PFAS AND WASTE
WHAT TO DO WITH IT?

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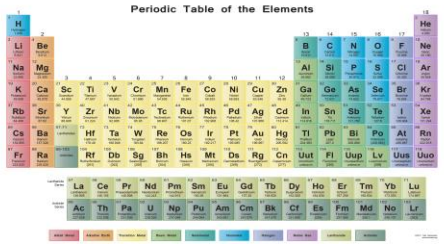
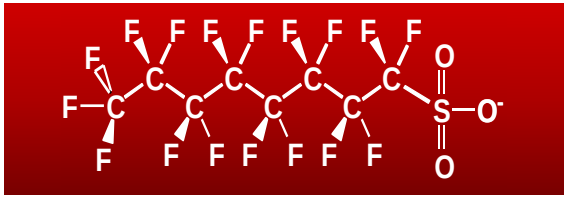
WHEN YOU NEED TO BE SURE

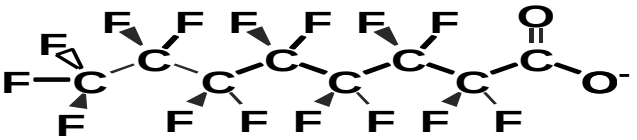
SGS

WHAT ARE PFAS COMPOUNDS?

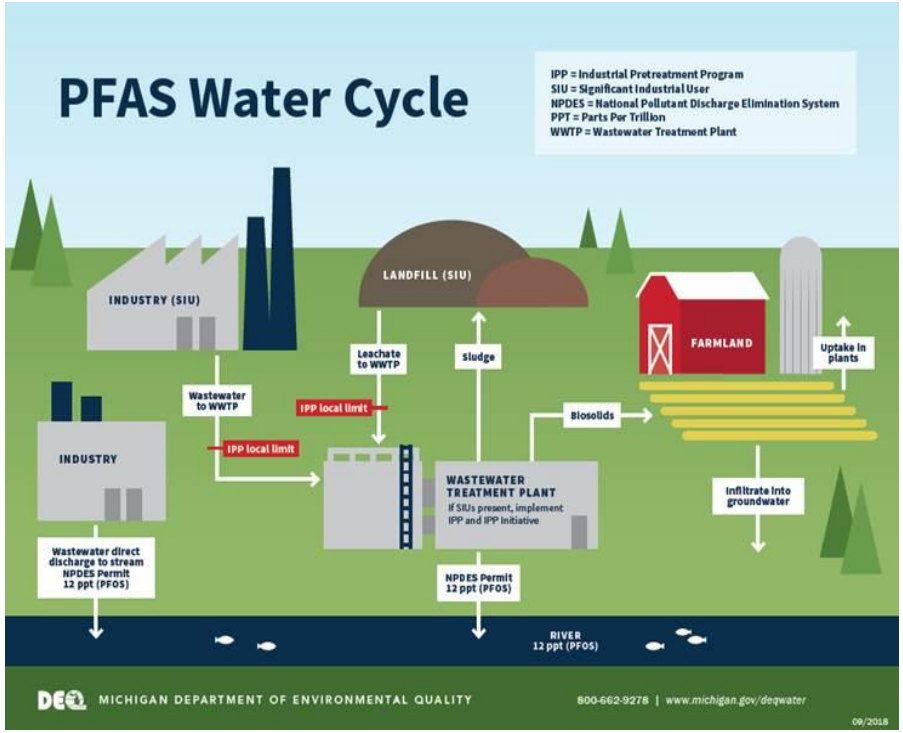
- PFAS are a class of synthetic compounds containing thousands of chemicals formed from carbon chains with fluorine attached to these chains
- The C-F bond is the shortest and strongest bond in nature and is responsible for most of the unique and useful characteristics of these compounds
- PFAS are surfactants that repel oil and water, and reduce wear or surface adhesion
- Introduced as early as 1948 (Teflon, or PTFE polymer) with a great increase in use in the late 1960s and 1970s
- At low concentrations, many have significant water solubility







