Shutterstock / ekipaj

MARINE CONSERVATION SOCIETY

Persistence- problems for the past, present and future

Published: October 2023

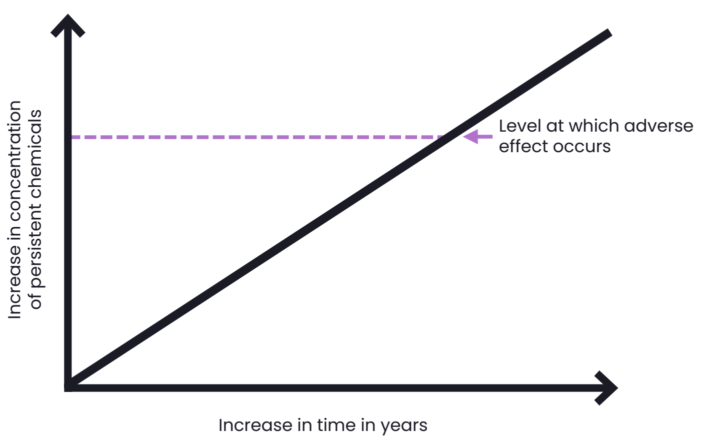
The Marine Conservation Society wants high persistence to be recognised as a standalone criterion within UK REACH. The phase out of very persistent chemicals is also one of the 12 Key asks for the UK Chemicals Strategy supported by 26 UK NGO's including CHEM Trust and Fidra.

Persistence is a characteristic of a chemical whereby it can withstand being broken down by environmental factors[1] such as sunlight, heat, water, bacteria or other substances, for many years. The strong bonds that often cause this feature of persistence in the environment are what make the chemical so useful. They are highly unreactive and able to withstand degradation, therefore are often found in materials that are exposed to high temperatures (non-stick pans); fires (flame retardants/firefighting foam); water (clothing); and chemicals (PPE and industrial uses). However, persistent chemicals are often used without considering the long-term environmental impacts and in products where better alternatives may already exist.

Persistence is already recognised in chemical regulation around the world. The Stockholm Convention,[2] a global treaty enacted in 2004, was introduced to protect humans and the environment from twelve initial very persistent chemicals including DDT, Endrin and PCBs. Other mentions of persistence in chemical regulation include in the PBT (Persistent, Bioaccumulative and Toxic) or vPvB (very Persistent and very Bioaccumulative) hazard assessments that are used to determine whether a chemical should be restricted from certain uses.[3] However, currently there is no regulation to restrict the use of a chemical based solely on persistence. Therefore, the Marine Conservation Society wants high persistence to be recognised as a standalone criterion within the UK's chemical regulation, REACH.

Persistent chemicals from the past and why it matters today

All chemicals become toxic at a particular dose.[4] Even chemicals like water can be toxic at the right dose. This fact is particularly pertinent to persistent chemicals, which don't break down. If their use is continued, they accumulate in the environment, increasing their concentration and their probability of causing harm (see graph 1).



Graph 1: Time vs Concentration to represent the build-up of a persistent chemical that is being continuously released over time, and where it would ultimately reach a level of adverse impact.

> "What is there that is not poison? All things are poison and nothing is without poison. Solely the dose determines that a thing is not a poison."
> **Paracelsus, 1500's**

Despite certain persistent chemicals having been banned, they are still causing harm today. For example, PCBs are a group of industrial chemicals first manufactured in the 1920s. Their uses were primarily in industrial applications such as electrical insulation, heat transferor lubricating fluids. They were first considered to be a concern around the 1960s/70s and their use was widely stopped in the 1980s.[1] They have however most recently been implicated in causing a population of orca on the west coast of Scotland to have failed to reproduce in decades, resulting in their population heading for a complete collapse.[5,6] If a short-lived chemical demonstrates a harmful effect and its use is halted, the pollution will cease and the effect will theoretically diminish quickly, but with persistent chemicals like PCBs, their impact remains for generations.[1]

Persistent chemicals used today

Since persistence remains a characteristic often sought by manufacturers, we continue to see novel persistent chemicals being utilised. One group of chemicals, PFAS, often described as 'forever chemicals' have an estimated 200 categories of uses including everything from textiles to cookware, electronics, and firefighting foam.[7] For more details see our briefing on PFAS . But these aren't the only persistent chemicals in use today: examples include the flame retardant DBDPE, decabromodiphenyl ethane. DBDPE was introduced as a replacement for the very similar sounding chemical, DecaBDE (decabromodiphenyl ether). DBDPE is a novel brominated flame retardant, often added to plastics, electronics, furniture and children's toys. It has also been widely found in environmental samples around the world.[8] In marine life specifically, it has already been shown to be neurotoxic in zebrafish[9] and have hormone disrupting effects on mussels,[10] as well as being shown to be passed to seal pups from their mothers.[11] Persistent chemicals can also be found in pesticides,[12] pharmaceuticals,[13] and other industrial and consumer uses.[14,15,16]

Fate of those persistent chemicals in use today

Sources of persistent chemicals into the environment are varied, but one major conduit for these chemicals is the sewerage system. Some persistent chemicals can be effectively removed at wastewater treatment plants. However, when treatment does not take place, for example due to the use of stormwater overflows or Emergency Overflows, this becomes a point source of persistent chemicals into the aquatic environment. It should be noted that some chemicals, even if treated, may be released in effluent water or captured in the sewage sludge, which is ultimately spread on land (sludge briefing). For example, some chemicals (e.g., DBDPE) have been shown by water company data to remain at environmentally harmful levels after treatment.[17]

