Microsurfacing Mix Design Parameters

Presented by

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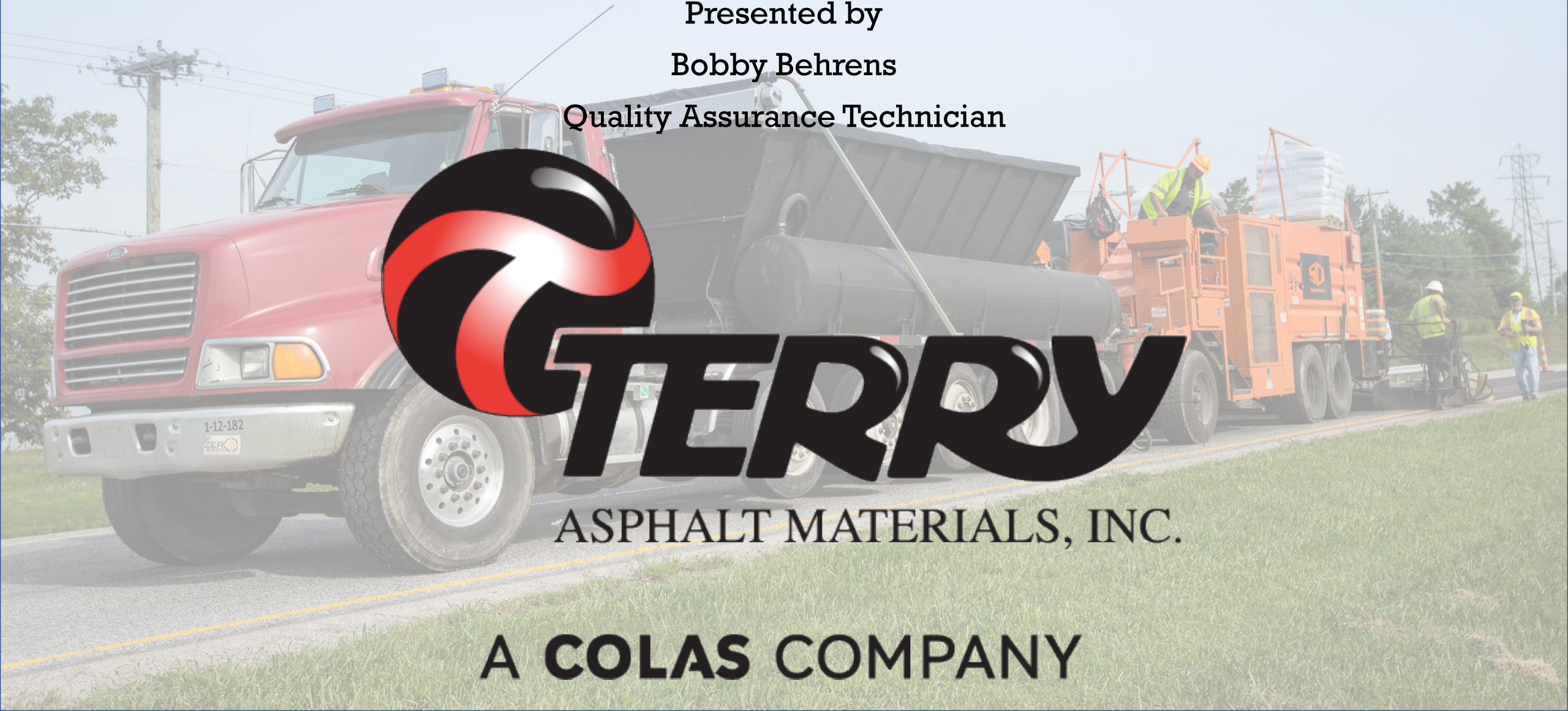
Quality Assurance Technician



TERRY

ASPHALT MATERIALS, INC.

