
Impact of a closed municipal solid waste landfill to microplastic groundwater pollution

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Abstract

By containing high amount of plastic wastes, municipal landfills may be hot spots of secondary microplastics from fragmentation and degradation. Recent studies actually demonstrated that landfills generate microplastics that can be transferred to groundwater via landfill leachates but evaluating the threat for groundwater require more researches. The former "Prairie de Mauves" landfill, operated from 1963 to 1987 by Nantes Métropole, is a good candidate to observe the microplastic contamination of the alluvial groundwater of the Loire River. As part of the Nantes Urban Environment Observatory (ONEVU), the site is monitored since 2008. Two campaigns were therefore carried out in March and June 2022 to sample landfill leachates and groundwater. One well and 4 piezometers upstream and downstream the landfill were considered. Microplastics ($> 25 \mu\text{m}$) were analyzed by μFTIR imaging in transmission mode and with a $25 \mu\text{m} \times 25 \mu\text{m}$ pixel resolution. Depending on their suspended solid loads, samples were directly filtered or followed an organic matter oxidation and a densimetric separation. Microplastics were observed in every sample with concentrations ranging from 10.3 to 106.7 particles/L. The highest concentrations were observed in the solid waste leachates. Twelve polymers were identified with polyethylene (PE) and polypropylene (PP) being the most predominant. Landfill leachates clearly impact the groundwater by increasing 2 to 5 times the microplastic concentrations from upstream to downstream of the landfill. The release of microplastics has nevertheless a high degree of temporal variability. Higher concentrations are observed in June in comparison to March. While groundwater water levels are similar, this increase can result from the difference of rain amounts between the 2 campaigns. The rainy period before the campaign carried out in June (16.2 mm) could have enhanced the microplastic migration from the landfill to the alluvial groundwater.

Keywords: landfill leachate, microplastic, groundwater, μFTIR

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