MCS / Dave Boyle

Persistent chemicals in the future

PFAS alone have caused an exceedance in the chemical and plastic pollution "planetary boundary", because of the irreversibility and widespread nature of their pollution.[18] (Read more about planetary boundaries here) This irreversibility is a key characteristic of persistent chemical pollution and by its very nature, a recipe for disaster for the marine environment. Persistent chemicals were a problem in the past, they are a problem today and they will be a problem in the future if action isn't taken. But there is hope, restrictions do work. For example, by achieving global commitments to banning CFCs (another example of persistent chemicals), the ozone layer will begin to slowly recover. Reducing the burden of persistent chemicals will help nature recover, but to do this, high persistence as a characteristic must be used alone as a criterion to initiate regulatory action. Researchers are already recommending this as the best approach to protecting against persistent chemical pollution.[1] The so called, P-sufficient approach, would mean that high persistence (P) or very high persistence (vP) would be enough to flag a chemical for further management, whether that be restricting their uses to unavoidable uses only or listed as a Substance of Very High Concern, regardless of its other properties. These options can be enacted under REACH in a similar way to how vPvB or PBT chemicals are already addressed.

References

[1.] Cousins, I. T., N, C. A., Wang, Z., Scheringer, M, (2019) Why is high persistence alone a major cause of concern?, *Environ. Sci.: Processes Impacts*, 21

[2.] https://www.pops.int/

[3.] https://sinlist.chemsec.org/the-science-behind/persistent-bioaccumulative-and-toxic/

[4.] Grandjean, P., (2017) Paracelsus Revisited: The Dose Concept in a Complex World, *Basic Clin Pharmacol Toxicol*, 119

[5.] Desforges, J. P., Hall, A., McConnel, B., Rosingasvid, A., Barber, J. L., Brownlow, A., DeGuise, S., Eulaers, I., Jepson, P. D., Letcher, R. J., Levin, M., Ross, P. S., Samarra, F., Vikinson, G., Sonne, C., Dietz, R., (2018) Predicting global killer whale population collapse from PCB pollution, *Science*, 361

[6.] https://uk.whales.org/2023/08/23/new-wdc-pollution-report-points-to-uk-toxic-tragedy/

[7.] Gluge, J., Scheringer, M., Cousins I. T., DeWitt, J. C., Goldenman, G., Herzke, D., Lohmann, R., N. C. A., Trier, X., Wang, Z., (2020) An overview of the uses of per- and polyfluoroalkyl substances (PFAS), *Environ. Sci.: Processes Impacts*, 22

[8.] Ricklund, N., Kierkegaard, A., McLachlan, M. S., (2010) Levels and potential sources of decabromodiphenyl ethane (DBDPE) and decabromodiphenyl ether (DecaBDE) in lake and marine sediments in Sweden, Environ. Sci. Technol., 44

[9.] Sun, Y., Zhou, s., Zhu, B., Li, F., Fu, K., Guo, Y., Men, J., Han, J., Zhang, W., Yang, L., Zhou, B., (2023) Multi- and Transgenerational Developmental Impairments Are Induced by Decabromodiphenyl Ethane (DBDPE) in Zebrafish Larvae, *Environ. Sci. Tech.*, 57

[10.] Wang, S., Wang, Z., Wang, X., Qu, J., Li, F. Ji, C., Wu, H., (2023) Histopathological and transcriptomic analyses reveal the reproductive endocrine-disrupting effects of decabromodiphenyl ethane (DBDPE) in mussel *Mytilus galloprovincialis*, *Science of the Total Environment*, 862

[11.] Berger, M. L., Shaw, S. D., Rolsky, C., Harris, J. H., Guo, Y., Kannan, K., (2023) Occurrence and tissue-specific partitioning of alternative brominated flame retardants in northwest Atlantic harbor seal pups (Phoca vitulina vitulina), *Chemosphere*, 318

[12.] https://www.unep.org/cep/persistent-organic-pollutants-pops-and-pesticides

[13.] https://www.unep.org/explore-topics/chemicals-waste/what-we-do/emerging-issues/environmentally-persistent-pharmaceutical

[14.] Dong, C., Xiong, S., Yang, R., Pei, Z., Li, Y., Zhang, Q., Jiang, G., (2022) Polychlorinated naphthalenes (PCNs) in soils and plants from Svalbard, Arctic: Levels, distribution, and potential sources, *Sci Total Environ.*, 849

[15.] Balmer, J., E., Hung, H., Vorkamp, K., Letcher, R. J., Muir, D. C. G., (2019) Hexachlorobutadiene (HCBD) contamination in the Arctic environment: A review, *Emerging Contaminants*, 5

[16.] https://chm.pops.int/Implementation/Alternatives/AlternativestoPOPs/ChemicalslistedinAnnexA/Shortchainchlorinatedparaffins(SCCPs)/tabid/5986/Default.aspx#:~:text=SCCPs%20are%20primarily%20used%20in,rubber%2C%20textiles%20and%20polymeric%20materials.

[17.] UKWIR, (2020-2022) The National Chemical Investigations Programme, Monitoring of Substances of Emerging Concern, 5

[18.] Cousins, I. T., Johansson, J. H., Sha, B., Scheringer, M., (2022) Outside the Safe Operating Space of a New Planetary Boundary for Per- and Polyfluoroalkyl Substances (PFAS), *Environ. Sci. Technol.*, 56