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Implementing AASHTO TP 110 for Alkali-Silica Reaction Potential Evaluation of Idaho Aggregates

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1. INTRODUCTION
- The Alkali-Silica reaction (ASR) is a destructive chemical reaction that occurs between the active silica SiO₂ constituents (reactive minerals) of aggregate and alkalis (Sodium-Na and Potassium-K) in the cement and other Pozzolanic materials causing a definite expansion in the presence of moisture or a pore solution of concrete.
- ASR forms a swelling gel, which can expand and cause internal stresses in cementitious materials leading to cracking, loss of strength, and eventually failure of concrete or concrete structures.
- Three essential conditions are necessary to create ASR-induced damage to concrete structures:
  - Presence of reactive siliceous components in aggregates
  - Sufficient availability of OH- ions and alkalis (Na+ and/or K+)
  - Sufficient moisture (above 75% RH).

2. OBJECTIVE
- Evaluate advantages (as compared to other test methods) associated with implementing AASHTO TP-110, a new test method to evaluate aggregate susceptibility to ASR within ITD specifications to better characterize the ASR potential of Idaho aggregates.
- The baseline ASR susceptibility for Idaho aggregates will be established. ASR potentials quantified through the AASHTO TP-110 procedure (MCPT) will be evaluated in light of ASTM C1293 and ASTM C 1260 (AASHTO T 303) test results.

3. ASR IN IDAHO AGGREGATES
- Results from Idaho Transportation Department (ITD) research project RP 212 confirmed 80% of the aggregates used in Idaho are reactive, or highly reactive.
- The primary bases for determining the reactivity of Idaho aggregate are still AASHTO T 303 or ASTM C 1260 and ASTM C 1293.
- According to RP 212, a very limited number of Idaho aggregate sources passed the ASTM C1260 test. Meanwhile, several aggregates that failed in ASTM C1260 passed the one-year ASTM C1293 test (Gillerman and Weppner, 2014).
- ASTM C 1260 gives false negative and false positive results for different aggregate samples of Idaho.

4. CHEMICAL REACTIONS INVOLVED IN ASR
- Siliceous aggregates in contact with the solution
- Expansion Pressure Exceeds the Tensile Strength of the Concrete
- Expansion of Alkali-Silica Gel
- Map Cracking in Concrete
- Surface of Aggregate Attacked by OH
- Once ASR damage has begun, expansion continues which leads to further cracking.
- Increased cracking leads to increased permeability of the concrete.
- Ingress of water into the concrete increases the alkali content, and therefore, the ASR.

5. MINIATURE CONCRETE PRISM TEST (MCPT)
- The new test method Miniature Concrete Prism Test (MCPT) was developed at Clemson University in 2013. It was developed as an alternative to the existing standard test methods such as ASTM C1260 and ASTM C1293 to evaluate aggregate ASR reactivity.
- Test duration: 8 weeks (56 days) or 12 weeks (84 days) for slow reactive aggregates.
- Test Temperature: 60.0 ± 1.7°C (140 ± 3°F)
- Maximum coarse aggregate size: 2.5 mm (in.)
- Volume fraction coarse aggregate: 65%
- MCPT: Non-Reactive: If expansion <0.030% at 56 days Reactive: If expansion >0.040% at 56 days.

6. CORRELATION OF MCPT WITH AMBT AND CPT
- During the development of MCPT, a total 33 aggregate samples were tested (19 coarse aggregate and 14 fine aggregates).
- Correlation of MCPT with AMBT and CPT are developed based on the results found for the selected aggregates.

7. IDENTIFIED AGGREGATE MATERIALS
- A total of 8 aggregate materials have been identified. Both coarse and fine materials will be tested for each aggregate type. Currently, twelve test set-ups are operating in our lab to expedite the total testing time required. The expected test completion date of our first aggregate is July 1st, 2019.
- Several AMBT (AASHTO T-303) tests were run on different aggregates to identify the non reactive reference aggregate types.

8. SUMMARY
- Implementing the MCPT test method into Idaho practice and mitigation of ASR reactivity will help increase the longevity of concrete structures.