Beneficial Use Case Study

MnROAD Stabilized Road Base Course

Coal Combustion Product Type:
High-carbon fly ash

Project Location:
Albertville, Minnesota

Project Participants:
U.S. Department of Energy, Minnesota Department of Transportation, Washington State University, University of Wisconsin, Bloom Companies LLC, Xcel Energy

Project Completion Date:
2008

Project Summary:
High-carbon fly ash is generally regarded as substandard for use in concrete, as the carbon's absorption of air-entraining admixture can reduce the concrete's durability. However, this is not necessarily a concern in applications such as for use as a base course under asphalt pavement, where maximum density and minimal air void can help to produce a sturdier road underpinning. A U.S. Department of Energy-sponsored study undertook to compare the strength, cost, and environmental effects of a base course of reclaimed pavement materials (RPM) stabilized with high-carbon fly ash against those of traditional road base materials.

Project Description:
Three test sections were built at the Minnesota Road Research Project (MnROAD) facility, each of identical length (500 feet), asphalt surface, subbase, and subgrade layer—but each with a different base course material. The three base courses consisted of conventional crushed aggregates, full-depth RPM, and fly ash-stabilized RPM. Fly ash was supplied from unit 8 of Xcel's Riverside Generating Plant, in St. Paul, Minn., and contained carbon content of 16.35% and calcium oxide content of 22.37%.

After the test sections were built, construction costs were compared among the three base courses. Because of heavy rainfalls, the untreated-RPM and crushed-aggregate sections had to be replaced, resulting in added costs. The fly ash-treated RPM base was not affected, helping it to achieve the lowest overall construction costs. Comparing the initial energy consumption and greenhouse gas emissions associated with the three base courses, the researchers found that the high-carbon, fly ash-treated RPM had the lowest figures in both of these categories as well.

During and after the construction of the three asphalt sections, laboratory and field tests were carried out to characterize the material properties. The test results were used in the mechanistic-empirical pavement design guide (MEPDG) to predict long-term pavement performance. Tests showed that the fly ash-stabilized RPM had a higher modulus than those of crushed aggregate and full-depth RPM and, based on the MEPDG performance prediction, a service life of 23.5 years—over twice the service life of the full-RPM base (11 years) and more than three times that of the crushed aggregate base (7.5 years). Life-cycle analysis indicated that the use of fly ash-stabilized RPM as a base for flexible pavement can greatly reduce life-cycle costs, energy consumption, and greenhouse gas emissions.

SOURCE: MnDOT.