Comparing Friction Reducers for Use in AMPT Testing

Background

- NCHRP 9-29
  - Conclusion: variability of unconfined Fn was not suitable for rutting criteria developed in NCHRP 9-33
  - Suggestion: improved guidance for fabrication and use of friction reducers could reduce test variability
- Friction reducers for Fn in AASHTO TP 79-13
  - Two layers of latex membrane
  - Paste silicone grease at 0.25 ± 0.05 g

Objectives

- Investigate the effect of friction reducers on Fn test results and variability:
  - Latex (paste and spray silicone)
  - Teflon (single and double without grease)
  - Reused latex (paste silicone)
- Select appropriate friction reducers for Fn
- Confirm selected friction reducers not affecting E* results

Testing Plan - Fn

Test Procedure	Friction Reducer Type	Application Rate
• **Unconfined Flow Number (NCHRP 09-33 Method):** o **Confinement: None** o **Deviator: 600kPa (87 psi)** o **Contact: 30kPa (4.35 psi)** o **Temperature: 60.5°C**	Paste Silicone Latex (DOW Corning 112 HP)	0.25 ± 0.02 g (baseline)
		0.15 ± 0.02 g
	Silicone Spray A Latex (3M Dry Type)	0.25 ± 0.02 g
		0.10 ± 0.02 g
	Silicone Spray B Latex (Permatex Wet Type)	0.25 ± 0.02 g
		0.15 ± 0.02 g
	Teflon	Single 0.01-in sheet
		Double 0.01-in sheet

Notes:

1 Test Method x 8 Friction Reducers = 8 Sets of Flow Number Specimens

4 Replicates per Flow Number Test.

Testing Plan - Fn

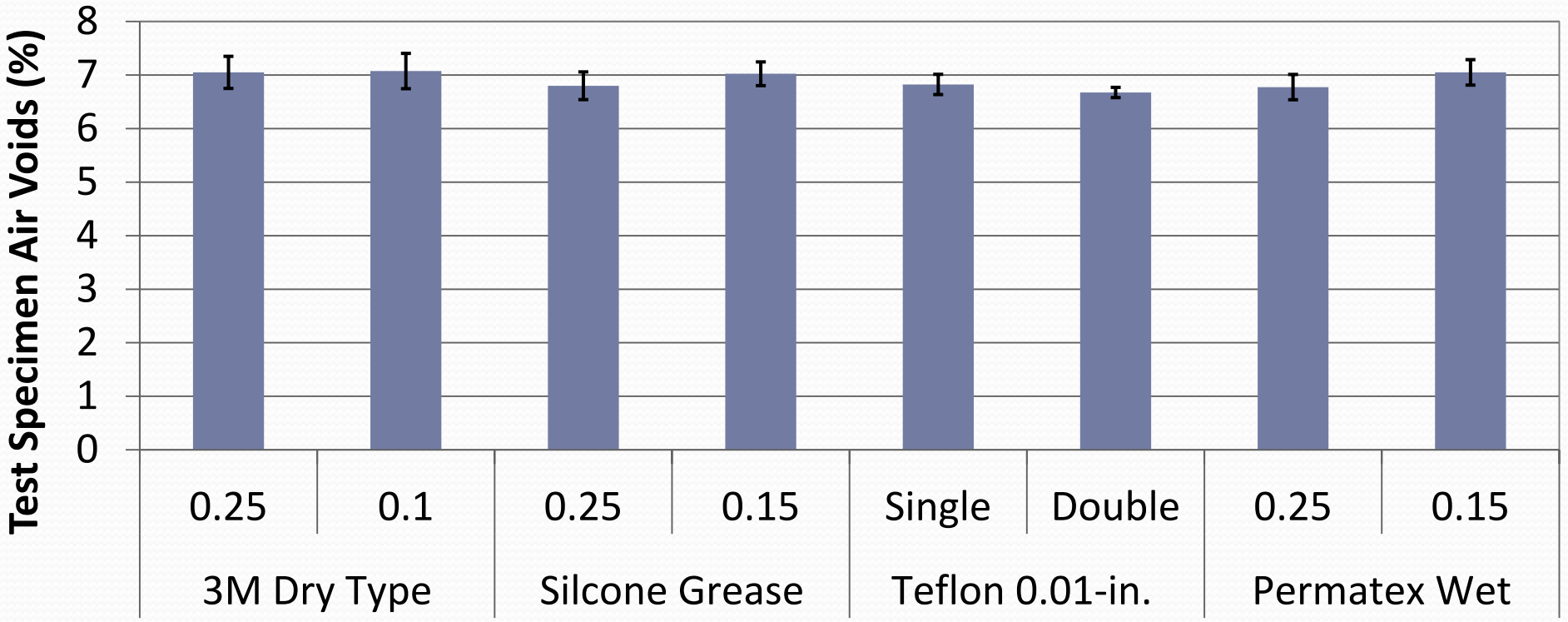
Test Procedure	Friction Reducer Type	Application Rate
• Unconfined Flow Number (NCHRP 09-33 Method): o Confinement: None o Deviator: 600kPa (87 psi) o Contact: 30kPa (4.35 psi) o Temperature: 60.5°C	New Set of Silicone-Latex Reducers	Paste silicone latex @ 0.20 ± 0.02 g
	Same Set of Friction Reducers Reused in 2 Weeks	
Notes:		
1 Test Method x 2 Friction Reducers = 2 Sets of Flow Number Specimens		
4 Replicates per Flow Number Test.		

