Improving Dense Graded Mixtures

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OUTLINE

- Research Question
- Results from Previous Research Project Phases
- Preliminary Results from Current Phase
- Potential Steps Forward in 2016

RESEARCH QUESTION

- Are dense graded mixes designed with SUPERPAVE system providing consistently longer service life compared to previous mixes?

- Criteria for Life
  - Durable or Fatigue resistant
  - Rutting resistant
  - No flushing
  - Skid resistant (surface mixes)
- Research Objective – Maximize the service life of dense graded asphalt mixes

PREVIOUS RESEARCH PHASE RESULTS

Phase I – Superpave Designed Mix Analysis

- **Comparisons**
  - Volumetrics for 50 and 65 Gyrations
  - Volumetric results for 50 and 75 blow Marshall
- **Mix gradations**
- **Bag samples for future phases**

RESULTS FROM PHASE I

- **VTM – Superpave Gyratory (SGC) produces approximately 2% lower VTM than the Marshall hammer.**
- **VMA – SGC produces approximately 1-2% lower VMA than the Marshall hammer.**
- **Review of the data did not produce a definitive “simple solution” (i.e., just reduce the number of gyrations).**

RESULTS FROM PHASE II

Sampled and tested plant produced SM-9.5 mixes

Targeted mixes with 23% or less passing #30 sieve and at least 58% passing #4 sieve

Test Results:

1. Determined that volumetrically in design, these mixes typically could safely handle 0.2 additional binder.

2. Performance tested for initial mix, mix at optimum, mix at optimum plus 0.2% binder, and mix at optimum plus 0.4% binder. In general all appeared to produced acceptable results from a rutting and cracking perspective.

Current Phase

- Finalized select use special provision with changes to:
  - Design Gradations (#30 and #4 sieves)
  - Design Gyrations (50)
- Solicited demonstration projects from across state
- Design and produce experimental mixes to meet referenced criteria
- Paved control (65 gyrations and 4% VTM) and experimental mixes
- Retrieve mix (control and experimental) for additional lab performance testing
  - Flow Number and APA for rutting
  - Fracture Energy for cracking
- Collect density data from control and experimental sites

Demonstration Sites

	Contractor	District	Mix	Location	Paving Date
✓	W-L Construction and Paving	Bristol	SM-12.5A	US 11, Wythe County	June 8-9
✓	Chemung Contracting	Culpeper	SM-12.5D	US 15, PM-7H-15	July 22, August 19
✓	Boxley Asphalt	Lynchburg	SM-9.5D	CR 682, Campbell County	17-Jun-22
✓	Colony Construction	Richmond	SM-12.5E	US 1, Schedule #405	2-Jul-09
✓	Superior Paving	Culpeper	SM-9.5D	Rt. 211, Rappahannock County	June 23-24
✓	Superior Paving	NOVA	SM-9.5D	Potomac View Rd, Cascades Parkway	June 15-16/23-24
✓	Branscome, Inc.	Hampton Roads	SM-9.5A	Rt. 13, Cheriton, Northampton County	July 28-29
✓	Virginia Paving	NOVA	SM-9.5D	Subdivisions, B Schedule	10-Aug-12
✓	S.L. Williamson	Culpeper	SM-12.5D	US 250, Albemarle County	21-Jun
✓	W-L Construction and Paving	Staunton	SM-12.5A	CR 682, Shenandoah County	June 9-10
✓	S.L. Williamson	Culpeper	SM-9.5D	5th Street, Albemarle County	9-Sep
✓ = sampled					(updated 9/30/15)

Mix Volumetrics - % AC

Mix	Trial	Control
1	5.49	5.55
2	5.64	5.56
3	5.44	5.38
4	5.50	5.81
5	6.87	
6	5.30	5.13
7	6.16	6.20
8		
9		
Avg.	5.77	5.60

t-Test: 2-Sample Assuming Unequal Var.		
	Trial	Control
Mean	5.585833	5.6025
Variance	0.089474	0.134328
Observations	6	6
Hyp Mean Difference	0	
df	10	
t Stat	-0.0863	
P(T<=t) two-tail	0.932934	
t Critical two-tail	2.228139	

