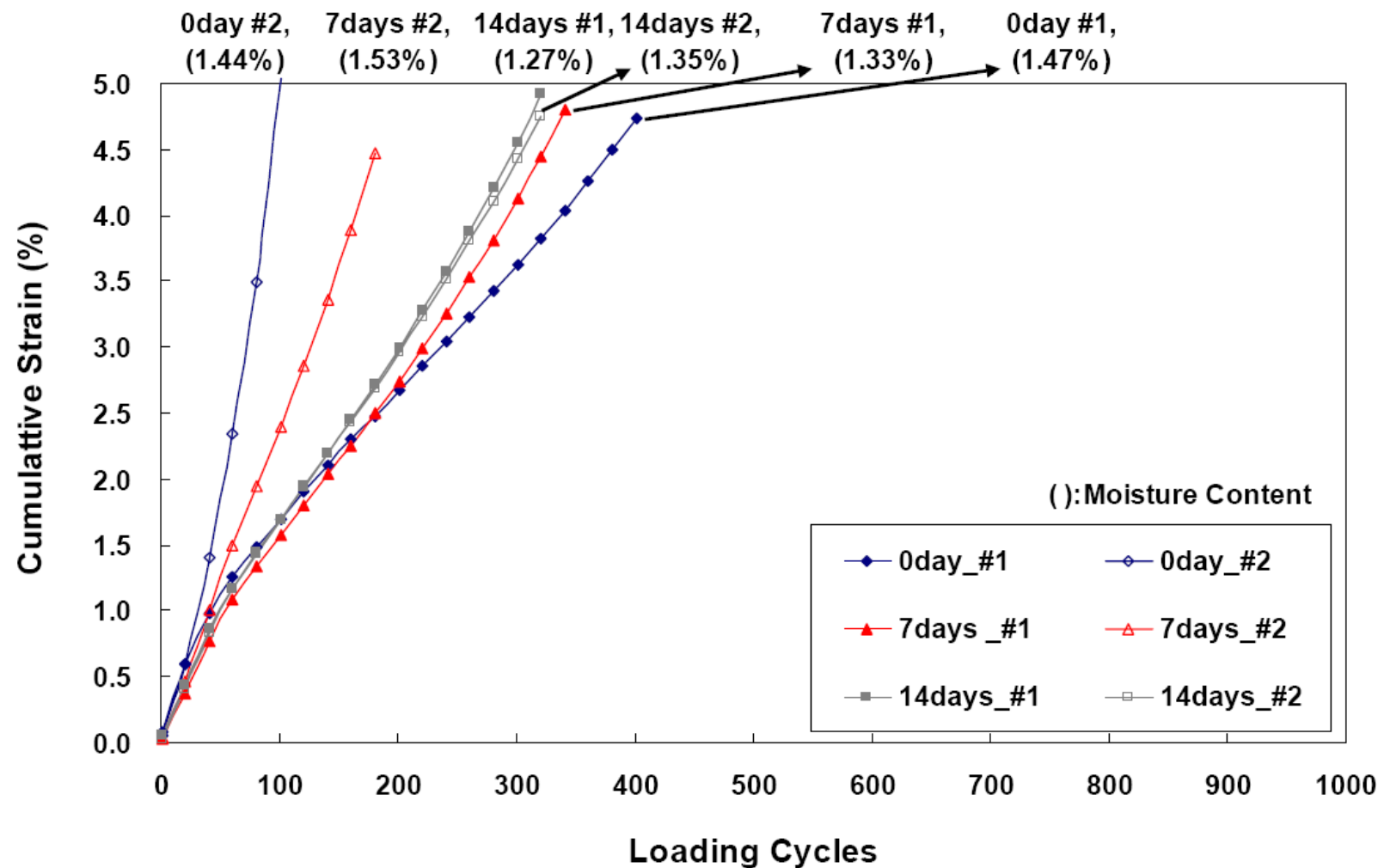
Curing – Indirect Tensile Strength



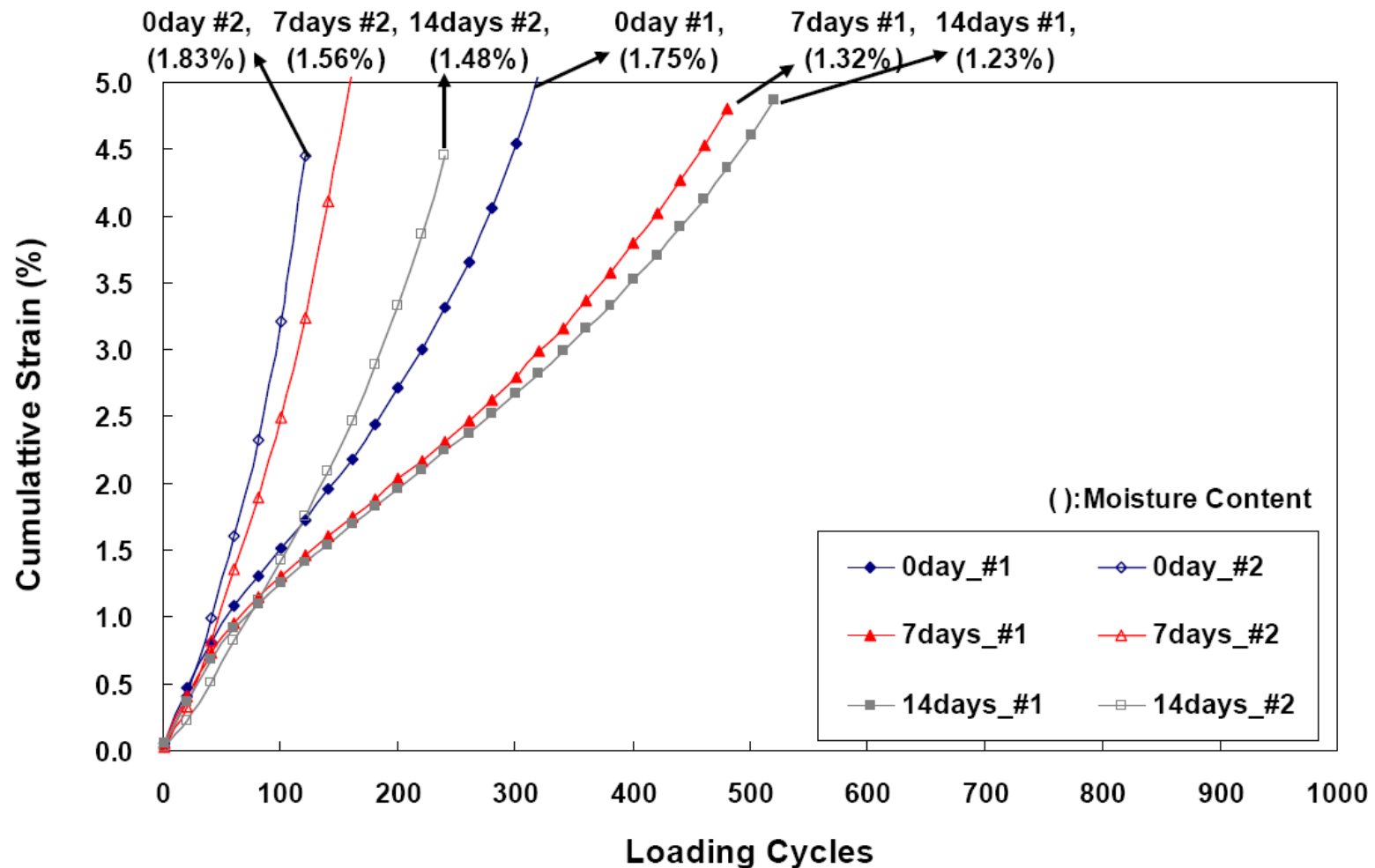
Curing – Flow Number (Foam #1)



