ENVIRONMENTAL LITIGATION GROUP, P.C.

LEGAL SERVICES FOR VICTIMS SINCE 1990

Aqueous Film-Forming Foam (AFFF)

Guidelines for Per- and Polyfluoroalkyl Substances

GUIDELINES FOR THEIR USE

This Guideline has been developed to minimize the spread of the adverse health outcomes in humans and negative environmental impacts of per-fluorooctane sulphonic acid (PFOS) and perfluorooctanoic acid (PFOA)

THE NEW INTOXICANTS:

Per- and polyfluoroalkyl chemicals or PFAS came under scrutiny in recent years as environmental pollutants that may present a serious risk to human well-being. According to the EPA, there are over 700 members of the PFAS class that saw commercial applications; in things like food packaging, waterproofing for clothing, non-adhesive cookware, and aqueous film-forming foam (AFFF) used to contain jet fuel blazes. Along with industrial discharge, the regular use of AFFF for firefighter training and equipment testing contributes the most in elevating PFAS concentrations for a given area.

SHORT HISTORY:

AFFF was developed jointly by the 3M Company of Minnesota and the US Navy to fulfill the need for a fast acting firefighting solution in the aftermath of the USS Forestall disaster, the worst accident in modern US naval history that took the lives of 134 sailors. While PFOS, the original active ingredient in AFFF hasn't been produced on US soil for over 15 years, large stocks of it remain in US military inventories, as well as those of civilian operators. Together with its equally notorious cousin, PFOA, this chemical is currently in the process of being phased out, but due to their extreme resilience in the environment, water supplies in or near military bases and airports remain contaminated to this day, and potentially dangerous to people who use them.

HEALTH EFFECTS:

PFAS has been associated with a number of adverse health effects, including elevated cholesterol, developmental birth defects, endocrine dysfunctions, liver damage, kidney, testicular, bladder, and thyroid cancers. After a long history of concerns related to PFAS, the US government is just now acting to screen for and clean PFOA and PFOS from the environment. Classed by the EPA as "environment pollutants", legislation to include these on the hazardous substance list, which will allow the environmental agency to force responsible parties to clean up, is currently in the works.

Endocrine-Disrupting Chemicals

Exposure to long-chain PFAS chemicals can increase cholesterol and interfere with the body's natural hormones.

Developmental Effects In Infants

Potential health effects from exposure to PFAS may affect the development of unborn babies and breastfeeding infants.

Neurodevelopmental Effects

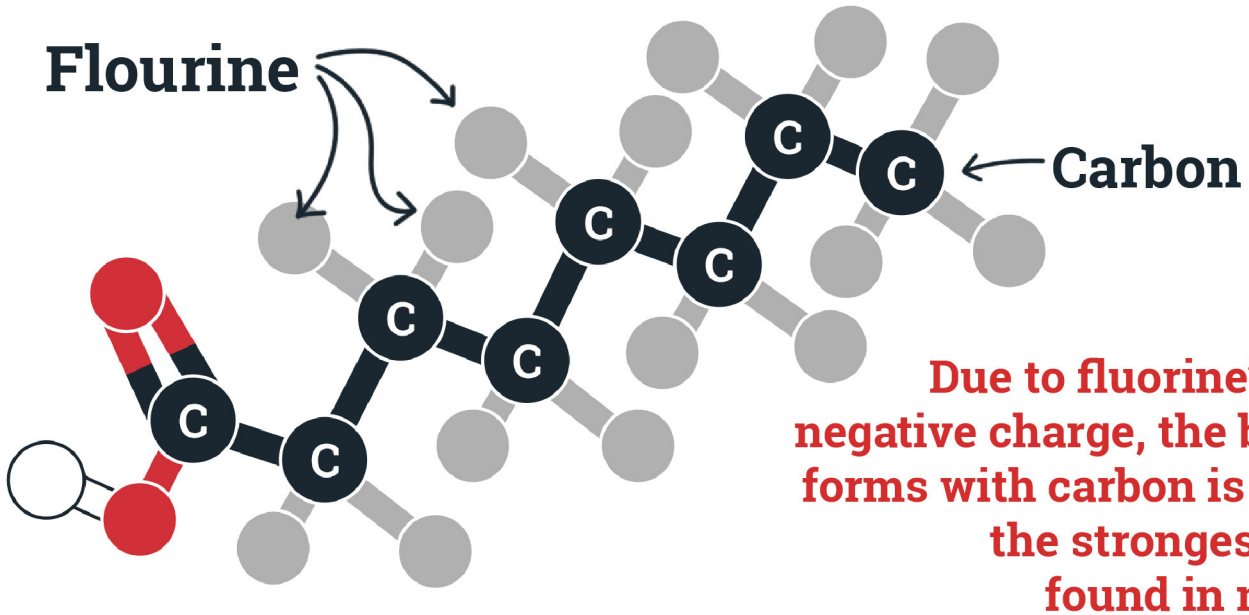
Relatively low amounts of PFAS can be responsible for neurological developmental disorders

Possibly Carcinogenic To Humans

A number of toxicological studies conducted on rats and fish provide further evidence of PFAS carcinogenic potential.