A COLAS COMPANY

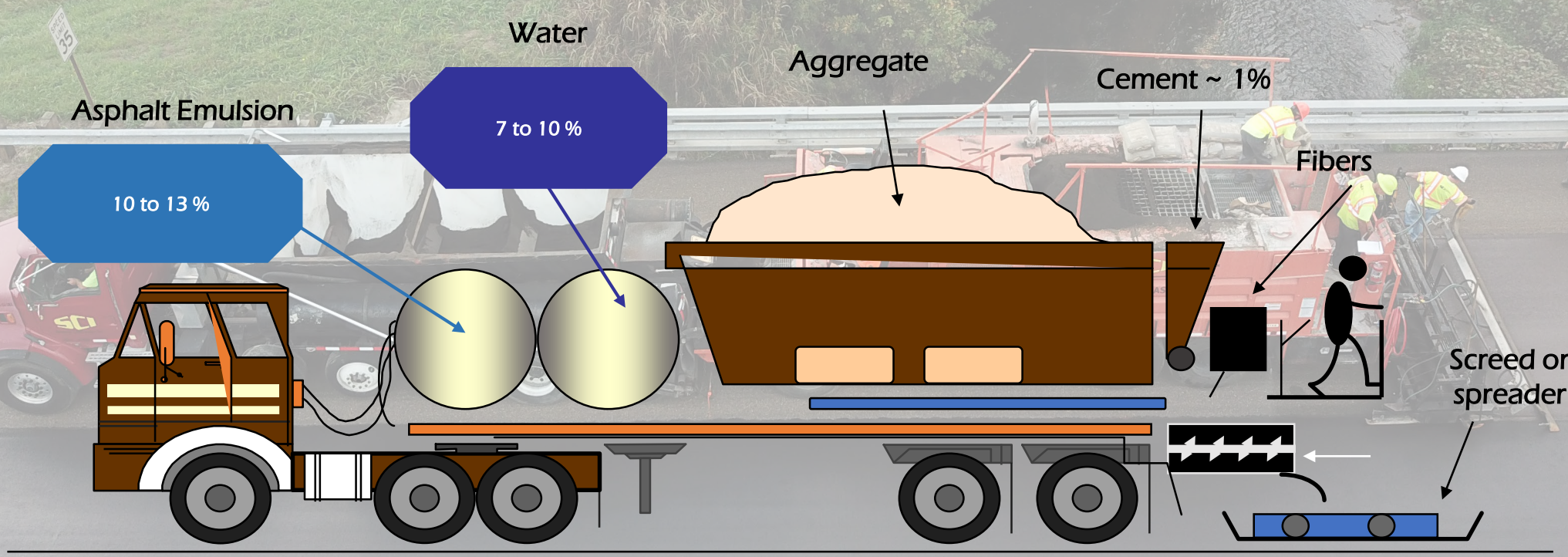
Where to start?

- ISSA Technical Bulletins
  - Slurry.org
  - A-143 Recommended Guidelines for Microsurfacing
  - ISSA Design Manual
- ASTM D6372/D3910
- Agency Specifications
  - Specification 413
- Agency Specs supersede guidelines!

