0-4605-2: Stormwater Quality Documentation of Roadside Shoulders Borrow Ditches

Background

A permeable friction course (PFC) is an alternative to traditional hot mix asphalt and is produced by eliminating the fine aggregate from the asphalt mix. A layer of porous asphalt approximately 2 inches thick is placed as an overlay on top of an existing conventional concrete or asphalt surface. Rain that falls on PFC drains through the porous layer to the original impervious road surface, at which point the water drains along the boundary between the pavement types until the runoff emerges at the edge of the pavement.

Porous asphalt overlays are used increasingly by state transportation agencies, including those in Georgia, Texas, California, and Utah, to improve drivability in wet weather conditions and to reduce noise from highway traffic. Acknowledged benefits include reduced splash and spray, better visibility, better traction, reduced hydroplaning and less noise.

The impact of PFC on stormwater runoff quality has never been evaluated in the United States; however, there are several reasons to think that improved water quality may result from the installation of this material. PFC might be expected to reduce the generation of pollutants, retain a portion of generated pollutants within the porous matrix, and impede the transport of pollutants to the edge of the pavement.

What the Researchers Did

A water quality sampler was placed at the edge of pavement of Loop 360 in Austin, Texas, in February 2004 to document improvements in water quality caused by the vegetation on the highway shoulder. At that time, the pavement was a conventional hot mix asphalt. During the summer and fall of 2004, a PFC overlay was installed on the portion of the highway where the sampler was located. The sampler was reinstalled and sampling of stormwater runoff from the new pavement surface began and continued until June 2006. Over the course of the study, 5 samples of runoff were collected from the conventional pavement and 21 samples were collected from the PFC.

Each of the samples was analyzed for a variety of constituents including total suspended solids, nitrogen, phosphorus, oxygen demand, and heavy metals. Samples from the two storms immediately before and after installation of the PFC were also analyzed for hydrocarbons.

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What They Found

The data indicates that the runoff generated from the PFC surface has consistently lower concentrations of particles and particle-associated pollutants than that from the traditional asphalt surface. The concentration reductions of these constituents were 91% for suspended solids, 90% for lead, 75% for zinc, and 47% for copper. The difference in water quality was very apparent just from a visual inspection of the runoff samples collected at the edge of pavement.

The concentrations of nitrate/nitrite, dissolved copper and zinc, and total and dissolved phosphorus did not exhibit a significant difference between the two road surfaces. This data indicates that the PFC has little to no effect upon the concentrations of dissolved constituents in the stormwater runoff.

One major question that still remains is whether the improvement in water quality will persist for the life of the pavement. As the solid materials accumulate within the pores of the PFC, it is likely to become clogged and function similarly to conventional hot mix asphalt. Once the pavement clogs, the other benefits (safety and noise) will also likely be substantially reduced. Monitoring is continuing at this site to document the continuing environmental benefits of this type of pavement.

What This Means

The Texas Commission on Environmental Quality requires that new construction located in the area of the Edwards Aquifer, which extends from north of Austin to southwest of San Antonio, include stormwater treatment to reduce the loads of solids from the development by 80%. Consequently, when building new highways or expanding existing ones in this area, the Texas Department of Transportation (TxDOT) has had to purchase additional right-of-way and construct structural treatment systems to remove the solids in runoff. These controls are very expensive and require significant resources to maintain. If the PFC surface continues to remove solids at the rate documented in this study, then it could eliminate the need for separate treatment systems, since the treatment occurs in the pavement itself.

In addition, TxDOT must go through a National Environmental Policy Act (NEPA) process when using federal funds for highway construction. It is often the case that mitigation must be provided to offset the environmental impacts of these projects. Since PFC improves the quality of stormwater runoff, its use for the road surface could be shown as mitigation in the NEPA documents. Consequently, there are potential environmental benefits to using PFC even where stormwater treatment is not required.

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