Moisture Sensitivity Testing
PAPA Regional Technical Meetings 2016

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ISSD

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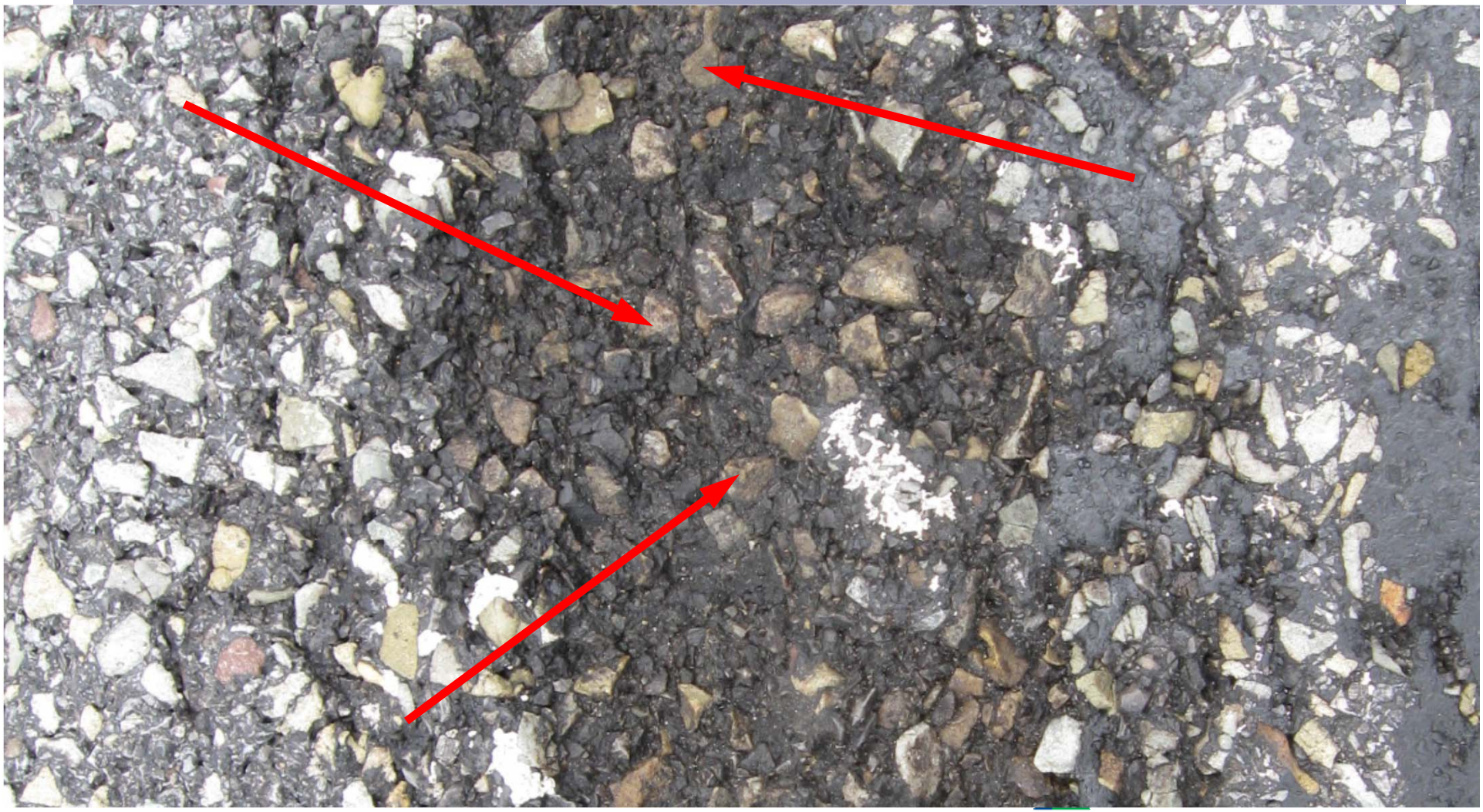
Stripping



Indications of a Problem

- Had severe and obvious problems with the premature deterioration of some asphalt mix designs with certain aggregates.
- Districts with moisture damage issues were forced to **require** minimum amounts of liquid anti-strip additives to mitigate moisture damage problems.
- Mix designs in border areas with other states needed anti-strip when used in other states but not in PA.
- No mix designs ever seemed to fail PA modified AASHTO T283 testing needing anti-strip.