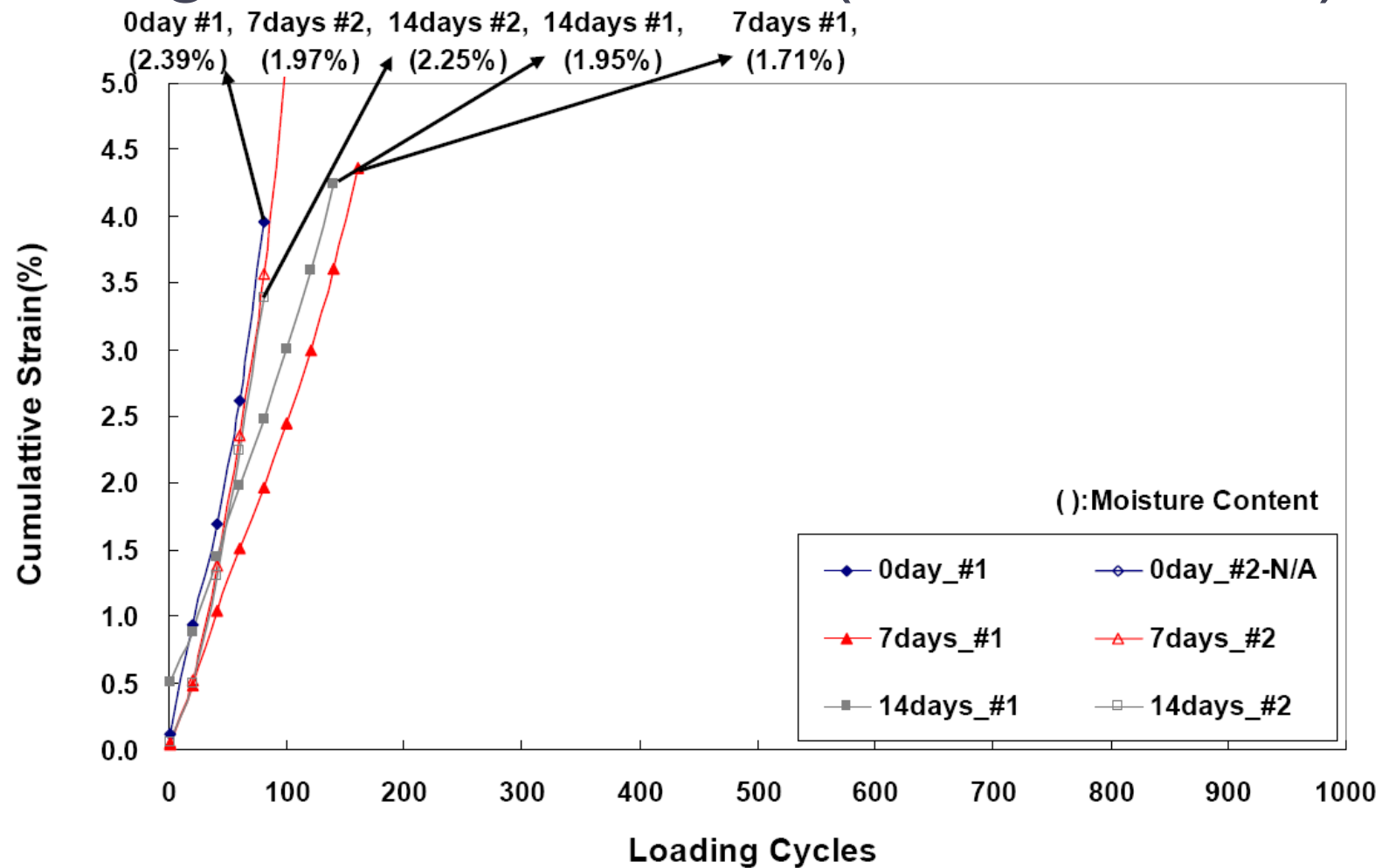
Curing – Flow Number (Emulsion #1)



