Using Performance Tests in Quality Assurance

Defining Quality Assurance

AASHTO: Quality Assurance (QA) is the planned and systematic actions necessary to provide confidence that a product is in conformance with agency plans and specifications. It contains both Quality Control (QC) and Acceptance as two separate functions.
Differences between a lab mix design and plant produced mix

- Changes in binder source / properties
- Changes in the aggregate properties
- Breakdown of aggregate through the plant
- Incomplete drying of aggregates
- Variations in baghouse fines return
- Differences in aging and absorption
- Inaccurate plant calibration
- Different laboratory equipment
- Different technicians
- Changes made to mix proportions

Performance Testing in QA

- Performance Tests (PT) should be conducted on plant produced mix and results used in acceptance decisions much like lab compacted air voids are currently used.
- Other pay factors may still include properties such as %AC, in-place density, and joint density (and smoothness for the final layer).
- Need to establish reasonable acceptance limits for PT results considering test precision. Will you use agency results for acceptance or “validated” contractor data?
- Need to establish suitable frequencies of tests.
Performance Testing in QA

- Timeliness of QA results is critical.
- Most plants produce 200-400 tph. If tests take 4 hours to complete, then 800 to 1600 tons of mix have been produced during that time.
- The cost of that mix would be $50k to $150k.

Time to Complete Tests

- Can we establish a relationship between test results before and after aging?
  - Answer: The relationship may be specific to a given binder source and grade, and rejuvenator, if used.
Possible Options to Deal with Aging in QA

Option A, Lab Based Limit for Field Mix

1. During mix design, in addition to conducting the selected cracking test on critically-aged mix, conduct additional tests on the mix design after just short-term conditioning for absorption. Use this result as the target for unaged plant mix.
2. For expediency during production, compact plant mix as soon as mix stabilizes at the compaction temperature. Then test specimens when they reach the test temp.
3. When using this approach, no changes in mix components (e.g. binder source, rejuvenator) would be permitted.

Possible Options to Deal with Aging in QA

Option A, Lab Based Limit for Field Mix: Example

- Mix design IDEAL-CT criteria ≥ 50 for critically-aged mix.
- Mix design IDEAL-CT result on critically-aged mix = 55
- IDEAL-CT result on short-term conditioned mix design = 120. Therefore, 120 becomes the target for unaged plant mix. The lower quality limit would be the target minus a set factor based on historical variability data. This is the same way most agencies set asphalt content acceptance limits.
- A rutting test would also be required on unaged plant mix at set frequency for QA.
Possible Options to Deal with Aging in QA

Option B: Field Verified BMD

1. Require a limited production verification lot (e.g. 200-500 tons). Mix sampled from the verification lot is tested for rutting without further aging and for cracking with critical aging. The same criteria from mix design must be satisfied. An additional cracking test is conducted on unaged plant mix to become the QA target as in Option A.

2. When verification test results are acceptable, production may continue with performance tests conducted on unaged plant mix per QA frequencies.

3. Agencies may require a full set of mix verification tests at the appropriate aging condition on a periodic basis (e.g. once per week; every 10,000 tons, etc.)

Possible Options to Deal with Aging in QA

Option B, Field Verified BMD: Example

- Mix design IDEAL-CT criteria ≥ 50 for critically-aged mix.
- Mix design IDEAL-CT result on critically-aged mix = 55 ✓
- Plant mix IDEAL CT result on critically aged mix = 51 ✓
- Plant mix IDEAL-CT result on unaged mix = 108. Therefore, 108 becomes the target for unaged plant mix. The lower quality limit would be the target minus a set factor based on historical variability data.
- A rutting test would also be required on unaged plant mix at set frequency for QA.
Performance Testing in QA

- Possible Surrogate Tests?
  - Rutting Tests:
    - High Temperature IDT (D. Christensen & R. Bonaquist)
    - Compact Shear Test (F. Zhou et al, TTI)
  - Cracking/Durability Tests:
    - IDEAL-CT
    - Nflex Factor (R. West et al) IDT on N_{design} specimens
    - Cantabro (I. Howard et al)

High Temp. IDT as Rutting Indicator

- Standard SGC specimens
- 4±0.5% air voids
- Test at 9°C below the 7-day max. pavement temp. at 20 mm below surface from LTPPBInd.
- Condition specimens at test temp. before test.
TTI Compact Shear as Rutting Indicator

- Same specimen prep. as IDEAL-CT
- Test at 9°C below the 7-day max. pavement temp. at 20 mm below surface from LTPPBind.
- Condition specimens at test temp. before test.

N_{flex} Factor

- Similar to IDEAL-CT
- Uses specimens compacted to \( N_{\text{design}} \) (i.e. same specimen used for volumetric properties)
- 25°C
- 2 inches/min.
- Simple IDT load frame capable of capturing load and vertical deformation.
Cantabro Test

- SGC specimen in L.A. Abrasion machine.
- Uses specimens compacted to $N_{\text{design}}$ or to a target air void content.
- 25°C
- Abrasion loss is determined after 300 revolutions.
- Developed for open-graded mixtures.

Questions