

Urban water pollution by perfluorinated surfactants and their precursors derived from surface runoff

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Perfluorinated surfactants (PFSs) such as perfluorooctane sulfonate (PFOS) and perfluorooctanoate (PFOA) have been world-widely detected in surface water, groundwater, seawater, drinking water and aquatic organisms. PFOS was added to the listing of the Stockholm Convention on persistent organic pollutants, and PFOS and PFOA were also added to the items for further study in drinking water quality standard in Japan. Concerns and interests about PFSs in water environments are rapidly increasing. PFSs are derived from point sources (e.g. wastewater) and nonpoint sources (e.g. surface runoff). Besides, PFSs are formed through biodegradation of their precursors in waters. However, the occurrences and sources of PFSs and their precursors are not still unraveled. Therefore, studies on water contamination by perfluorinated surfactants and its precursors from urban runoff are introduced in this presentation.

PFSs in wastewater and road runoff were measured to determine their pathways of travel to water environments. Concentrations of perfluorocarboxylates (PFCAs), including PFOA, in road runoff were equal to or higher than those in wastewater influents and secondary effluents, but PFOS concentrations were lower in road runoff.

The contribution of non-point sources to perfluorinated surfactants (PFSs) in the Irumagawa River was evaluated by estimating their fluxes at dry and wet weather. The concentrations and fluxes of PFCAs (e.g. PFOA and perfluorononanoate (PFNA)) were higher during wet weather, but those of perfluoroalkyl sulfonates (PFASs, e.g. PFOS) were not. This result is consistent with previous findings: PFCAs were abundant in road runoff but PFOS was not. These results suggest that road runoff is not a negligible source of PFCAs in water environments.

We then evaluated the contributions of wastewater and surface runoff to PFSs in Tokyo Bay during dry and wet weather. Sewage markers (i.e. pharmaceuticals and personal care products (PPCPs)) of untreated and treated wastewater revealed that PFCAs were derived from combined sewer overflow (41%) during wet weather and surface runoff contributed more than half of PFCA contamination via the CSO.

The formations of PFSs through biodegradation of their precursors in road runoff, rain water, and wastewater secondary effluent were evaluated by using microorganism in groundwater. PFSs were significantly formed from their precursors in road runoff, while those were not in rain water and wastewater secondary effluent. This result indicates that formation of PFSs from their precursors in road runoff can be a pathway to groundwater.

Keywords: Road runoff, Nonpoint pollution, Perfluorinated surfactants, PFOS, Precursors, Emerging contaminants