Melamine Formaldehyde Adhesives for Use in Engineered Wood Products

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Background

Sample Preparation & Testing

Test Results

Conclusions

Background

- Melamine Formaldehyde (MF) Resins have been used as adhesives for more than 50 years
  - Structural Bond Durability
    - Selbo, M.L. 1965. Performance of Melamine Resin Adhesives In Various Exposures. Forest Products Journal 15(12): 475-483.
  - Search for Long Term Durability Tests
    - Caster, D. 1980. Correlation Between Exterior Exposure and Automatic Boil Test Results. Wood Adhesives-Research, Application, and Needs Symposium, University of Wisconsin, September 23-25, 179-188.
- Finger Joints >10 years
- Limited Data on Lam Beam Durability

Sample Preparation and Testing

- Samples prepared according to ASTM D 905-03
- Weyerhaeuser Company's Materials Testing Services
- Tested per ASTM D 3434-00
  - 40 days & $2000/ sample

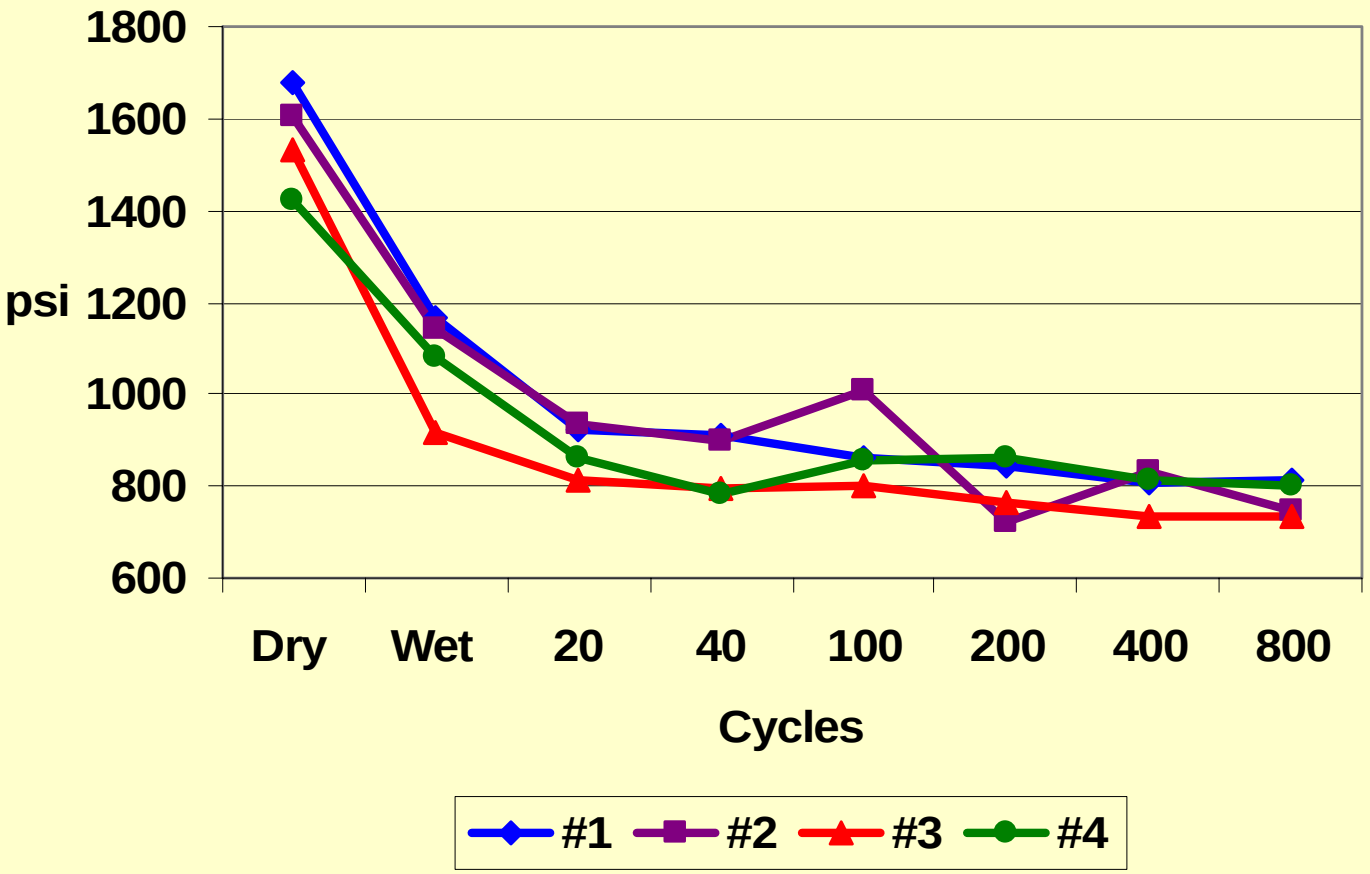
D-3434 Test Procedure

- Dry Controls - Ten specimens were tested for dry shear strength.
- Wet Controls – Ten specimens were submerged in 23º C water for 3 days then tested while wet.