WASTE CONTAINING PFAS

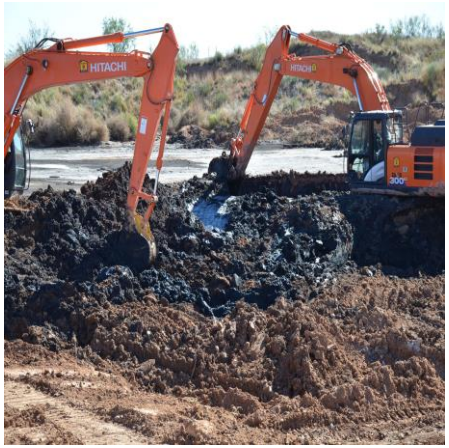


The Stockholm Convention prescribes that wastes containing persistent organic pollutants shall be processed for destruction or to irreversibly transform such pollutants so that their hazardous characteristics are no longer detectable, unless the contents of the pollutants in wastes are low enough.

TYPES OF PFAS WASTE

- Waste from Household Consumer Products
  - Carpet, furniture and upholstery - stain-resistant coatings such as Scotchgard™ used on them
  - Other fabrics - outdoor clothing, boots, tents
  - Fast food containers/wrappers, microwave popcorn bags, pizza boxes, candy wrappers
  - Non-stick cookware such as Teflon™ coated pots/pans
  - Personal care products such as shampoo, dental floss, and cosmetics (nail polish, eye makeup)
- Waste from Industrial Products
  - AFFF foams
  - Paints, varnishes and sealants
  - Adhesives, aviation hydraulic fluids, cleaning products

TYPES OF PFAS WASTE



- Waste from Industrial Products (Cont.)
  - Paper manufacturer, water and grease-proofing
  - Chrome plating waste
  - Textile manufacturing waste
  - Tannery waste, water proofing (Wolverine)
- Waste from Water Remediation Processes
  - Waste water highly contaminated
  - Contaminated ground water
  - Biosolids
  - Contaminated absorbent and resins used in remediation process (Granular Activated Carbon, Ion exchange (IX) or polymer media used to remove PFAS from water)
- Waste from Soil Remediation
  - Contaminated soil and sediment

FINAL DESTINATION

- Sanitary Landfills
  - Waste containing PFAS
    - Consumer Products
    - Industrial Waste
    - Carpet and upholstery
    - Food waste
    - Biosolids
  - Landfill fires when foam is used

At present, the only technologies that are sufficiently mature for the treatment of PFAS-contaminated soils are excavation with off-site disposal in a sanitary landfill or incineration, capping or covering and monitoring infiltration, and soil washing (Ross et al. 2018).

FINAL DESTINATION

- Thermal Treatment and Incineration

NJ LANDFILL AGREES TO ACCEPT PFAS-CONTAMINATED SOIL FROM PENNSYLVANIA MILITARY BASE

JON HURDLE | JANUARY 28, 2019

Some New Jersey environmental groups want the planned dumping of material from former Willow Grove naval station to be halted

A landfill near Vineland, which has agreed to accept 4,500 tons of PFAS-contaminated soil from former Naval Air Station at Willow Grove, Pa.

A New Jersey landfill has agreed to accept a consignment of soil contaminated with toxic PFAS chemicals that are increasingly seen as a threat to public health and are being more tightly regulated by New Jersey and other states. Some environmentalists have expressed alarm at the decision and have called for the dumping to be halted.

The soil is from the former Naval Air Station at Willow Grove, Pennsylvania, where high levels of PFAS chemicals have