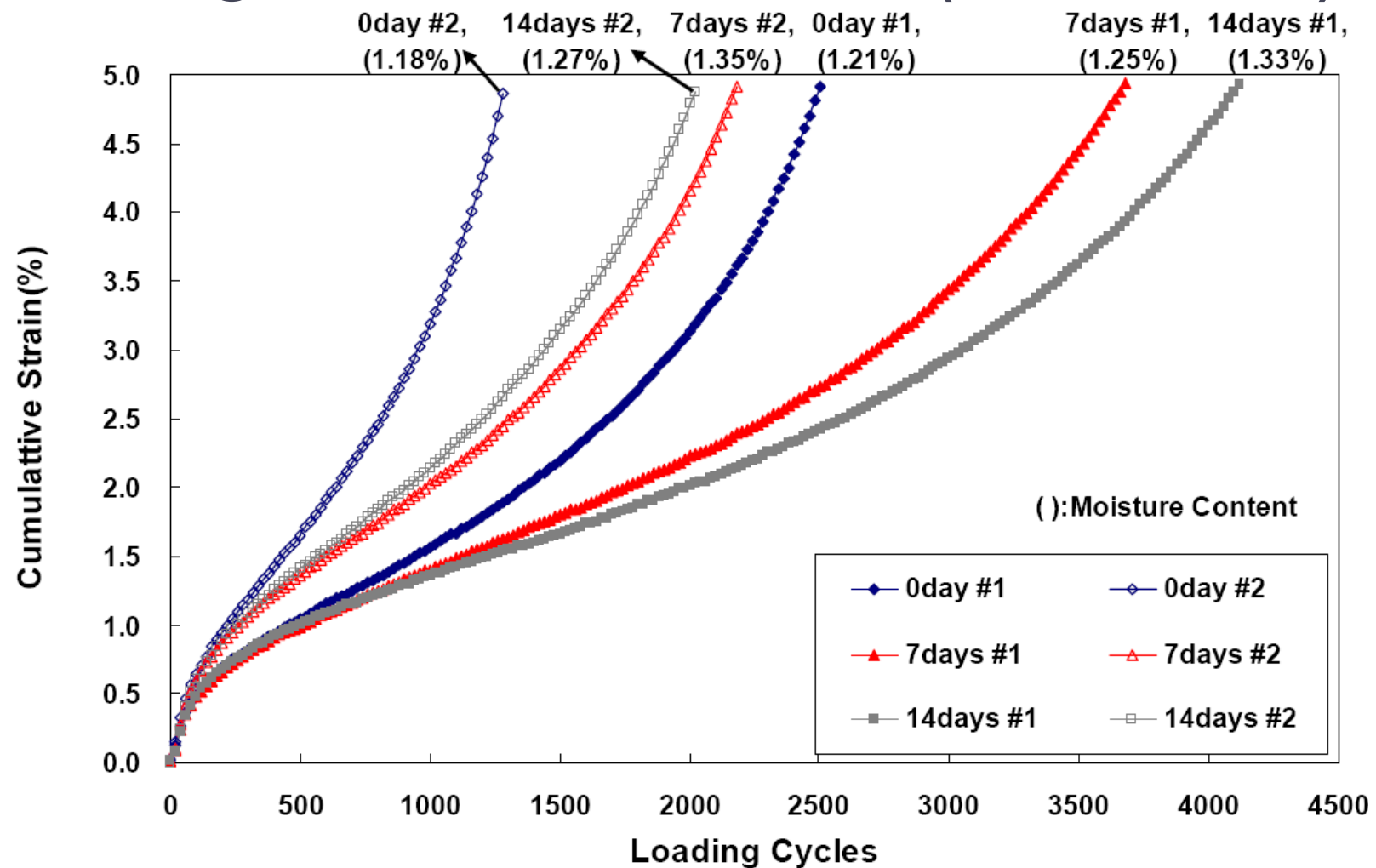
Curing – Flow Number (Foam #2)



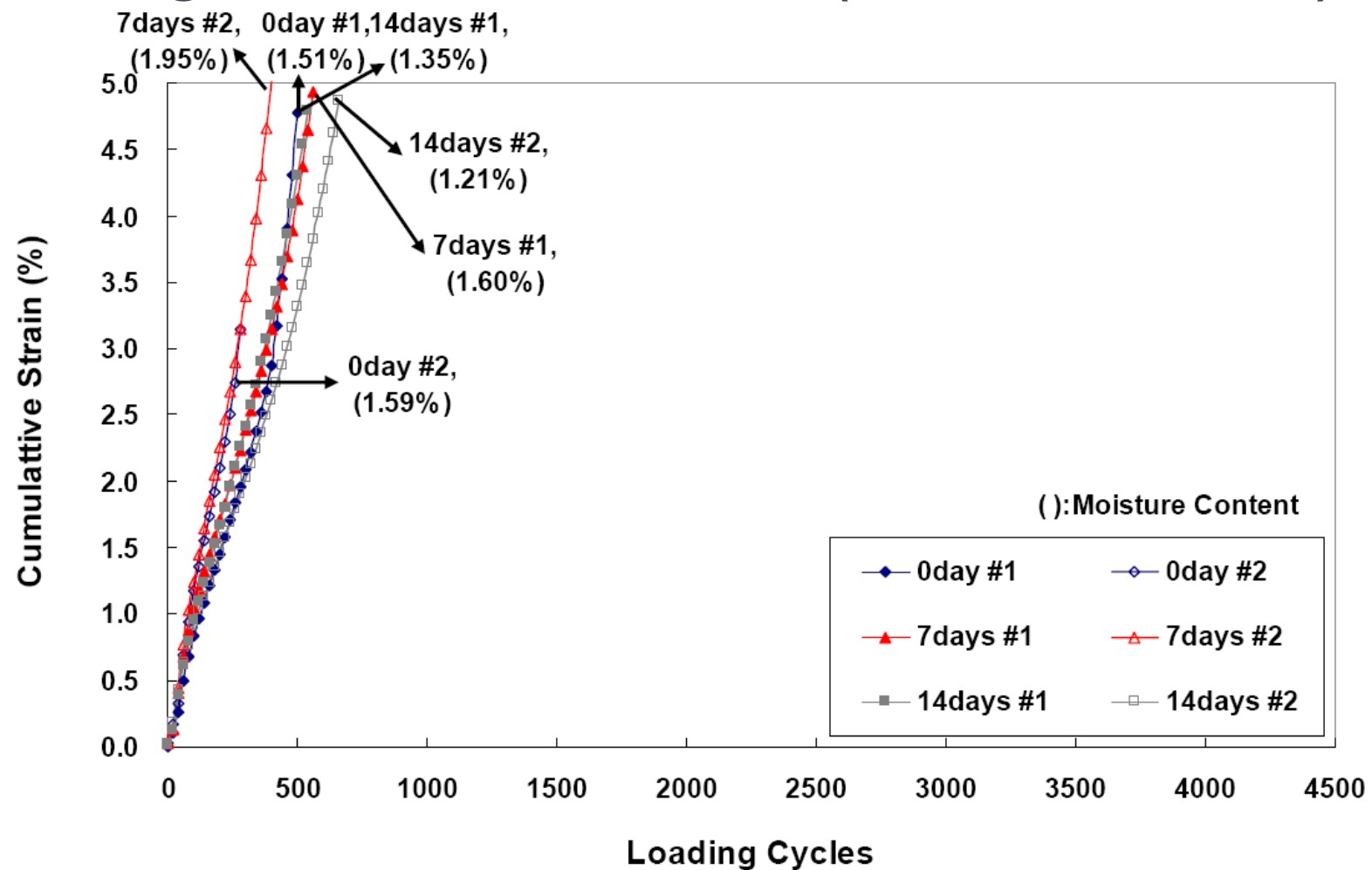
Curing – Flow Number (Emulsion #2)