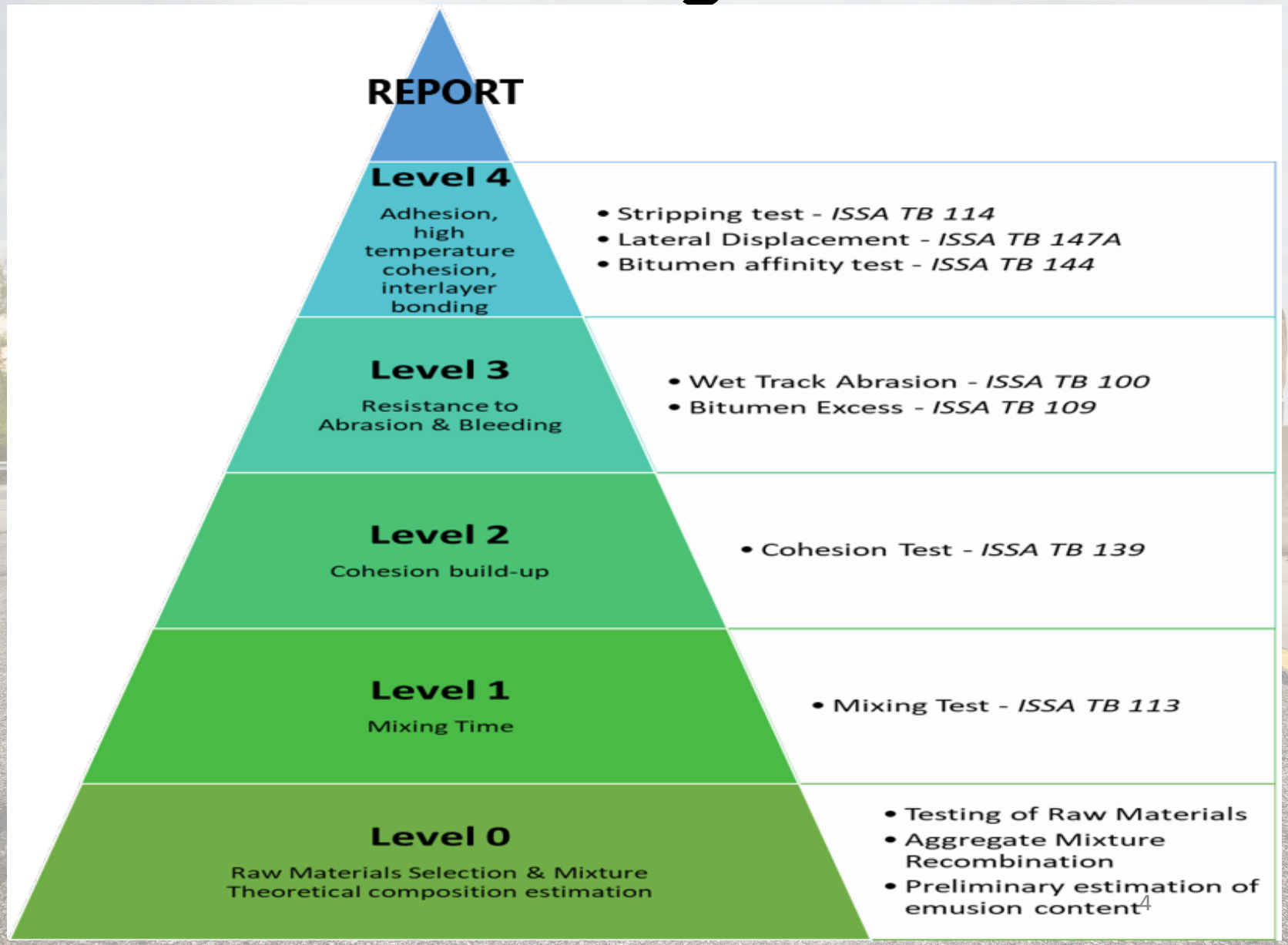
ISSA™
Innovation Through Preservation.

What makes up a micro mix?

- Fine aggregate, asphalt emulsion, mineral filler and water
  - Sometimes mix-set additives and fibers are also used

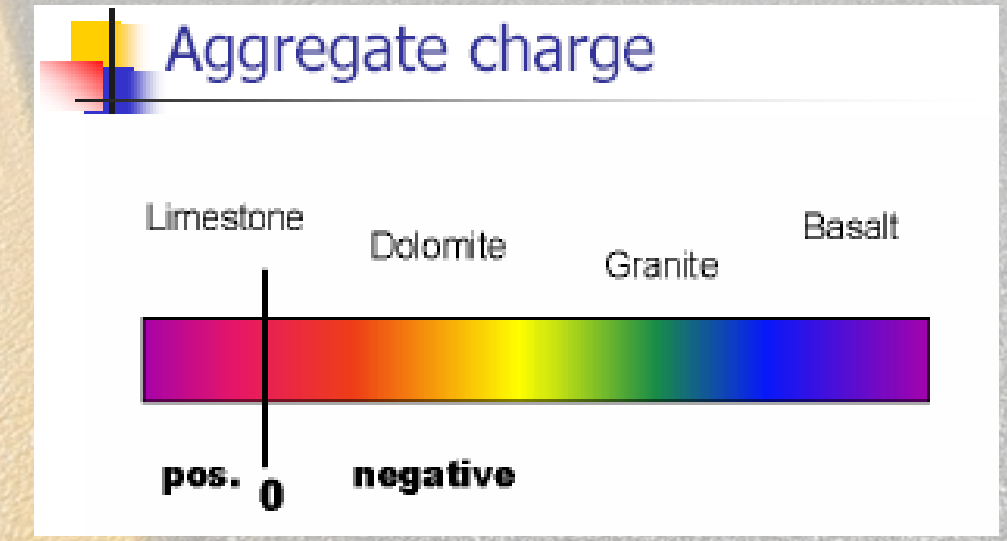


Mix Design Process



Fine Aggregate Selection

- 100% crushed aggregate
- LA Abrasion, Sulfate Soundness and Unit Weight
- Clean and free of deleterious materials
- Geology: reactivity and adhesion



