Environmental-Fate Patterns for Perfluoroalkylates and their Precursors

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Two sites with elevated concentrations of perfluoroalkylates (PFAs) and fluorotelomer alcohols (FTOHs) were studied: 1) agricultural fields near Decatur, AL on which sewage sludge had been applied; and 2) the Conasauga River system near Dalton, GA where treated sewage effluent is sprayed on land abutting the river. The sewage-treatment facilities at both sites received waste streams from industries that used fluorinated compounds. Decatur samples of surface soil, subsurface soil, and plants have been characterized for PFCs and FTOHs. Conasauga River water and sediments, collected from near Dalton, upstream and downstream, were characterized for PFAs. Additionally, oligochaetes (sediment-dwelling worms) exposed to the Conasauga sediments were analyzed for PFAs.

For the Decatur study: 1) surface-soil perfluorocarboxylic acids (PFCAs) are statistically related to secondary FTOHs which are related to primary FTOHs suggesting sequential degradation is active in the soil; 2) PFAs are detected in subsurface soils and plants suggesting that leaching and plant uptake are active processes for PFAs in soils; 3) FTOHs are not detected in significant concentrations in subsurface soil or plants; 4) deep-soil/surface-soil PFCA ratios are greatest for short-chains and decrease with greater chain lengths suggesting higher mobility through the soil column for short chains; 5) disappearance half-lives for surface-soil PFCAs range from 1-5 y and increase with increasing chain length; and 6) disappearance half-lives for surface-soil FTOHs generally are about a year and do not trend with chain length.

For the Dalton study: 1) C6 through C10 PFCAs and perfluorosulfonates (PFSAs) were detected in river water at Dalton and all sites down-river as far as Rome, GA; 2) C6 through C14 PFCAs and PFSAs were detected in river sediments at all sites albeit at higher levels from Dalton to Rome; 3) PFA levels that we detected in water and sediments appear to be lower than in samples collected in the past; and 4) oligochaetes grown in the PFA-rich sediments accumulated PFAs in their whole-body tissues.

Taking Decatur and Dalton as model terrestrial and aquatic systems, respectively, patterns in PFA bioaccumulation factors for basal trophic levels, plant from soil for Decatur and oligochaete from detritus for Dalton, are compared.