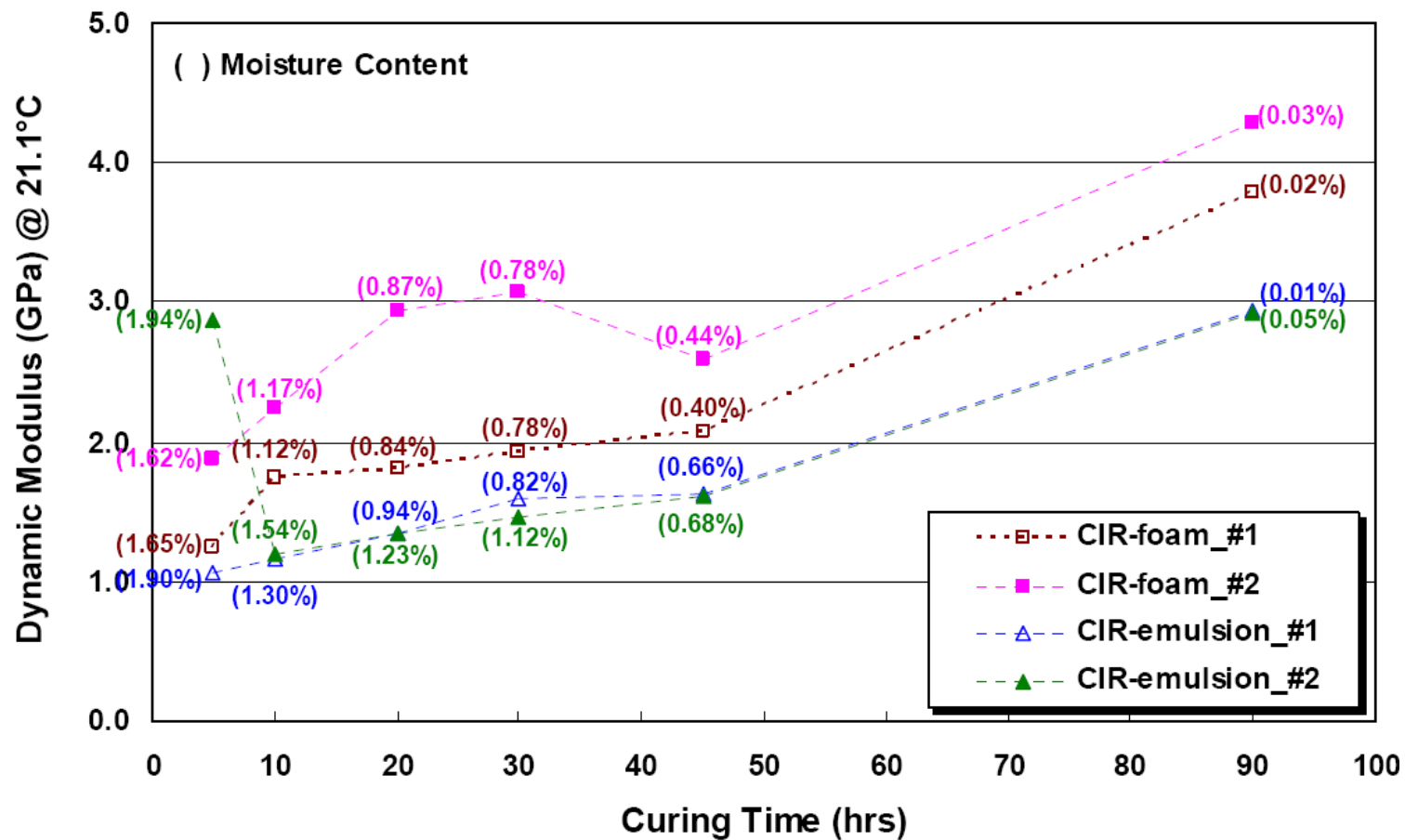
Curing – Flow Number (Foam #3)



Curing – Flow Number (Emulsion #3)