Research Project Started

- COST BENEFIT ANALYSIS OF ANTISTRIP-ADDITIVES IN HOT MIX ASPHALT WITH VARIOUS AGGREGATES research started 2011.

- Final report May 2015.

Test result that told us we had a problem

Test Result	Moisture Resistance of Aggregates in Mix		
	Good	Moderate	Poor
Passed	3	1	5
Failed	0	0	0
Error Rates	Type I	Type II	
	0 %	100 %	100 %

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Action Taken

- Letter to all producers of bituminous mixtures dated October 20,2014.
  - Requires all

    SRL – E and H, 9.5 mm NMAS mixes must be revaluated before being used in the 2015 construction season.
  - Any new mix designs submitted must also be evaluated under the new requirements.
  - Districts that currently require minimum anti-strip amounts for certain aggregate types will continue to require them.

2016 & 2017 Requirements

- **All wearing and binder mixes approved in 2016** must be reevaluated using the revised moisture susceptibility criteria in order to be approved in 2016.
- **All Base mixes approved in 2017** must be reevaluated using the revised moisture susceptibility criteria in order to be approved in 2017.

Overall Accuracy of Modified Lottman Procedure, Level 2 Severity as Reported in Literature

Test Result	Stripping Potential of Aggregates in Mix		
	Low	Moderate	High
Passed	18	8	5.5
Failed	1	5	17.5
Error Rates	Type I	Type II	
	5 %	61 %	25 %

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Benefit / Cost for anti-strip use