Aggregate Gradation

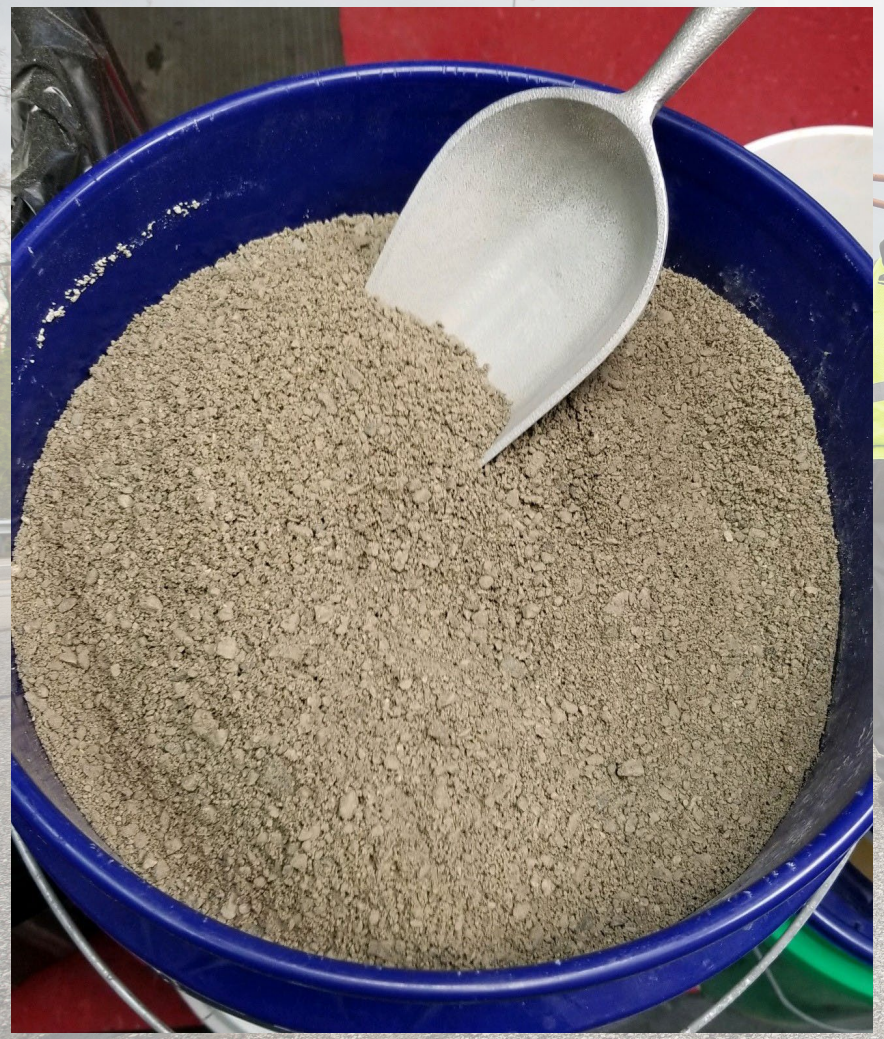
Type II

- Most commonly used
- Seal and fill surface voids
- Finer gradation
- Tighter surface texture

Type III

- Rut-fill and leveling
- Rarely used for surfacing
- Coarser gradation
- More open surface texture