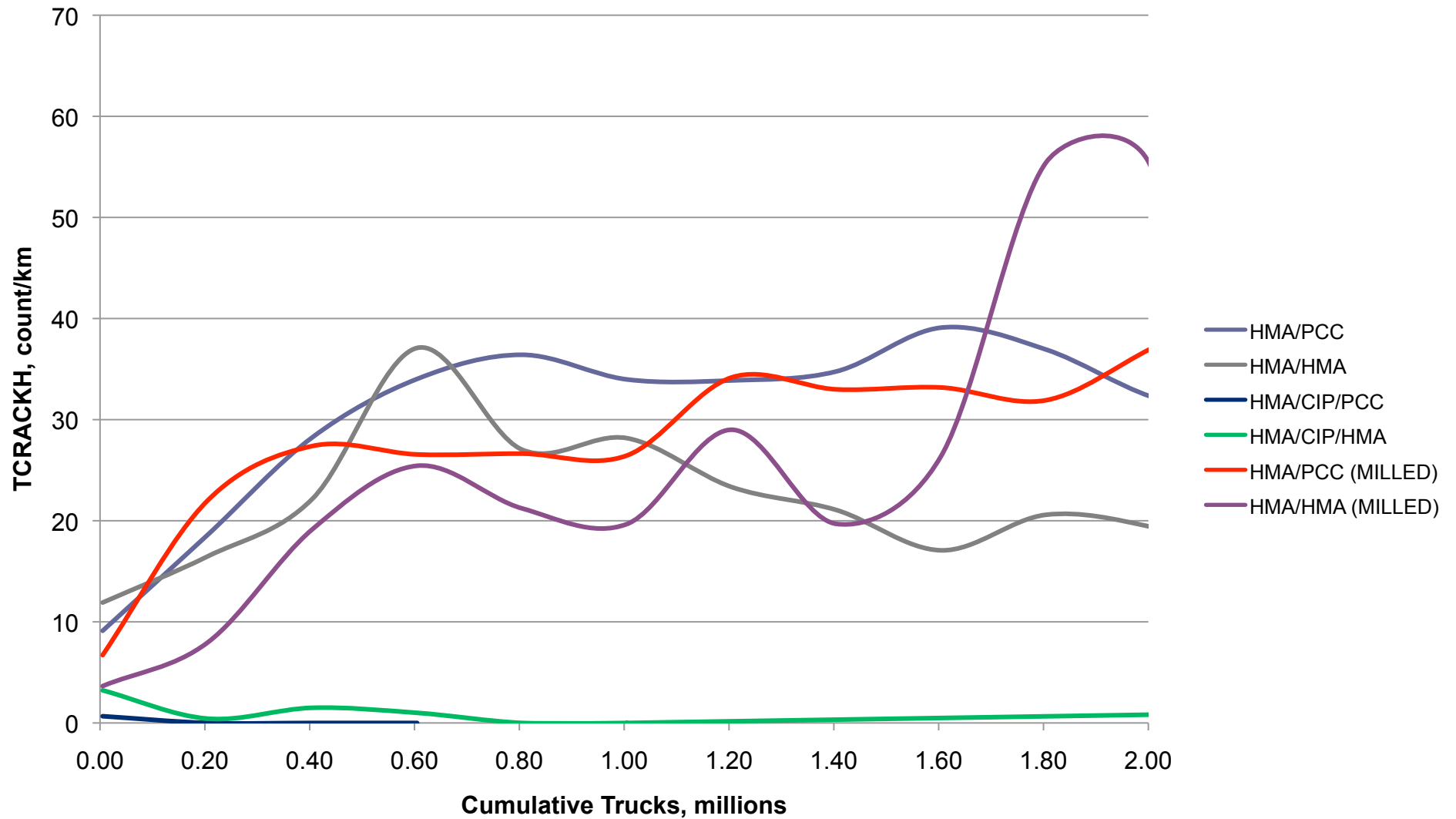
Curing – Dynamic Modulus



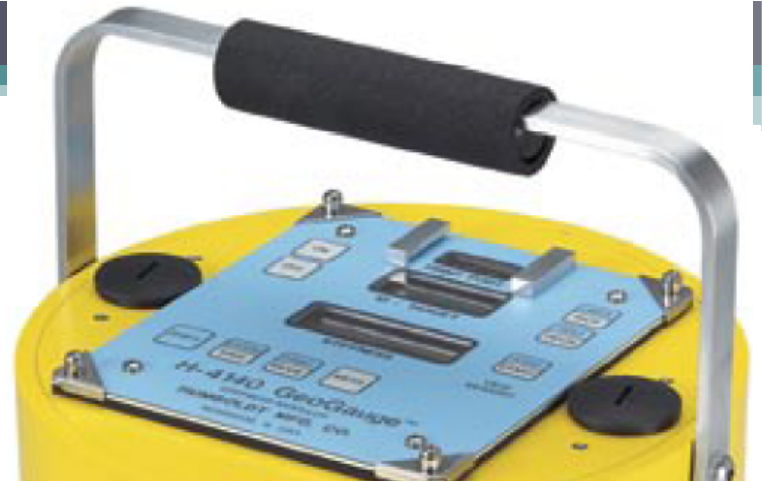
Foam or Emulsion?

- 12-month price history (2/2010 – 2/2011)
- Foam
 - \$530/ton
 - \$0.58 - \$0.70 per yd²-in
- Emulsion
 - \$1.88/gal
 - \$0.49 - \$0.66 per yd²-in
- CIR
 - \$1.30 - \$2.10/yd²

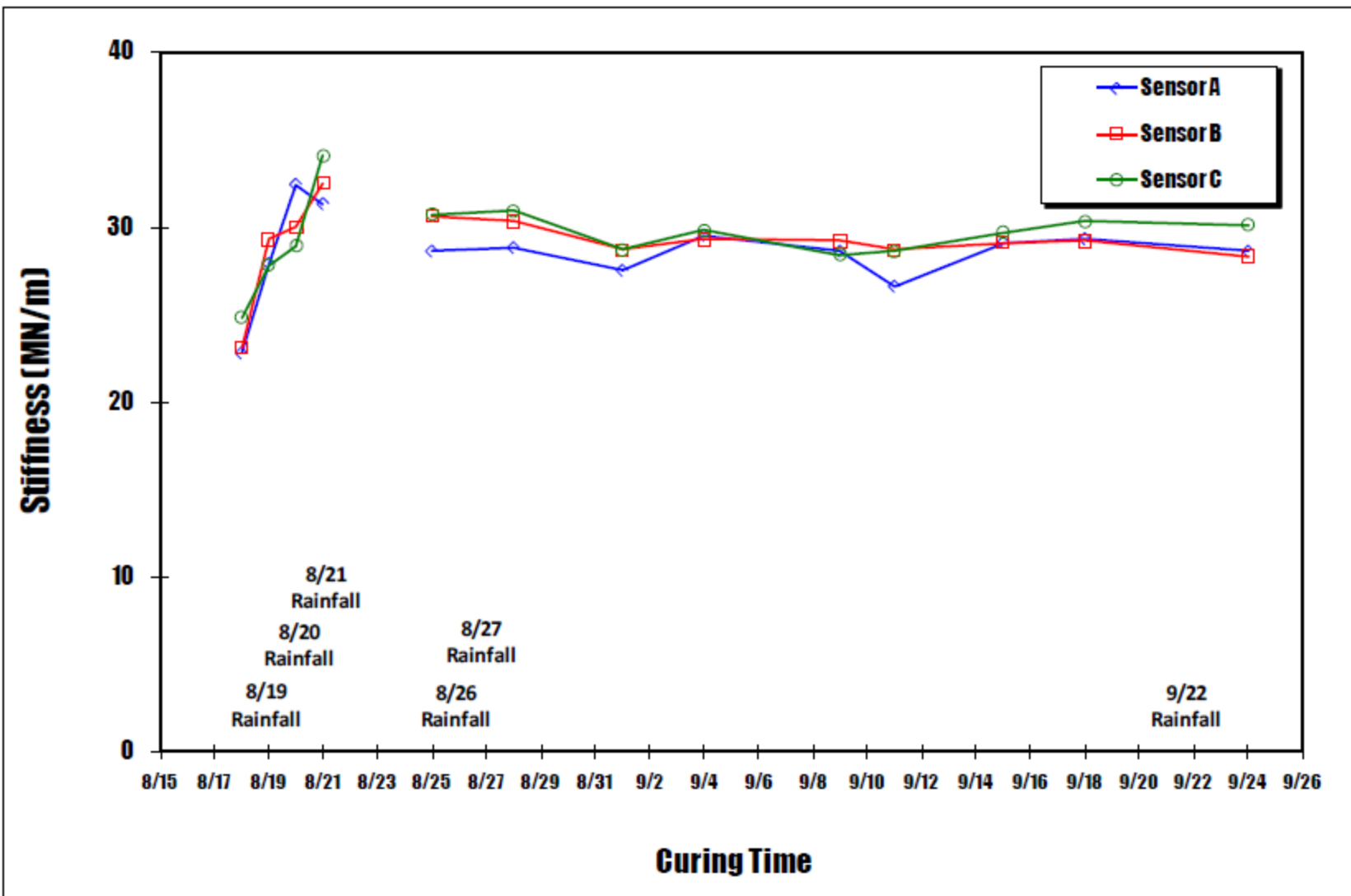
Average High Severity Transverse Cracking 10 Year Span (3-4 inches HMA Surface)



