



0-6635: Water Quality Performance of Permeable Friction Course on Curbed Sections

Background

The Texas Department of Transportation (TxDOT) has funded a number of studies to investigate the pollutant removal associated with use of the permeable friction course (PFC) on highways. PFC is placed in layers approximately 2 inches thick on top of conventional impermeable pavement, either asphalt or portland cement concrete. PFC allows rainfall to drain within the porous layer rather than on top of the pavement. By removing water from the road surface, PFC improves safety by reducing splashing and improving visibility.

In addition to safety benefits, the previous research by TxDOT demonstrated that PFC reduces concentrations of pollutants commonly observed in highway runoff. In the areas of Texas overlying the Edwards Aquifer Recharge and Contributing Zones, all new highway projects must demonstrate an 80 percent reduction in suspended solids. Based on the previous work, the Texas Commission on Environmental Quality (TCEQ) recognized PFC as an approved practice for complying with the water quality requirements; however, the approval was limited to the highway configurations previously tested, which included a maximum of two lanes of traffic and a rural cross section (no curb and gutter). The primary objective of this work was to determine whether the same water quality benefits would be realized on wider highways that included a curb and gutter drainage system,

which is more common in urban areas of the state.

What the Researchers Did

The researchers identified two locations for additional monitoring on the Mopac Expressway (Loop 1) in Austin that were wider (four lanes) and used curb and gutter drainage systems. One location was on the southbound lanes, and the other was almost directly across the freeway on the northbound lanes. The PFC mix designs were different for these two locations, with the northbound lanes overlain with asphalt rubber (A-R) binder and the southbound lanes using a performance-graded (PG) binder. This allowed the researchers to investigate whether the different mix designs affected the water quality performance.

Automatic samplers, flow meters, and a rain gauge were installed at each of the locations, and monitoring of storm events occurred between January 9, 2011, and October 11, 2012. Over the course of the study, 30 storms were sampled and analyzed from the monitoring site on the southbound lanes and 31 storms from the

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northbound lanes. The quality of the runoff was compared to that at a nearby site on Mopac that was monitored a number of years ago when the pavement was conventional hot-mix asphalt. Permeability tests were also conducted to determine the impact of mix design on initial permeability.

What They Found

The monitoring results show a reduction in the concentration of suspended solids, nitrogen, total phosphorus, zinc, lead, and copper compared to conventional pavement. The median suspended solids removal observed on Mopac was 92 percent, easily exceeding the TCEQ requirements for highway treatment of stormwater runoff over the Edwards Aquifer. Consequently, the presence of a curb and the much wider highway had no discernable impact on water quality. The permeability of the PG binder was about three times higher than that of the A-R mix, allowing water to move more easily into and through it. The lower permeability of the A-R binder resulted in more water on the surface of the road during storm events. The only statistically significant difference in water quality between the binders is that the runoff from the A-R binder contained significantly higher concentrations of total and dissolved zinc. This result likely arises because the recycled rubber contained about 1–2 percent zinc, which is used in the vulcanization process.

What This Means

The results of this study indicate that TxDOT can expand the use of PFC to meet water quality requirements in more urban settings with wider roads and curb and gutter drainage systems. Many of the projects that TxDOT undertakes are expansions of existing roads in urban areas to meet increasing traffic demands. This generally means that there is little or no excess right of way (ROW) on these projects, which would be required for the construction and operation of conventional stormwater treatment facilities. PFC provides stormwater treatment within the pavement itself, so no additional ROW is required. In addition, the data indicate that no special maintenance is needed to maintain the water quality benefits over the structural life of the pavement. Because of the higher permeability, the PG binder is preferred for increasing the porosity of the pavement and minimizing the amount of water on the road surface during storms.

In conclusion, this project has provided TxDOT with a flexible method to meet water quality standards using a paving material that is already widely used in the state because of the recognized safety benefits, so one of the largest benefits to TxDOT is that the environmental requirements can now be met for no additional project cost.

For More Information

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