

ASPHALT INSTITUTE
Executive Offices and Research Center
Research Park Drive
P.O. Box 14052
Lexington, KY 40512-4052
USA
Telephone 859-288-4960
FAX No. 859-288-4999\

Asphalt Pavement Doubles as Hazardous Soils Cap and Loading Area

By Roger Smith, Asphalt Institute Regional Engineer

It was a problem that could only be solved by asphalt. How do you construct a cap for a contaminated soil site that is both impervious to water and tough enough to carry heavy truck loads? The cap's primary function is to prevent surface water penetration from percolation and runoff.

Barney Vallerga, Consulting Civil Engineer of Oakland, California, and Geomatrix Consultants of San Francisco had the answer. Vallerga believed a Full-Depth asphalt pavement of minimum overall thickness was the logical choice. The critical question was how that asphalt could perform the dual function of waterproof cap and traffic bearing pavement.

The consultants were aware that an asphalt pavement designed to be waterproof may not have the strength to withstand heavy wheel loadings.

DEEP SOIL MIXING

The Bay Road site, located in an industrial area of East Palo Alto, California, was found to have contaminated soil and groundwater. After a study of the site was completed, it was determined soil remediation and capping were necessary. Geomatrix had to determine whether the soil should be removed or remediated on-site. They decided to remediate the spoiled earth on-site by deep-soil mixing.

"We found a Hazmat remediation firm that mixed the earth with silicates and portland cement to a depth of 26 feet," says Michael Rafferty, Principal Engineer and environmental scientist for Geomatrix Consultants. This reduced the leachability of the arsenic and raised the pH of the cement. The mixed earth then behaved much like a cement treated base.

There were other potential complications. "The site had a high water line and was close to the bay," says Vallerga. "Our design had to ensure that no water would percolate through the soil to the underlying groundwater." At the same time, the caps had to structurally sustain the weight of a number of 18 wheel trucks.

"We initially looked at using a high density polyethylene liner capped with several layers of sand and soil," says Rafferty. "But a thorough cost evaluation revealed that asphalt was not only more economical but more effective than a soils cap." One reason was that little or no soil had to be imported to the site.

TWO PHASE DESIGN

Vallerga and Geomatrix did a two phase design for the manufacturing facility. In the first phase they specified a 9-inch asphalt cap over one portion of the remediated site. In the second phase, they specified a 6-inch-thick cap for the back portion of the site.

Both caps were waterproof and ensured that rain water or runoff would not leach through the caps to the remediated soil beneath. Both caps were designed to structurally sustain the weight of 18-wheel trucks and heavy forklifts used at the site.

A 9-inch-thick asphalt cap was used on Phase I of the site because the underlying soil had a lower support, or R value. R values on the Phase I site ranged from 19 to 86. R values on the second site, which required a lesser, 6-inch cap, were much higher; having an average support value of about 75.

THREE LAYERS, THREE MIXES

After considering all factors, Vallerga and Geomatrix decided upon a three layer hot-mix asphalt pavement for the cap. They specified a 3-inch-thick hydraulic mix for the bottom layer. The mix, designed with high asphalt content and low air voids, is impervious to water but has sufficient strength to serve as a base course without deforming under traffic loads. The hydraulic mix was compacted to 98 percent theoretical maximum density (2 percent air voids). This type of mix will typically offer permeability less than 10^{-7} cm/sec (ASTM 2434).

The second or middle layer was a 3-inch-thick asphalt drainage layer that served as a drainage path for water entering the pavement through the surface layer or from any other source. "Any water that came through the surface course was collected by the open graded drainage course and drained from the site toward the bay," says Vallerga.

This layer also prevented hydrostatic pressures developing on the bottom layer of hydraulic asphalt. It had no density requirement.

"An anti-strip additive in the open graded mix ensured that stripping did not occur," says Frank Szerdy, Principal Engineer for Geomatrix. "The anti-strip promotes a superior bond between the aggregate and the asphalt and made the mix virtually hydrophobic." The drainage layer mix was also highly resistant to deformation under traffic loads.

The top or surface layer was a conventional 3-inch-thick dense-graded asphalt used for heavy-duty highways and industrial pavements. It sustains light vehicular traffic with a moderate number of two axle and three axle trucks, as well as some fully loaded five axle trucks. Forklift vehicles with 100 psi tire pressures travel the surface daily without scarring or deforming the pavement. The dense-graded surface mix was compacted to 92 percent theoretical maximum density (8 percent air voids).

The site was originally a wetland and was therefore regulated by the U.S. Environmental Protection Agency. Because it was a Superfund project, however; standard EPA permits were waived. Construction of the cap for Phase I began in late 1992 and was completed early in 1993. "Performance of both the drainage and loading aspects of the pavement cap have been excellent," says Szerdy. "So far; there is no visible deformation and no visible wear and tear on the surface."

Asphalt capping systems can prove very economical because cover soil does not have to be imported and simple asphalt paving techniques minimize construction time. Additionally, the paved surface gives a second life to the site.

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