WHAT ARE PFAS AND HOW THEY WORK

The great degree of functionality offered by PFAS chemicals motivated their extensive use for a wide range of applications. They are heat resistant, grease, and water-repellent as well as near impervious to reacting with other chemicals under normal environmental conditions. A closer look at their chemical make-up is required to understand what makes PFAS so useful. Compounds are made up from a chain of fluorinated carbon groups linked to a charged radical at one end - often a carboxy or a sulfoxy group, like in the case of PFOA and PFOS.



Due to fluorine's high negative charge, the bond it forms with carbon is one of the strongest to be found in nature.

The highly fluorinated carbon tail of per-polyfluoroalkil substances is oleophobic and hydrophobic, which means it repels both water and carbohydrates like kerosene. The charged head of PFAS used in firefighting is hydrophilic, making the compound adhere to water from that end. This creates a molecule-thin layer of PFAS around H2O particles, which reduces surface tension to such a degree that water will slide over lighter fluids, covering and cutting them off from oxygen.

The fire crews on the USS Forestall witnessed to their horror that seawater used to contain the flames was having the exact opposite effect in giving burning jet fuel a wet surface to slide on.

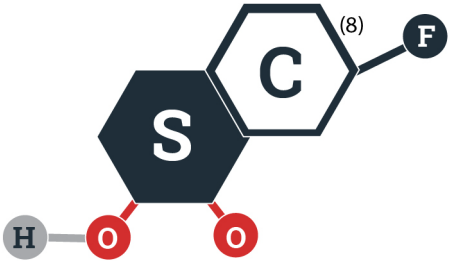
This is because the two substances don't mix, and seawater being heavier than kerosene, simply slipped beneath it.

THE IMPORTANT DIFFERENCE BETWEEN PER- AND POLYFLURINATED COMPOUNDS

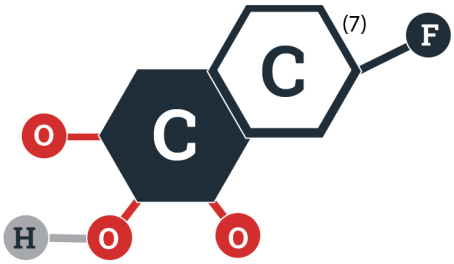
From an ecological point of view, the distinction between per- and polyfluorinated compounds is an important one, although it's seldom addressed in media articles.

Perfluorinated PFAS have all the carbon atoms in their tails shielded by fluorine, with no "weak link" in the chain.

Perfluorooctane sulfonic acid (PFOS)



Perfluorooctanoic acid (PFOA)



Both PFOS (perfluorooctane sulfonic acid) and PFOA (perfluorooctanoic acid) are perfluorinated compounds, impervious to oxidation under natural conditions and "resistant to direct photolysis and reaction with acids, bases, oxidants, and reductants" (as per 3M's description).

Polyfluorinated compounds can be broken down by atmospheric oxygen, as some of the links in their carbon chain aren't shielded by fluorine, but feature a hydrogen or a hydro-carbon radical instead. The fluorotelomersulfonate (FTSA) structure was made possible by a new process called telomerization, which involves adding carbon blocks to the tail section piece by piece. The original intent was to make naturally degradable PFAS, but this only partially succeeded, as polyfluorinated generally break down into toxic PFOA and other PFCA.

Although most of the research and regulatory efforts so far have focused on PFOS and PFOA, it is important to notice that hundreds of different polyfluorinated compounds are still in use.

THE PFAS FAMILY NUMBERS THOUSANDS OF CHEMICALS, MANY TOXIC

Most of the 5,000 or so PFAS in existence are only of interest to chemists and can be categorized under a myriad of criteria. The more common substances in this class are identified after the radical, which makes up the “head” and the number of links in the “tail”.

Perfluoroalkylsulfonate (PFSA)

With a sulfonic radical and between four and eight carbons making up its tail, this structure is a longtime favorite of 3M. Examples include the original AFFF that started it all, PFOS, the 6-carbon chain PFHxS, and the more modern PFBS.

PFOS (perfluorooctane sulfonic acid) was developed during the 60s and is an 8-carbon (8C) sulfonic acid. Due to its relatively long structure, it can stay in the human body for a very long time, taking up to five years to half its concentration. A relatively large amount of research concluded that the chemical is highly toxic, being strongly associated with most diseases for which PFAS can act as an environmental factor. 3M decided to stop production of the compound in 2002, and all other manufacturers of PFOS followed suit, replacing it with PFBS for all practical applications.

