Journal of Environmental Management

Volume 187, 1 February 2017, Pages 43–53

Research article

Evaluation of permeable pavement responses to urban surface runoff

Meysam Kamali, Madjid Delkash, Massoud Tajrishy

Show more

https://doi.org/10.1016/j.jenvman.2016.11.027

Highlights

- We investigated performances of a PP in controlling water quality and quantity.
- Realistic laboratory experiments validated our infiltration model.
- Hydraulic conductivity ratio $\left(\frac{K_h}{K_v}\right)$ was estimated to be 3.5.
- Our results showed the failure occurs in the seventh year at the middle of the PP.
- Complete TSS removal and moderate $N-NH_4^+$ and PO_4^{-3} removal were observed.

Abstract

The construction of permeable pavement (PP) in sidewalks of urban areas is an alternative low impact development (LID) to control stormwater runoff volume and consequently decrease the discharge of pollutants in receiving water bodies. In this paper, some laboratory experiments were performed to evaluate the efficiency of a PP subjected to sediment loadings during its life span. Simple infiltration models were validated by the laboratory experiments to evaluate the trend and extend of PP infiltration capacity throughout the life of the pavement operation. In addition, performances of the PP in removing total suspended solids (TSS) and selective nutrient pollutants such as NO_3^-, NH_4^+ and PO_4^{-3} from the surface runoff have been investigated. Experimental data showed that the PP was completely clogged after seven hydrological years. The model revealed that the ratio of horizontal to vertical hydraulic conductivity is 3.5 for this PP. Moreover, it was found that 20% reduction in hydraulic conductivity occurred after three hydrological years. The PP showed 100%, 23% and 59% efficiencies in sediment retention (TSS removal), (PO_4^{-3}), and $N-NH_4^+$ removal during the entire study, respectively. However, the removal efficiency of $(N-NO_3^-)$ was −12% and we suspect the increase in effluent $(N-NO_3^-)$ is due to the nitrification process in subsurface layers. This study demonstrated that when PPs are annually cleaned, it is expected that PPs can function hydraulically and be able to remove particulate pollutants during their life span by a proper maintenance.