Detection of Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) following Firefighting Foam Deployment during the Lac-Mégantic Railway Accident

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Background/Objectives. Perfluoroalkyl and polyfluoroalkyl substances (PFAS) are key components of aqueous film forming foam (AFFF) formulations used against hydrocarbon fuel fires. Various lines of evidence have, however, raised concerns on the persistence, bioaccumulation, and toxicity of some AFFF components. Though perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) have been banned from AFFF products, knowledge is lacking on the environmental fate and safety of the PFASs permitted in current AFFF products. The 2013 Lac-Mégantic railway accident involved one of the large releases of crude oil and AFFFs into the environment in Canadian history, providing a case study to allow examination of identity and temporal trends of PFASs in soil, sediment and fish samples collected within two years after the accident.

Approach/Activities. Benthic fish (*Catostomus commersonii*) and sediments were collected from Chaudière River and Lake Mégantic. Soil was sampled three months after the accident in a heavily impacted area, and also two years later from an unexcavated area in downtown Lac-Megantic and from the biopiles where the oil-contaminated soil was subject to bioremediation. 36 target and more than 100 suspect-target PFASs were investigated using ultra-high performance liquid chromatography polarity-switching electrospray ionization coupled to Orbitrap mass spectrometry.

Results/Lessons Learned. Overall, the levels of PFAS in sediments and fish remained low, only slightly higher than those before the accident. Both samples showed the dominance of zwitterionic PFASs (e.g., fluorotelomer sulfonamide betaines and fluorotelomer betaines) over perfluoroalkyl acids (PFAAs). Soil samples showed a much greater number of PFAS compounds and also at levels significantly higher than no-impacted area but remained lower than a Canada provisional value. The highest observed concentrations corresponded to those of 6:2 fluorotelomer sulfonamide betaine, 6:2 and 8:2 fluorotelomer sulfonates and short-chain PFAAs. The soils collected two years after the accident showed a total PFAS concentration that was ~50 times lower than the soils collected in 2013, while the proportion of PFAAs in those samples showed an increase, which supports the hypothesis that partially fluorinated PFASs biotransform in the soil to PFAAs. Semi-qualitative analysis of 55 additional compounds present in the soil suggested that current target analysis would likely to miss a significant fraction of PFASs originated from AFFFs. The findings showed that PFOS ban was effective in Quebec and probably in Canada, but the environmental risks of other PFAS present in AFFFs are yet to be thoroughly evaluated.