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Effects of biofouling on the uptake of perfluorinated alkyl acids by organic-diffusive gradients in thin films passive samplers

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ABSTRACT

While organic-diffusive gradients in thin films (o-DGT) passive samplers have been used to assess organic contaminants in water, the effects of biofouling on accurate analyte quantification by o-DGT are poorly understood. We evaluated the effects of biofouling on the uptake of six common perfluoroalkyl substances (PFAS) using a previously developed polyacrylamide-WAX (weak anion exchange) o-DGT without a filter membrane. Linear uptake (R^2 > 0.91) over 21 days was observed in fouled samplers. The measured sampling rates (R_s) and accumulated masses of PFAS in pre-fouled o-DGT were significantly lower (p < 0.05, 20–39% relative error) than in control-fouled samplers. However, compared to clean o-DGT (no biofouling), the R_s of most PFAS in control-fouled samplers (*i.e.*, those with clean diffusive and binding gels initially) were not affected by biofouling. Under flowing (~5.8 cm s^{-1}) and static conditions, the measured diffusive boundary layer (DBL) thicknesses for clean o-DGT were 0.016 and 0.082 cm, respectively, whereas the effective *in situ* biofilm thicknesses for fouled o-DGT were 0.018 and 0.14 cm, respectively. These results suggest that biofilm growth does not have significant effects on target PFAS sampling by o-DGT under typical flowing conditions (≥2 cm s^{-1}). However, rapid surface growth of biofilm on o-DGT deployed in quiescent waters over long periods of time may exacerbate the adverse effects of biofilms, necessitating the estimation of biofilm thickness *in situ*. This study provides new insights for evaluating the capability of o-DGT samplers when biofilm growth can be significant.