

Fate and Transport of Ubiquitous Pollutants in the Soil Environment

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In this study, a representative group of microplastics, perfluoroalkyl and polyfluoroalkyl substances (PFAS) and agrochemical were taken as the ubiquitous pollutants due to their pervasive nature. Among plastics, nylon being the versatile material used in day-to-day life and when exposed to environment, it releases microplastics, hence, nylon-microplastics (NMP) was chosen. Likewise, perfluorooctanoic acid is a per-fluorinated carboxylic acid used as an industrial surfactant in chemical processes and as a material feedstock, hence selected for this study. Similarly, 2, 4 dichlorophenoxyacetic acid (2,4-D) was one of the most common herbicides, hence chosen as given in Fig. 1. The presence of NMP, PFOA and 2,4-D as a pollutant matrix can be seen in aquatic environments such as surface water bodies (lake), agricultural lands, sea water, etc. Due to their toxicity, it is important to track their mobility in soil environments.

In this study, the soil sample was collected from Lake ecosystem, Kandi, Telangana, India and characterized for geotechnical and hydrodynamic properties. Continuous-flow column experiments were conducted in one-dimensional column simulating the situation pertaining to the actual lake water infiltration and relative transport of ubiquitous pollutants as shown in Fig. 2. To understand the influence of lake soil during the transport of NMP, PFOA and 2,4-D, similar experiments were conducted in engineered-glass medium. The flow rate and concentrations of the selected-ubiquitous pollutants were considered as the study factors.

The following are the results that are interpreted from the fate and transport of individual and combinations of selected-ubiquitous pollutants: (i) the aqueous ions of PFOA and 2,4-D were transported faster than the solid-NMP, (ii) NMP carried PFOA and 2,4-D via adsorption which was influenced by the concentrations of adsorbent (NMP) and adsorbate (PFOA and 2,4-D), and (iii) NMP act as the vector by releasing the PFOA and 2,4-D in the studied-system. It was observed that the behavior of PFOA and 2,4-D when injected together needs detailed analysis to understand their long-term impacts. This study enlightens the fundamental knowledge of the behavior of single and mixed ubiquitous pollutants in the soil ecosystem and gives deeper insights into the carrier and vector behavior of the NMP.

