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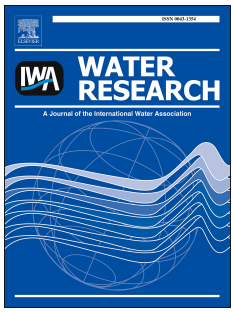

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Predicting long term removal of heavy metals from porous pavements for stormwater treatment

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Abstract

Porous pavements are commonly used stormwater management systems. However, the understanding of their long-term capacity to retain heavy metals is limited. This study aims to investigate the long-term removal of heavy metals in three different porous pavements – Porous Asphalt (PA), Hydrapave (HP) and Permapave (PP) over accelerated laboratory experiments representing 26 years with varying hydrological conditions (drying/wetting periods and flow rates). A treatment model that simulates adsorption and desorption processes was developed for the first time to predict the long-term heavy metal removal by porous pavements. Unsurprisingly, all tested porous pavements performed better in removing metals that tend to attach to solid particles (*e.g.* Pb, Al, Fe) than more soluble ones (*e.g.* Cu, Zn, and Mn). There was a general increase of heavy metal concentrations at the outlet of the pavements over time as a result of a decrease in adsorption capacity of the systems, especially after the occurrence of clogging; the soluble heavy metals removal decreased with a reduction in flow rates which was speculated to be due to more time being available for desorption of metals and breakdown of accumulated sediments. The proposed model simulated the trend, fluctuations and peaks of heavy metal concentrations reasonably well, achieving the Nash-Sutcliffe coefficient (NSE) values of 0.53-0.68 during model calibration. The model was most promising in predicting Al and Cu release from porous pavements (50%-91% of the observed data within the 90% uncertainty bands, NSE=0.44-0.74), followed by Fe and Pb (27-77% observations within the bands, NSE=0.20-0.69). Further improvements of the model are needed for it to be applicable for Zn and Mn.