Appendix 6

Persistent Chemicals sometimes called Forever Chemicals

Persistent chemicals are those that do not break down in the environment but linger for years, sometimes decades. When chemicals fail to break down and are continually released into the environment, their concentration will inevitably increase. If a persistent chemical is also toxic, then widespread and worrying contamination can occur.

Since the mid-1940s, adding fluoride to a mix of chemicals has been a way of making some of these persistent chemicals, and this has enabled the creation of new materials and products which, while very effective, very strong and very durable, and indispensable to industry, have come at a price for humanity.

As an example, today, the metallurgy industry uses three different grades of purity of 'fluorspar', as fluxes. The lowest of the three grades is used as a flux to lower the melting point of raw materials/ores in steel production and aluminium. The second grade is used in the manufacture of opalescent glass, enamels, and Teflon. The highest grade is used to make hydrogen fluoride and hydrofluoric acid (HF) which is highly prized by industry.

A coating of Teflon, (perfluoroalkyls, PFAs, or perfluorooctanoic acid PFOA, C8), a plastic containing fluorine, prevents sticking and eliminates the need for oil. This ability has revolutionised industry where it is used to coat rollers, bearings, sockets of ball joints etc, and it is essential for space flight. Teflon is also used in surgical procedures to replace blood vessels and heart valves and to coat cooking pots and pans. However, when overheated, Teflon produces a toxic gas. In one instance, a burning cigarette laid on some Teflon produced enough toxic gas to kill the smoker For this reason, Teflon non-stick cookware was banned in 2005 in the UK, banned in the EU in 2008, and banned globally in 2019, although a modified version still exists.

(Source: Waldbott, 'Fluoridation the Great Dilemma', pages 20- 26).

Theo Colborn, in her book, describes the discovery of the chemical that was responsible for creating a hole in the ozone layer – it was chlorofluorocarbons known as CFCs – the F or 'fluoro' in the name meaning fluoride. Fluoride makes a chemical very durable and persistent – meaning that it does not break down easily once combined with other elements. CFCs are non-flammable chemicals containing atoms of carbon, chlorine and fluorine. They are used in the manufacturing of aerosol sprays, blowing agents for foam and packing materials, as solvents and as refrigerants. Since Colborn's book, these CFCs are being replaced and the ozone is recovering, but there are now many other persistent chemicals, possibly thousands, mostly untested for safety. These persistent chemicals are building up in our bodies, causing disruption and ill health. Colburn explains how reproductive cycles are being harmed, causing sexual disruption and sexual disorientation in both animals and humans. This confirms the work of Pottenger and Cox.

Robert Bilott's book, 'Exposure' published in 2019, documents damage done to health from PFCs, PFOAs, PFOS – persistent toxic chemicals that are now ubiquitous in the environment.

Philippe Grandjean in his book, 'Only One Chance' published in 2013, looked at industrial chemicals and the hidden dangers they pose to our brains. Grandjean lists substances that damage the brain – fluoride and mercury are both listed.

John MacArthur, in his book, states:

"Increasing evidence reveals that prenatal exposure to some widely used chemicals are implicated in the growing pandemic of developmental neurotoxicity."

(Ref: Grandjean P. Landrigan P.J. 'Neurobehavioural effects of development toxicity,' *Lancet Neurol.* 2014 Mar;13(3):330–338; Choi AL, Sun GF. Zhang Y, Gandjean P. 'Development fluoride neurotoxicity: a systematic review and meta-analysis', *Environ Health Perspective.* 2012 Oct; 120(10):1362–1368).

A study by co-investigator and health epidemiologist Dr Leonardo Trasande, Professor of Paediatrics at NYU Langone, published May 11 2020 in *Environmental Research* journal, examined the levels of toxic chemicals in the blood of 30 children and young adults from three to 21 years and recently diagnosed with coeliac disease at the NYU Langone Hassenfeld Children's Hospital. He then compared them to those of 60 other participants of similar age, gender and race without coeliac disease. The NYU team discovered that:

- Children and young adults who have high levels of pesticides and pesticide-related chemicals had the chance of being diagnosed with coeliac disease.

- For females, higher-than-normal pesticide exposure meant they were at least eight times more likely to become gluten intolerant.
- People with elevated levels of non-stick substances (perfluoroalkyle substances PFAS), including Teflon, were up to nine times more likely to be diagnosed with the condition.

Dr Trasande said:

"There's emerging science that certain chemicals disrupt immune function and not just hormonal function. There is already suggestive evidence that endocrine-disrupting chemicals contribute to coeliac disease and are associated with other diseases, like Crohn's disease."

"There's a lot of cross-talk between the endocrine system and the immune system, in the context of coeliac and other autoimmune conditions."