Critical Sieves

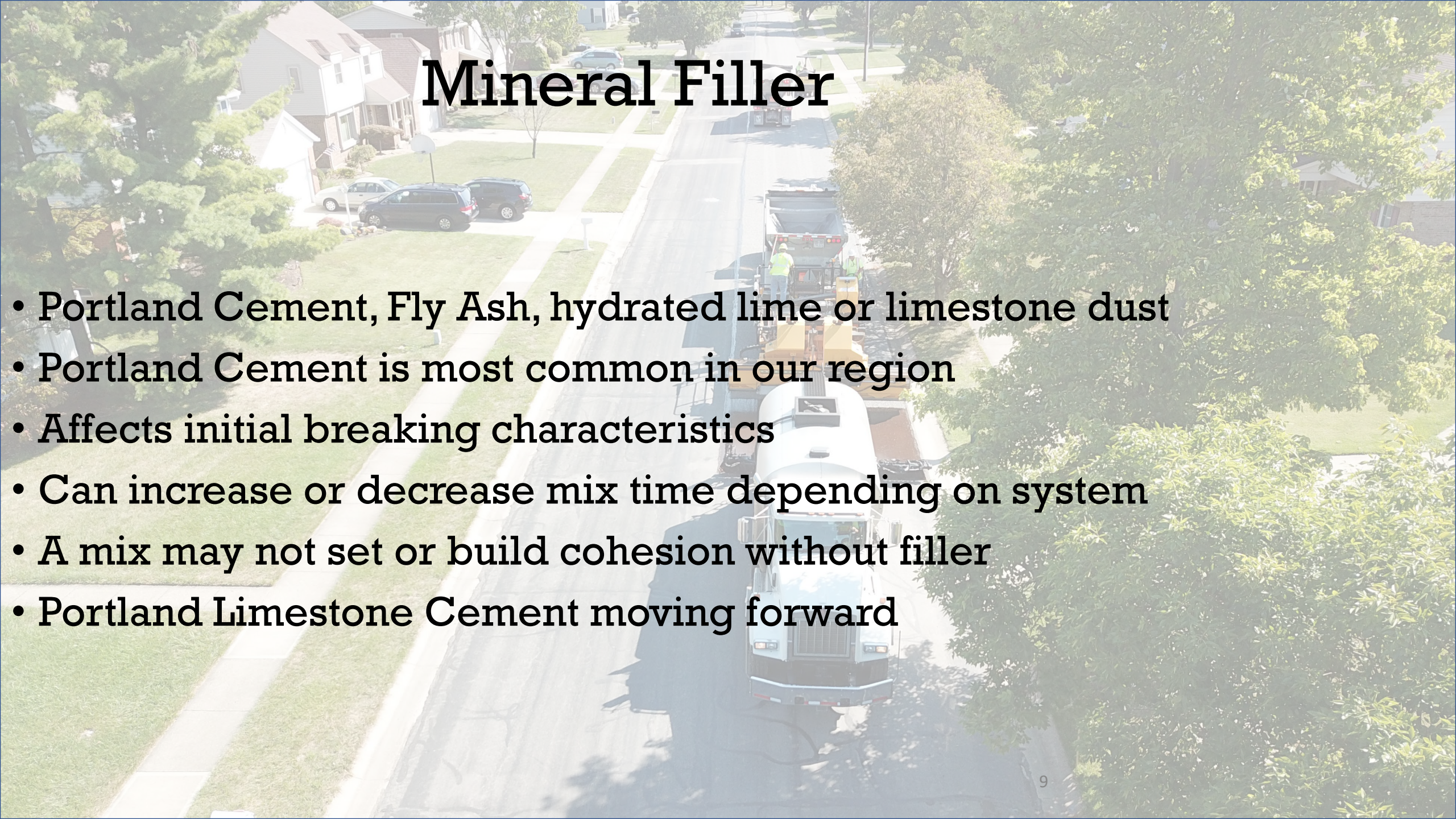


- No. 4 sieve will have a significant impact on surface texture.
- P200 contributes the most surface area to mastic system
- P200 impacts reactivity of mix the most

Sand Equivalency

- Distinguish clay and sand fines in P200
- Can have dramatic effect on reactivity of agg in mix
- Quarry must understand importance
- Caution with stockpile at staging area

Mineral Filler



- Portland Cement, Fly Ash, hydrated lime or limestone dust
- Portland Cement is most common in our region
- Affects initial breaking characteristics
- Can increase or decrease mix time depending on system
- A mix may not set or build cohesion without filler
- Portland Limestone Cement moving forward

Asphalt Emulsion

- CQS-1HP
- AC base selection
- Emulsifier selection/dosage
- pH effect
- Polymer type and %
- AC residue %
- Particle Size

Asphalt Emulsion

- Emulsion AC residue and mix AC residue both have an impact on mix time
- Production consistency
- CQS-1HP may settle but should not separate
- Emulsion temp < 135 F

Water

- Potable source is a good baseline
- Other sources should be evaluated in the lab
- pH and contaminants can impact mixes
- Water in aggregate must be accounted for
- Proportioned for mix consistency, not mix time

