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Assessment of PFOA and PFOS Sorption to Engineered Media in Biofiltration Columns

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ABSTRACT
Per- and polyfluoroalkyl substances (PFAS) in stormwater are receiving increasing attention as emerging contaminants of concern. Limited research is available on the performance of engineered media in stormwater best management practices such as biofiltration systems for PFAS removal from runoff. This study evaluated the treatment effectiveness of engineered media mixes for perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) using flow-through column experiments designed to closely mimic biofiltration systems. Four different engineered media compositions were tested in duplicate, with each column receiving 230–330-cm simulated rainfall spiked with PFOA and PFOS at around 1,000 and 650 ng/L, respectively, assuming the column surface area is equivalent to 5% of an impervious drainage area. To represent local design guidance, media with particle sizes in the millimeter range were used, resulting in high infiltration rates ranging from 43 to 150 cm/h under a 15-cm ponding depth. Under these conditions, columns containing sand amended with 15% (v/v) regenerated activated carbon (RAC) were effective at PFAS removal, while the other media—sand, sand mixed with 10% biochar, and sand mixed with 10% zeolite—were either ineffective or only effective at the initial stages of treatment. Notably, columns containing 15% RAC reduced the influent concentration to approximately 300 ng/L for PFOA and 200 ng/L for PFOS, after receiving a cumulative rainfall of 307 cm. The RAC in the top 25% of media sorbed 1,910±97 ng/g of PFOA and 1,832±35 ng/g of PFOS, with effluents reaching 92 and 82% exhaustion, respectively. Further analysis of the breakthrough curves estimated that full columns with 45 cm of engineered media are expected to have a lifespan of 35–59 years under Southern California rainfall conditions, highlighting their potential for long-term PFAS removal.