Mix Volumetrics - % VMA

Mix	Trial	Control
1	18.7	16.2
2	18.6	15.1
3	16.9	17.6
4	16.7	17.4
5	17.4	
6	17.4	17.2
7	18.3	19.5
8		
9		
Avg.	17.7	17.2

t-Test: 2-Sample Assuming Unequal Var.		
	Trial	Control
Mean	17.76128	17.1872
Variance	0.765422	2.171481
Observations	6	6
Hyp. Mean Difference	0	
df	8	
t Stat	0.820547	
P(T<=t) two-tail	0.43567	
t Critical two-tail	2.306004	

Mix Volumetrics - % VFA

Mix	Trial	Control
1	64.7	77.6
2	67.3	80.1
3	78.0	73.0
4	73.9	75.3
5	90.6	
6	72.8	69.6
7	73.4	69.0
8		
9		
Avg.	74.4	74.1

t-Test: 2-Sample Assuming Unequal Var		
	Trial	Control
Mean	71.6984	74.11708
Variance	23.60779	19.62905
Observations	6	6
Hyp. Mean Difference	0	
df	10	
t Stat	-0.901	
P(T<=t) two-tail	0.38877	
t Critical two-tail	2.228139	

Improving Dense-Graded Mixtures
Fall 2015 Status – In-Place Sampling

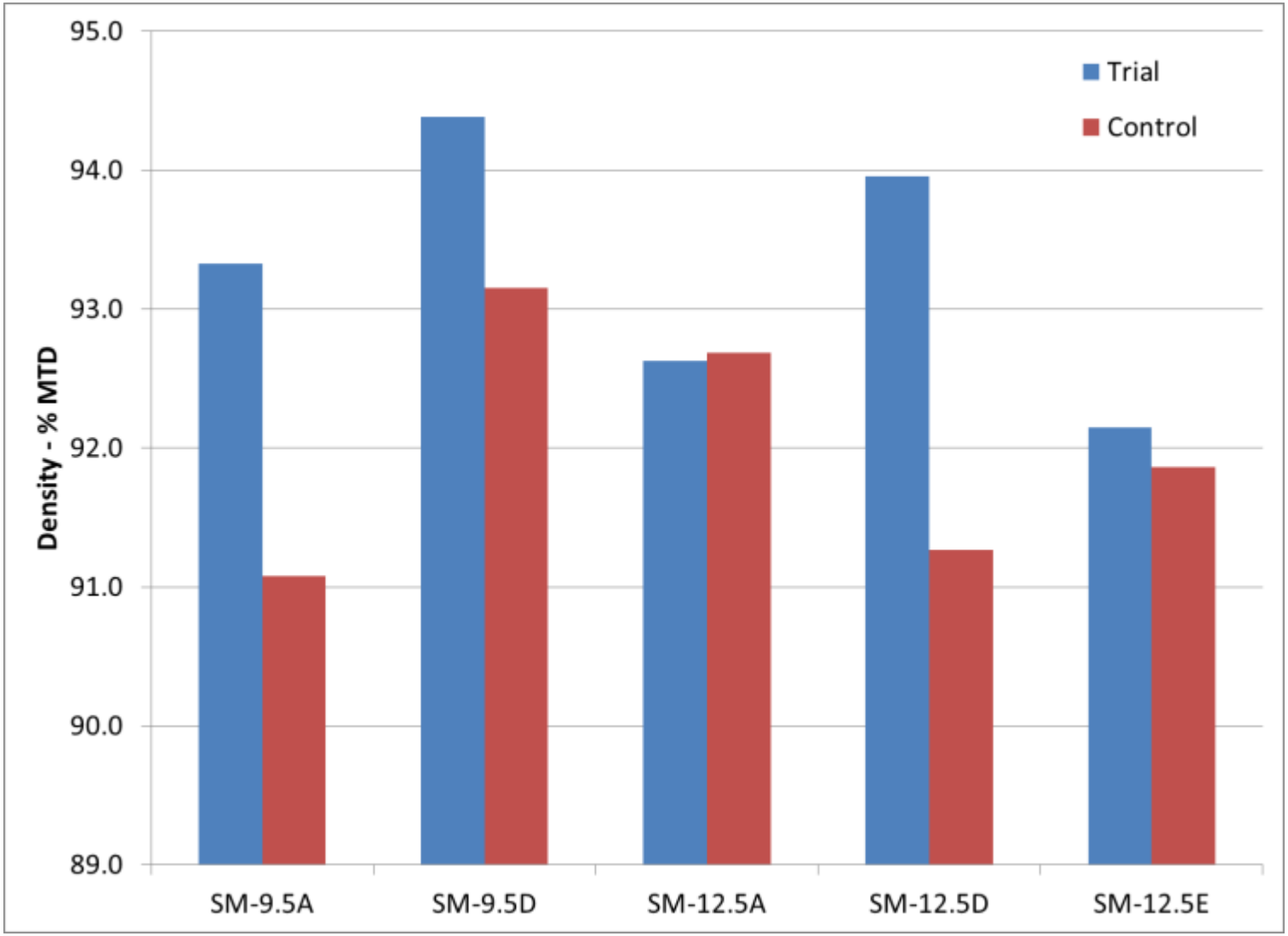
Field Sampling:

