Stormwater Treatment Systems – A Long-term Sink or Source of Microplastics?

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Abstract

Stormwater, particularly urban runoff, conveys of high concentration of microplastics from their sources to terrestrial water bodies such as ponds, lakes, and rivers. In urban areas, stormwater treatment systems such as biofilters are typically used to reduce over-land flow, increase infiltration or groundwater recharge, and treat stormwater for reuse in water-stressed areas. Microplastics could accumulate in these systems, which may later serve as a net source of microplastics. Yet, the fate of microplastics in these systems is unknown. Furthermore, it is unclear to what extent microplastics may migrate deeper into the subsurface and whether they could pose any risk to groundwater pollution. The overall objective of the proposed study is to examine the accumulation and transport of microplastics in stormwater treatment systems. We analyzed the subsurface distribution of microplastics in and outside the boundaries of fourteen stormwater infrastructures including bioretention system, bioswales, and biofilters in Los Angeles, and compared the distribution above and below ground in the bioswale to compare the relative contribution of wind and stormwater that carry microplastics to bioswales. The concentration of microplastics exponentially decreased with subsurface depth, indicating the accumulation of microplastics within the top 5 cm of subsurface soil and groundwater pollution risk from the accumulated microplastics is low. Outside the

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treatment system boundary, the subsurface retardation coefficient decreases with increases in soil grain size (D50), indicating filtration or straining of microplastics. Inside the boundary of the treatment system, however, the retardation coefficient was independent of soil grain size, indicating compost or mulch used in the filter layer may have been contaminated with microplastics. The retardation coefficient appears to be independent of land use. Surprisingly, the concentration of microplastics within stormwater infrastructures is not different ($p>0.5$) from the concentration outside stormwater infrastructures boundary, indicating atmospheric deposition is a significant factor in the deposition and accumulation of microplastics on the surface of stormwater infrastructures. The high concentration of microplastics on leaves of vegetation in stormwater infrastructures confirmed that atmospheric deposition can be a dominant pathway of delivering microplastics to stormwater infrastructures in addition to stormwater. Overall, these results improve the understanding of how and where microplastics may accumulate in stormwater infrastructures in urban areas.

Keywords: Microplastics, stormwater, urban pollution, green infrastructure, biofilters.

Biography

Dr. Sanjay Mohanty is an assistant professor at the Department of Civil and Environmental Engineering at the University of California Los Angeles (UCLA). He directs the Subsurface Engineering and Analysis Laboratory at UCLA. His research group examines how fundamental physical and biochemical processes in subsurface soil are shifted under natural and anthropogenic stressors such as compaction, excess pollutant loading, wildfire, drying, freezing, and flooding. His research applies these fundamental concepts to engineering the subsurface soil for different purposes: treat stormwater from a wide range of pollutants, improve bioremediation methods, and alleviate deterioration of soil and water quality during climate change.