Demarcation of Pollution by Perfluoroalkyl Substances (PFAS) in Soil at Former Firefighting Training Area Using Different Sampling Strategies

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Background/Objectives. More recently, military and municipal firefighting training sites around the world have been identified as point sources of PFAS to the surrounding environment. Although many firefighting training sites have not been used for decades the historical use of PFAS containing aqueous film forming foams (AFFF), at these training sites has caused the sites to become potential PFAS pollution hot spot with the potential to continue to leach PFASs into the environment for a long time to come. In the Nordic countries, the PFAS contamination of groundwater has become a concern from environmental, socio-economical and authority perspectives. Thereby the monitoring focus on PFAS have been primarily ground- and surface water near the firefighting training sites, which have led to a current knowledge gap regarding the distribution of PFAS in soil at these sites. The first objective of this study was to compare two sampling techniques, e.g., sonic drilling and scope sampling in the investigation of the spatial and temporal distribution of PFASs in soil at one former firefighting training site. The site has been contaminated by intensive use of PFAAs containing AFFF over a period of more than 30 years. The groundwater aquifer of glacial debris and gravel in the area is partly situated beneath a thick layer, ~30 m, of post-glacial silt and clay. Another purpose was to find out the effect of the sampling technique on the results of the calculated estimation of the total mass of PFASs in the soil. The last objective was to examine how comparable the amount of PFAS in soil samples are in relation to the results from leachate experiments. This is the first study to our knowledge that investigate the demarcation of the mitigation of PFAS in soil columns at a AFFF-affected firefighting training.

Approach/Activities. Two sampling methodologies of soil (i) soil pits (demarcation of pollution in two dimensions) and (ii) sonic drilling (demarcation of pollution in three dimensions) were applied to define the PFAS contamination levels and the spatial and vertical distribution of the contaminant. In total 53 soil samples from 49 shallow soil pits were collected, and 144 samples from 15 deep soil cores were collected using sonic drilling. The total amount of PFAS at the site was calculated and the estimations was compared between the two different sampling techniques. Nine soil samples were selected for assessing the leaching capability of PFAS by applying column leaching tests at a liquid/solid ratio of L/S 0.2 and 10. The concentration of PFAS in the leachates was compared with the results of the total concentration of PFAS in the soil to find out their conformity.

Results/Lessons Learned. At the investigated firefighting training area, perfluorooctane sulfonate (PFOS) was the dominant PFASs measured. In the soil columns PFOS was detected down to 10.5 m depth, in the saturated zone. Generally longer chain PFASs (C>7) were detected in higher concentrations and at higher frequencies in the upper soil, with decreasing PFAS concentrations with increasing soil depth. Suggesting vertical movement of PFAS in the unsaturated soil column. The total mass of 15 different PFASs in the soil layer of 0-0.5 m depth, in addition to a mass range for the whole sampling area/depth, will also be calculated and compared between the two sampling strategies (e.g., scope sampling and sonic drilling). The results from the leaching tests indicate that the contaminated firefighting training area will likely remain a source of PFASs for several decades.