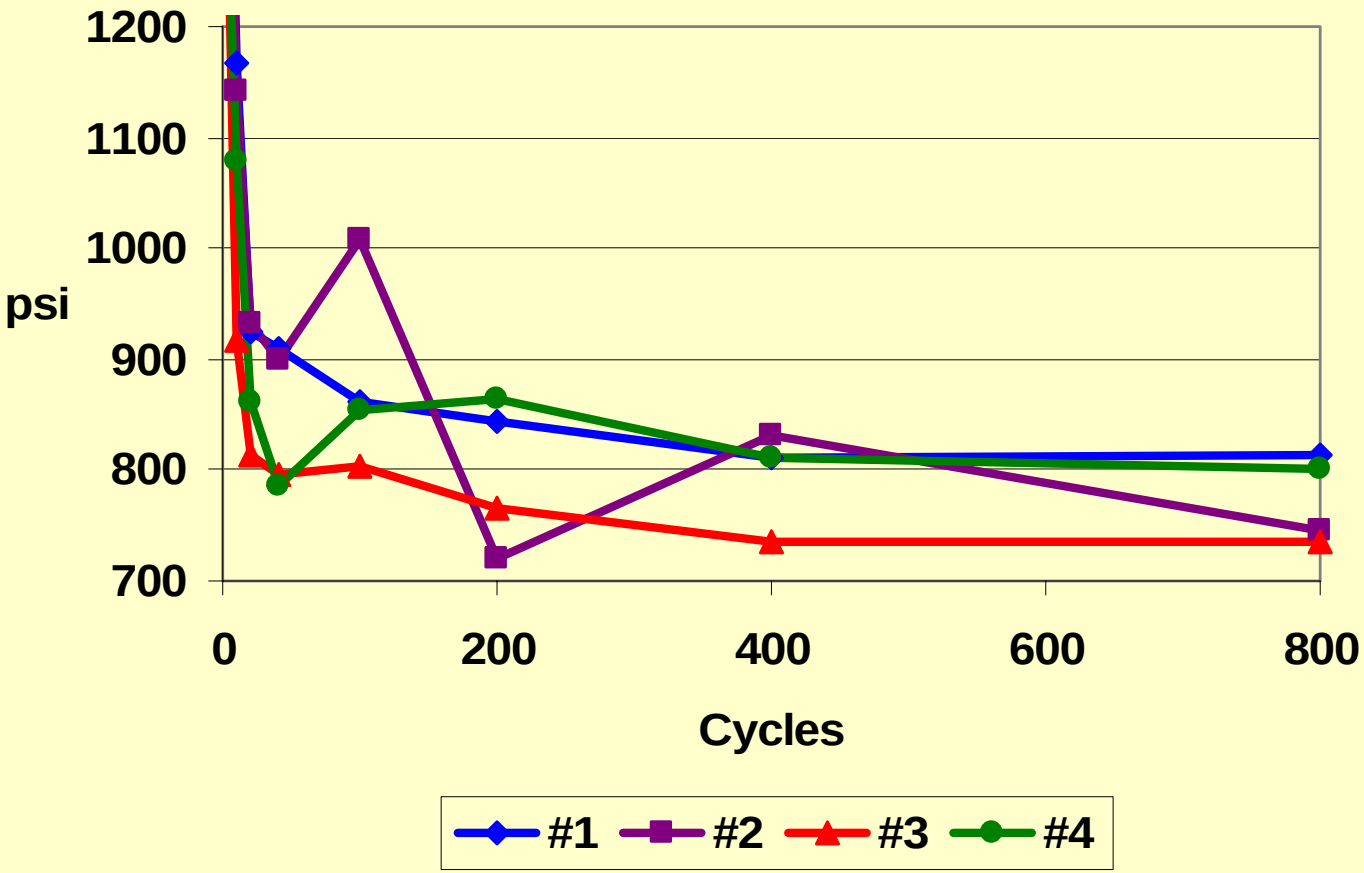
D-3434 Durability Testing

- Accelerated Aging Cycles
  - Submerge the specimens for 10 minutes in boiling water.
  - Dry for 4 minutes with a 23º C air flow.
  - Dry for 57 minutes with a 107º C air flow.
  - Following the desired number of cycles, specimens are cooled in 23º C water then tested wet.
- Ten samples from each set were tested after exposure to 20, 40, 100, 200, 400, and 800 cycles.

