NCHRP 9-56: Identifying Influences on and Minimizing the Variability of Ignition Furnace Correction Factors

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Mix ETG Meeting

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National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

Project Objectives

- Determine significant factors that affect asphalt and aggregate correction factors (CF) for ignition furnaces
  - Effect of sharing CFs between units/mixes
  - Minimize variability in CFs
- Develop guidelines for installation, operation, and maintenance of ignition furnaces

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Project Scope

Phase I
- Literature Review
- DOT's/Industry Survey
- Experimental Plan

Phase II
- Conduct Experimental Plan
  - Sensitivity Study at NCAT
  - Interlaboratory Study
  - Troubleshooting Outliers from Interlaboratory Study

Phase III
- AASHTO Practices –Final Report

Experimental Plan- Mixes

Four Aggregates/Mixes, 12.5mm NMAS; PG 67-22

Agg./ Mix	Aggregate Description	Source	Optimum AC %	Expected CF Range
1	Limestone and Granite	Calera, AL & Lithonia, GA	5.2	0.0 - 0.5
2	Limestone and Granite with 1% Lime	Calera, AL & Lithonia, GA	5.2	0.0 - 0.5
3	Limestone	Barbeau, MI	6.2	0.5 - 1.0
4	Dolomite	Delphi, IN	6.1	1.0 - 3.0

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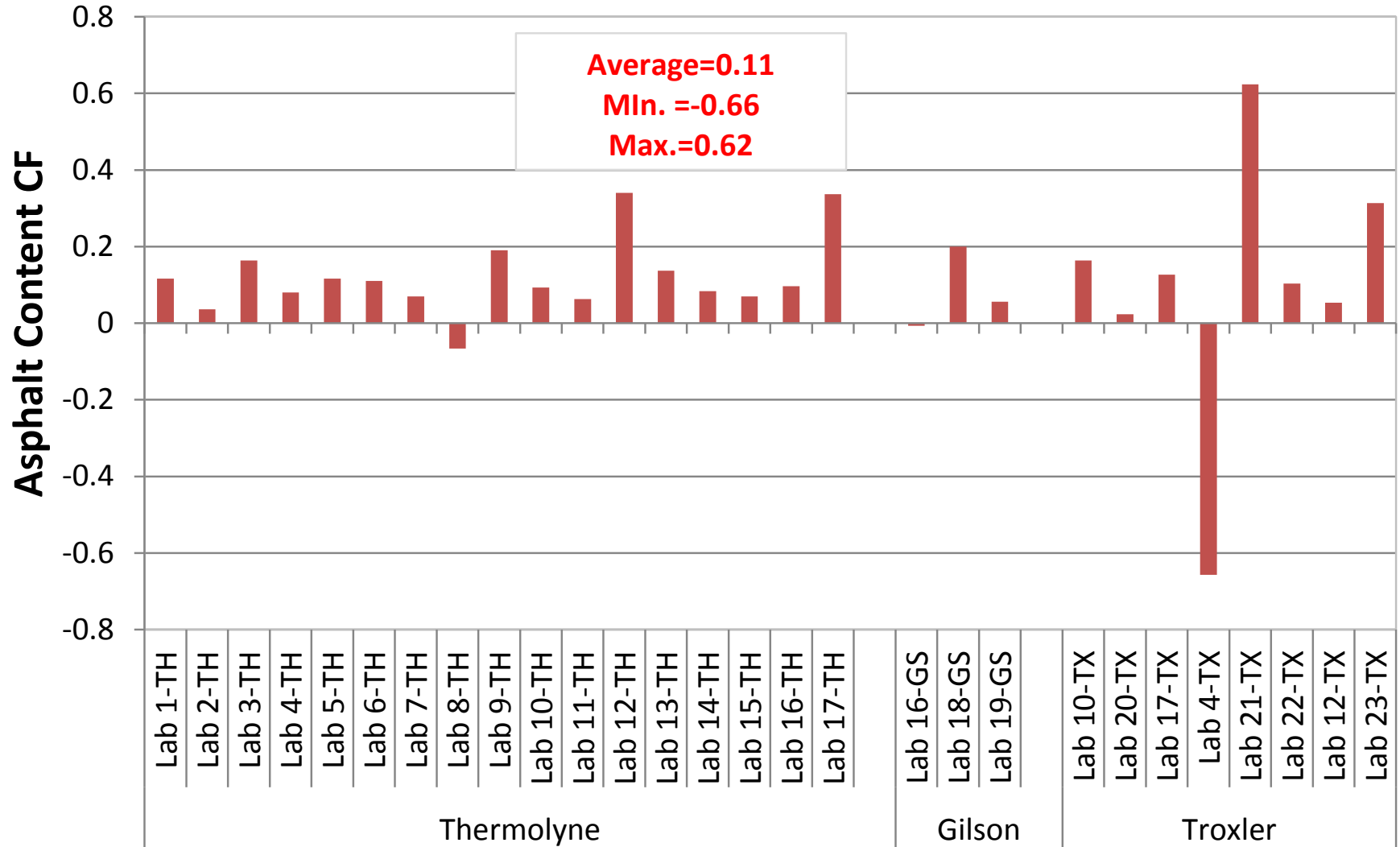# Sensitivity Study at NCAT Lab

