2013 CCSA Pavement Preservation Workshop

Materials Lab Testing – Talking points for Scott's presentation

Sampling = the Key to accessing without bias a material's property

From California Test Method (CTM) 125 sampling - Representative sampling is defined as the taking of all materials in the same proportion as they exist or will be used. Good sampling practices must be followed during the process of obtaining materials or products for testing. If the sample does not represent the true conditions of the material under consideration, the subsequent test results and analysis of the data will be erroneous.

Aggregates come in different shapes and sizes, coarse and fine, wet and dry and from stockpiles, belts, plants or from the roadway. Knowing sampling protocols for each different situation will ensure that a representative sample of the material being incorporated into the work is taken. CTM 125, Test Method for Sampling Highway Materials and Products Used in the Roadway Structural Sections, covers the sampling of aggregates from HMA & Concrete plants, windrows, roadways, transportation units, and stockpiles. Each of these sampling points has a specific procedure outlined to obtain a representative sample.

Example: Sampling aggregate from a stockpile (from CTM 125)

It is very difficult to ensure unbiased samples when sampling from stockpiles. This is due to segregation that occurs when material is stockpiled and coarser particles roll to the outside base of the pile. For all coarse aggregates, the use of a loader to develop a separate, small sampling pile composed of materials drawn from various levels and locations in the main pile is recommended. Then the top half of the new pile is dragged off and shovels full of material are taken from the remaining half of the pile. When a loader is not available, samples from stockpiles should be made up of at least 3 portions, 1 each from the top third, at the midpoint, and at the bottom third of the volume of the pile. A board shoved into the pile just above the sampling point can prevent further segregation.

The following are some basic tests used to evaluate material from a representative sample

Sand Equivalent often called the "SE" test

From ASTM D2419 – The purpose of this test method is to indicate, under standard conditions, the relative proportions of clay-like or plastic fines and dust in granular soils and fine aggregates that pass the 4.75mm (No. 4) sieve. The term "sand equivalent" expresses the concept that most granular soils and fine aggregates are mixtures of desirable coarse particles, sand, and generally undesirable clay or plastic fines and dust.

Why is an SE important? Too many **claylike** or **plastic fines** can be detrimental to the aggregates' ability to bond with asphalt binder or emulsion, resulting in coating issues, and can cause a stability issue with

HMA or aggregate base materials. For example, in HMA, a low SE will hinder the asphalt binders' ability to adhere to the aggregate resulting in inconsistent coating and discoloration. Also, a low SE will increase the claylike or plastic fines percentage passing the No. 200 sieve causing the HMA to become more susceptible to plastic deformation (mix stability).

Summary of Test Method from ASTM D2419 – A measured volume of soil or fine aggregate and a small quantity of calcium chloride solution are poured into a graduated cylinder and are agitated to loosen the claylike coatings from the sand particles in the test specimen. The specimen is the "irrigated" using additional working calcium chloride solution forcing the claylike material into suspension above the sand. After a prescribed sedimentation period, the height of the clay is read and the height of the sand in the cylinder is determined. The SE is the ratio of the height of sand to the height of clay times 100. The SE test can only identify the presence and relative amount of fine material, it does not identify whether the material is actually clay or plastic. Consequently a material may show a low SE but perform very well because the fines are not Clay or Plastic but just fine dust. In fact, fine dust depending upon its character can help act as an extender in asphalt mixes.

Gradation

From ASTM C136 – This test method covers the determination of the particle size distribution of fine and coarse aggregates by sieving. This test method is used primarily to determine the grading of materials proposed for use as aggregates or being used as aggregates. The results are used to determine compliance of the particle size distribution with applicable specification requirements and to provide necessary data for control of the production of various aggregate products and mixtures containing aggregates.

Gradation can have many impacts on a product or mixture. Gradation can provide, among other things, the structural value needed for a product in pavement construction applications (HMA, PCC), provide the durability necessary in pavement preservation applications (Chip seals, slurry seals, BWC), and provide the aggregate structure/packing needed in order to obtain certain properties in a HMA mix (VMA, air voids, VFA, etc.). Controlling the gradation in the production process by accurately measuring the particle size distribution is very important in order to maintain consistent properties and provide a quality product.

Summary of Test Method from ASTM C136– A sample of dry aggregate of known mass is separated through a series of sieves of progressively smaller openings for determination of particle size distribution.

Durability

From CT 229 – This test method describes the procedure for measuring the relative resistance of an aggregate to producing clay-sized fines when subjected to prescribed methods of inter-particle abrasion in the presence of water.

From ASTM D3744 - The durability index results have been correlated with aggregate performance in various construction applications, including: aggregate base, permeable material for backfill, fine concrete aggregate, and riprap for slope protection. A minimum durability index is permitted to be specified to prohibit the use of an aggregate in various construction applications that is prone to degradation, resulting in generation of clay-like fines. Although the application of this test method has been limited to aggregates for specific construction uses, the possibility exists for expanding the application of this test method to control the quality of aggregates used in other areas of construction, such as aggregates for use in HMA, coarse aggregate for use in PCC, and aggregate for use as railroad ballast. As we all know, the presence of or generation of clay-like materials in construction materials is detrimental to the quality of the product.

Summary of Test Method – This test can be run on both fine and coarse aggregate. Separate and different test procedures are used to evaluate the coarse and fine portions of a material. A sample of the coarse aggregate is prepared to a specific grading and then washed in a mechanical washing vessel for a 2-min. agitation time. After discarding the passing 4.75mm (No. 4) material, the washed test sample is then dried. The coarse aggregate test sample is then agitated in the mechanical washing vessel for a period of 10 min. A representative portion of the resulting wash water and minus 75-um (No. 200) size fines is collected and mixed with a stock calcium chloride solution and placed in a plastic cylinder. After a 20-min. sedimentation time, the level of the sediment column is read. The height of the sediment value is then used to calculate the durability index of the coarse aggregate (Dc).

The fine aggregate sample is prepared by washing a specific quantity of the material in the mechanical washing vessel for a 2-min. agitation period. All minus 75-um (No. 200) is washed from the sample through a 75-um (No. 200) sieve and discarded. The plus 75-um (No. 200) fraction is then dried. The fine aggregate sample is then tested by the Standard Sand Equivalent Test Method except for modifications to the test sample preparation and duration of the shaking time. The mechanical shaker is required. A shaking time of 10 min. instead of 45 s is used. The Df is then calculated the same as an SE.