PRF Shear Strength Variability



PRF Variability - Cycle Dependence

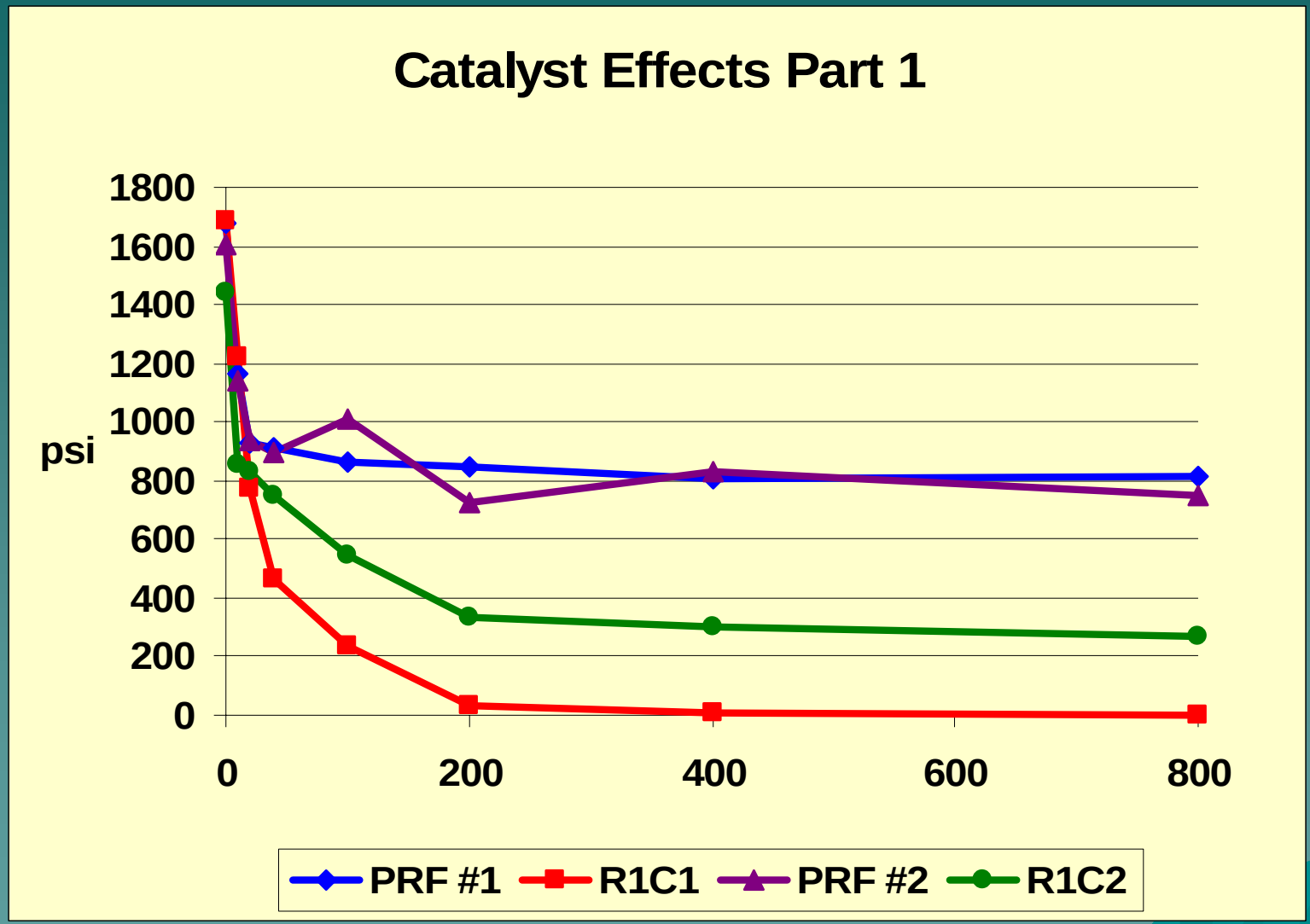


PRF Strength Retention

- 25-40% reduction in strength from dry to wet shear values
- values level out at about 45-60% of the original dry strength
- uncertainty of at least +/- 5% in values from run to run

