

High Reactivity Metakaolin Utilized in High Performance Virginia Bridge

The Virginia Department of Transportation and Marshall Concrete Products have included Headwaters Resources' HRM modified concrete as one of the high performance concrete mixes for the Virginia DOT "Smart Road" research project. Unlike most research that investigates one item on a limited scale in a laboratory, the Smart Road is a \$35 million combined construction and research project to investigate multiple technologies to improve the design and safety of pavements and structures.

High Reactivity Metakaolin (HRM) was a cost-effective alternative to silica fume in the concrete used in the Bridge Over Wilson Creek. The highlight of the project is the "Bridge Over Wilson Creek". A post-tension segmental cantilever structure, the bridge is a half-mile long and rises more than 175 feet above the ground. High levels of performance were required for all elements of the structure, including the concrete. The concrete had to attain 4,000 psi in 24 hours to allow for stressing of the post-tension cables, achieve the design strength of 8,000 psi in 28 days and achieve rapid chloride permeability values below 1500 coulombs at 28 days.

Initially, Marshall Concrete Products had chosen to use 640 pounds of Type I / II cement and 49 pounds of silica fume to meet the high performance standards of the project, and had placed less than 500 cubic yards in the

structure. At the same time as the early silica fume pours were occurring, Headwaters approached the Virginia DOT and Marshall Concrete Products with a proposal to use Headwaters' HRM as an economical alternative to the silica fume for the balance of the project. HRM is an engineered pozzolanic material that is manufactured by controlled low temperature calcination of high purity kaolinite clay in a rotary kiln. Headwaters manufactures HRM in Andersonville, Georgia, with further processing in Pacolet, South Carolina.

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In tests performed by Marshall Concrete Products, concrete produced with HRM exceeded strength and permeability values required by the Virginia DOT.
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Laboratory tests were conducted by Marshall Concrete Products to prove that HRM would exceed the Virginia DOT design requirements when used at the same rate per yard in concrete as silica fume. The HRM mix of 640 pounds of cement, 49 pounds of HRM, a water cementitious ratio of .35 and entrained air of 5.7% attained compressive strengths of 4,810 psi at 1 day, 6,750 psi in 3 days, 8,710 psi in 7 days and 10,150 psi at 28 days. Strength results at all ages are well in excess of the design criteria. Twenty-eight day permeability tests of the HRM mix provided coulomb results ranging from a high of 1360 to a low of 1140 coulombs – all well below the 1500 coulomb limit set by the Virginia DOT. Beginning in November of 1999, Marshall Concrete switched from the silica fume concrete mix to the HRM mix for the 3,300 cubic yard balance of the project.

Headwaters' HRM modified concrete was selected as a cost-effective alternative to silica fume in the construction of this high performance highway bridge in Virginia.



For more information or answers to questions about the use of fly ash in specific applications, contact your nearest Headwaters Resources Technical Sales Representative or call 1-888-236-6236.

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