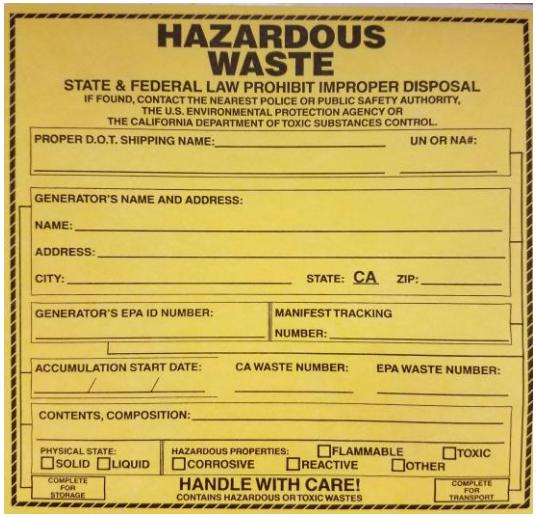
- The incineration of excavated soils and granular activated carbon from treatment
- The Concawe (2016) report recommends incineration temperatures of between 1,000 and 1200°C for complete destruction of PFOS
- More than 3 million gallons of the foam and related waste have been retrieved from U.S. Navy, Marine Corps, National Guard, Army, and Air Force bases around the world. Now the question is what to do with them.
- In January 2017, a waste disposal company hired by the Defense Department began incinerating more than 1 million gallons of the foam and AFFF-contaminated water that had been collected from Air Force bases around the country.

TYPES OF LANDFILL

- **Sanitary landfill**: Is a pit with a protected bottom where trash is buried in layers and compressed to make it more solid. The main purpose of sanitary landfill is to ensure waste is safe by reducing the harm from accumulated waste and allowing safe decomposition. Sanitary landfill contains:

  - A liner system layer
  - A drainage system
  - A gas collection system
  - The trash itself

TYPES OF LANDFILL



- **<u>Hazardous Waste Landfill</u>**: According to 40 CFR 260.10, hazardous waste landfill is defined as a disposal facility or part of a facility where hazardous waste is placed in or on land and which is not a pile, it could be a land treatment facility, a surface impoundment, an underground injection well, a salt dome formation, a salt bed formation, an underground mine, a cave, or a corrective action management unit. Hazardous waste landfill contains:

  - Double liner
  - Double leachate collection and removal systems
  - Leak detection system
  - Run on, runoff, and wind dispersal controls
  - Construction quality assurance program

LANDFILL ISSUE

- Landfills are not only the final destination for PFAS-contaminated industrial waste, sewage sludge, and waste from site remediation, but also for PFAS-bearing consumer products.
- Since 1990, federal or state regulations have required the installation of a composite liner, a layer of compacted soil, and a leachate collection system (40 CFR 258.40); however, sanitary landfills placed into service prior to 1990 may still be active.
- PFAS may directly enter the environment from waste buried in unlined landfills prior to 1990 or if liners or leachate collection systems fail.
- Leachate collected from landfills is typically treated on site or transported to a nearby municipal WWTP.

PFAS AND LEACHATE


Landfill Leachate

- PFAS' has been reported in landfill leachate survey of U.S. landfills of varying climates and waste ages.
- In 2013, the total volume of leachate generated in the U.S. was estimated to be 61.1 million m3, with 79% of this volume coming from landfills in wet climates (>75 cm/yr precipitation) that contain 47% of U.S. solid waste. The mass of measured PFAS' from U.S. landfill leachate to wastewater treatment plants was estimated to be between 563 and 638 kg for 2013.
- US Landfill Study (Environ. Sci. Technol., 2017, 51 (4), pp 2197–2205)
  - 95 samples from 18 landfills
  - 70 PFAS measured, 19 PFAS detected in >50% of samples
  - PFOS: 3 to 200 ppt
  - PFOA: 100 to 1,000 ppt
  - Total PFAS: 2,000 to 29,000 ppt
  - Majority of leachates: 400 to 15,000 ppt

