Hydro-demolition is a method for removing concrete from bridge decks and concrete surfaces that uses high-pressure water and is faster and less labor-intensive than jackhammering. The process, however, creates a water-based slurry that contains high concentrations of hardened cement paste as suspended solids. This cement paste must be removed from the slurry before the water can be properly returned to the environment.

Past New York State DOT (NYSDOT) construction practices did not produce sufficient environmental controls because the concrete slurry generated by the operation rapidly plugged up the filter fabric, causing the slurry to overtop the basin. This result—known as the “swimming pool effect”—quickly proved inadequate to control the proper release of this waste material.

Moved by the State Pollutant Discharge Elimination System (SPDES) Phase II regulations and financial considerations, the NYSDOT had to find more cost-effective, environmentally friendly designs to clean up slurry generated from the hydro-demolition of the concrete decking, to prevent negative impacts on neighboring ground surfaces, and—most importantly—to prevent negative impact on the adjacent surface waters.

TESTING A NEW MATERIAL

Other DOTs have used crushed glass in the past because mixed colored glass cullet, or scraps, tends to have a low market value (about $4.50 per ton) and is usually viewed as “waste” rather than a product by most municipal recyclers. The crushed glass can be used as a substitute for granular soils, for roadway sub-base, or added to hot-mix asphalt as a granular component. It also has been used as a pre-filter for subsurface drainage lines.

Because crushed glass had been successfully used for filtration, the NYSDOT proposed to design a crushed glass filtration system. The purpose of the filtration basin is to reduce or eliminate total suspended solids (TSS) from the concrete slurry, thereby reducing one or more of the major contributors of water pollution.

The department selected two bridges on I-481, near Syracuse, N.Y., to test this fast filtration system. The design incorporated pea gravel, crushed glass, filter fabric, and hay bales to quickly filter and release the treated water back into the environment. The system was installed by Vector Construction Corp., Cicero, N.Y., as a way to save money and reduce the maintenance of the system. Since Vector planned to expedite the bridge-deck hydro-demolition with crews working nearly 23 hours a day, the developed system had to require very little maintenance.

In order to prevent the swimming pool effect, NYSDOT Region 3 landscape, environmental, and construction staff proposed a design that was both environmentally and economically feasible. Each bridge is about ¾ mile long and curbed with a series of drainage scuppers. The size of the filtration basin designed system was based on the volume of slurry to be generated by the hydro-demolition process, plus 50% of additional volume from rainfall events collected by the drainage scuppers during the operation. Subcontractor IVS Hydro Demolition Services, North Waverly, W.V., continued hydro-demolition for two weeks on each bridge, with an average production time of 21 hours per day.
The filtration system, constructed of hay bales, was 60x20x4 feet. The bales were staked in the ground over a 12-inch layer of under-drain filter material for drainage. The stone bed was pitched about 1% to 2% to allow for drainage from underneath. A highly permeable filter fabric was draped over the bales and stone, and the rest of the filtration system was filled with 3/8- to 5/8-inch crushed glass cullet from Strategic Materials Inc., of Mattydale, N.Y. (now owned by Tomra Systems ASA in Asker, Norway), to approximately 18 inches deep.

The filtration system bed was divided into "cells" by using hay bales as a wall between each cell; as one cell plugged up, a discharge pipe extended to the next one. This feature reduced the need to constantly rake the glass within the bed as the slurry started to set. Since there were wetlands near the basin (approximately 30 feet away), the existing pea gravel used for the access road did triple duty as a buffer and as a diversion structure for the effluent percolating out of the basin.

TESTING THE RESULTS

Specialists took a set of grab samples as the slurry entered the filtration system, and from the area at the base of the filter bed (the exit point) to quantify the percent removal of TSS and change in pH. Life Science Laboratories of East Syracuse, N.Y. (a New York State Department of Health certified lab) conducted the analysis, determining the average TSS concentration of the influent to be about 2950 mg/L and the effluent about 115 mg/L. This indicated a TSS removal rate of approximately 96% and a reduction of pH from 11.8 to 11.6 standard units. Although there are not any quantitative limits for a specific pollutant of concern from such operations to date, water quality violations can still be issued based on visual cues, such as turbidity.

The regional staff also has discussed the idea of placing pine mulch or peat moss around the base of the basin to promote a natural neutralization of the effluent. In other parts of the state where acid rain is a major concern, such as the Adirondacks, the high pH of the effluent may prove to be a suitable low-cost method for temporarily liming surface waters.

Although the contractor initially had reservations about using glass, it turned out to be lightweight, less difficult to manage, and more economical than stone; the contractor vowed to use it again on similar projects. Even officials from the NYS Department of Environmental Conservation—the body that regulates the SPDES program—visited the site and were pleased with the operation.

Based on the successful filtration achieved at the test site, a number of projects within the region have been designed to use crushed glass as a component for structures for temporary and/or permanent stormwater management.

The filtration system using the crushed glass cullet is a beneficial solution. The material is a recycled product that reduces the waste stream; is environmental friendly, cost-effective, and easy to handle; and most of all, it works. PW

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