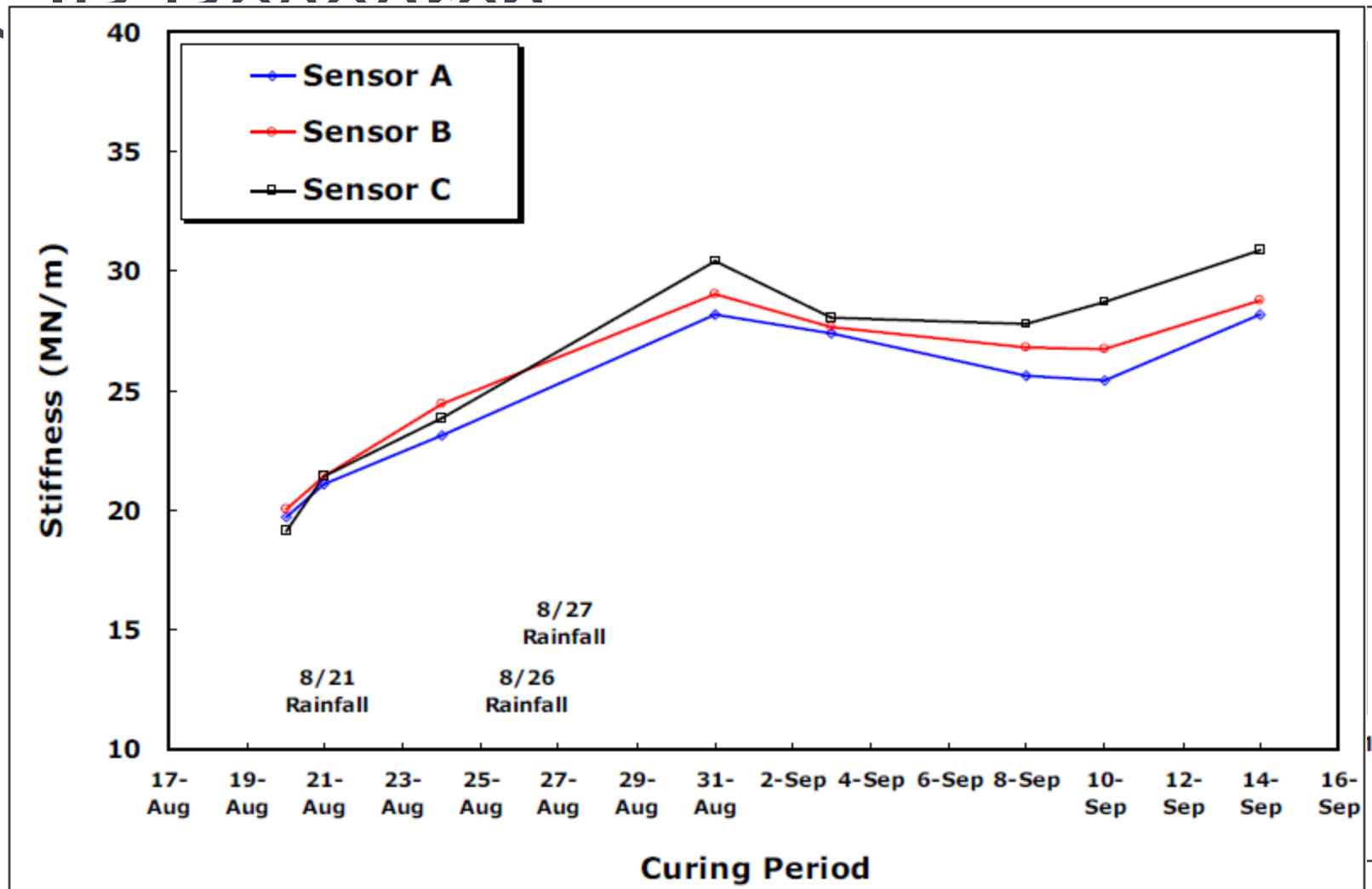
Cold In-Place Recycli

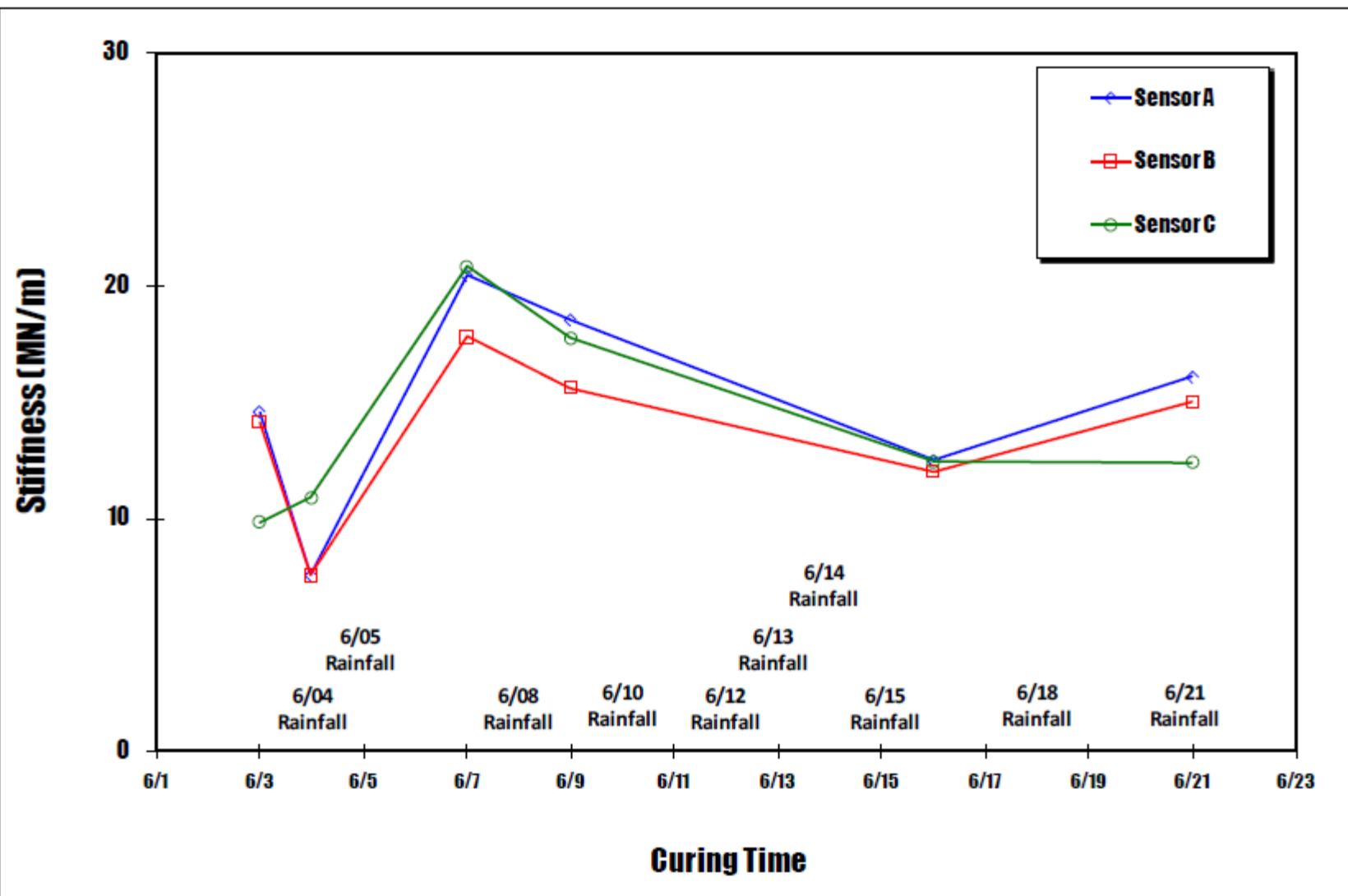


