Moisture Sensitivity Testing

Changes to PENNDOT testing requirements

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Stripping

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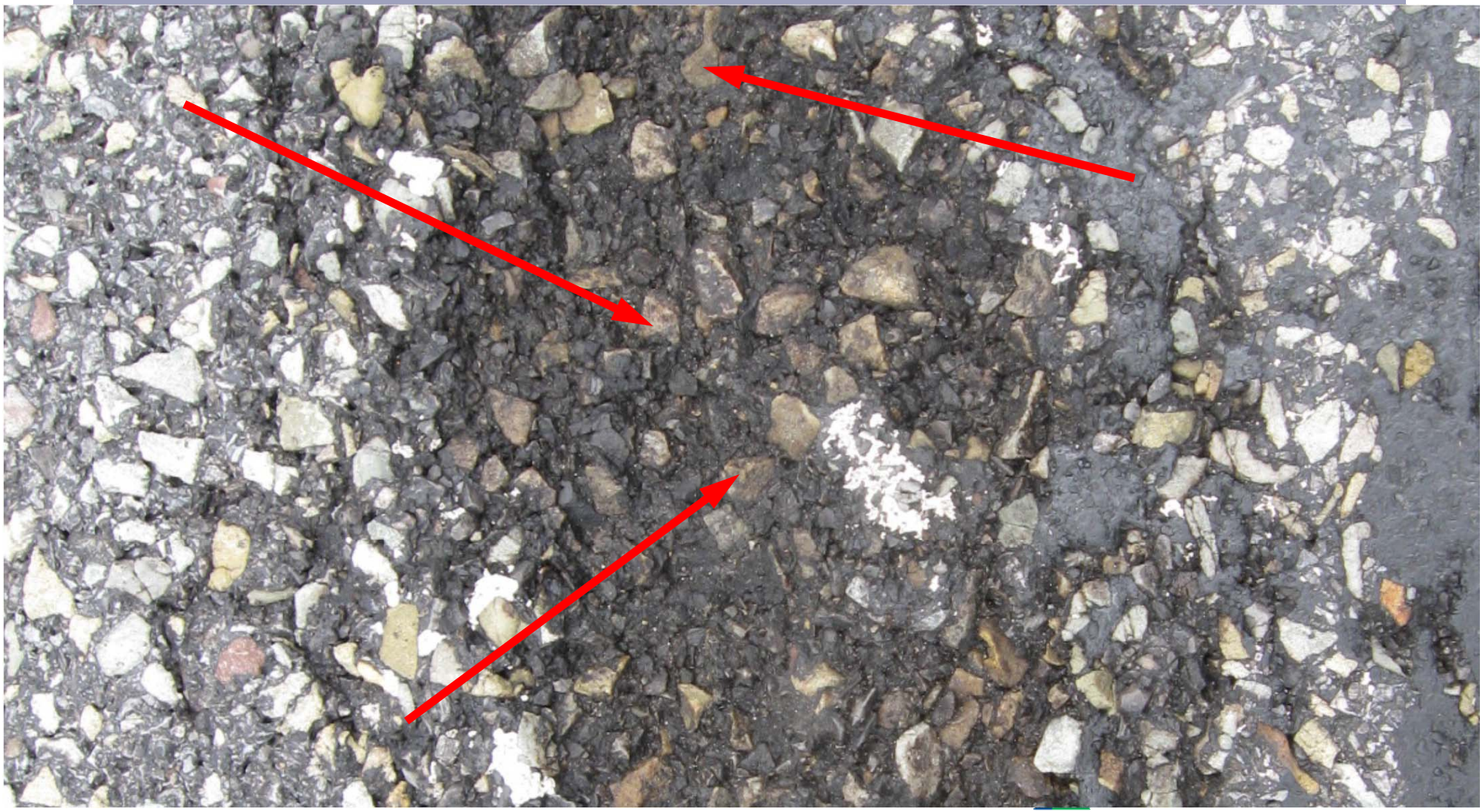
Stripping



Chemical Stripping Theory

- Water migrates into asphalt and gets into the asphalt / aggregate interface causing a negative charge to develop on both aggregate and asphalt surface over time.

