

# Fate and Effects of POPs

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## Mass balance of perfluoroalkyl acids and their precursors in sewage treatment plants

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Per- and poly-fluoroalkyl substances (PFASs) have received broad attention due to their persistence and global distribution. They have been used for industrial and consumer applications due to their excellent properties such as chemical stability, water/oil repellency, etc. Among them, perfluorooctanesulfonic acid (PFOS), its salts, and perfluorooctane sulfonyl fluoride are now regulated under the Stockholm Convention on POPs. The production of perfluorooctane carboxylic acid (PFOA) is voluntarily phasing out by its manufacturers. However, many PFAS precursors that may transform into PFOS or PFOA in the environment are still being produced. As the precursors are numerous, their occurrence in the environment is difficult to grasp by individual analyses. Recently, Houtz and Sedlak (ES&T, Vol. 46, p. 9342-9349, 2012) proposed a novel method of detecting total PFAS precursors by their oxidative conversion into perfluoroalkyl acids (PFAAs) that have corresponding perfluoroalkyl chain. In this study, we used their method to explore the behavior and mass balance of PFASs in the three sewage treatment plants in Japan. The total concentration of  $\Sigma$ PFAAs (carboxylic, sulfonic and phosphoric acids), increased by 3.8 to 11 times in the influents after the oxidation treatment indicating that total concentration of PFAA precursors are much higher than the that of PFAAs. Among the PFAAs, C7–10 perfluoroalkyl carboxylic acids increased most by the oxidation conversion. While the concentrations of  $\Sigma$ PFCA did not change much during the secondary biological treatment, the concentration of  $\Sigma$ PFASs including precursors decreased by 70–80%. The removal of  $\Sigma$ PFASs as excess sludge, however, only accounted for 10–20% of the influent loads. This indicated that large removal of  $\Sigma$ PFASs occurred in aeration tanks, possibly by the evaporation of volatile PFAA precursors. The tertiary treatments, such as chlorination and ozonation did, not remove  $\Sigma$ PFASs significantly.

**Keywords:** Perfluoroalkyl acid, Precursor, Oxidative conversion, Sewage treatment plant, Mass balance.

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## Sublethal assessment of pesticide mixture toxicity to the Australian freshwater yabby *Cherax destructor*

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Organophosphate (OP) and carbamate (CB) pesticides are widely used in Australia and the combination of these pesticide groups are commonly detected in the aquatic environment. Both OP and CB pesticides are known to inhibit the activity of cholinesterase and affect the behaviour of aquatic organisms. The toxicity of various individual OP and CB pesticides on aquatic biota have been reported in numerous