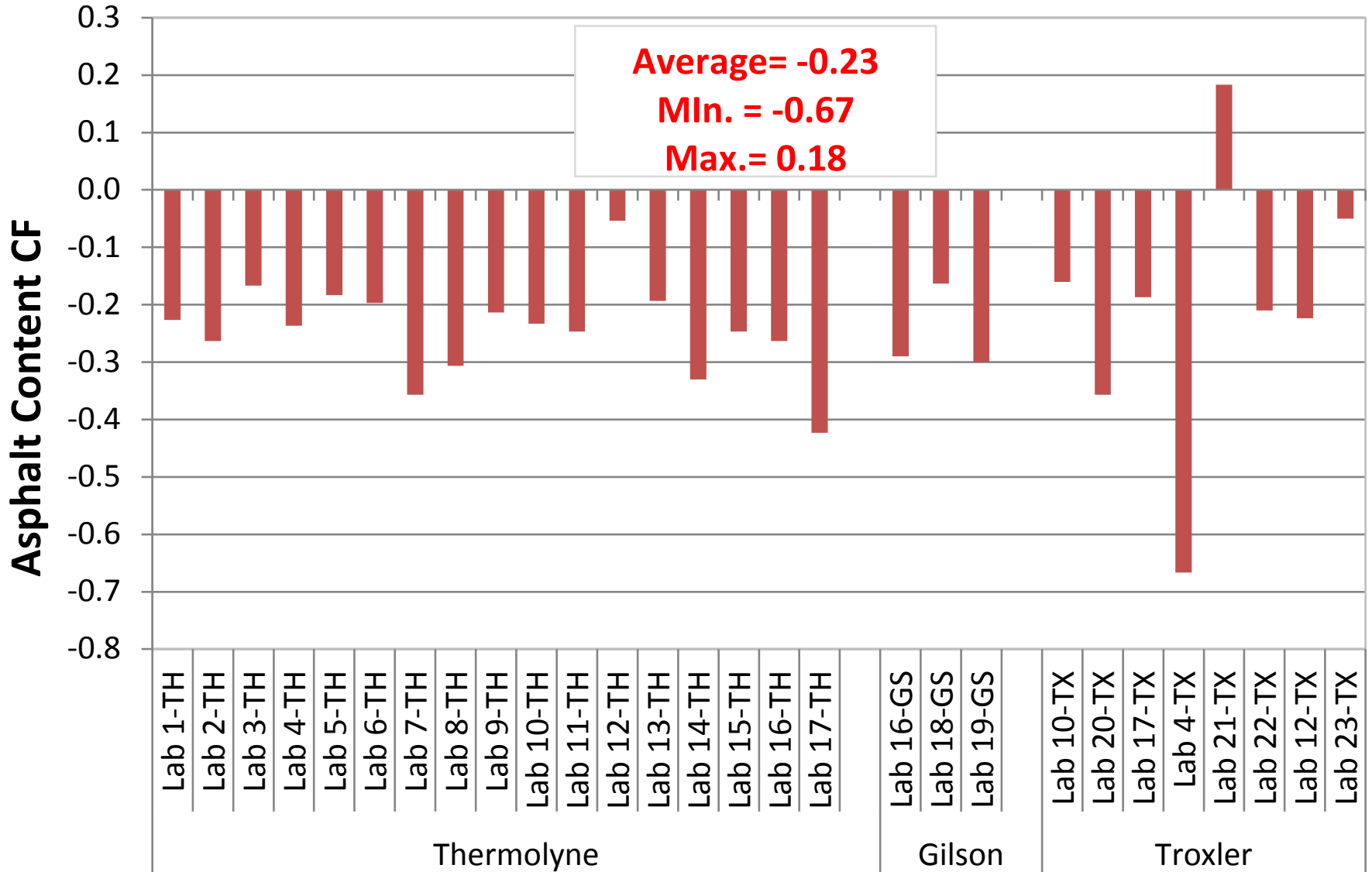| Factors	Levels
Oven	Thermolyne, Troxler, Gilson
Test Temperature	427°C, 538°C (Option 1, Default, for Troxler)
Air Flow	30% Open, 100% Open
Sample Mass	1500, 2000 grams
AC Content	Optimum AC -1%, Optimum AC +1%
Burning Profile (Troxler Only)	Default, Option 1, Option 2

