Aggregate Handling
Best Practices

SCAPA Winter Conference 2016

Brian D. Prowell, Ph.D., P.E.
Mix Design Phase
What to do before you begin a mix design

• Read the specifications!
• Characterize aggregates and recycle
  – Stockpile gradations
  – Bulk specific gravity
  – Consensus aggregate properties
• What is plant breakdown?
• Think about construction aspects of what mix will be used for
Which stockpile gradations do you use?

- Quarries?
- Long-term historical average?
- Recent running average?
- Stockpile sample(s)?
- Communicate with quarry?
## Coarse Concrete Aggregate Properties – 20 to 5 mm Martin Marietta at Aulds Cove, Nova Scotia

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### Test Method CSA A23.2-12A, ASTM C 127
- Apparent Relative Density
  - 2.66
- Bulk Relative Density (SSD)
  - 2.66
- Absorption, %
  - 0.08

### Test Method CSA A23.2-16A, ASTM C 131
- Los Angeles Abrasion, % Loss at 500 Revolutions (Type B Charge)
  - 13.2
- Unconfined Freeze Thaw, % Loss
  - 1.0

### Test Method CSA A23.2-21A
- Micro Deval, % Loss
  - 3.3
- Soundness in MgSO4, Weighted Average Loss, %
  - 0.4

### Test Method CSA A23.2-2A-9A, ASTM C 60
- Petrographic Number
  - 110

### Test Method CSA A23.2-23A, ASTM C 142
- Clay Lumps, %
  - 0

### Test Method CSA A23.2-2A-4A, ASTM C 123
- Low Density Granular Material, %
  - 0

### Test Method CSA A23.2-13A, ASTM D 4791
- Flat and Elongated Particles, %
  - (4:1)
  - 0

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**AMS LLC**
# Product Quality Summary Report

Rougemont Quarry CA217
#34'S, #44'S, #67 & #78M Gradation Report

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Where does breakdown occur?

• During loading and unloading,
• In transportation
  – Barge,
  – Rail,
  – Truck,
• Stockpiling,
• Going through plant!
Recommended Steps

- Communicate with quarry regarding expected changes – remember quarry serves multiple customers,
- Look at recent running average,
- Adjust, if quarry values, for expected breakdown based on historical data,
- Sample stockpile and run washed gradations,
- Base mix design on expected gradation quarry is to supply,
- Batch to match expected gradation.
Best Practice

• One of our clients develops targets and range with quarry,

• Gradation data shared between quarry and contractor
  – Quarry provides QC gradations
  – Asphalt plant provides sample gradations of new material

• Regular meetings to discuss
Aggregate Specific Gravity

- Apparent
- Effective
- Bulk
Aggregate Specific Gravity

- Bulk specific gravity used to calculate voids in mineral aggregate – critical
- Apparent always largest, then effective, bulk gravity always smallest
- Gravity can change between ledges in a quarry or if material blended between two aggregate types
- Correction factor, between effective and bulk, established in design, used for production
Batching Samples

• Fractionate each aggregate to No. 8 sieve
  – Recommended by Asphalt Institute. We do not like this method due to potential for fines to segregate

• Fractionate each aggregate to No. 200
  – If stockpile aggregates do not match what quarry expects to produce.

• Bulk batch
  – Essentially what a plant does
Account for Plant Breakdown

- Goal of mix design is to match plant production
- Aggregate will breakdown tumbling through plant
- Goal to return baghouse fines to mix. In a perfect world would have storage silo and meter back into mix
- Need to add baghouse fines to mix design to account for, typically 1.0 to 3.0%
No matter what method of batching you use, you need to run a washed gradation to confirm that what you think you batched is what you really batched!
Controlling Gradation in Production

Stockpile Management
Operations

- How are stockpiles built?
- How does loader work though pile?
- What is the minimum amount cold feed bin can consistently feed?
- What is the maximum amount you should feed through a single bin?
SEGREATION IN A PILE

LARGER PARTICLES ROLL TO THE OUTSIDE
Dump aggregates in piles not larger than a truckload.

Make piles so they stay in place and do not roll down slopes.

Use numerous small piles.
Running equipment on pile tends to cause more breakdown.
Push it over the edge "DO NOT THROW IT!!"
Make sure your stockpiles are pushed off and properly mixed to insure that our customers get consistent products.
Keep stockpiles separated to prevent contamination and commingling
Proper separation?
Shape Matters

• Specifications include:
  – Flat and elongated particles
  – Fine aggregate angularity

• Shape, particularly coarse aggregate shape, effects how aggregates pack together and aggregate breakdown
  – Cubical aggregates pack together better = lower VMA
  – Less breakdown with cubical aggregates
Deleterious Material
Deleterious Material
1997 Virginia Asphalt Association Survey:

What determines % of RAP used?

- 10% of producers said specification limits set by VDOT (20% surface, 25% base).
- 34% of producers said they used maximum permitted without changing binder grade.
- 58% of producers said their RAP dust content (-200’s) determined their RAP use.
Basic Goals of Processing RAP

- Create uniform stockpile(s) of RAP from various sources,
- Separate large agglomerations (chunks) of RAP to a size that can be heated and broken apart during mixing, and
- Minimize generation of additional dust

Break asphalt bonds not rock!
RAP Processing Mistakes That Limit RAP Usage

• Sizing all RAP to a 5/8” or 9/16” top size - crushing old asphalt mixes that contain aggregates larger than 1/2” creates excess fines (-200’s).

• Combining milled material with material from the RAP crusher: Milled material typically has 4-8% more fines (-200’s) than processed (crushed) RAP.
Fractionated RAP

Coarse Fraction
- Still contains particles finer than screen size
- Lower AC%
- Lower -200

Fine Fraction
- +1.0% higher AC than coarse fraction
- 2-3% higher -200
Keep RAP/RAS Dry to save Fuel!
Summary

- Design mixes using expected gradation
- More stockpiles allow mix to be adjusted
- Provide quarry with targets – Communication!
- Best practices for handling and stockpiling
- Loader makes a difference!
- Minimize dust creation when processing recycle!
Questions?

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