Use of Fly Ash Stabilization in Highway Construction

Introduction

Cementitious high carbon fly ash (CHCFA), a byproduct of coal-burning power plants, has self-hardening properties in the presence of moisture, but cannot be used in concrete paving since the high carbon content absorbs air in the concrete and affects durability. The current practice is to dispose of this fly ash in a landfill. However, laboratory testing and limited field trials have shown high carbon fly ash to be a viable stabilizing material for unbound layers in highway construction projects.

Mn/DOT entered into a partnership with Bloom Consultants to evaluate the long term engineering and environmental characteristics of fly ash stablized base materials and compare these to the performance of non-stabilized materials. To this effect three 375-ft test cells were constructed at MnROAD in 2007 including the following base types with a 4" HMA surface:

- Cell 77 – Full depth reclamation of 50% HMA + 50% Class 4 gravel (non-stabilized)
- Cell 78 – Class 6 crushed stone aggregate base (from on-site stockpile)
- Cell 79 – Full depth reclamation of 50% HMA + 50% Class 3 gravel (stabilized with 14% CHCFA)

Construction Details

Stabilization of the reclaimed base with fly ash was completed in early August, following a precise sequence of events to ensure proper mixing and uniformity throughout the test cell. Mn/DOT waited one month prior to paving the test cells because of a separate agreement with an outside asphalt binder supplier. During that time an excessive amount of rain fell at MnROAD, soaking into the exposed base layers. When we attempted to pave Cells 77 and 78 on September 11, the HMA trucks sunk into the base and created ruts in excess of 4" and made it impossible to pave. The fly ash stabilized base showed no such deformation, and paving went on as scheduled. After several weeks of waiting for the rain to stop in order to dry out the base & subgrade, work continued under a Force Account Work Order. The contractor spent 3 days excavating the wet base layer, drying the subgrade, and replacing the base prior to paving on October 25. Field performance under traffic for two years has shown all three test cells to be performing well.

Successes and Concerns

For this project Mn/DOT spent an extra $10,282 per cell on the force account work to dry out the non-stabilized base materials. This is in comparison to the $8,970 for fly ash stabilization, or a 15% cost savings. A major benefit of the use of fly ash was that we were able to save six weeks of construction time by being able to pave immediately on a stable construction platform. Although the force account work will likely not be required on many jobs and although MnROAD paid a premium price for the fly ash because of the small quantity, this project serves as a useful illustration of what can happen in the real world.

The fly ash used for construction contains small amounts of mercury and other heavy metals. Lysimeters were installed in the three cells to collect and monitor leachate generated by water percolating through the pavement. The leaching analysis is ongoing to monitor whether or not trace elements are being leached out of the pavement layers. Several laboratory studies at the University of Minnesota are also investigating the leaching characteristics of fly ash stabilized material.