Total Number of Tests 352

Experimental Plan - Interlab. Study

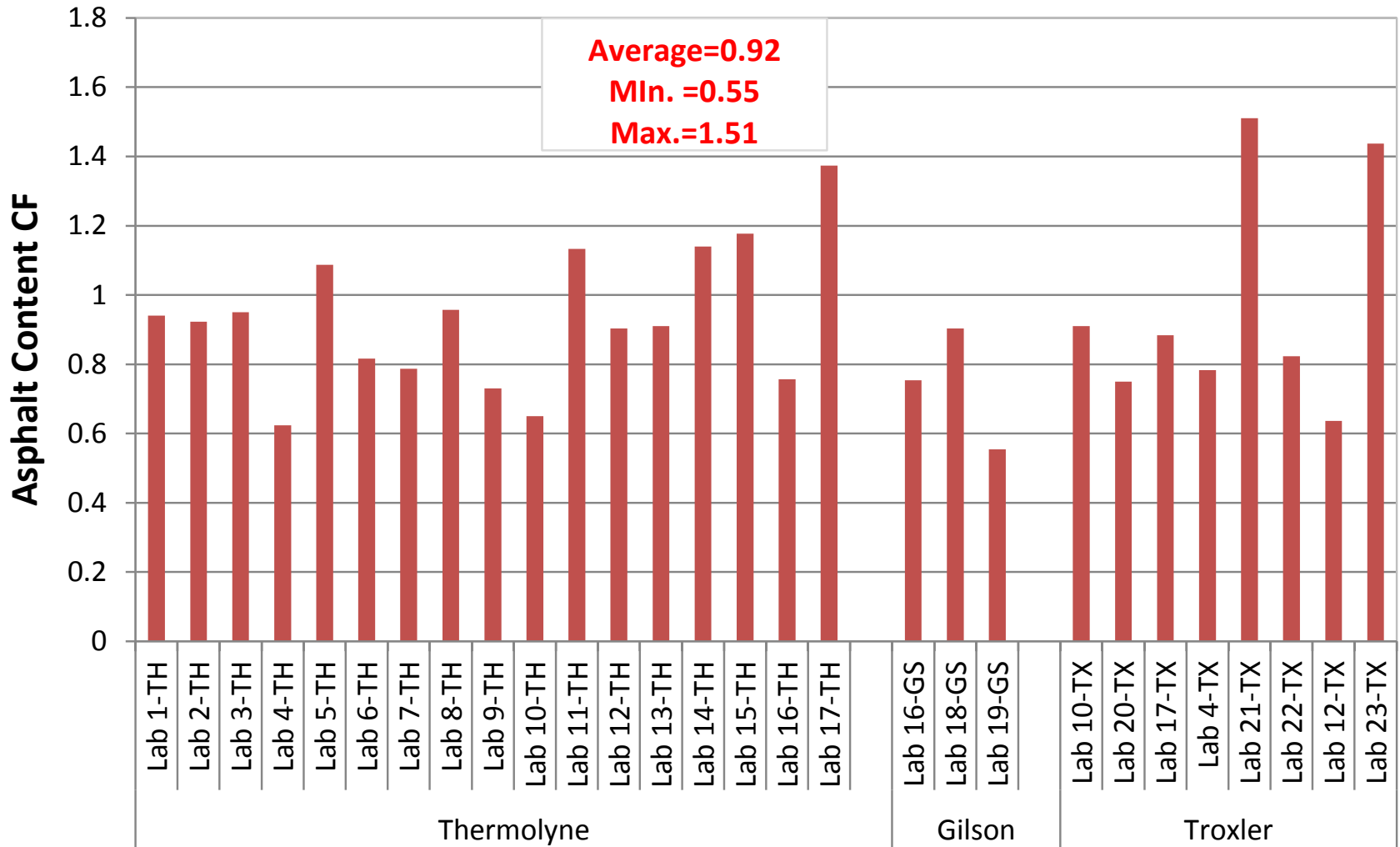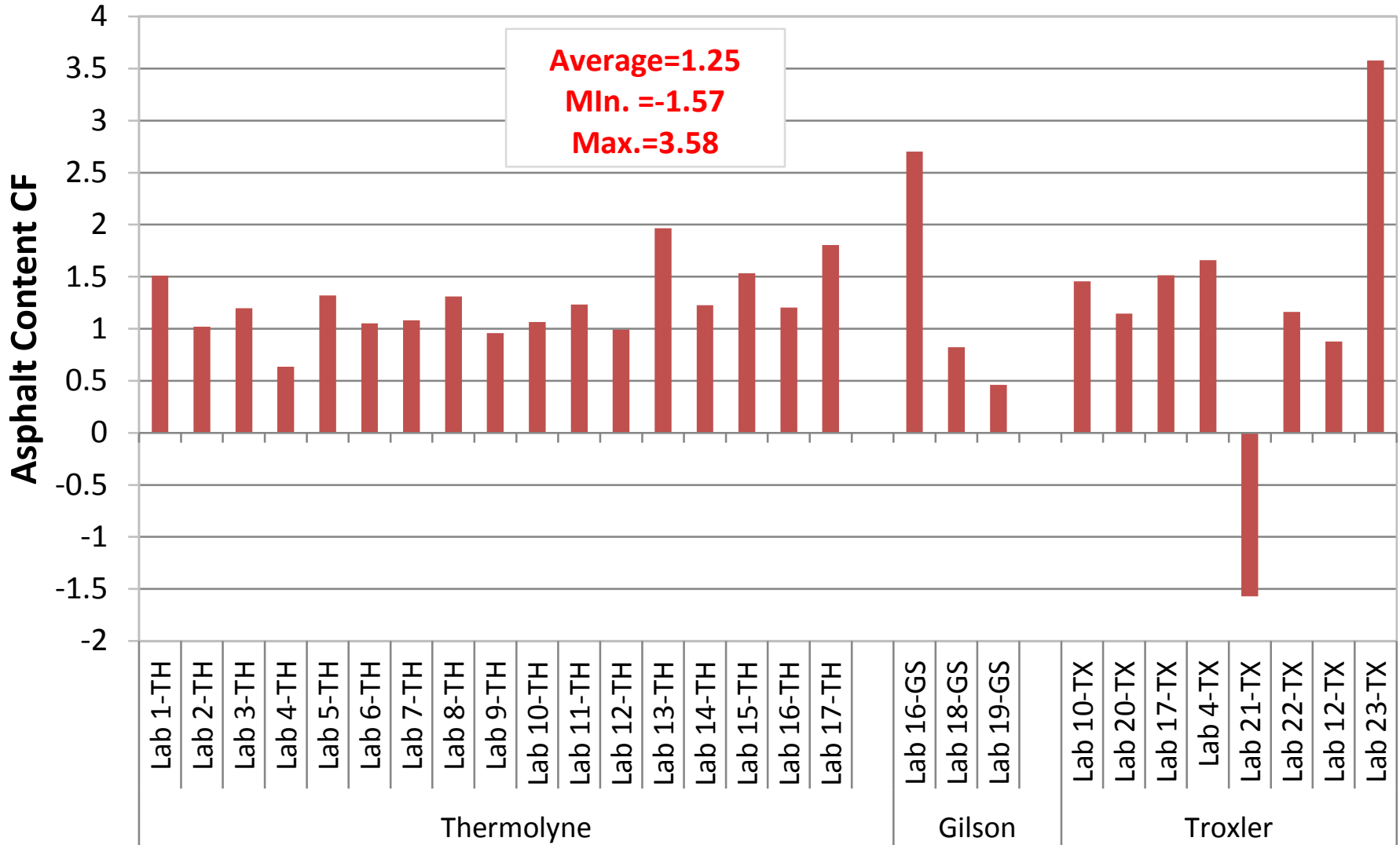| Labs	18 DOT agencies; 5 Contractors/Research
Oven brands	17 Thermolyne, 8 Troxler, 3 Gilson
Multi-labs	5 labs with two different oven brands
Number of Mixes	Four mixes at their optimum asphalt content
Test temperature	538°C (mixes 1-3) and 482°C (mix 4) for convection units (Thermolyne, Gilson); default and option 1 for infrared unit (Troxler)
Replicates	3 per mix