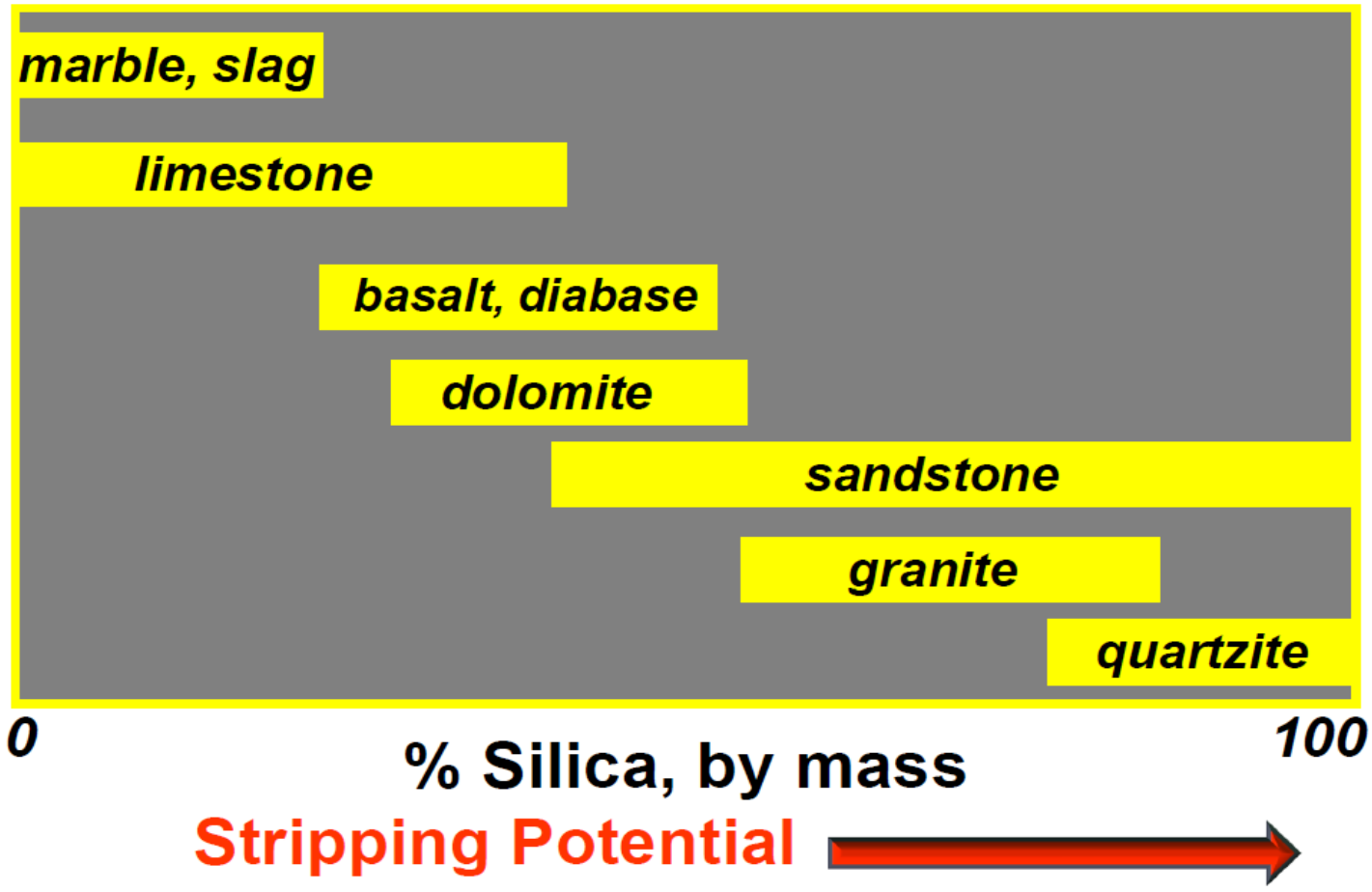
- The asphalt strips from the aggregate because of this repulsive force.

Role of Silicates in Stripping

- Most abundant mineral in the earth ‘s crust.
- Occur in almost all construction aggregates including most limestone and dolomite.
- Silica in the aggregate reacts with water yielding a negatively charged aggregate surface.

ArrMaz Custom Chemicals

Aggregates Rich in Silica Have More Propensity to Strip



Asphalt roll in stripping

- When water comes in contact with carboxylic acid groups in asphalts a reaction occurs yielding a negative charge.
- Asphalts with high asphaltenes resist this reaction (hydrophobic properties)
- Asphalts with high acidity and low asphaltenes can have poor performance even with low silica percentage aggregates.
  - This is why we need to retest mixes when we change asphalt sources.

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.
- No mix designs ever seemed to fail PA modified AASHTO T283 testing needing anti-strip.
- Mix designs in border areas with other states needed anti-strip when used in other states but not in PA.

Previous Specification

- The procedure for Moisture Susceptibility testing in PA prior to Oct 20, 2014 had several large differences from the AASHTO T 283 specification.
  - Loose mix is conditioned for 4 hours at 145^{o} C instead of 16 hours at 60^{o} C.
  - Vacuum was applied to conditioned specimens at 254 mm (10 in.) of mercury, for 30 minutes regardless of the degree of saturation.
  - Did not allow any field mixed material to be used for testing. (foamed WMA not testable)

Research Project Started

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

- Final report due May 2015.

- Unexpected results during the material testing phase of the project demanded action.

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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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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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.

Highlights of Revised Testing Requirements

- Allows plant mixed lab compacted mixture to be used for T 283 testing.
  - Gradation and asphalt content for plant mixed material must meet multiple sample (n>=3) tolerances.
  - Foamed warm mix can be tested.
- Mixture curing times revert to the T 283 curing time of 16+/- 1 hour at 60+/- 3ºC. (140+/- 5ºF)
  - Curing times do not apply to field mixed specimens.
- The conditioned specimens must reach a degree of saturation of between 70 and 80 percent.

Highlights of Revised Testing Requirements

- If the DME/DMM determines that moisture susceptibility results are suspect or inconsistent with historical data or field performance , a specified level of anti-strip additive may be required in a mixture at no additional cost to the Department prior to approval.

- **All testing is required to be witnessed unless approved by the DME.**

Highlights of 2/25/15 Clarification letter

- The mixture used to determine the Gmm that is required as part of the AASHTO T 283 test must be conditioned identically to the mixture used to produce the samples for the TSR test.

- The bulletin 27 allows the DME to accept the lowest asphalt, highest RAP mixture to represent the JMFs that use the same aggregate combination and PG binder.
  - Only applys to 15% RAP or less.
  - When the conditioned strength is within 5psi of the minimum required AASHTO T 283 TSR strength the nonRAP version should be run also.

- JMFs with different PG grades of asphalt require separate T 283 tests.

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.

Sources

- C, Ivan Harnish, ArrMaz Custom Chemicals, 2/3/2010 PowerPoint
- Kevin Gnegy P.E., District 9-0
- Don Christensen, Advanced Asphalt Technologies, LLC
- Dennis Morian, Quality Engineering Solutions, Inc.

Questions?