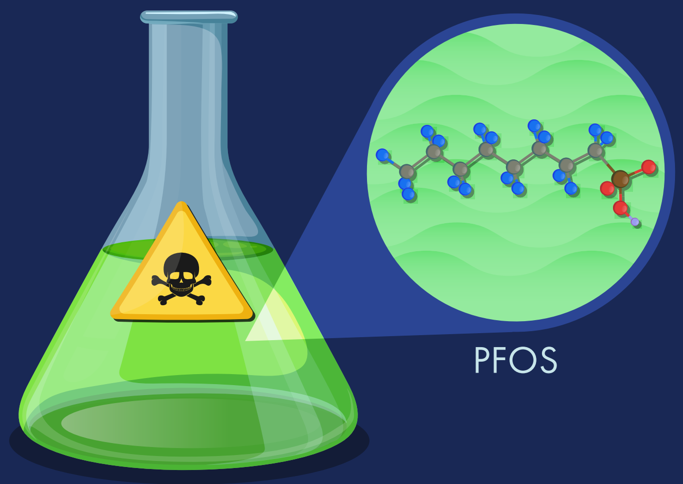
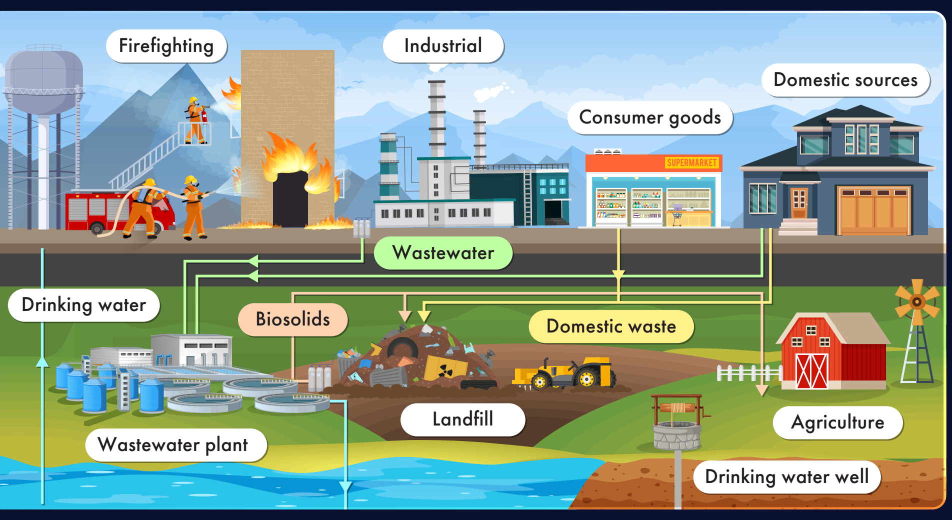
Environmental Accumulation and Management of Per- and Polyfluoroalkyl Substances



- **Per- and polyfluoroalkyl substances (PFAS)** are toxic chemicals used for making nonstick cookware, waterproof clothing, stain-resistant fabric, and food packaging
- **Perfluorooctane sulfonate (PFOS)** is a highly toxic PFAS, especially found in drinking water
- The chemical stability and thermal inertness of PFAS allow them to accumulate and persist in the environment for a long time



PFAS sources in the environment

Access to clean and safe water is critical to public health and economic prosperity

6 CLEAN WATER AND SANITATION

⚠ Utilities face the increasing challenge of keeping pace with PFAS

ASCE collection of studies on the fate and removal of PFAS in natural and engineered systems

PFAS accumulation

Stormwater runoff
- Rainwater runoff accumulates PFAS in stormwater ponds
- The landscape development intensity index can be used as a predictive tool for better monitoring

Firefighting training
- PFOS-containing aqueous film-forming foams (AFFF) are used in firefighting training
- 27% of this PFOS reaches groundwater

Generation during water treatment
- PFOS are generated via the biotransformation of fluorotelomer alcohol and N-ethyl perfluorooctane sulfonamidoethanol (N-EtFOSE)
- Water treatment using ozone or chlorine can generate PFOS from poly fluoroalkyl amides or sulfonamides

Cycling in water treatment plants (WTPs)
- PFAS that enter the WTPs are often cycled endlessly and introduced into household water supplies

PFAS destruction

Supercritical water oxidation (SCWO)
- Water becomes supercritical above 374°C and 22.1 MPa, which increases organic solubility and accelerates oxidation
- SCWO destroys 99% of AFFF-derived PFAS, including PFOS

Silica-based granular media (SGM)
- Photocatalytic porous SGM, activated using UV light and combined with a nucleophilic attack, destroys PFAS, especially PFOS
- Sodium thiosulfate for nucleophilic attack removes PFOS from water in just 30 minutes

Ultrasonic irradiation
- Ultrasonic irradiation combined with TiO_2 photocatalysis and radiolysis can remove stubborn PFAS from wastewater
- It can destroy 80% of the perfluorinated compound GenX within 60 minutes

Computational modeling

- Predicts the fate of PFAS, such as transport via groundwater and through the vadose zone and uptake by plants and animals
- Large-scale modeling requires individual tools for simulating each phenomenon
- Accurate predictions require more frequent water transport, soil, and stormwater runoff monitoring

Understanding PFAS and developing computational models to predict its fate can help shape better mitigation strategies and reduce adverse environmental impacts and social difficulties

Special Collection on Fate and Removal of Poly- and Perfluoralkyl Substances (PFAS) in Natural and Engineered Systems
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