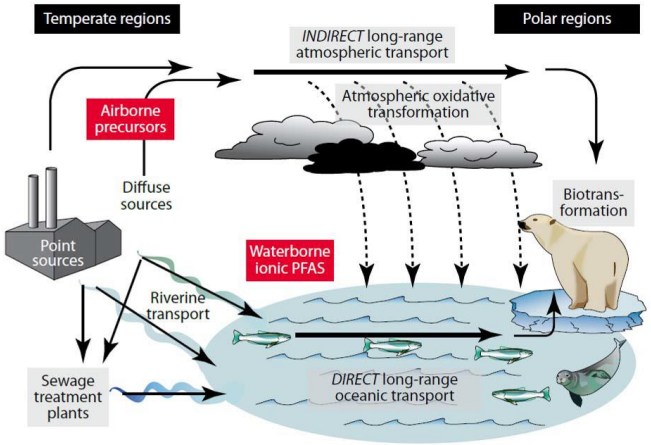
INCINERATION ISSUE

- PCBs can be destroyed by commercial incineration in special plants achieving temperatures of 1,200ºF (650° C) in the presence of oxygen. Attempts at incineration at low temperature unfortunately results in degradation compounds which are even more toxic than the commercially synthesized PCB compounds
- The incineration of PFAS requires temperatures in excess of 1,100°C (2000°F) and is, therefore, very expensive.
- Incomplete incineration sends PFAS chemicals back out into the environment where they have the potential to form new, harmful chemicals that are damaging to human health or deplete the ozone layer.

INCINERATION ISSUE

- MDEQ (2018) states that incinerators operating in Michigan function at temperatures between 590 and 980°C. As such, incomplete destruction and the formation of reaction byproducts is likely (Concawe Soil and Groundwater Taskforce 2016) and stack treatment to remove fluorinated chemicals would be required.
- While GAC has been shown to be effective for the removal of PFOS and PFOA in waters, there are no known studies demonstrating its use for stack gasses. Wet scrubbers are used at three Michigan incinerators. The use of this technology for stack gas treatment has the potential of transferring PFAS and byproducts to wastewater.

PFAS IN AIR



- Once PFAS' enter the air thru stacks, they can be carried long distances by air currents or adsorb to particulate matter (Barber et al. 2007; Dreyer et al. 2015; Liu et al. 2015a; Shoeib et al. 2010; Wang et al. 2014).
- Once in the atmosphere, it can travel long-range followed by deposition onto land and water, resulting in PFAS-contaminated food chains and accumulation in plants and animals, even in remote Arctic and Antarctic regions.
- Despite the U.S.-wide phaseout of longer-chain PFAS', atmospheric emissions of these compounds from offshore manufacturing could potentially still impact the United States. Trans-Pacific atmospheric transport from China leading to adverse impacts on air quality in California have previously been documented for other pollutants (Lin et al. 2014b).

CARPET CASE STUDY

- Carpets and Rugs as Sources of Significant and Widespread Human and Ecological PFAS Exposures.

- Carpets and rugs constitute nearly half of all floor coverings in U.S. homes and workplaces. A large percentage of the PFAS produced worldwide are used to treat carpets, rugs, and other home textiles to confer stain-, soil-, oil- or water-resistance.
- PFAS from carpets and rugs can be found in home and office air samples, and in the blood of residents and office workers. Compared to outdoor air, indoor air can have >1,000 times higher levels of fluorotelomer alcohols (FTOHs) (Fraser et al. 2012; Fraser et al. 2013).

CARPET CASE STUDY

- In 2016, 343 million pounds of post-consumer carpet were discarded in California.
  - 257 million pounds (75 percent) were landfilled
  - 38 million pounds (11 percent) were recycled
  - 926,000 pounds (0.27 percent) were reused
  - 21 million pounds (6.1 percent) were combusted for energy recovery
- PFAS from discarded carpets and rugs can be released into the atmosphere during carpet decomposition in landfills and combustion, and become widely dispersed.
- They can leach into groundwater from unlined landfills or, contaminated leachates from lined landfills can be transferred to surface water via incomplete removal at WWTPs.

PFAS IN WWTP

- PFAS entering conventional wastewater treatment plants (WWTP) or produced from precursors during treatment can exit the plant in either the aqueous or sludge phase.
- Studies have shown that the discharge of waste water effluent is a significant source of PFAS in the environment.
- PFOS and PFOA were still the main forms of PFAS in municipal wastewater treatment plant effluents five to ten years after the major phase-outs of C8-based PFAS' commenced.

PFAS IN WWTP

- The perfluoroalkyl acids (PFAS) are very non-reactive to typical wastewater and drinking water treatment processes, and only long-chain PFAS' are effectively removed by sorption. However, these compounds can undergo transformation during treatment processes, but their byproducts are often other measurable PFAS' that contain a similarly-sized (i.e., equivalent or one to two carbons shorter) perfluorinated group.