PFBS (perfluorobutane sulfonate) is considered by many to be one of the least toxic members of the class. This is due to its short 4-carbon tail, which allows it to clear the human body faster than most of its relatives. As a rule of thumb, the less carbon links a PFAS has, the faster it can pass through a biological system.

This, however, doesn’t seem to apply to PFHxS, despite the fact that the 6-chain was initially intended as a safer alternative to older compounds. Pharmacokinetic studies show it to be the PFAS that takes the longest (!) to clear the human body, which gives it an unusually high level of toxicity.

Perfluoroalkylcarboxylates (PFCA)

These have a carbon atom instead of a sulfur in their charged head, giving them a relatively more reactive carboxyl group as well as a shorter structure overall. A simple way of describing this would be that PFCAs lack the sulfur atom at the end of their carbon chain. PFOA, PFHpA, PFHxA, and PFBA are all examples of this sub-class.

Only slightly less toxic than PFOS, the 8-chain PFOA (perfluorooctanoic acid) was originally made by DuPont beginning in the early 70s. It is relatively well studied and enjoys a high degree of attention from the EPA and ATSDR, among a long list of international regulatory bodies and research groups.

PFHxA (perfluorohexanoic acid) is a noticeably less toxic PFAS. PFHxA can be damaging in its own right, but as of yet, this didn’t justify the same amount of

scrutiny from regulatory bodies that 8-Cs or PFHxS received.

There's little functional difference between PFBA (perfluorobutaneic acid) and PFBS, with both compounds being relatively easy on the body, as suggested by a somewhat permissive minimum threshold for safety recommended for either of them thus far.

However, it is important to note that their diminutive size means both molecules are significantly harder to clean from the environment than other PFAS.

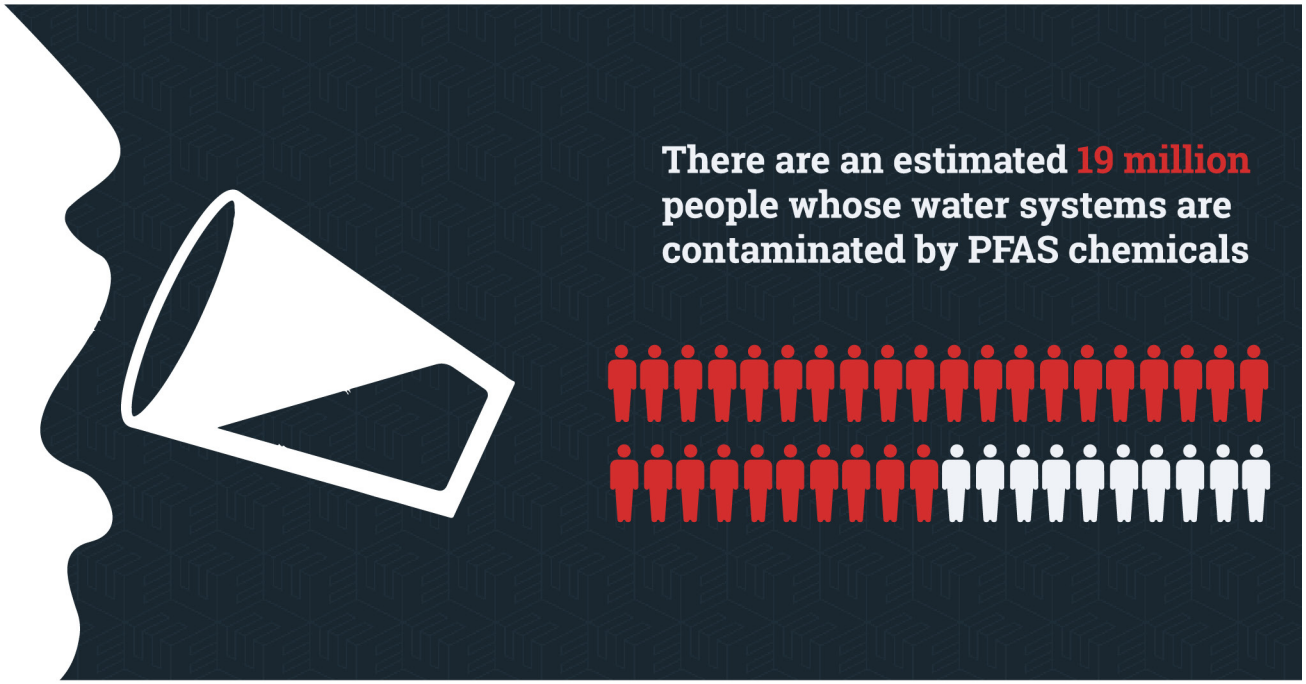
Fluorotelomsulfonates (FTSA)

These are the polyfluoro substances mentioned previously. They differ in notation to other PFAS by the fact that the fluorocarbon, as well as the hydrocarbon series, are mentioned, as in – 6:2 Fluorotelomer sulfonic acid, for 6:2 FtS, where the first figure stands for the number of fluorocarbon links and the second for hydrocarbon. Another common fluorotelomer is the longer 8:2 FtS

THE EXTENT OF ENVIRONMENTAL CONTAMINATION OF PFAS

Due to their high persistence in the environment and widespread use, some amounts of PFAS are present in nearly all US drinking water sources, and consequently in the blood of almost all Americans. What constitutes a toxic concentration in the environment, however, is still under dispute.

