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Temperature-dependence of per- and polyfluorinated substance (PFAS) adsorption to soil and activated carbon

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Per- and polyfluorinated substances (PFASs) are a group of fluorinated organic compounds that are widely known for their environmental persistence and toxicity. For several decades they have found a variety of commercial and industrial applications (e.g. in fire-fighting activities) with uncontrolled disposal, thus resulting in an extensive soil and groundwater pollution. The use of activated carbons in soils as a stabilisation remediation technique has been studied in the last decade and has been applied in field scale projects. However, there is a lack of knowledge regarding the underlying sorption mechanisms and influence of the efficiency parameters. Thus, the present study aims to evaluate the effect of temperature on the efficiency of PFAS sorption in soils and granular activated carbon (GAC). Batch sorption tests were conducted at 5 oC and 25 oC with spiked soil, sorbent, and sorbent-amended soil (4% w/w) in equilibrium for 14 individual PFASs including C3-C11, C13, C15 perfluoroalkyl carboxylates (PFCAs) and C4, C6, C8 perfluoroalkyl sulfonates (PFSAs). Quantification of the compounds was conducted using high performance liquid chromatography coupled with tandem mass spectrometry (HPLC-MS/MS). Preliminary results have shown that temperature is positively related with sorption capacity, with a higher sorption of PFASs to soil with up to 28% at 25 oC than at 5 oC. Temperature-dependence was noticed predominantly for PFASs with a sulfonate functional group, while for carboxylic acids it was more prominent on short-chain compounds.However, no such temperature effect was identified for sorption to GAC and sorbent-amended soil. The study will also investigate kinetic effects, in order to identify if and how the sorption equilibrium time of PFASs is affected by temperature. The findings suggest that temperature could be a source of bias for sorption of PFASs in lab-scale partitioning tests, which are normally conducted at room temperature.