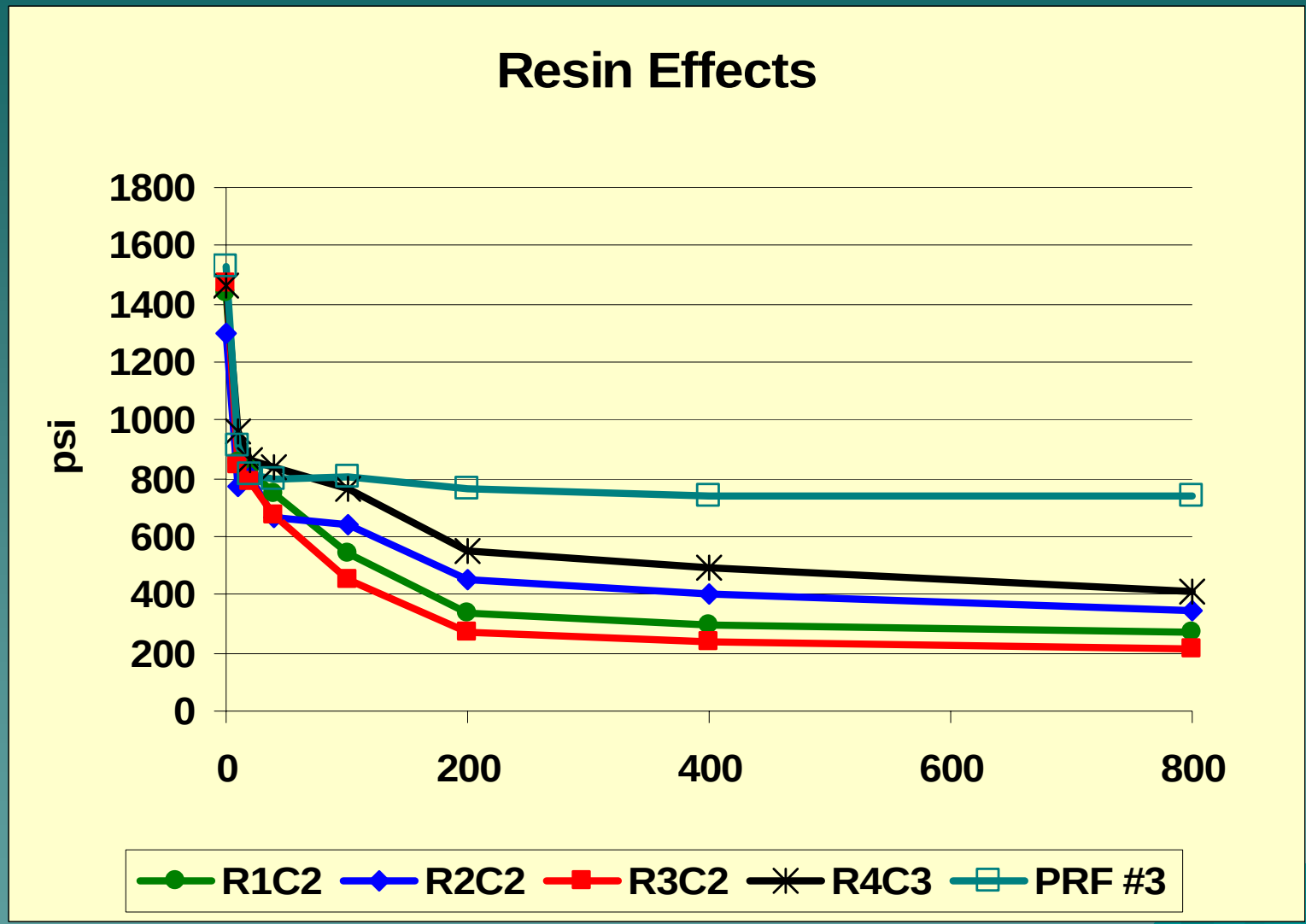
Shear Strength Retention

PRF	wet/dry	final/dry
1	70%	48%
2	71%	47%
3	60%	48%
4	76%	56%