From 2013, the EPA has started testing national water systems in order to detect the levels of PFAS and PFOS chemicals present in the population's drinking water. However, considering that the testing is still continuing and the full results obtained up until this point weren't completely disclosed to the public, there is no exact number of affected water systems, only estimates. Contamination of drinking water in American communities is continuing to grow at an alarming rate.



A CONSIDERABLE NUMBER OF SITES HAVE BEEN AFFECTED

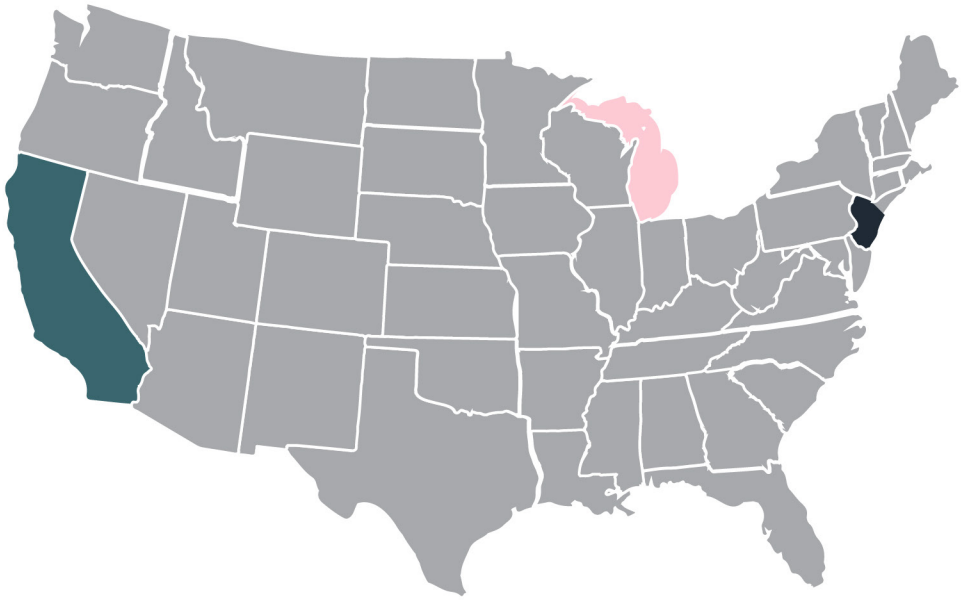
Given that the process of testing water and soil samples for PFAS is still ongoing, it is difficult to say what the final tally will be, but as per March 2019, the Environmental Working Group found 610 contaminated locations in 43 states by consulting publically available data from the Safe Drinking Water Information System and the Pentagon.

An analysis over unpublished EPA data has estimated that there could be over 1500 contaminated water sites across the country.

Michigan
192 sites

California
47 sites

New Jersey
43 sites



By August 2019, the DoD found some level of PFOA and PFOS contamination in water sources at 401 active and former military installations, over 25% of which exceeds the EPA's threshold for safety. In November 2019, the Pentagon admitted it had undercounted the number of affected sites, with the revised figures to be released.

Out of the 100 most severely affected sites known to date, 64 show PFAS concentrations in excess of 100.000 ppt, with the former England Air Force Base in Louisiana topping the list at 20.7 million ppt of PFHxS.

Among the states, the negative record is held by Michigan with 192 found contamination sites. It's not clear, however, if the high figure is an accurate reflection of the state's actual ranking or a result of the exceptional investigative efforts undertaken by local authorities. According to Michigan environmental officials' estimates, the final figure of contaminated sites can increase by orders of magnitude as more testing is done.

PFAS EXPAND QUICKLY THROUGHT THE ENVIRNMENT

People may be exposed to PFAS through contact with everyday consumer products including the following: non-stick products, stain-resistant coatings, cleaning sprays, impregnating and nanospray agents (for waterproofing), carpets, leather, and wood glue.

For decades, the Federal Aviation Administration policy has been to require airports the application of fluorinated firefighting foam that meets specifications developed by the Navy in the 1960s, to rapidly extinguish so-called “catastrophic fires” such as airplane crashes involving jet fuel. AFFF containing PFAS has been used extensively at airports during equipment testing, fire training, fuel spills, and accidental discharges from the hangar dispersal systems.

