Lateral flow sand filters are effective for removal of antibiotic resistance genes from domestic wastewater - DTU Orbit (12/08/2019)

Lateral flow sand filters are effective for removal of antibiotic resistance genes from domestic wastewater

The ability of lateral flow sand filters, used as on-site wastewater treatment systems (OWTS), to remove antibiotic resistance genes (ARGs), antibiotic resistant bacteria (ARB), and other relevant genetic markers (HF183, 16S rRNA, and int1) was assessed. Municipal wastewater was settled in a septic tank prior to loading into six pilot-scale lateral flow sand filters comprised of three different sand media types, at 5 and 30% slopes. The sand filters were sampled bi-weekly for: 9 ARGs and 3 other complimentary gene markers (sul1, sul2, qnrS, tetO, ermB, blaTEM, blaCTX-M, mecA, vanA, int1, HF183, 16S rRNA), and conventional microbial and water quality indicators, from July to November in 2017, and four times in the summer of 2018. The sand filters were observed to attenuate 7 of the ARGs to mostly below 2 log gene copies per mL. Log reductions ranging from 2.9 to 5.4 log were observed for the removal of absolute abundances of ARGs from septic tank effluent in 5 of the 6 sand filters. The fine-grained filter on the 5% slope did not perform as well for ARG attenuation due to hydraulic failure. The apportionment of cell-associated versus cell-free DNA was determined for the gene markers and this indicated that the genes were primarily carried intracellularly. Average log reductions of ARB with resistance to either sulfamethoxazole, erythromycin, or tetracycline were approximately 2.3 log CFU per mL within the filters compared to the septic tank effluent. This field study provides in-depth insights into the attenuation of ARB, ARGs, and their genetic compartmentalization in variably saturated sand OWTS. Overall, this type of OWTS was found to pose little risk of antimicrobial resistance contamination spread into surrounding environments when proper hydraulic function was maintained.

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