Asphalt Mixture Used

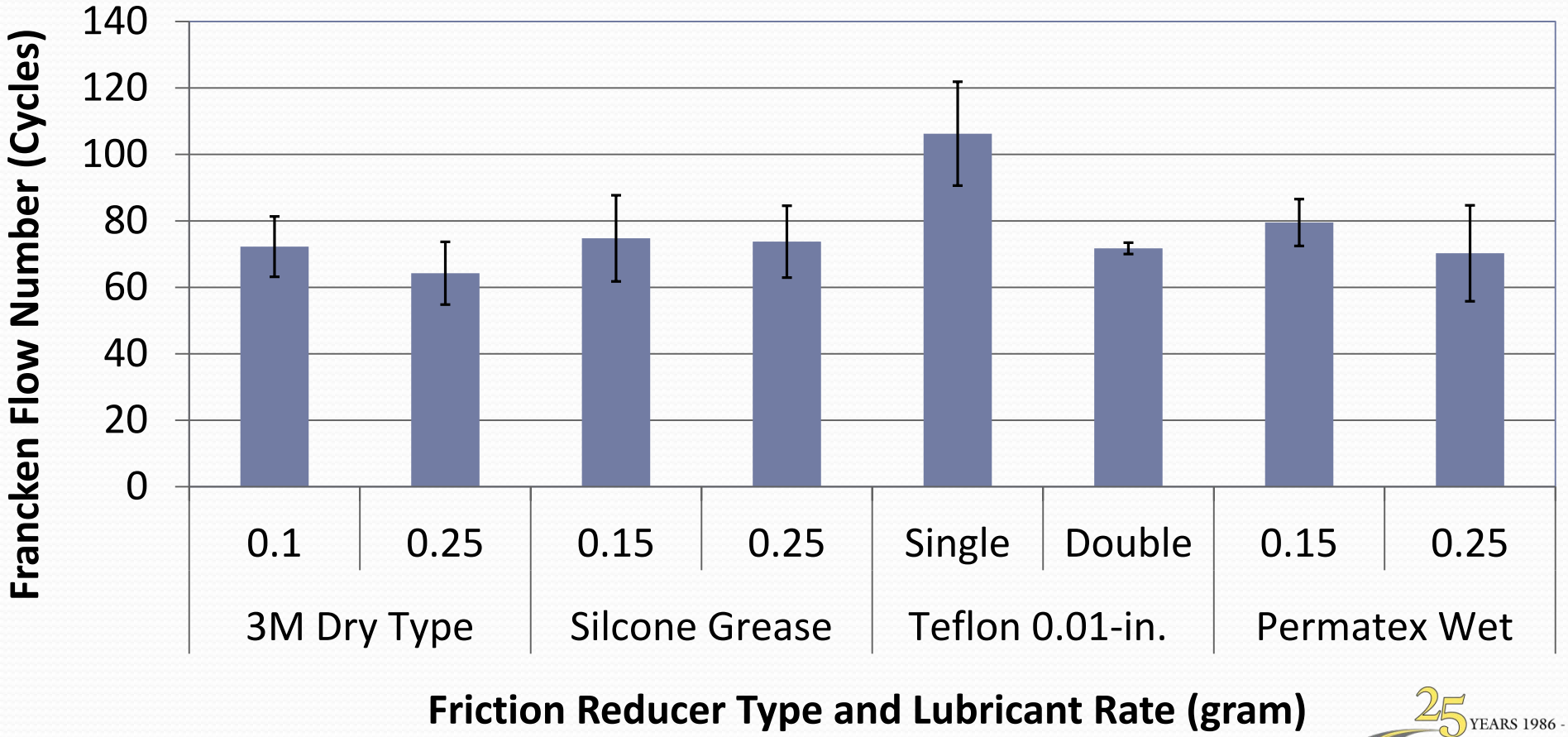
- Dense-graded mix
  - 9.5-mm NMAS
  - PG 67-22
  - 20% RAP by weight of aggregate
    - Total AC = 5.50% (4.38% virgin binder; 1.12% RAP binder)
  - N_{des} = 60
  - Plant produced