- 30 six-inch cores per set over ~1500'
  - 15 Trial
  - 15 Control
- In-place Voids/Permeability

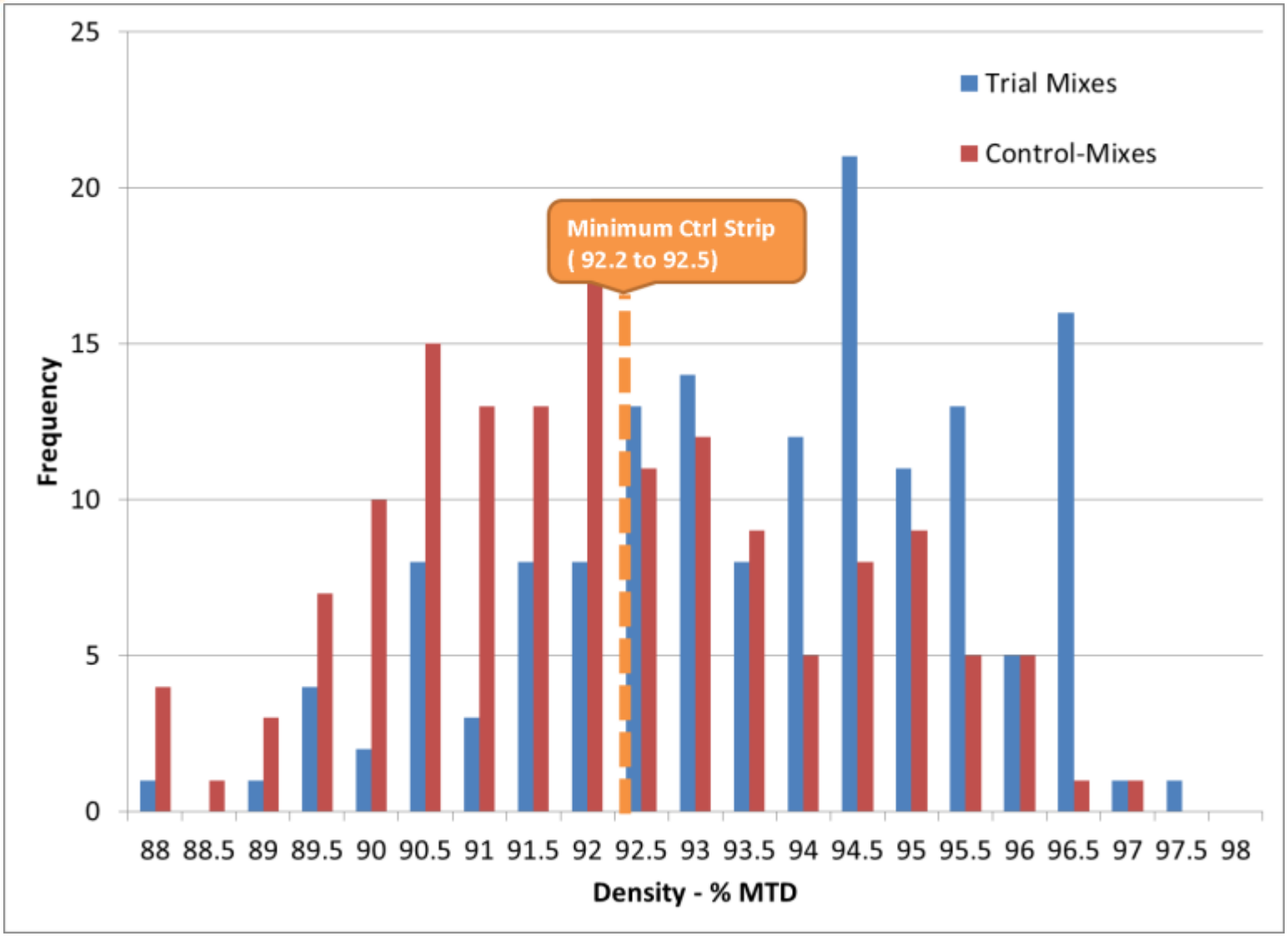
Mix Type	Binder Designation		
	A	D	E
SM-9.5	3	2*	-
SM-12.5	2	2	1