Asphalt Content CFs-Mix 3

Asphalt Content CFs -Mix 4

Precision Statistics - Interlab. Study ASTM E 691

Mix #	Actual AC %	Measured AC%	CF	s_r	s_R	r	R
1	5.2	5.32	0.12	0.089	0.131	0.225	0.329
2	5.2	4.97	-0.23	0.074	0.111	0.203	0.244
3	6.2	7.08	0.90	0.112	0.264	0.314	0.740
4	6.1	7.31	1.21	0.178	0.403	0.499	1.135
AASHTO T 308				**0.069**	**0.117**	**0.196**	**0.330**

Conclusions

- Type of oven and test temperature primary factors affecting CFs

- Conducting test at 800°F substantially reduce magnitude and standard deviation(σ) of CF factors for asphalt mixtures that do not contain lime

- Different precision statements may be necessary for aggregates with higher CFs

  - For mixes 1 and 2 within-lab and between-lab σ similar to AASHTO T 308

  - For mixes 3 and 4 as CF increased σ also increased

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Conclusions

- Precision statement in AASHTO T 308 applicable only to mixtures with low CF aggregates

- Although not recommended in AASHTO T 308, sharing CFs among different ignition furnaces appears acceptable for low CF aggregates

- Amount of lime has to be closely controlled during production otherwise this will affect the CF and result in incorrect AC content

- Causes of differences in CF for troubleshooting study were related to wrong equipment settings

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Recommendations/Future work

- Key product of this research is a Proposed Standard Practice for Installation, Operation, and Maintenance of Ignition Furnaces

- Conducting ignition test for RAP materials at 427°C, may allow more accurate determination of RAP asphalt content which can be difficult since CF is not known

- Future work will evaluate effect of reducing test temperature for mixes that contain significant recycled materials compared to those with virgin binder and aggregate only.

Thank you!

Photo Courtesy of Tim Ramirez, PennDOT