Effect of Friction Reducers on Fn Test Results

Specimen Air Voids



Fn Test Results



Statistical Analysis

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Mix ID	7	4537	648.2	5.39	0.001
Error	24	2884	120.2		
Total	31	7422			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
10.9625	61.14%	49.80%	30.91%

Grouping Information Using the Tukey Method and 95% Confidence

Mix ID	N	Mean	Grouping
Teflon - Single	4	106.25	A
Permatex Wet Type - 0.15	4	79.50	B
Silicone Grease - 0.15	4	74.75	B
Silicone Grease - 0.25	4	73.75	B
3M Dry Type - 0.15	4	72.25	B
Teflon - Double	4	71.75	B
Permatex Wet Type - 0.25	4	70.25	B
3M Dry Type - 0.25	4	64.25	B

Specimen Deformation

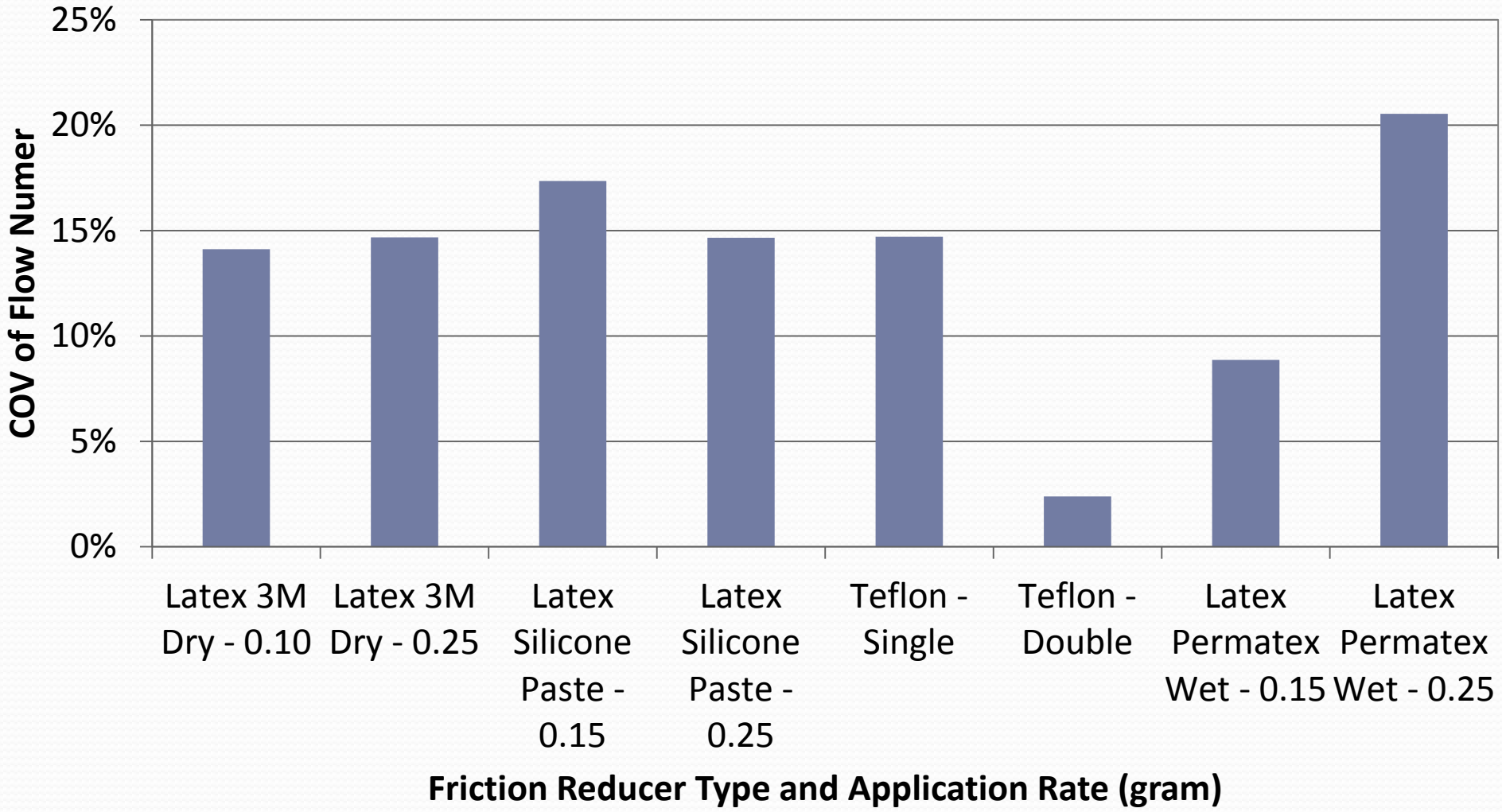
Untested

Single Teflon
“bulging”

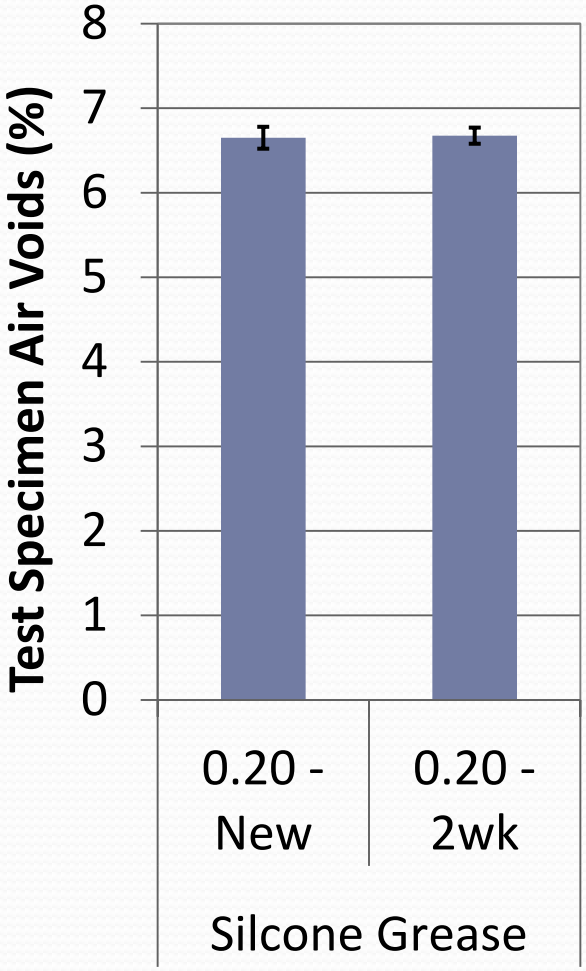
Spray Silicone
“constant
deformation”

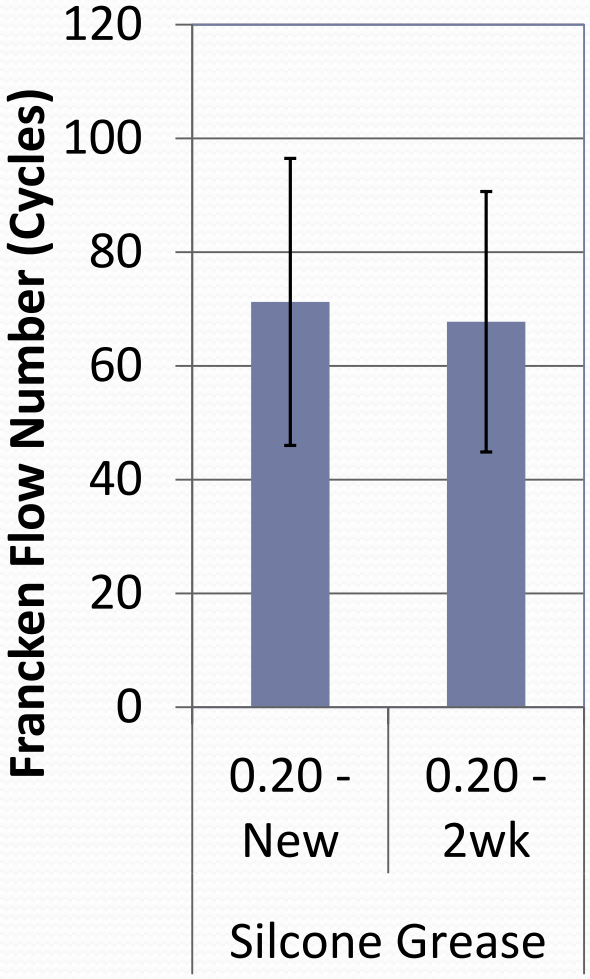
Double Teflon
“bulging”