The study authors wrote;

"According to the Environmental Protection Agency (EPA) in the US, persistent organic pollution (POPs) includes thousands of synthetic chemicals widely used during the industrial production boom after the second World War. Some well-known POPs include polychlorinated biphenyls (PCBs), the pesticide DDT, and dioxins which come from chlorine bleaching of paper pulp, the manufacturing of some herbicides and pesticides, and other industrial process. Although many POPs have been phased out of use, these chemicals remain in the environment as they are resistant to degradation and tend to accumulate in animal and human tissue."

According to Jennifer Giusstra-Kozak LPC NBCC, in her article of 3rd May, 2020:

"An increased viral or toxic load cross over the blood brain barrier causing (the) immune system to overproduce antibodies with (the resulting increased inflammatory response in the brain. This caused brain encephalitis (inflammation). Antigens attack the dopamine receptors in the basal ganglia, causing fluctuation in dopamine leading to mental illness such as too much anxiety (OCD) or oppositional defiant disorder (ODD)."

"Very low doses of PFAS found in drinking water, food, food packaging and personal care products has been linked to suppression of the immune system and are associated with an elevated risk of cancer and reproductive and developmental harms, among other serious health concerns, states the American Environmental Working Group (EWG) Oct 2020."

"When we look for PFAS contamination we almost always find it," said David Andrews, PhD, a senior scientist at EWG. They are found in the blood of everyone on earth, including newborn babies. They never break down in the environment."

A study finds high levels of PFAS in anti–fogging sprays and cloths.

(Credit: Unsplash/CC0 Public Domain)

This peer-reviewed study was published, on 5th January, 2022, in the journal, '*Environmental Science & Technology'*.

Herkert and Stapleton conducted the study with Lee Ferguson and Sharon Zhang of Duke University, Christopher Kassotis of Wayne State University, and Yuling Han, Vivek Pulikkal and Mei Sun of the University of North Carolina at Charlotte.

Nicholas Herkert, a postdoctoral researcher at Duke's Nicholas School of the Environment, led the study.

Heather Stapleton, the Ronie-Richele Garcia-Jones Distinguished Professor of Environmental Chemistry and Health at Duke University, initiated the study after reviewing the ingredient label on a bottle of anti-fogging spray she purchased for her nine-year-old daughter.

The anti-fogging sprays and cloths many people use to prevent condensation on their eyeglasses when wearing a mask or face shield may contain high levels of per- and polyfluorinated alkyl substances (PFAS).

The researchers named above, tested four top-rated anti-fogging sprays and five top-rated anti-fogging cloths sold on Amazon. They found all nine products contained fluorotelomer alcohols (FTOHs) and fluorotelomer ethoxylates (FTEOs), two types of PFAS that have largely flown under the scientific radar until now.

Exposure to some PFAS, particularly perfluorooctanoic acid (PFOA) and perfluoro-octanesulfonic acid (PFOS), is associated with impaired immune function, cancer, thyroid disease, and other health disorders. Mothers and young children may be especially vulnerable to the chemicals, which can affect reproductive and developmental health.

Nicholas Herkert, said,

"Our tests show the sprays contain up to 20.7mg of PFAS per millilitre of solution, which is a pretty high concentration,"

Herkert noted that because FTOHs and FTEOs have received relatively little study, scientists do not yet know what health risks they might pose but he said that,

“research suggests that, once FTOHs have been inhaled or absorbed through the skin, they could break down in the body to PFOA or other long-lived PFAS substances that are known to be toxic. Additionally, the FTEOs used in all four spray mixtures that were analysed in the new study exhibited significant cell-altering toxicity and conversion to fat cells in lab tests”

"If we were to assume that FTOHs and FTEOs have similar toxicity to PFOA and PFOS, then one spray from these bottles would expose you to PFAS at levels that are several orders of magnitude higher than you'd receive from drinking a litre of water that contains PFAS at the current EPA health advisory limit for safe consumption, which is 70 nanograms per litre.

Heather Stapleton said,

"It's disturbing to think that products people have been using on a daily basis to help keep themselves safe during the Covid pandemic may be exposing them to a different risk."

"Ironically, it was advertised as safe and nontoxic... It said to spray it on your glasses and use your fingers to rub it around."

She added that, *“none of the other eight products tested, even listed their ingredients, making it next to impossible to tell if they contained potentially harmful chemicals, until they were analysed using high-resolution mass spectrometry in their research laboratory”.*

The authors said that because their study is only the second to focus on FTEOs and had a small sample size, more research will be needed to flesh out these initial findings. Larger studies involving tests with living organisms are the logical next step.

Herkert explained that,

"FTOHs and FTEOs could be metabolic disrupters, but the only way to tell is through in vivo testing on whole organisms. We only did in vitro (lab dish) testing,"

“Studies with larger sample sizes might also identify other undisclosed chemicals that are being used in the sprays or cloths”.

Stapleton said that,

"Because of Covid, more people than ever – including many medical professionals and other first-responders – are using these sprays and cloths to keep their glasses from fogging up when they wear masks or face shields....They deserve to know what's in the products they're using."