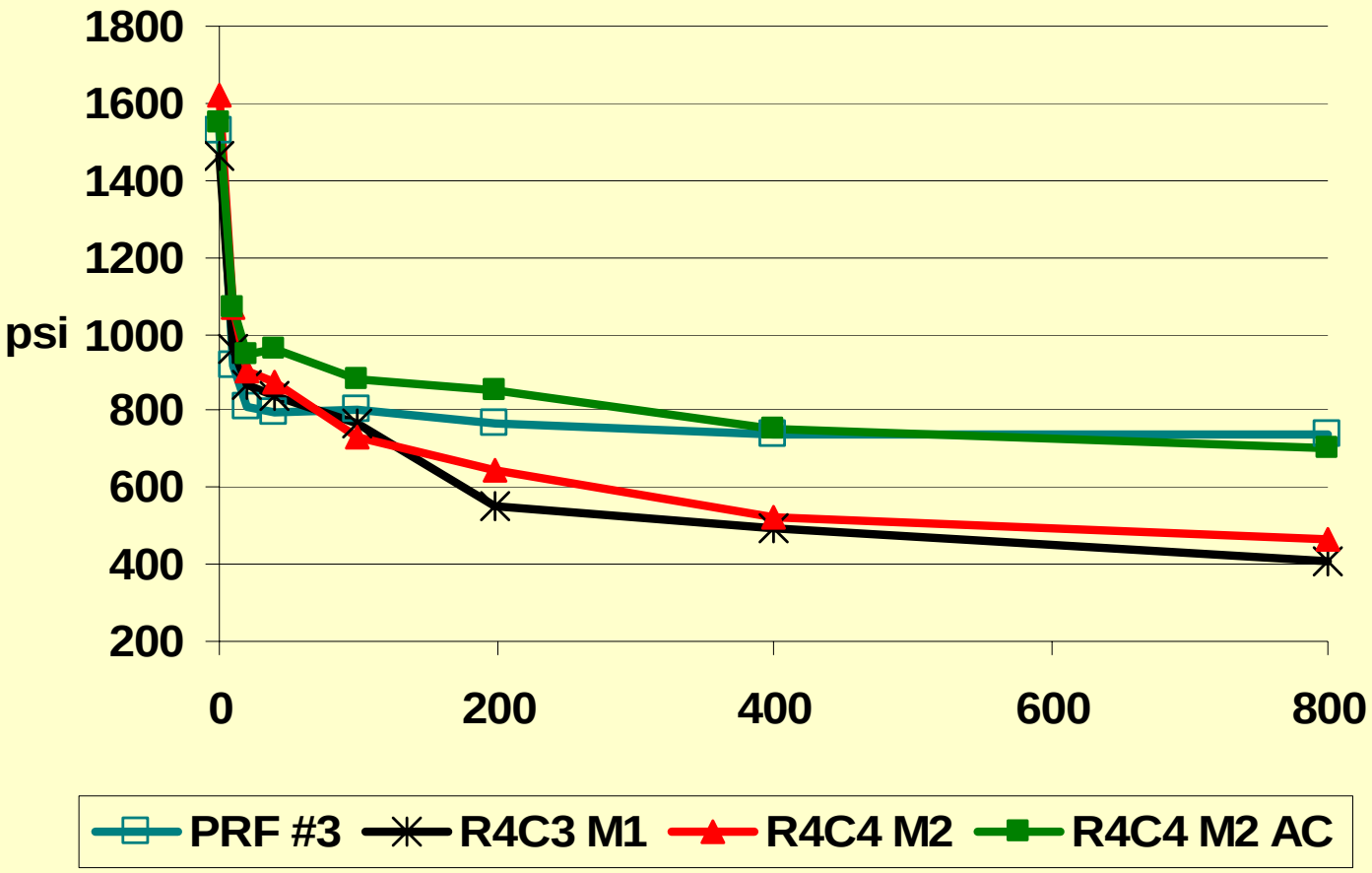

Catalyst Effects Part 1
psi
1800
1600
1400
1200
1000
800
600
400
200
0
0
200
400
600
800
PRF #1
R1C1
PRF #2
R1C2