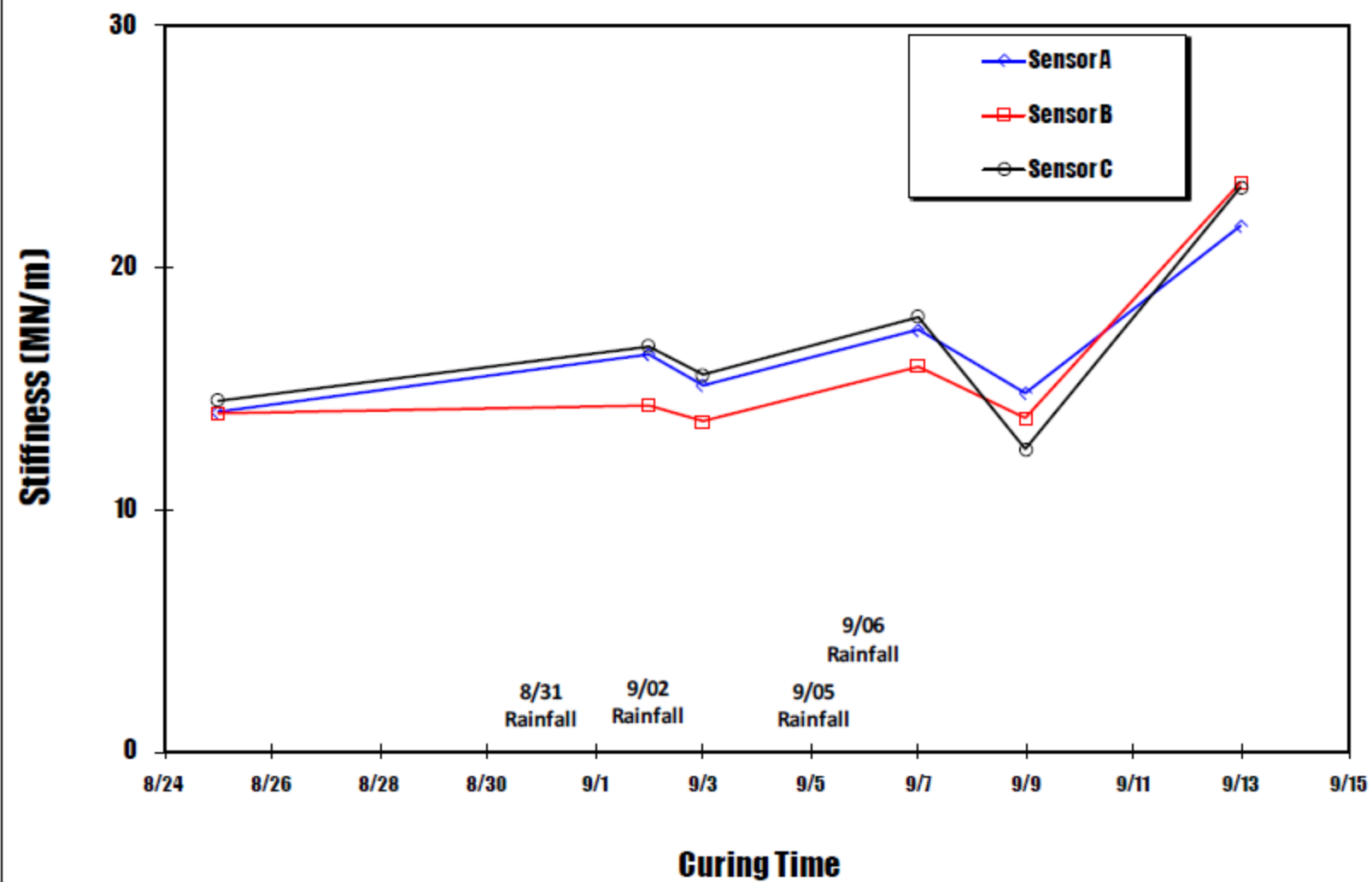
- 22 lbs
- Applies sinusoidal loading and measures deflection
- 3 to 70 MN/m