* One more set in the queue

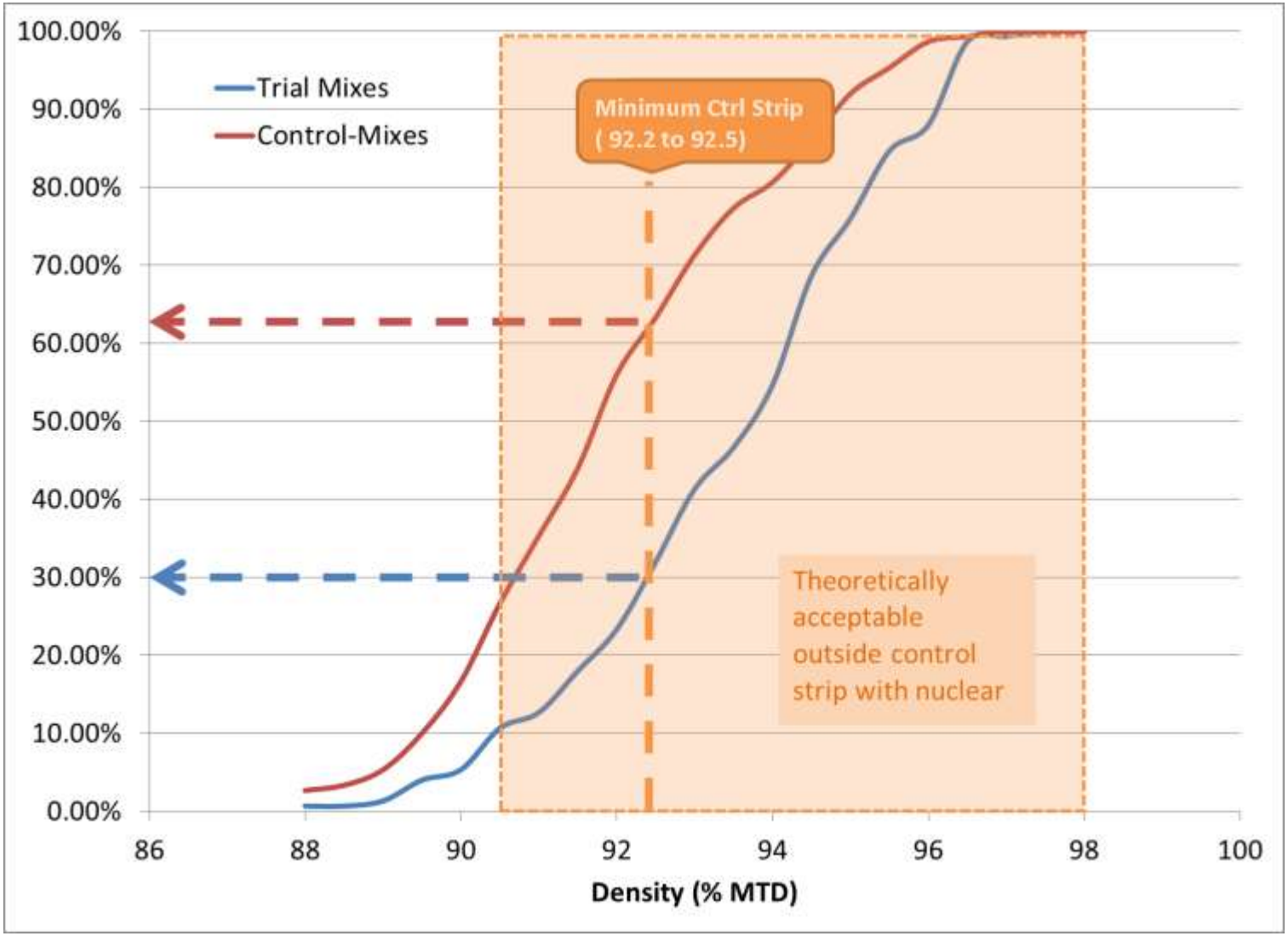
Density – Mix Type



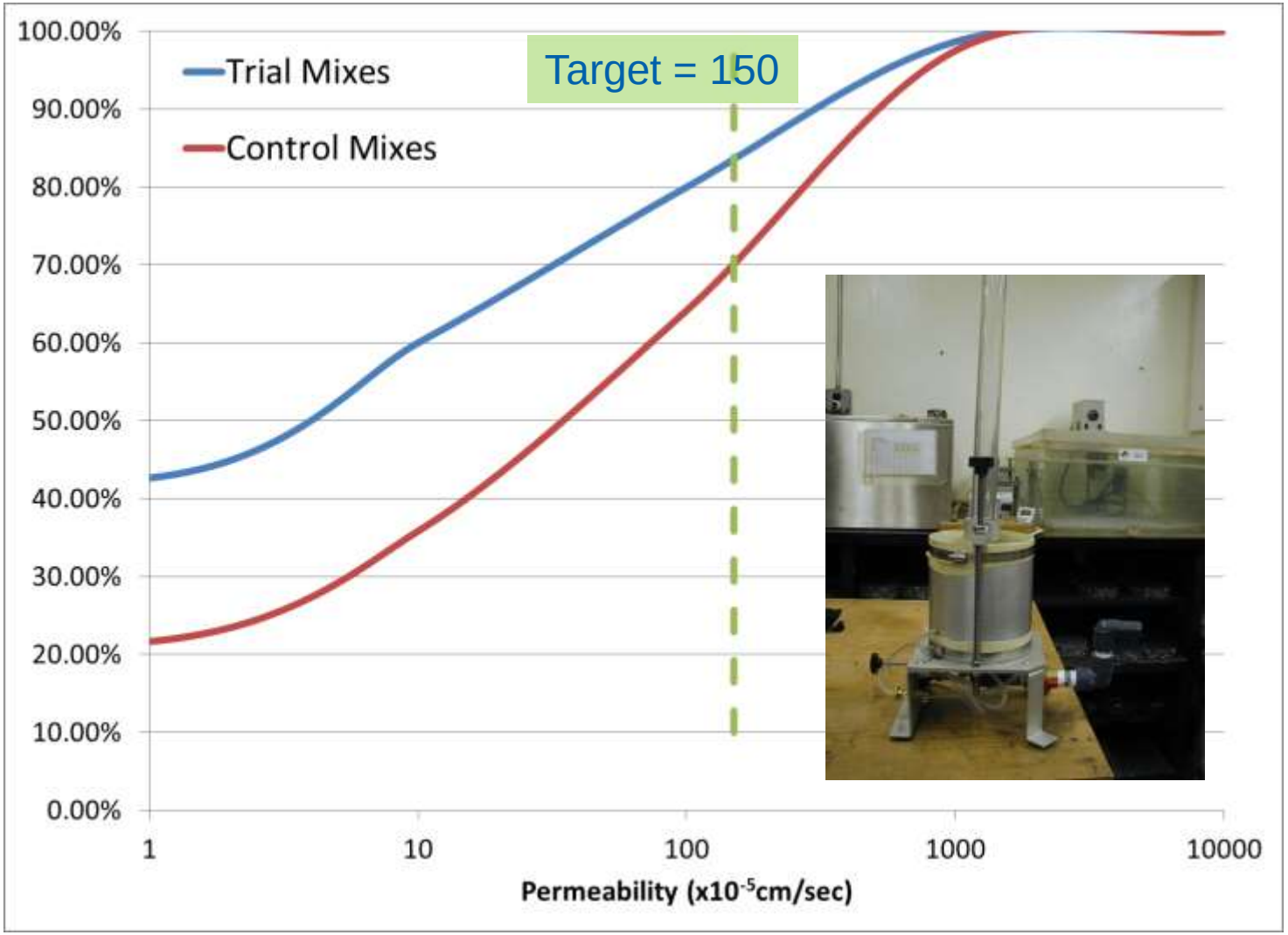