It is important to note that PFAS aren’t uniform in their expansion patterns. Long molecules like PFOS and PFOA have an increased affinity for binding to particles in the soil and biomass. This can act to decrease their concentration in groundwater but it also means that absent any measures, they can persist in an area for longer, “stored” in the soil to be pushed ever so closer to underground wells by each rainfall.

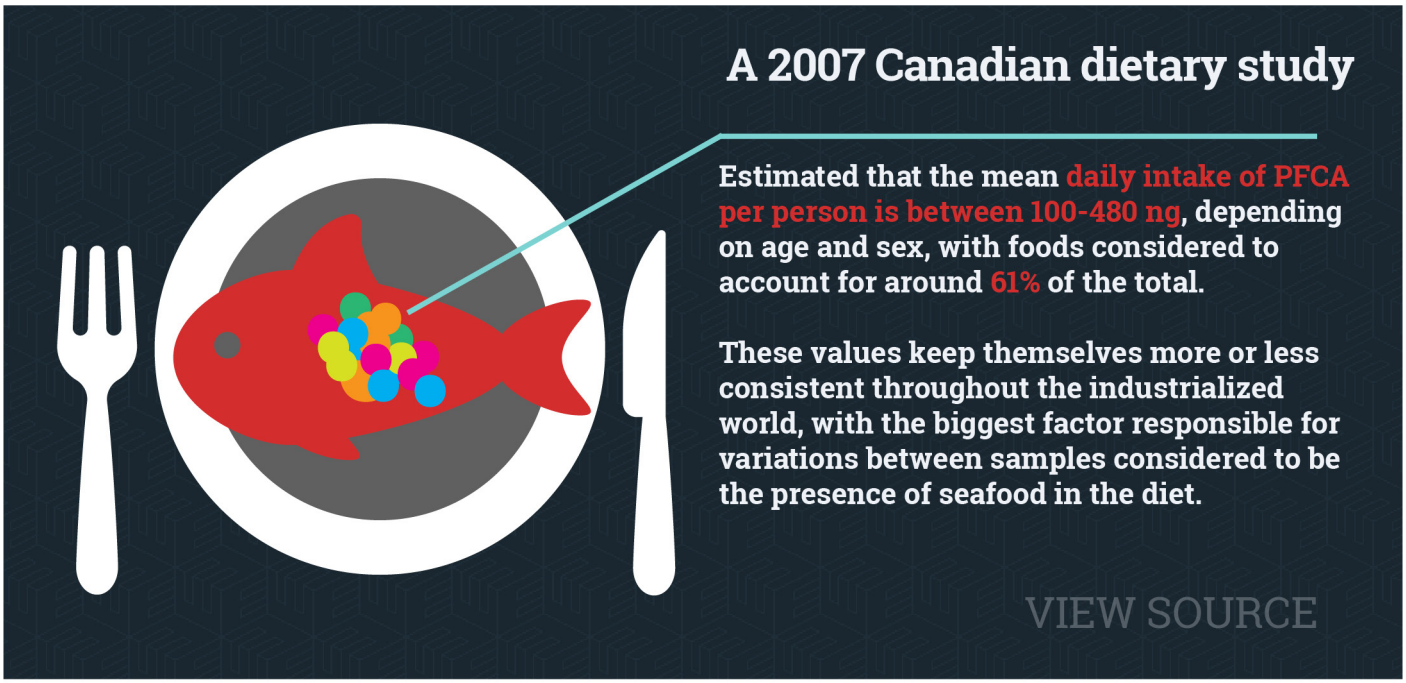
PFAS are extremely resilient and can be carried along water pathways to pollute large areas, especially since regular wastewater treatment plants do not effectively break these man-made chemicals when no special provisions are in place. From dumping sites near designated firefighting training areas or industrial plants, PFAS can either seep into the ground down to drinkable water basins or flow through storm drains into local rivers.

Regular firefighter training and equipment testing amounted to half a century of PFAS discharge near military and civilian airports, especially as only in the last few years attempts were made to restrict the use of toxic chemicals to actual emergency situations. Ecologically friendly training foams are beginning to be employed more frequently as fire departments become aware of the toxic potential of PFAS surfactants.

Landfills can also act as a source for PFAS release, either through discarded consumer goods or industrial waste. The use of sewage sludge (biosolids) as fertilizer from plants processing industrial wastewater can over time increase the concentration of PFSAs in farmland. These can pass into crops or into local water systems, potentially reaching populations far from the immediate area through agricultural trade. Whenever possible, buying produce harvested in developing nations should be avoided.