CID Research







Iowa DOT Specifications

- Mix Design
 - Foam: 0.0011 tons/yd²-in
 - Emulsion: 0.30 gallons/yd²-in
- CIR allowed May 1 – October 1
 - 60F and rising
- Quality Assurance (Nuclear Gauge)
 - 94% density (primary)
 - 92% density (other)
- Overlay
 - <2% moisture (or 0.3% of residual moisture)
 - Then 14 calendar days to complete overlay

Hwy 78 Keokuk County (2000)



Hwy 78 Keokuk County (5 years)



Hwy 78 Keokuk County (7 years)



Hwy 78 Keokuk County (9 years)



Webster County 175

- 2009 Construction
- 9" FDR + 3" HMA (2011 = NO DISTRESS)

Test	1	2	3	4	5	6	7	8	9	10	11	12
DCP, blows/ in	3.3	2.7	0.5	2.0	2.0	5.5	4.0	0.0	2.9	2.7	3.0	2.7
Thickness, in	8.0	7.5	10.0	7.5	9.0	6.8	9.5	10.3	8.3	8.5	8.0	7.8

Hwy 175 Webster County (Pre-CIR)



Hwy 175 Webster County (CIR)



Hwy 175 Webster County (CIR 2 years)



Hwy 175 Webster County (Pre-FDD)



Hwy 175 Webster County (FDR)



Hwy 175 Webster County (FDR 2 years)



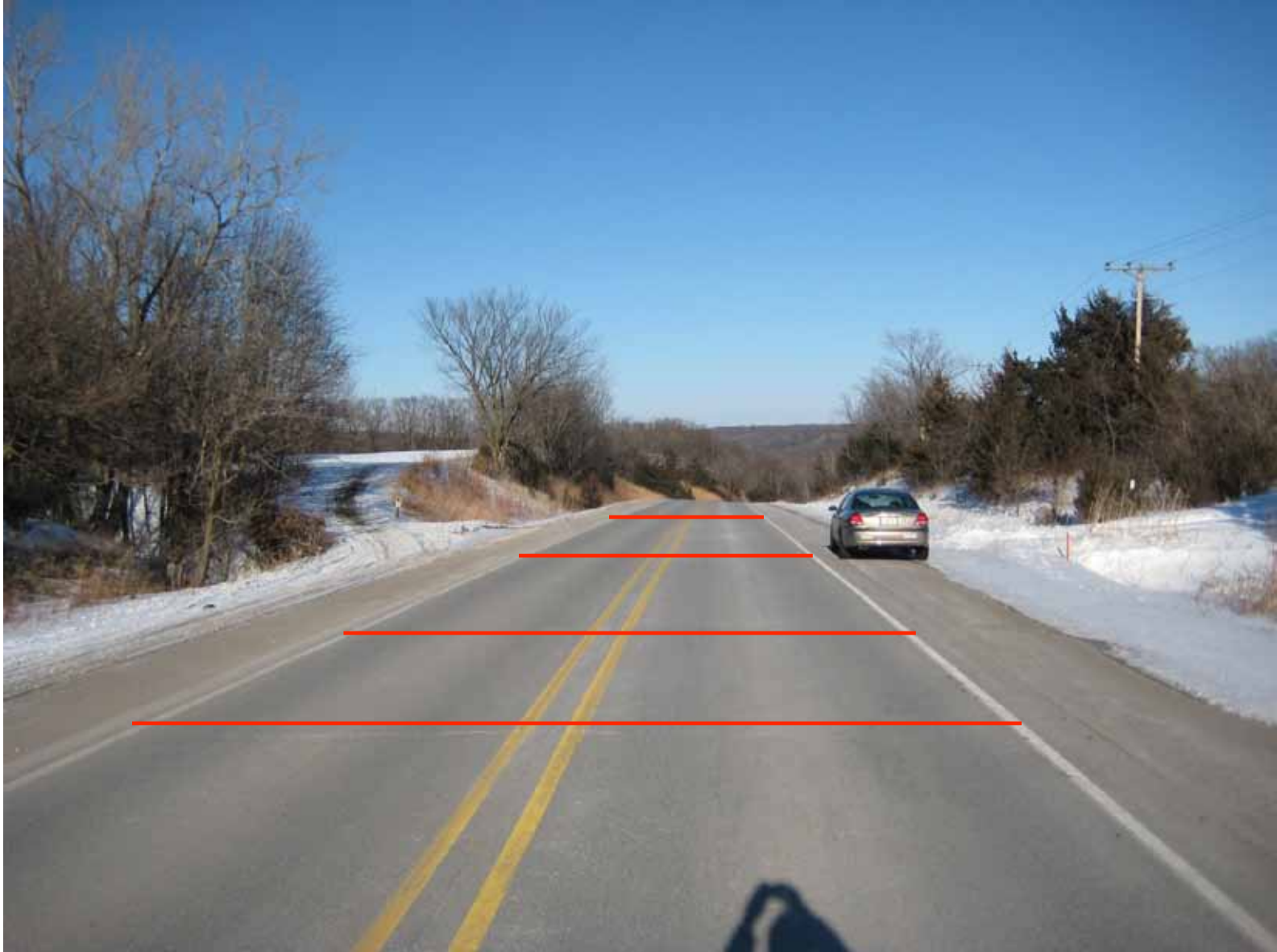
Hwy 175 Webster County (Pre-Mill)



Hwy 175 Webster County (Milled)



Hwy 175 Webster County (2 years)



Hwy 175 Webster County (Overlay)





Keys to Successful Future Projects

- Right time + Right place + Right project
- Don't blame the technology!



Thank you