- **Evaluate potential sources of PFAS in wastewater influent -** for example, landfill leachate may be a significant source and should be tested. Additional treatment may be required for sources that contribute elevated levels of PFAS'.

BIOSOLIDS AND PFAS

- Biosolids have been widely used on farms and other lands across North America for decades.
- Every US State and Canadian province allows biosolids use on soils. US EPA, USDA, and US FDA all support biosolids recycling. Biosolids reflect what is in our daily lives.
- Currently, the United States Environmental Protection Agency (US EPA) regulates land application of biosolids based on pathogen, metal, and nutrient content under 40 CFR Part 503)11. However, PFAS in biosolids are not regulated.
- PFOS and PFOA are known to be non-biodegradable by an activated sludge process. Therefore, a reduction in mass flow following activated sludge treatment was neither expected nor observed.

BIOSOLIDS AND PFAS

- The core concern being expressed by regulatory officials regarding biosolids applications to soils is about leaching of PFAS to groundwater.

- One famous horror story is given in the application of WWTP biosolids and resulting perfluorinated compound contamination of surface and well water which “describes a situation in Decatur, Alabama, where PFC contaminated biosolids from a local municipal wastewater treatment facility that had received waste from local fluorochemical facilities were used as a soil amendment in local agricultural fields for as many as twelve years.” Biosolids-borne PFAS were implicated in groundwater contamination.

PFAS: RCRA LEGAL CONSIDERATIONS

- In February 2017, a U.S. District Court denied motions to dismiss RCRA "imminent and substantial endangerment" claims relating to PFAS. See Tennessee Riverkeeper, Inc. v. 3M Co., No. 5:16-cv-01029-AKK, 2017 WL 784991 (N.D. Ala. Feb. 10, 2017). This case involved the alleged continuing contamination of the Tennessee River and associated public drinking water supplies with PFAS that the plaintiff claims originated from a local manufacturing facility and two local landfills
- RCRA 7002 orders have been filed to address PFAS contamination as "solid waste" that "may present an imminent and substantial endangerment"
  - Solid waste can be "any discarded material"
  - "may present endangerment"
  - RCRA 7002 lawsuits have been filed in AL, NC, and MI

WHAT IS NEXT?

- Future NPDES permits for WWTP wastewater discharge, stormwater and other industries for PFAS-related compounds.
- Reduction and restriction on waste impacted with PFAS to landfills and other waste storage facilities.
- Groundwater standard consideration for PFAS by different states.
- PFAS air emission regulation and monitoring
- Remember, litigation continued many years after production and use of MTBE, PCBs and Asbestos.

CONTACT INFORMATION

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PFAS CAPABILITIES BY FACILITY

- **SGS Orlando, FL**
  - Full Service Regulatory Analysis
  - PFAS in Drinking Water, Water and Solids by internal standard
  - PFAS in Water and Solids by isotope dilution (ID)
  - DoD / NELAP / ISO 17025 accredited (with state accreditations for DW, NPW, Solids where available)
- **SGS Wilmington, NC**
  - HRMS Specialty (Dioxin/Furans, PCB Congeners, HRMS PAHs) + PFAS
  - Serve Source Evaluation, Con. Sites, NPDES
  - PFAS in Drinking Water, Water and Solids by internal standard (non-ID)
  - DoD / NELAP / ISO 17025 accredited

PFAS CAPABILITIES BY FACILITY

- **SGS AXYS, Victoria, BC**
  - HRMS , LC/MS/MS, GC/MS ultratrace only, all matrices excluding DW
  - PFAS in Water, Solids, Tissue, Serum, Method Development (multiple target analyte methods)
  - TOPS (Total Oxidizable Precursor Assay)

- **SGS West Creek, NJ**
  - North American Environmental Drilling Division
    - United States
    - Virgin Islands
  - Sampling for PFAS in Drinking Water, Water and Solids
  - PFC/PFAS Free