QUARTERLY PROGRESS REPORT

September 1, 2016 to November 30, 2016

PROJECT TITLE: Use of Solid Wastes in Asphalt and Concrete

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COMPLETION DATE: May 31, 2017 **PHONE NUMBER: 352-392-0846**

PROJECT WEBSITE: https://www.essie.ufl.edu/home/townsend/research/bu/hc15/

Work accomplished during this reporting period:

A mobile screening machinery vendor was contracted to process stockpiled combined ashes from a mass burn waste-to-energy (WTE) facility in central Florida. Graduate and undergraduate students assisted in the field screening of this combined ash to obtain an ideal particle size distribution for use as aggregate. The target particle size range was 1/4" to 3/4" for use as concrete and asphalt coarse aggregates. Samples of this screened ash fraction were collected in accordance with ASTM D75, Standard Practice for Sampling Aggregates, and transported to UF to assess the potential of using them as aggregate material.

The gradation of this ash fraction was then determined at UF's labs using ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates. This step is particularly important for developing a Superpave mix design for asphalt concrete. The gradation of an asphalt mix design plays a crucial role in the volumetrics, which determines whether a mix design meets Superpave criteria or not. Two other important aggregate properties that the UF research team tested for were specific gravity and absorptivity using ASTM C127, Standard Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate. Specific gravity describes how dense a material is relative to water (pure water = 1.0) and is a very important parameter for any portland cement concrete (PCC) or asphalt concrete mix design. Additionally, absorptivity is a very important parameter for any PCC or asphalt concrete mix design as this quality plays a role in water demand (for PCC) and asphalt demand (for asphalt concrete). Specific gravity and absorption data from this combined ash aggregate was similar to that observed from other ashes from other Florida WTE facilities.

From these tests, unique PCC mix designs were developed for this screened combined ash aggregate. A total of five concrete mixes were developed and cast each with a different replacement of screened combined ash as coarse aggregate (i.e., 0, 15, 30, 50, 100%). These

specimens were created in accordance with ASTM C192, Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory. These PCC specimens were cast as cylinders in quantities (in triplicate) to allow for three different performance tests to be performed: ASTM C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens, ASTM C469, Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression, and ASTM C496, Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens. Compressive strength testing (ASTM C39) will be conducted in triplicate at 7, 28, and 56 days of curing for each mix (45 specimens total), while ASTM C469 and ASTM C496 will be tested in triplicate at 28 days of curing for each mix (30 specimens total).

Asphalt concrete mix designs were also developed during this time period for the combined ash aggregate and two bottom ash aggregates (1/4"-3/4"). The design method used to develop these mixes was Superpave, which is the standard used for public roads in Florida by the Florida Department of Transportation (FDOT). With assistance from staff at the FDOT State Materials Office in Gainesville, FL, the UF research team was able to develop preliminary asphalt mix designs for each ash aggregate.

Work planned for the next reporting period:

ASTM C1260, Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method), and ASTM C1567, Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method), are planned to be performed on mortar bars (i.e., crushed aggregates and cementitious materials) made with various replacements of WTE bottom ash as crushed aggregate during the next quarter. Additionally, performance testing (i.e., ASTMs C39, C469, C496) on combined ash-amended PCC will be done in the next reporting period.

The UF research team will also focus on finalizing three asphalt mix designs utilizing three different WTE ash aggregates (two bottom ashes, one combined ash) over the following reporting period.

Metrics:

Graduate Students

Name	Rank	Department	Professor	Institution
Linda Monroy Sarmiento	PhD Student	Environmental Engineering	Timothy Townsend	University of Florida
Matthew Schafer	Master's Student	Environmental Engineering	Timothy Townsend	University of Florida
Chad Spreadbury	PhD Student	Environmental Engineering	Timothy Townsend	University of Florida

Stephen Townsend	Master's Student	Environmental Engineering	Timothy Townsend	University of Florida

Undergraduate Students

Name	Rank	Department	Professor	Institution
Kyle Clavier	Undergraduate Research Assistant	Environmental Engineering Sciences	Timothy Townsend	University of Florida
Sara Fox	Undergraduate Research Assistant	Environmental Engineering Sciences	Timothy Townsend	University of Florida
Edward Galvan	Undergraduate Research Assistant	Environmental Engineering Sciences	Timothy Townsend	University of Florida
Jarrod Petrohvich	Undergraduate Research Assistant	Environmental Engineering Sciences	Timothy Townsend	University of Florida

TAG Meetings:

No Technical Awareness Group (TAG) meetings were held during this period.