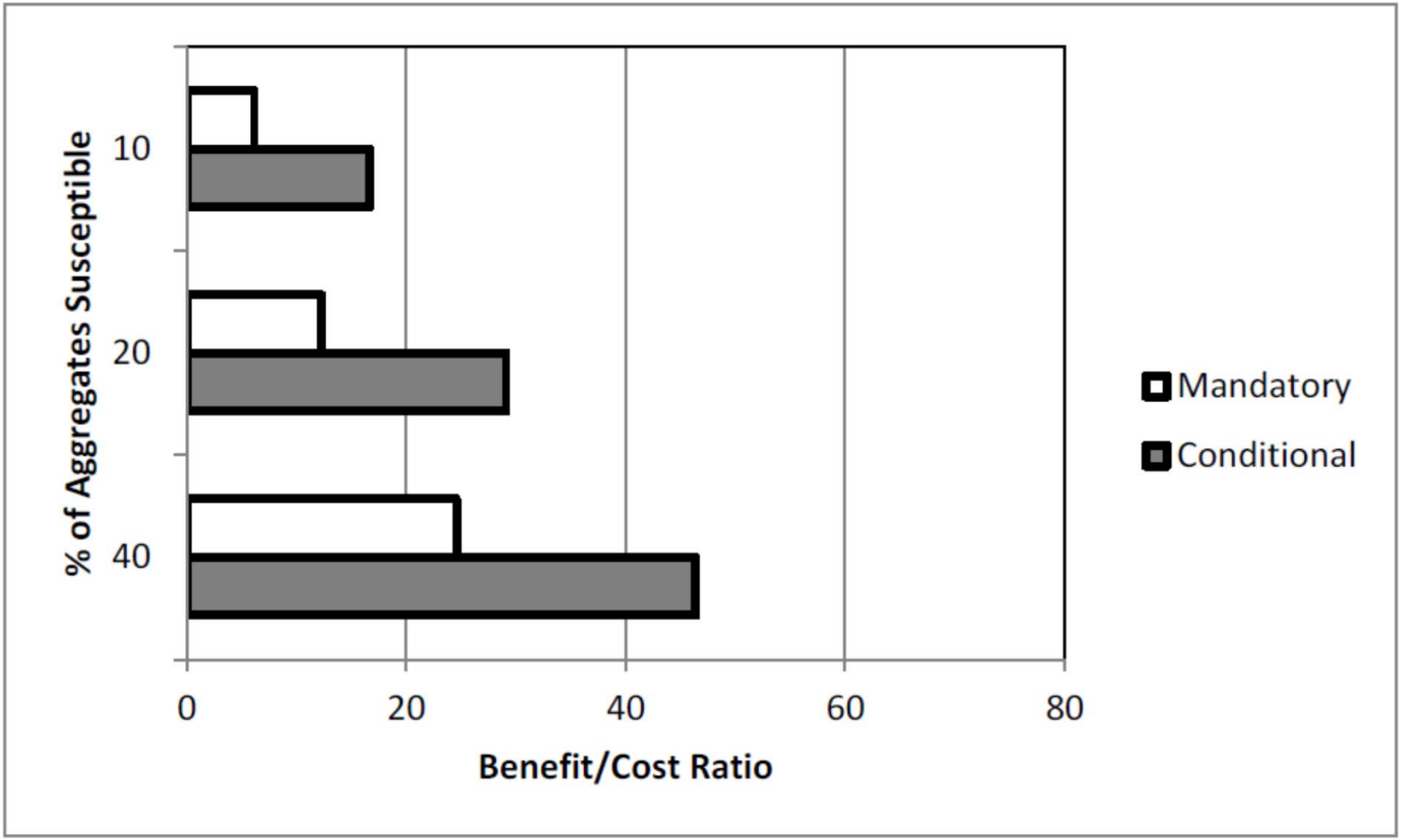


Figure 23. B/C Ratio for Optimistic Performance, without User Delay Costs, for Different Percentages of Aggregates Susceptible to Moisture Damage, Averaged for All Traffic Levels. *Legend refers to whether antistrip usage is mandatory or conditional upon test results.*

Cost Savings

Table 32. Summary Results of LCCA Comparing High-saturation Moisture Resistance Testing to No Testing, without User Delay Costs.

Performance of Susceptible Mixes/ Antistrip Usage	*Cost Savings for Percentage of Susceptible Aggregates:*		
	40	**20**	**10**
Realistic Performance/Conditional on Test Result	$8,003,222	$3,958,155	$1,935,622
Realistic Performance/Mandatory for All Mixes	$14,725,686	$7,183,226	$3,411,995
Savings, Mandatory over Conditional	$6,722,464	$3,225,071	$1,476,374
Savings, % of Total Cost	6.0	3.2	1.6
Optimistic Performance/Conditional on Test Result	$6,649,216	$3,281,152	$1,597,120
Optimistic Performance/Mandatory for All Mixes	$8,466,489	$4,053,627	$1,847,196
Savings, Mandatory over Conditional	$1,817,273	$772,475	$250,076
Savings, % of Total Cost	1.9	0.8	0.3

Anti-strip Research Implementation

- Current Specials / Requirements
  - Districts 1, 2, 4, & 9 Using special that requires:
    - 0.25% if coarse aggregate used is gravel, sandstone, siltstone, calcareous sandstone.
    - 0.25% if fine aggregate used is gravel, sandstone, siltstone, calcareous sandstone.
    - 0.5% if both fine and coarse aggregate used is gravel, sandstone, siltstone, calcareous sandstone.
  - Warm mix requires 0.25% anti-strip.

Anti-strip Research Implementation

- Proposed change
  - Require 0.25% (or minimum required by manufacturer of anti-strip) in all asphalt mixes.
    - **Will not require additional testing of mixtures.**
  - Foamed warm mix would not require additional testing but would contain the same anti-strip as the hot mix parent.
  - Require additional AASHTO T283 testing for mixes with both coarse **and** fine aggregates that are gravel, sandstone, siltstone, slag, quartz, or shale with 0.5% (or dosage rate recommended by manufacturer for mixtures that fail AASTO T 283 test at lowest dosage)