Additives

- Liquid additives
  - Often similar chemicals used in the asphalt emulsion
  - Used to modify mix time over the heat of the day
  - Must be verified during the mix design process
  - Be aware of dilution ratio in the field (varies by paver)

- Solid additives
  - Fibers for mix consistency and crack reduction
  - Powdered dyes for colored pavement

Mix Design Testing

Test	ASTM	ISSA	Spec
Mix Time @77F (25C)		TB 113	120 seconds min
Wet Cohesion	D3910	TB139	
@30 Minutes (Set)			12 kg-cm, minimum
@60 Minutes (Traffic)			20 kg-cm min or Near Spin
Wet Stripping		TB 114	Pass (90% min)
Wet-Track Abrasion Test	D3910	TB 100	
1-hr Soak			538 g/m2 max
6-day Soak			807 g/m2 max
Lateral Displacement	D6372	TB 147	5% max
Excess Asphalt by LWT Sand Adhesion		TB 109	50 g/ft2 max
Saturated Abrasion Loss	D6372	TB 144	2.0 g max

TB-113 Mix Testing

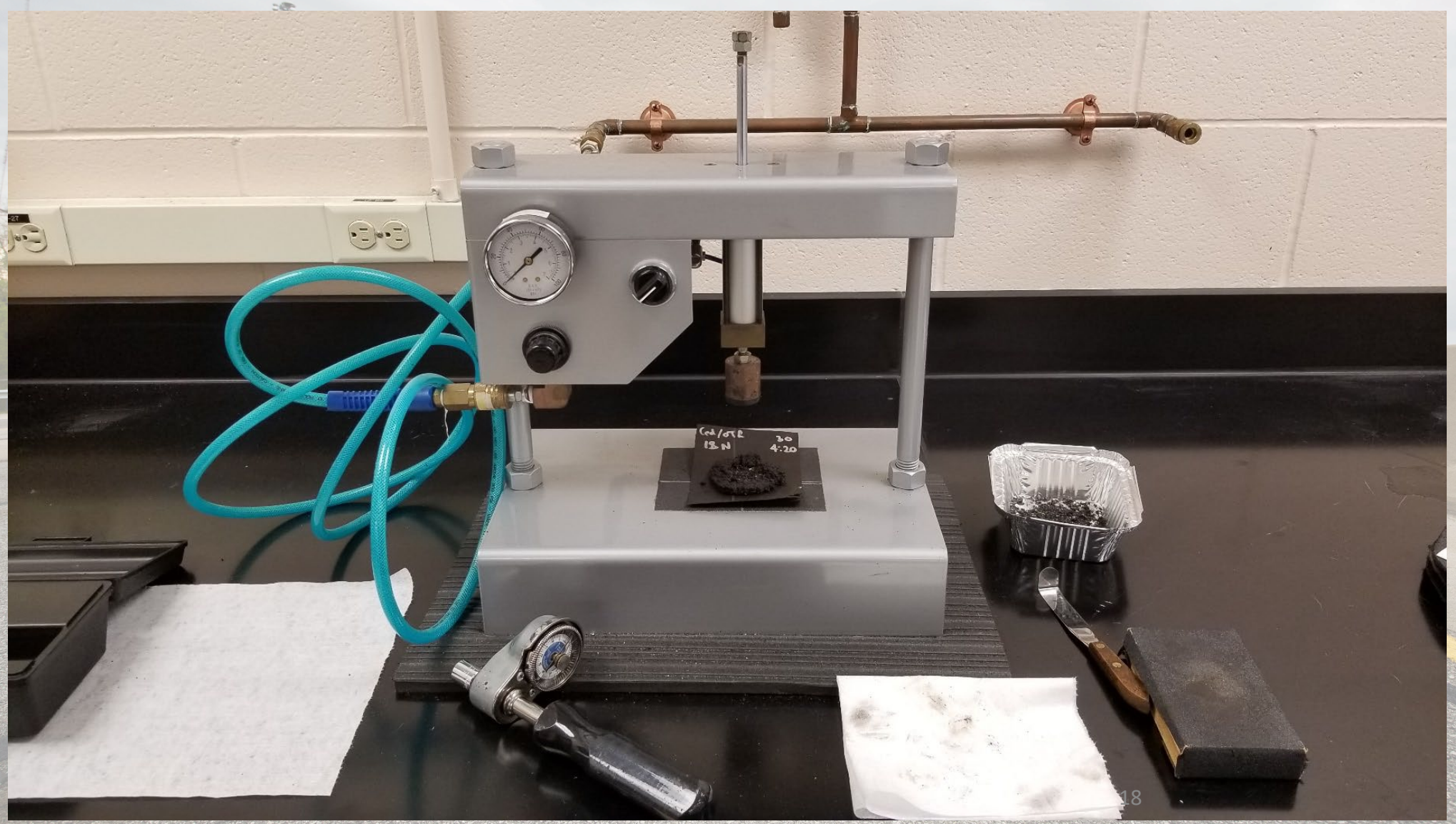
TB-113 Mix Testing

- Critical first step
- Establish mix proportions
- Ensure workability of mix
- Liquidity and consistency
- Pour off for blot test
- Elevated temperature mix test to simulate field (100 F)

- Balanced against cohesion

TB-113 Mix Testing

TB-139/D3910 Wet Cohesion



Wet Cohesion

- Measure cohesion build-up at 30 and 60 minutes
- "Qualnitative" test looks at torque value and mode of rupture
- 30 minutes verifies "time to set"
- 60 minutes verifies "time to traffic"
- Mold thickness varies by agg gradation
- Modes of rupture:
  - Normal (N), Near Spin (NS), Spin (S), and Solid Spin (SS)

Wet Cohesion

TB-100/D3910 Wet Track Abrasion

Wet Track Abrasion

- Determine minimum asphalt content of mix
- One hour water soak
  - Measure of mix integrity. "Junk Test"
- Six day water soak
  - Moisture susceptibility
  - Worst possible conditions
- Overall quality test

TB 109 & 147 – Sand Adhesion & Lateral/Vertical Displacement

TB-109 and TB-147 (D6372)

Lateral Displacement

- Loaded Wheel Test (LWT)
- Determine maximum asphalt content of mix
- Check for excessive compaction
- Sample cured at ambient temperature and in oven

Excess Asphalt by Sand Adhesion

- Another max AC test
- Possibly redundant to TB-147
- Check for bleeding/flushing
- Heated sand is applied to compacted LWT sample
- Better for high residue mixes

