TVA KINGSTON ASH RECOVERY PROJECT
ROANE COUNTY EDUCATION INITIATIVE

"PHYSICAL PROPERTIES OF COAL ASH"

Abstract: The physical properties of coal ash make it suitable for a variety of uses including road and bridge construction (as an additive to concrete), soil amendment for agriculture, recreational products such as surfboards and bowling balls, and even cosmetics. These same physical properties can create challenges for characterizing ash in the environment, particularly in river sediments.

The chemical properties of coal ash, including the concentrations of various elements like arsenic and selenium, are similar to those of native soils, so chemical analysis can't be relied on to determine the presence or absence of coal ash in river sediments. TVA has utilized some sampling and analysis techniques for river sediment characterization that consider the unique physical properties of coal ash. These will be demonstrated to the students with some "hands on" and observational activities.

Coal Ash Strength

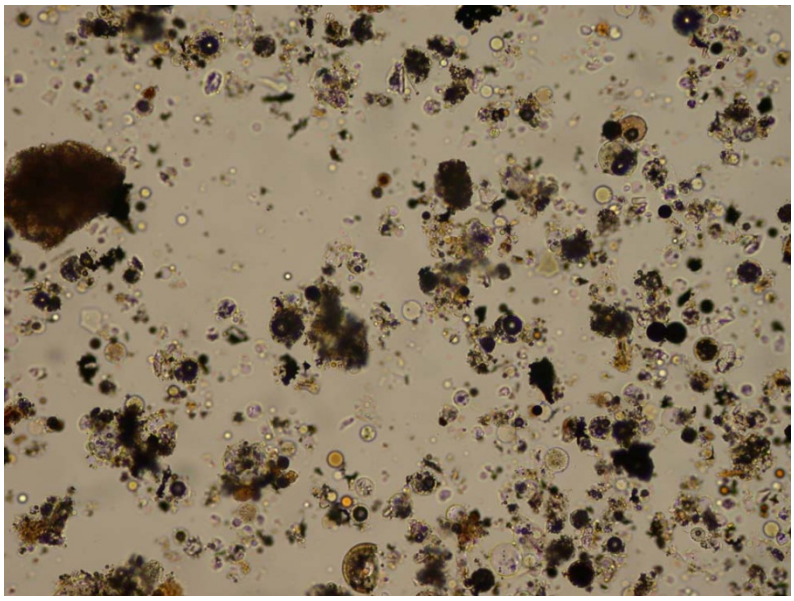
Samples of coal ash, sand, and native soil will be tested by the students with a "pocket" penetrometer. The penetrometer provides a measure of structural strength and demonstrates one of the properties of coal ash that makes it desirable for use a concrete additive. In fact, the concrete structures of the Metro subway in Washington, D.C. used substantial quantities of coal ash.

Pocket Penetrometer

Microscopic Examination of Coal Ash

Coal ash is comprised of spherical particles, including those called cenospheres. A polarizing light microscope (PLM) will be set up for students to examine the difference between coal ash and native sediments, which have an irregular appearance. Ash particles have a characteristic spherical shape that is readily observed under the microscope. The spherical particles can also be determined by touch. Students will feel a small quantity of ash (through a plastic bag) and compare it to the feel of sand or gravel. This "tactile" observation is often used in the field by TVA's soil scientists to confirm visual observations.

The students will be provided micrographs of actual samples collected from the Emory River and asked to determine what percentage of the samples might be ash. Teachers will be furnished with the answers for further discussion.



Polarizing Light Microscope Image of a Sample Containing ~70% Ash

<u>Cenospheres</u>

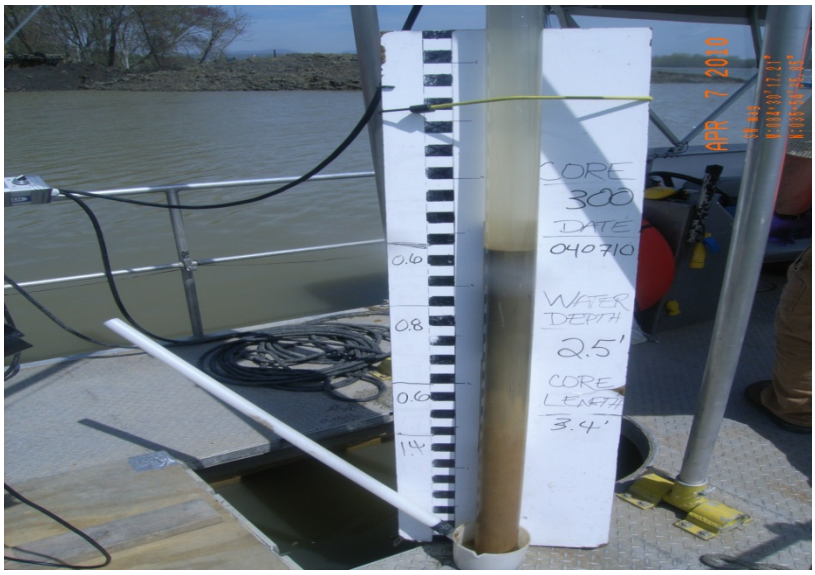
Another unique property of coal ash is the presence of cenospheres. These spherical particles trap gas as they are formed during the coal combustion process. They typically float on water, and in large quantities, have appearance of a "scum" on the water surface. TVA had several crews with land-based and barge-mounted vacuum trucks to clean areas down river from the spill where cenospheres collected and became a visual nuisance. Students will be able to observe a jar of water with the same cenospheres that they have observed under the polarizing light microscope.

Photograph of Cenospheres Aggregated Along a Riverbank

River Bottom Core Sampling

As the penetrometer tests indicated, ash can be difficult to penetrate. When TVA was trying to determine where the thickest ash deposits in the Emory River were to guide dredging, standard gravity-drop core samplers typically used for river bottom sediment sampling could not penetrate deep enough to determine the ash/native sediment boundaries. TVA outfitted several pontoon boats with a device called a VibeCore sampler. The VibeCore sampler uses a 5-6 foot long Lexan tube attached to a submersible electric motor that vibrates the tube through the river bottom sediment material. The tube creates a vacuum enabling a core sample to be brought to the surface for examination and sampling.

A core sample will be on display along with a poster of sampling photos. Students will be able to observe the difference in strata between ash and native material. Samples can be removed for the "feel test" described above and also examined under the microscope.



Photograph of a Vibecore Sample