Research Project: SP909B4P
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RESEARCH SUMMARY

GEOENVIRONMENTAL IMPACTS OF USING HIGH CARBON FLY ASH IN STRUCTURAL FILL APPLICATIONS

Problem

Coal power plants generate approximately 50% of the electricity in the United States. As a result, large amounts of coal combustion byproducts, especially fly ash, are produced annually. Only 40% of the fly ash (mainly C and F-type classifications) can be successfully reused in applications such as cement, concrete production, and soil stabilization. The rest of these materials contain significant amounts of unburned carbon and cannot be used as a concrete additive. As a result, they are largely disposed of in landfills.

There have been significant efforts to reuse high-carbon fly ash (HCFA) in highway applications such as highway base layers and embankments because it is a geomechancially strong material. However, the potential for leaching heavy metals to groundwater is the key concern that currently prevents reuse for these applications.

Objective

The objective of this study was to evaluate the leaching potential of 10 metals (aluminum, arsenic, antimony, boron, chromium, copper, iron, manganese, selenium, vanadium, and zinc) from highway base layers stabilized with HCFAs and highway embankment structures amended with HCFA and to determine its suitability for these purposes.

Description

During the study, three different laboratory tests were conducted: (1) batch water leach tests, (2) toxicity characteristics leaching procedure tests, and (3) column leach tests. Additionally, two numerical modeling analyses were conducted: WisLEACH and MINTEQA2. Analyses were conducted on eight fly ashes and two locally available sand soil materials that are mainly used in highway base layer and embankment structures. The results of the experimental and numerical tests are discussed in detail in the final report.

RESEARCH SUMMARY

Results

Based on the study results, the research team believes that the reuse of HCFAs as a stabilizing agent and for soil amendment in geotechnical applications is environmentally safe. However, designing the ratio of fly ash in the soil mixture must be done carefully. Adding fly ash greater than 20% by weight may yield an excessive amount of leached metals into the environment and groundwater which may cause significant health issues to aquatic life and humans. The following steps should be followed in the construction of fly ash-amended highway structures:

1. The chemical and physical properties of the fly ash and soil should be determined.
2. The mechanical stability of fly-ash-amended highway structures should be evaluated.
3. Leachate samples should be collected from the construction site and should be analyzed for pH and leached metal concentrations.
4. The design of base layers and embankments must be done carefully especially if the pH and leached metal concentrations of leachate exceed EPA regulation limits. Extra care should be taken for the soil-fly ash mixtures prepared with Morgantown and Paul Smith Precipitator fly ashes. The contents of these fly ashes should not be higher than 20% by weight according to the laboratory test and numerical analyses results.

Next Steps

SHA's next steps include developing a pilot specification and identifying a location to construct a fill embankment using the soil- fly ash. Once the pilot is complete, SHA will compare the results with the laboratory test data.

Report Information

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Link to Full Report

http://www.roads.maryland.gov/OPR_Research/MD-13-SP909B4P-Geoenvironmental-Impacts-Of-Using-HCFA-In-Structural-Fill-Applications.pdf