FOOD CONTAMINATION IS A SERIOUS ISSUE

While drinking water has been given the most attention, consuming contaminated foods seems to amount for much of a person's daily PFAS intake. This comes mainly from fish but also fruit harvested near areas with high industrial activity. The amount of PFAS leaching from packaging is small, but not negligible.



Toxic PFAS chemicals are known to bioaccumulate in the tissue of fish, which can create a route of human exposure through fish consumption. Pregnant women and children are particularly vulnerable to the effects of per- and poly-fluoroalkyl substances. Moderate consumption of fish and seafood during these periods may contribute to lower exposures of PFAS.

For the US, the FDA **tested 91 produce** samples in **8 states for PFAS** and found the chemical **present in 10 of them.**

Concentrations ranging from **134 to 865 ppt of PFOS** were recorded for meat and fish.

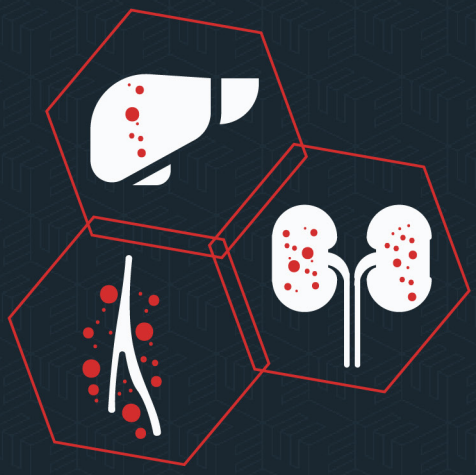
Chocolate cake with frosting stood out with **17,640 ppt of PFPeA.**

Not to be misunderstood, water remains the main vector for PFAS intoxication by a significant margin in areas with a nearby point of release, commonly a firefighter training site or industrial plant.

SOME OF THE MAJOR WAYS PFAS CAN ATTACK THE BODY

PFAS bind to proteins in the body, but are not known to metabolize in any way, leaving bioaccumulation as the most likely mechanism for their toxicity.

PFAS are stored primarily in the liver, kidneys, and blood, but tend to be broadly distributed throughout the body, with some 40-50% of them, much higher in the case of 4C, having no determined location.



Recent studies found that PFAS can pass the placental barrier from mother to fetus and can accumulate in breast milk.

VIEW SOURCE

The amount of time it takes for the body to eliminate half of the concentration ingested, commonly referred to as a substance's "half-life", varies greatly between PFAS, and it's generally a good but not sufficient indicator of how harmful each specific chemical can be.

- C4 compounds appear to be the "safest", with a half-life of 3 and 28 days for PFBA and PFBS respectively.
- the 6C PFHxA is not far behind, with some 32 days necessary to decrease plasma concentration by half.
- C7 and C8 can potentially take decades to clear, giving half-lives of 2.1 to 3.8 years for PFOA; 3.4 to 5 years for PFOS and 14 to 17 months for PFHpA.
- 6C PFHxS is the worst offender with a 5.3 to 8.5 years half-life inside the human body.
- there's not much human data for other common PFAS, but we can deduce from animal studies that the C9 PFNA can be nearly twice as persistent than PFOA, and GenX tends to have 2 to 3 times the half-life of PFBS.

PFAS-RELATED IMBALANCES AND DISEASES

In their fact sheet concerning PFAS the ATSDR considered there was sufficient evidence to link PFAS to high cholesterol, kidney, and liver dysfunctions, prostate, kidney and testicular cancers, as well as ulcerative colitis, thyroid disease, and pregnancy-induced hypertension.

A large number of reports from state scientific panels, most notably New Jersey, Michigan, and Minnesota, the ministries of health in some European nations, international bodies like the Stockholm Convention, and various environmental research groups compiled sufficient data to indicate PFAS as an environmental factor for a number of health issues.

Immune System Disorders

A number of epidemiological studies (here and here) found associations between PFOA/PFOS blood levels and immune response to vaccines in children. The immune system's reaction to vaccines is essentially a metric of how well it can handle live aggressors, and many instances showed an inverse correlation between how much PFAS were in the blood and the number of anti-bodies produced. In other words, the higher the concentration of PFAS in the blood, the less the immune system responds to infection.

This is extremely significant for children, as developing immune systems are very vulnerable to environmental stressors. Damage at this stage can have significant consequences later in life, affecting everything from your ability to resist a common cold to certain forms of cancer. In fact, follow-ups to the studies showed that children who have been exposed earliest to PFAS were significantly more likely to suffer from influenza.

Studies of adult humans showed a "small, yet visible" immune impact; but higher concentrations of long-chain PFAS administered to grown rats significantly slowed their response to potential pathogens lowered anti-bodies count, and reduced the weight of immune cell producing glands like the thymus and spleen.

