Florida Department of Transportation Research

Field Device to Measure Viscosity, Density, and Other Slurry Properties in Drilled Shafts

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Current Situation

Proper performance of the mineral slurries used to stabilize drilled shaft excavations is maintained by assuring that the density, viscosity, pH, and sand content of the slurry stay within limits set by the Florida Department of Transportation (FDOT), which are derived from past experience, research findings and/or by manufacturer-recommended values. However, the repetitive slurry testing required in the field is a time-consuming, manual process. Applying modern technology to this problem could offer more rapid and reliable testing.

A worker prepares to lower the testing device into the slurry in a drilled shaft excavation.

Research Objectives

University of South Florida researchers developed and tested a device that estimates slurry viscosity, density, and sand content within a drilled shaft excavation. The test can be performed at the surface; a slurry sample is not needed.

Project Activities

The researchers reviewed the literature regarding the use of mineral slurries in drilled shaft excavations. They focused initially on FDOT specifications, which are based on density, viscosity, sand content, and pH. Then taking each of these properties in turn, they examined current methods of measurement, concepts associated with automating the measurements, and methods and availability of applicable sensor technologies. The literature research served as the basis for the development of a conceptual slurry measurement system.

The next step was to create a working device based on conceptual designs. A set of relationships between hydrostatic pressure and flow rates were developed in the laboratory which could be calibrated to field data. The device was fabricated, tested, and calibrated. Each part of this process suggested changes or refinements of the devices. In addition to the device, a computerized data collection system was developed.

Field trials were performed first in simulated excavation settings. These tests allowed the researchers to determine field setup logistics and incorporation of depth tracking of the device as well as operating the all-in-one system under conditions of high hydrostatic pressure. Tests conducted in the simulated well (a 1 ft × 45 ft PVC pipe) made it possible to test the device in conditions beyond those that might be encountered in most construction work.

Field tests in working excavations were conducted at sites selected by FDOT District 1 engineers. These tests led to further refinements of recommended test procedures in several areas: data analysis, instrumentation, clean-up, and calibration. Viscosity, which was expected to be the most problematic measurement, turned out to be the most robust. Further use and testing of the device is expected to lead to further refinements and eventual implementation.

Project Benefits

Automated, real-time testing of slurry properties will increase the efficiency and reliability of drilled shaft operations.

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