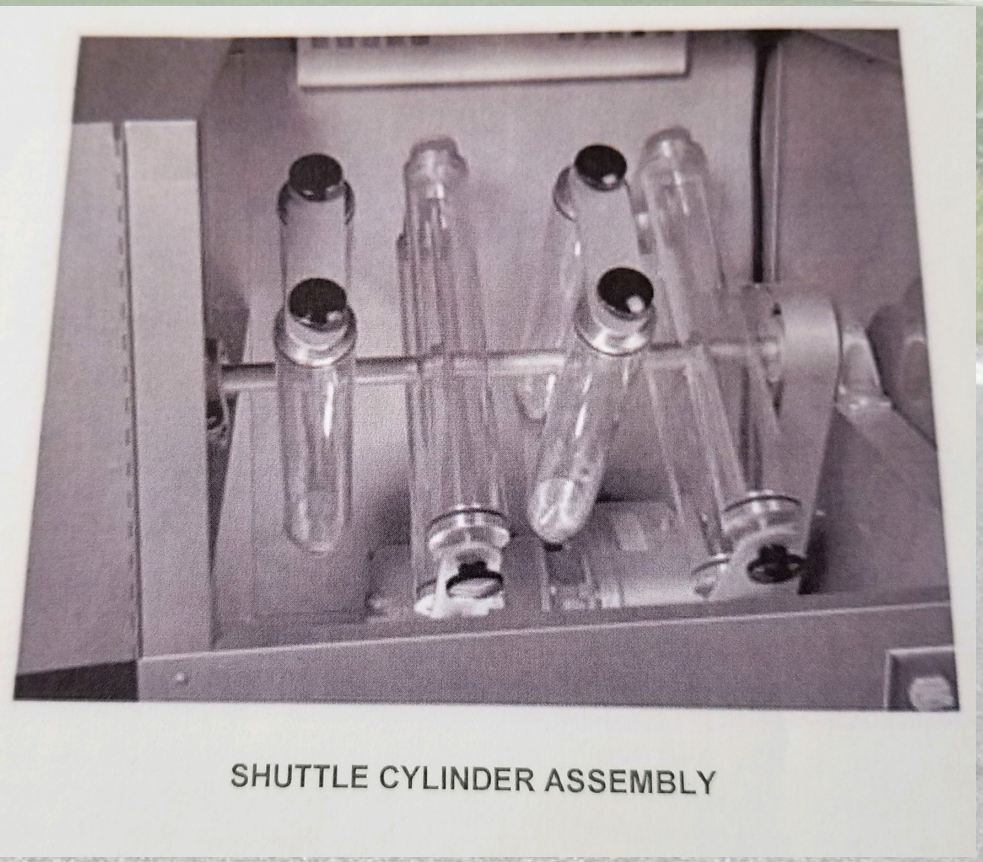
TB-114 Wet Stripping

TB-144/D6372 Saturated Abrasion Compatibility

- Also called SBR
- Mastic compatibility
- Fixed AC residue (8.125%)
- Only agg passing No.10
- Material is batched and compacted at 60 C
- Weighed dry, soaked, and soaked-abraided

U.S. Sieve Size, %
No. 30 to No. 10 = 35%
No. 50 to No. 30 = 25%
No. 200 to No. 50 = 22%
Pan to No.200 = 18%

Saturated Abrasion Compatibility



SHUTTLE CYLINDER ASSEMBLY

Bringing Everything Together

Aggregate data

Supplier: Hanson

Type: Type II

Sieve	% Passing	Spec
3/8 in.	***100%***	*100*
No. 4	***97%***	*90-100*
No. 8	***72%***	*60-90*
No. 16	***47%***	*40-75*
No. 30	***31%***	*25-50*
No. 50	***21%***	*15-30*
No. 100	***15%***	*10-21*
No. 200	***11.1%***	*5-15*

Quant eff of moist
0%-98.5 lbs/cu. ft.
1%-95.3 lbs/cu. ft.
2%-91.1 lbs/cu. ft.
3%-88.0 lbs/cu. ft.
4%-85.7 lbs/cu. ft.
5%-85.1 lbs/cu. ft.
6%-85.9 lbs/cu. ft.

Soundness	LA Abrasion	Sand Eqv
1.9	**28**	**75**

Moisture%
3%

Emulsion data

Supplier: Terry Asphalt

Type: CQS-1hP

Test on emulsion	Result	Spec
Residual solids, pct.	**66.7**	*62.0 min.*
Storage stability, pct.	**0.8**	*1 max*
Particle charge	**Positive**	*Positive*
Viscosity, Saybolt, 25°C, sec.	**40**	*20 - 100*
Sieve, pct.	**0.00**	*0.10 max*

Test on residue	Result	Spec
Penetration, 25°C, dmm	**53**	*40-90*
Ductility, 25°C, cm	**82**	*40 min*
Elastic recovery, 10°C, pct.	**60**	*45 min*
Solubility in TCE, pct.	**99.8**	*97.5*
Softening point, °C	**63**	*60°C min.*

Job Identifiers: Breathitt County

KYTC 20xx11

Project No. / Contract ID: FD05 013 0015 000-xxx

Customer: Strawser Construction

Job Mix Formula

Component	Amount
Aggregate	100%
Cement	1.0% ± 0.5%
Tot. water (avg. agg moist. 3%)	9.0% ± 1.0%
Emulsion	11.7% ± 0.5%
Residual	7.8% ± 0.3%
Additive	0% ± 0.04%

Designed by: B. Behrens

QA Technician

2/3/2023

Mixture performance data

Test		Result @ 7.8%		Spec
Mix time @ 77F (25C), TB113		160 seconds		Ctrl to 120 Sec. Min.
Mix time @ 104F (40C), TB113		45 seconds		Ctrl to 35 Sec. Min.
Cohesion @ 30min, TB139		14 N kg-cm		12 kg-cm Min.
Cohesion @ 60min, TB139		21 N kg-cm		20 kg-cm or NS Min.
Wet stripping test, TB114		99%		Pass (90% Minimum)
WTAT 1 hour, TB100		130 g/m2		538 g/m2 Max
WTAT 6 day, TB100		395 g/m2		807 g/m2 Max
Lateral displacement, TB147		0.92%		5% Maximum
Excess asphalt/sand adhesion, TB109		21 g/ft2		50 g/ft2 Maximum
Schulze-Breuer and Ruck, TB144		1.1 g		2.0 g max

Questions?

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Thank You!