Developmental Disorders

The lowest amount of a substance that can be responsible for any adverse health effects is referred to as a "toxicological limit". For PFOA and PFOS, this stands at only 1 ppt and the action they were found to cause was inhibiting mammary gland development in rats. High doses are likely to kill most rodent

fetuses while even relatively low amounts of PFAS can be responsible for severe neurological developmental disorders, among a long list of other morbidities.

It is interesting to note that neurological damage has been suggested as a potential effect of PFHxS exposure in humans as well, but enough scientific data for a definitive link to conditions such as autism or ADHD remains to be gathered. It is certain, however, that even in concentrations low enough to be found in the environment, PFAS can cause a significant decrease in birth weight for human babies.

Liver Disease

There is consistent toxicological data linking PFAS to altered liver functions going all the way back to the 1980s. What scientists most often noticed after administering high doses of PFAS to rats was the activation of the enzymes involved in lipid and glucose metabolism, suggesting that these foreign compounds are “mistaken” for either fat or sugar by the body.

Other than that, the liver reacts to high concentrations of PFAS as it would do with any other intoxicant, by increasing in size and forming a protective layer of fat. This is the well-known fatty liver disease, most prevalent in heavy eaters and drinkers. As with alcohol, excessive amounts of PFAS over a long period of time will lead to the forming of necrotic tissue on the liver.

The 8C Science Panel’s epidemiological study found that PFAS can increase the incidence of liver disease among humans living in a contaminated environment.

Cancer

Upon reviewing the scientific literature on PFOA, The International Agency for Research on Cancer concluded that the fluorocarbon compound is “possibly carcinogenic to humans”. The strongest support for a connection between PFAS and cancer was given by the C8 Science Panel in their giant epidemiological study of over 69,000 Ohio River valley Inhabitants. What the researchers found was a “probable link” between drinking water containing between 50-100 ppt of PFAS for at least a year and kidney cancer, testicular cancer, ovarian cancer, and thyroid disease. Given the huge cohort, C8SP’s results are strong enough to not need duplication, but regardless, there is additional research data supporting this connection.

In 1997, DuPont researchers noted an increased incidence of testicular cancer in their workers at the Parkersburg plant. An Italian occupational exposure study centering on the Veneto region suggested a similar conclusion while adding a weak link between PFAS and leukemia to the list. Three American epidemiological studies found an increased incidence of prostate cancer in their sample population as well as 50% to 90% higher lethality for bladder cancer cases.

A number of toxicological studies conducted on rats and fish provide further evidence of PFAS carcinogenic potential, with Leyden cell testicular tumors and renal tumors occurring most often in the animals tested.

Thyroid Disease

Research results on PFAS and thyroid disease are not very consistent, but some associations might be incurred from what we know so far. The C8 panel found a “probable link” between PFOA and hypothyroidism in humans while lab animals exposed to PFAS showed endocrinal imbalances as well as a shrunken thyroid. It is believed that the compound’s protein binding properties are the mechanism by which it affects the thyroid, causing, among other things, cholesterol imbalances, even in relatively small concentrations.

Neurotoxicity

The research evidence supporting a link between PFAS and human neurotoxicity is comparatively weaker than what has been found for other negative health outcomes. A number of studies did associate PFOS, PFHxS, and PFOA with neural disruption in cell systems. However, no evidence has been found for PFHxA affecting the brain and nerve cells of rodent fetuses.

Other Imbalances

Subclinical changes in biomarkers are seen as important by researchers even when their values are too low to indicate a disease per se. The scientific literature on PFAS substances points to a myriad of changes at the bimolecular

level when the concentration of the foreign compound exceeds certain concentrations in plasma. These include alterations in the level of cholesterol, the presence of uric acid, activation of certain liver enzymes, decreases in kidney filtration rates, etc. This is particularly significant since the kidneys are the primary route of PFAS excretion and a slowing down in function would compound the problem by allowing more of the chemical to build up in the body.

WHAT IS THE GOVERNMENT DOING TO ADDRESS PFAS PROBLEM?

For the past five years, the DoD has been busy screening for PFOS and PFOA around former and active military bases. Some parties lament that these measures were taken far too late, as the harmful potential of PFAS chemicals was a matter of public record for at least a decade previously, and 3M, as well as DuPont, ceased production of the two compounds around the turn of the millennium. Additionally, a number of environmental watchdogs, together with the ATSDR and the EPA have expressed a number of concerns as to whether what the Pentagon is doing under the Superfund Law is sufficient.

First, there is a minimum safety advisory level in drinking water for the two compounds, set by the EPA in 2016 at 70 parts per trillion, which the DoD declared it will be using as a guideline for cleaning operations where no other standards are in place (such is the case in Michigan, for example, with minimums of 13 and 14ppt). This is considered too high by critics, as there is a good amount of scientific evidence pointing to a far lower toxicological threshold, most notably for developmental birth defects and reproductive effects.

