Per- and Polyfluoroalkyl Substances (PFAS): Addressing Limited Toxicity Data in Site Characterization

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Background/Objectives. Typically, characterization and remediation strategies focus on those site-related contaminants with regulatory agency-derived toxicity criteria. In combination with site-specific exposure data, these toxicity criteria provide the basis for risk-based cleanup goals, developed to protect human or ecological receptors. Cleanup goals affect the choice of remediation technology, cleanup costs, and the cleanup duration. The limited availability of toxicity data for most per- and polyfluoroalkyl substances (PFAS) tests this paradigm, as a paucity of toxicity data in combination with the large number of PFASs challenges many of the conventional approaches used to develop effective site characterization and remediation strategies, particularly for sites contaminated with aqueous film forming foam (AFFF). Additionally, analytical methods are being developed far more rapidly than toxicity studies can be completed, and our ability to quantify individual PFAS by standardized commercially-available methods greatly exceeds our ability to interpret the significance of detections.

We evaluated the number of toxicity studies that are currently available for 50 common PFAS, and considered the implications for managing contaminated sites. Of these PFAS, only two compounds (perfluorooctanoic acid [PFOA] and perfluorooctane sulfonate [PFOS]) have robust toxicity literature, while 14 other PFAS, primarily perfluoroalkyl acids (PFAAs) have much more limited data. Only three PFAS have US EPA-derived reference doses (RfDs). We found almost no peer-reviewed toxicity data for most of the non-PFAAs in the 50 that we studied.

Approach/Activities. Parallel examples from other classes of toxicologically related mixtures, e.g., polychlorinated dibenzodioxins, polychlorinated biphenyls, and total petroleum hydrocarbons, indicate that a toxicity weighting approach for select PFAS might offer an interim solution for the development of toxicity criteria. We evaluated the scientific basis of the different strategies that have been used to evaluate the relative toxicity of select PFAAs. We considered whether the weighting strategy included in vivo, as well as in vitro studies; data from multiple species and dosing regimens; and incorporated information on the toxicological mechanisms of action (MOA).

Results/Lessons Learned. Currently available toxicity weighting strategies range from the assignment of simple surrogate criteria to more comprehensive approaches that consider perfluorinated carbon chain length and MOA. We conclude that neither the assignment of surrogates or application of MOA toxicity data are sufficiently robust to apply to most PFAS, and that currently-available scientific data do not support the use of a toxicity weighting scheme for PFAS at this time.