Density – Trial vs. Control



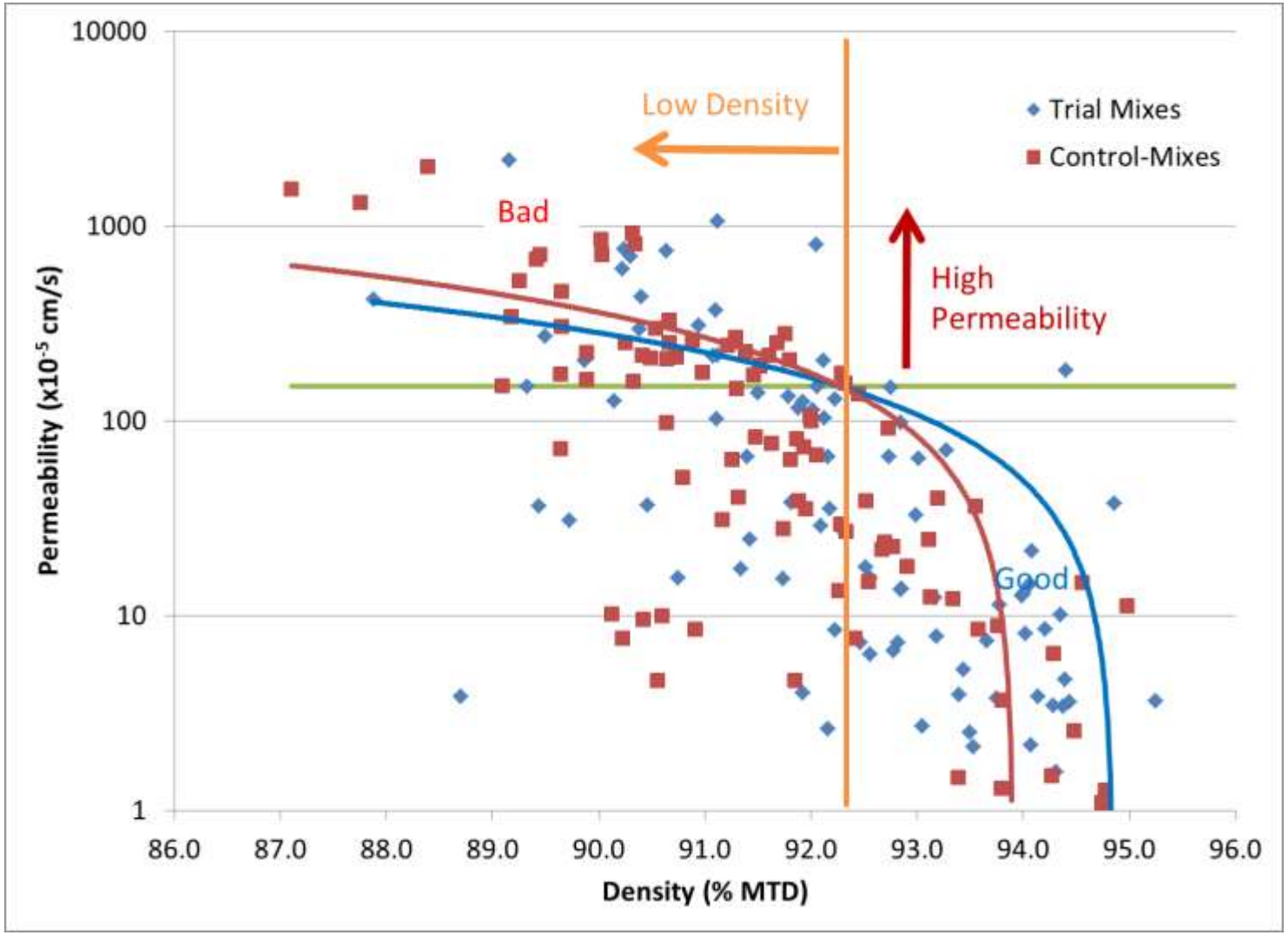
Density – Trial vs. Control



Permeability – Trial vs. Control



Permeability – Trial vs. Control



Save Questions for the Panel Discussion