The ATSDR suggested a minimum of 10 times lower than the figure arrived at by the EPA and the NRDC research group went as low as 1 ppt, basically the lowest concentration to which PFOA and PFOS can be reduced in the environment using current water filtration methods.

However, with a projected price tag of $2bn for cleanup operations, the DoD might even consider disregarding the EPAs advisory values of 70ppt.

VIEW SOURCE

In an October 2019 memo circulated between the top brass of all military services, a Pentagon official suggested a screening level of 400 ppt, which is ten times higher than what the EPA recommends for screening; and six times higher than the 70 ppt at which the DoD said it would engage in cleaning operations. Furthermore, since the removal of PFAS doesn't hold an "emergency" status within the EPA, the agency isn't in any way bound to intervene if the military neglects to conform to its guidelines. In addition to PFOA and PFOS, the 2019 document also mentions PFBS, but the threshold proposed for its removal stands at 40,000 ppt. Furthermore, it is not always clear from military documentation if the two chemicals are to be treated together or separately, although in EPA toxicology drafts it has always been stressed that the 40 ppt and 70 ppt values refer to concentrations of PFOA and PFOS combined.

This is significant, as oftentimes there are more than just these two PFAS contaminating a given environment, and water filtration methods are not consistent in their effective removal due to differences in size and electrical charge between various poly- and perfluoroalkyls.

Measures intended to address the problem at the "point of use" include issuing affected residences with water filters, and supplying military base personnel with bottled water when local sources are found to be undrinkable. However, more comprehensive actions aimed at removing the contaminants are slow to take effect.

According to policy advisor Nathan Frey, this is because the military is still assessing cost-effective cleaning methods, and precipitous action at this point runs the risk of setting an unwanted procedural standard for years to come.

An example of this would be the situation in the Bucks and Montgomery counties of Pennsylvania. Despite the fact that screening tests detected high concentrations of PFOS and PFOA and identified a point of release in the former Willow Grove Joint Navy and Air National Guard the two chemicals continue to seep into the local water system as no measure is being taken to address the contamination at the source.

AFFF containing PFOA and PFOS is at present being being disposed from the military inventories by burning, through a process that raised its own environmental concerns.

This is expected to be completed around the beginning of the next decade. It's important to note that the replacement foams the DoD will decide upon also uses PFAS as per military performance specifications, although ecologically friendly alternatives are present.

CURRENT FILTRATION METHODS

Fluorine's high electronegativity gives PFAS an extremely strong bond which makes these chemicals particularly resilient and near impervious to biodegradation. Furthermore, PFAS cannot be removed by boiling, hydrolysis, photolysis, oxidation and through regular water filtration. The few methods known to work can be employed in centralized drinking water facilities, or in a distributed manner, either at the point of entry (POE), or point of use (POU), meaning in homes and buildings.

Powdered or granular activated carbon

The effectiveness of carbon filtration methods varies considerably depending on the type of carbon used, the depth of the filter and on allowing adequate contact time. PFAS chemicals have limited absorption but both powdered and granular activated carbon had been shown to work adequately at plant level, contained in either stand-alone cartridges or as a section of a regular sand filter.

Carbon has to be replaced at regular intervals, and although the military covers all initial costs of setting up POU filters, it does not currently pay for maintenance. Carbon masses have been found to clog relatively fast, especially when dealing with shorter chain compounds, like PFBS.

Membrane technologies

Only high-pressure membranes have been found effective in removing PFAS by themselves. However, low-pressure varieties can work in conjunction with activated carbon, where these act in removing the powdered carbon particles.

High-pressure systems like nano-filtration and reverse osmosis have been shown to be extremely effective in removing PFOS, as these can reject dissolved contaminants like organic compounds and salts as well as particles.

Ion exchange resins

Since most PFAS chemicals are positively charged, anion exchange resins can be effective at removing them, although it's been noted that this method demands a high amount of effort from operators.

PRACTICAL WAYS IN WICH TO REDUCE PFAS INTAKE

1

Don't buy **stain-free carpets**, especially if you have small children, and **skip the stain-repellent treatment** for new furniture.

2

A significant number of PFAS chemicals can get into your body through the skin after contact with fabrics treated to be stain, grease or water-resistant.

Avoid using **raincoats** that employ **Polartec or Gore-tex**, and any textiles with **Teflon, Scotchgard, and Stainmaster.**

3

Many items of food packaging, especially pizza boxes and microwave popcorn bags contain PFAS. If you have to eat fast-food, at least make sure the box it comes in only uses organic materials.

Stay far away from noodles and other forms of **take-away** that **absorb large amounts of water** when they are prepared.

4

Stainless steel and cast iron cookware should be favored over the alternatives, and you can live without sandwich makers.

These are particularly prone to **scratching as you lift** the sandwich out using a knife or fork, **releasing a good amount of stain-free coating in your food.**