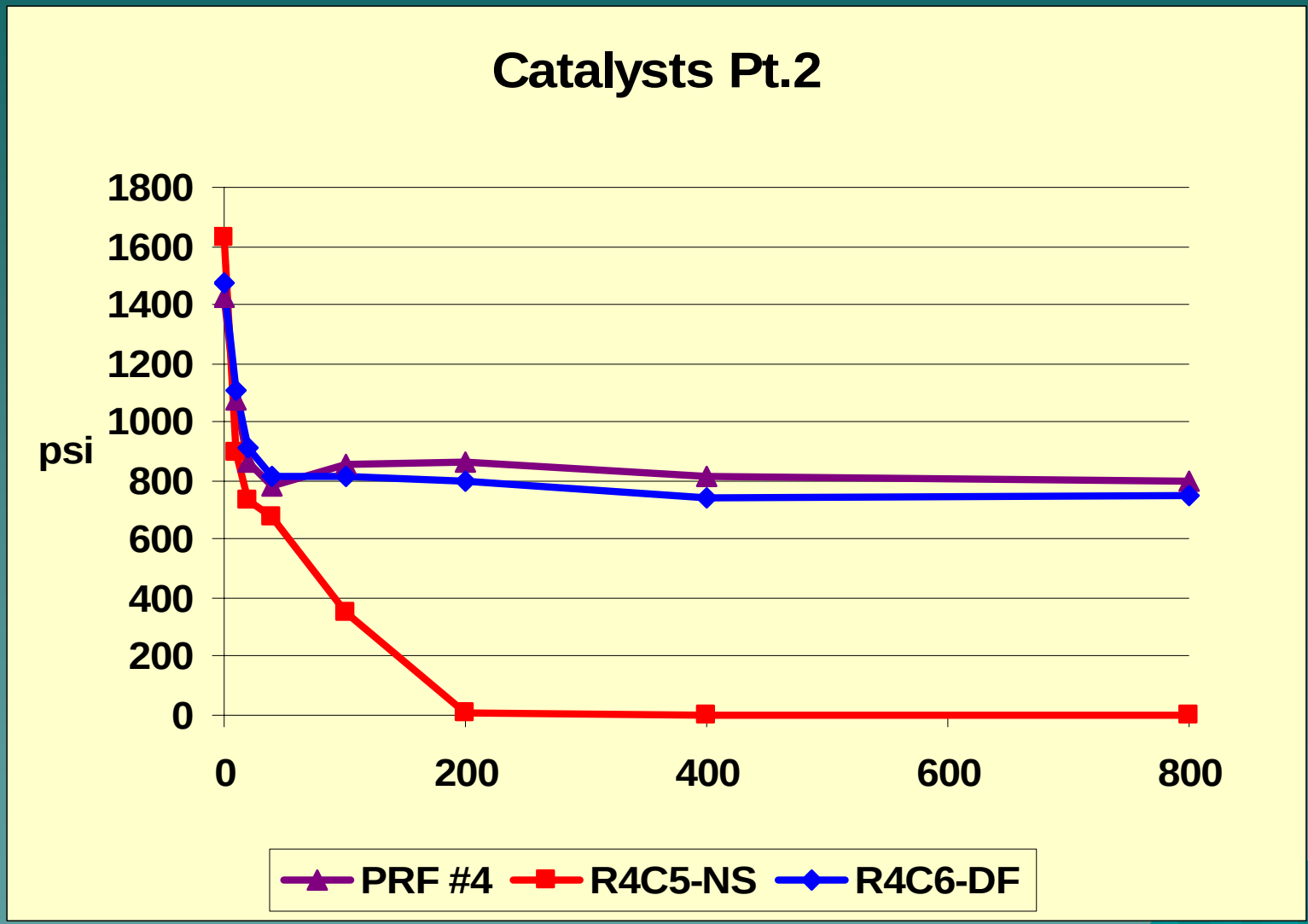
ASTM D-2559 & ASTM D-3434

R1C1			R4C5		
D-2559	D-3434		D-2559	D-3434	
	Cycles	psi		Cycles	psi
1640 psi	dry	1682	1697 psi	dry	1629
	100	239		100	351
0% delam	200	35	0% delam	200	7


Resin Effects
psi
1800
1600
1400
1200
1000
800
600
400
200
0
0
200
400
600
800
R1C2
R2C2
R3C2
R4C3
PRF #3

Mix Ratio and Cure Effects




Catalysts Pt.2
psi
1800
1600
1400
1200
1000
800
600
400
200
0
0
200
400
600
800
PRF #4
R4C5-NS
R4C6-DF

Conclusions

- MF Adhesive Systems were developed with Strength Retention and Degradation Rates Similar to Commercial PRF Adhesives
- Using ASTM D-3434 as the Standard, ASTM D-2559 is not acceptable as a long term durability test for new adhesives
- At least 200 cycles for screening studies

Conclusions

- Catalyst Formula-
  - Significant: 0 – 300 psi
- Resin formula
  - Significant: 200 – 400 psi
- Mix Ratios
  - Minimal effects: 400 – 450 psi
- Cure Conditions
  - -Significant: 450 – 750 psi

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