

PFOS and other perfluorinated alkylated substances are widely found in the Nordic environment

PFOS and PFOA are found in nearly all samples in a joint Nordic screening project, but the concentrations are below the reported toxicological threshold levels with a possible exception for the marine predating mammals. Other perfluorinated alkylated substances (PFAS) were also commonly found. Since the chemicals of this group are very persistent, measures should be considered to ensure that PFAS will not turn into environmental problems in the future.

Perfluorinated alkylated substances (PFAS) make up a large group of chemicals that have been used in different industrial and consumer products since the 1950s. The substances are mainly used in fire fighting foams, protective coating, textiles, floor wax, polish and electronic industries. From this use the substances are likely to end up in waste dumps, sewage water and the general environment.

The chemicals of the PFAS group are virtually indestructible and were until recently thought to be completely biologically inert and not available for uptake in living organisms. Since the late 1990s, increasing numbers scientific studies have brought PFAS chemicals in the focus of international environmental concern. PFAS are shown to be globally distributed and some of them are bioaccumulative with implication also for human exposure

Little has been known on the occurrence and levels of PFAS in the Nordic environment. Therefore the Nordic Council of Ministers and the Nordic countries have performed a joint screening project. Samples of rainwater, lake water, coastal water, sewage effluent, sewage sludge, landfill effluent, sediments, freshwater fish, marine fish, seal and whale were collected and analysed. Most of the samples were collected close to populated areas and possible sources (see map below), but remote areas were also covered.

Of the PFAS related compounds Perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) are best documented so far with regard to environmental hazards, and they are the major motivation for the screening project. Other compounds are also included, either because they may be transformed to PFOS or PFOA in the environment or have similar properties. For the latter group only sparse information about environmental properties and toxicity is available yet.

PFAS compounds are found in nearly every sample in the study, and so are the specific compounds PFOS and PFOA. Compared with the available toxicological and ecotoxicological data, all concentration

values are below the reported threshold levels with a possible exception for the marine predating mammals. The available toxicity data for mammals are sparse and risk assessment is done with quite high uncertainty.

Contamination was found to be relatively low in lakes, seawater and rainwater. However, measurable amounts of PFAS were found in all of them. Higher concentrations of PFAS residues were found in sewage sludge and landfill effluents, which confirms this as important anthropogenic sources for releases into the environment. PFOS and PFOA dominated in sewage sludge samples. Landfill effluent was highest contaminated of all aqueous samples, with PFOA dominating the levels.

The Nordic biota samples the highest PFAS levels were found in top predating Danish seal samples with PFOS as the predominant PFAS contaminant. In Faroese pilot whales both PFOSA and PFOS were dominating. Also Nordic pike and perch samples may have considerable concentrations of PFOS, demonstrating that also the freshwater ecosystem is contaminated with PFAS chemicals. The patterns found in biota seem to reflect both country specific release patterns and species depended up-take/ accumulation properties. The results also give a clear indication of transboundary transportation with currents in air and marine waters.

The broad representation of samples in the study and the high quality of the analysis make the results internationally interesting. EU is at the moment discussing the need for restrictions of PFOS related compounds. The results of the screening project will be useful in this process as well as in the Nordic countries' further evaluation of risks related to the use of PFAS and the need for restricting the use of any of the compounds. The study also shows that it is important to bring forth more data on the properties and possible toxicity within a broad spectre of PFAS.

The project was financed by the Nordic council of ministers and the Nordic countries. Sample preparation analysis and reporting were performed jointly by the Norwegian Institute for Air Research (NILU, Kjeller, Norway) and the Institute for Applied Environmental Research (ITM, Stockholm, Sweden).

Contact person at the Nordic Council of ministers: Sidsel Dyekjær, Senior Advisor, smd@norden.org

Contact persons in each of the participating countries:

Denmark: Betty Bügel Mogensen, National Environmental Research Institute

The Faroe Islands : Maria Dam, Veterinary, Food and Environment agency

Finland: Juha-Pekka Hirvi, Finnish Environment Institute

Iceland: Albert S. Sigurdsson, Environment and Food Agency of Iceland

Norway: Ola Glesne, Norwegian Pollution Control Authority (project leader)

Sweden: Britta Hedlund and Jonas Rodhe, Swedish Environmental Protection Agency

Contact person at The Norwegian Institute for Air Research: Roland Kallenborn

Contact person at The Institute for Applied Environmental Research: Ulf Järnberg

Perfluorinated alkylated substances(PFAS) included in the study

Substance	Full name	CAS number
PFBS	Perfluorobutane sulfonate	29420-49-3
PFHxS	Perfluorohexane sulfonate	432-50-7
PFOS	Perfluorooctane sulfonate	2795-39-3
PFDS	Perfluorodecane sulfonate	67906-42-7
PFHxA	Perfluorohexanoic acid	307-24-4
PFHpA	Perfluoroheptanoic acid	375-85-9
PFOA	Perfluorooctanoic acid	335-67-1
PFNA	Perfluorononanoic acid	375-95-1
PFOSA	Perfluorooctane sulfonamide	4151-50-2