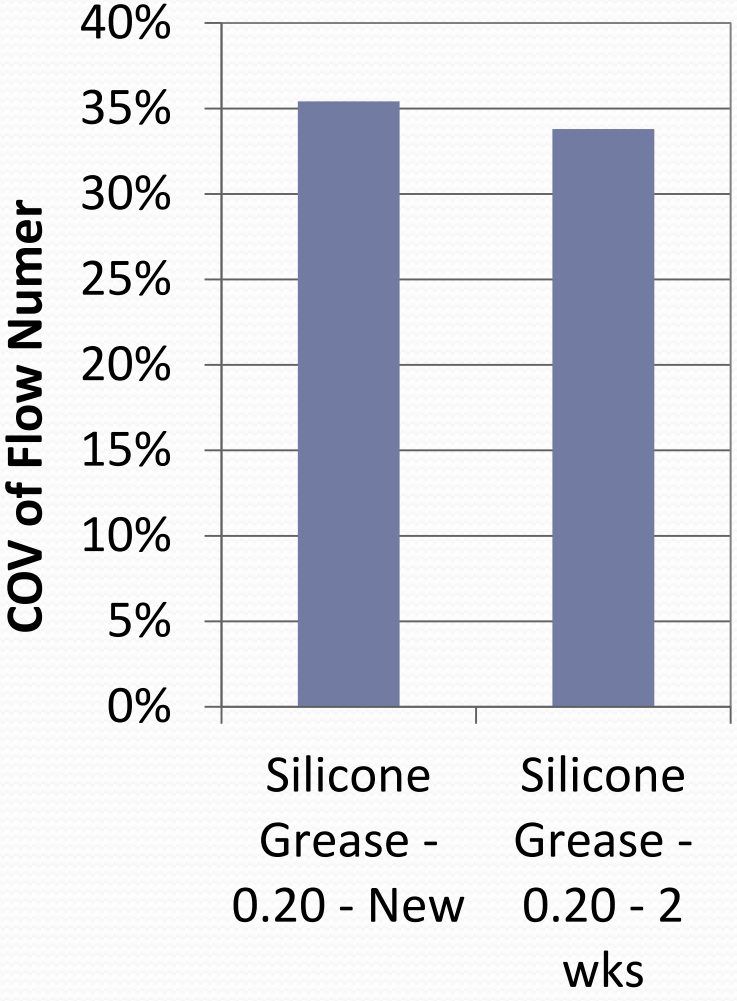
COV of Fn Results



Effect of Reusing Friction Reducers







Findings

- Fn test
  - Single-Teflon friction reducers yielded higher Fn results
  - Double-Teflon and latex friction reducers did not statistically affect Fn results
  - Both single-Teflon and double-Teflon friction reducers showed “bulging” effect
  - Reusing friction reducers once did not statistically affect Fn results
- E* test
  - Single-Teflon and latex friction reducers did not statistically affect E* results

Recommendations

- Only 2-layer latex friction reducers be used for Fn test
  - Paste silicone, dry-type silicone spray, or wet-type silicone spray
  - Application rate: 0.20 ± 0.05 g
- Latex or single-Teflon friction reducer be used for E* test
  - For a latex friction reducer, any of the silicones can be used and application rate is 0.20 ± 0.05 g
- A study be conducted to determine if the same set of friction reducers can be used to test one set of Fn or E* specimens

Acknowledgments

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