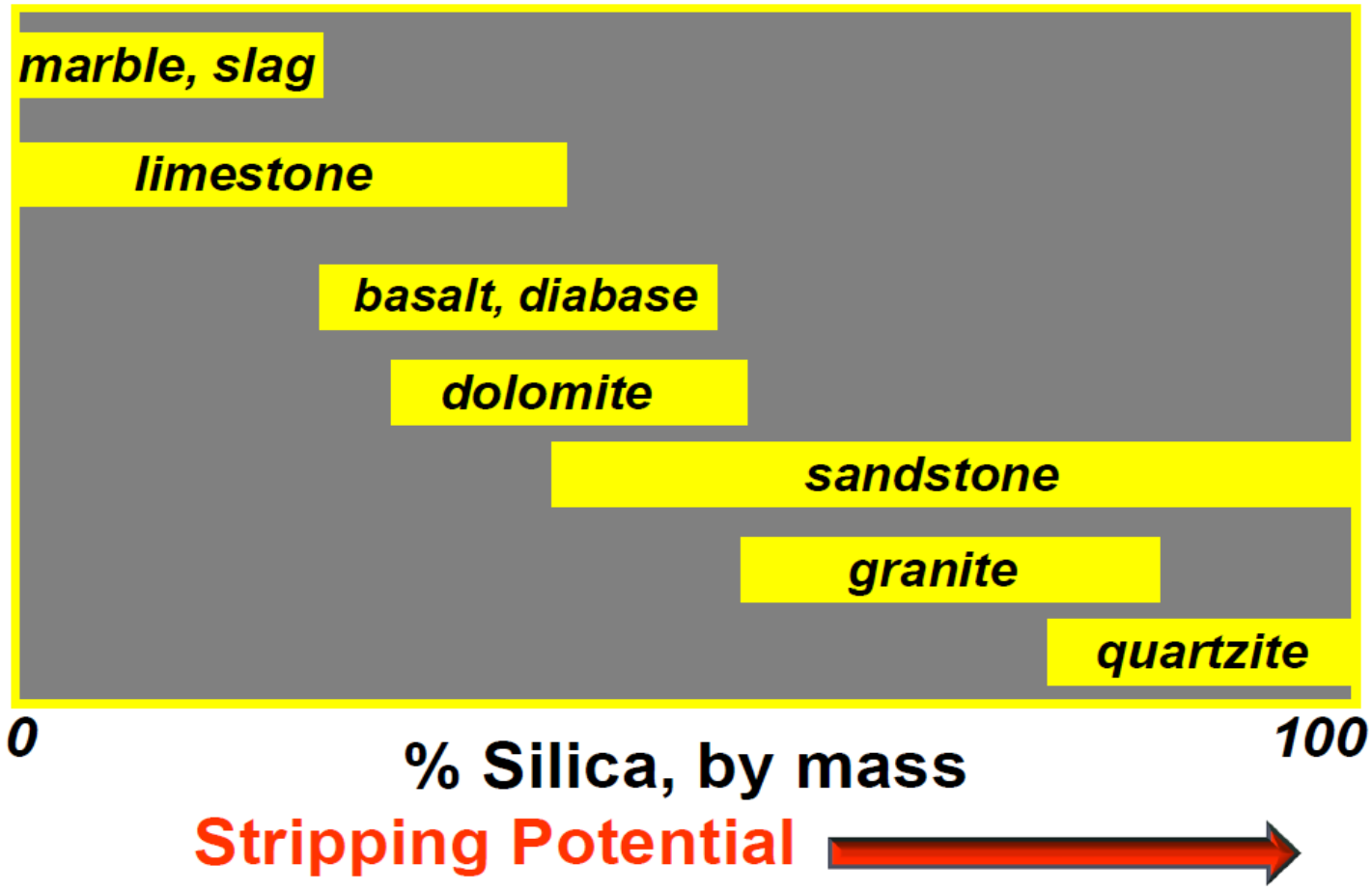
Anti-strip Research Implementation

- Proposed change
  - Require additional AASHTO T283 testing for mixes with both coarse **and** fine aggregates that are gravel, sandstone, siltstone, slag, quartz, or shale with 0.5% (or dosage rate recommended by manufacturer for mixtures that fail AASTO T 283 test at lowest dosage)
  - Producers may add higher dosage and avoid testing.

Silicates play a large role in asphalt stripping.

ArrMaz Custom Chemicals

Aggregates Rich in Silica Have More Propensity to Strip



Anti-strip Research Implementation

- Proposed change
  - Computation of anti-strip dosage.
    - Based on virgin asphalt for mixes with RBR of 0.15 or less.
    - Based on total asphalt for mixes over 0.15 RBR.

Anti-strip Research Implementation

- Please comment on the CT 1.
- Comments due - 2/4/2016

Sources

- C, Ivan Harnish, ArrMaz Custom Chemicals, 2/3/2010 PowerPoint
- Kevin Gnegy, District 9-0, Garth Bridenbaugh, Q.A., John Swalligan, District 2-0.
- Don Christensen, Advanced Asphalt Technologies, LLC
- Dennis Morian, Quality Engineering Solutions, Inc.

Questions?