Awareness-raising and serious action is being taken over PFAS contamination by some countries, as shown by the following…

In ‘Chemical World’, January 2022, a report stated that:

1) efforts were underway in Europe to ban PFAS compounds with five countries – Denmark, Germany, the Netherlands, Sweden and Norway – announcing that they will formally propose to bar the production trade and use of per- and polyfluoroalkyl substances by July 2022

2) a long-anticipated plan to regulate PFAS chemical was unveiled in the US, with PFAS substances facing enforceable drinking water limits which required toxicity tests by industry.

In January 2022, a petition signed by ‘organisations’ called on the UK Government to act urgently to regulate against the continued PFAS pollution into the UK environment. The petition stated that, as there is now clear and unequivocal evidence that demonstrates global contamination of the environment, wildlife and human populations by per- and polyfluorinated alkyl substances (PFAS), they must be immediately restricted ‘as a group’ to protect current and future generations.

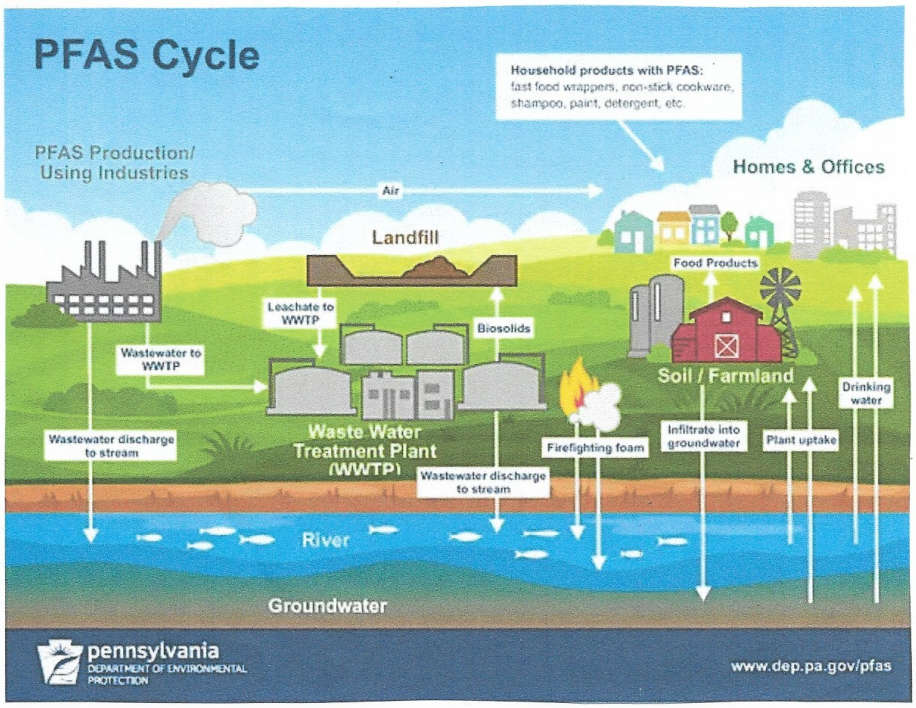
In 2023, the Royal Society of Chemistry, in the UK, called on the government to reduce the maximum allowable level of individual PFAS such as PFOA in drinking water from 100ng/ 1 to 10ng/1. This is to bring the UK more in line with other countries such as the US, who are proposing a maximum allowable concentration for PFOA of 4ng/1.

Unfortunately, there is still a long way to go, as Anna Watson details in her article on, 18th January, 2024, for Chem Trust, which had the headline;

“New study finds banned “forever chemicals” being used in children’s clothing”

In her article, Anna reported on a study, published, 28th November 2023, by Arnika, IPEN, and 14 partner organisations, including ChemTrust, which revealed the presence of toxic pre-and polyfluoroalkyl (fluoride) substances (PFAS) in outdoor coats and clothing from 13 countries across Asia, Africa, Europe and North America. Out of 72 clothing samples tested – including coats, swimsuits, and T-shirts – 46 items contained PFAS, that is 64%, revealing a widespread issue and making them a ubiquitous presence in our wardrobes. PFOA, a globally banned PFAS, was the most common chemical in the coats tested.

Below is a picture, designed by the Department of Environmental Protection, Pennsylvania, USA, showing the PFAS cycle.


PFAS Cycle
Household products with PFAS:
fast food wrappers, non-stick cookware, shampoo, paint, detergent, etc.
PFAS Production/
Using Industries
Air
Homes & Offices
Landfill
Food Products
Leachate to WWTP
Biosolids
Wastewater to WWTP
Soil / Farmland
Drinking water
Wastewater discharge to stream
Waste Water Treatment Plant (WWTP)
Firefighting foam
Infiltrate into groundwater
Plant uptake
Wastewater discharge to stream
River
Groundwater
pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION
www.dep.pa.gov/pfas