PFHxS – *excerpts from Annex XV Identification of PFHxS as SVHC – Mar2017*

PERSISTENCE

The stability of organic fluorine compounds has been described in detail by Siegemund et al. (2000). When all valences of a carbon chain are satisfied by fluorine, the zig-zagshaped carbon skeleton is twisted out of its plane in the form of a helix. This situation allows the electronegative fluorine substituents to envelope the carbon skeleton completely and shield it from chemical attack.

Abiotic degradation

Photolysis in air: Using AOPWIN v1.92 to predict the atmospheric half-life for PFHxS results in an estimated half-life of 76.4 days (12.hr day; 1.5E6 OH/cm3)

Photolysis in water: Taniyasu and co-workers (2013) performed a field study on photolysis of several PFAS, No significant photolysis was observed for PFHxS

Biodegradation

Biodegradation in water: modeled using BIOWIN v4.10 (not all PFHxS molecular fragments are incl in training sets of model, but along w/ results for PFOS, it adds to weight of evidence of persistence):

BIOWIN 2 = 0.0000 (<0.5 = persistent)
BIOWIN 3 = 0.9340 (<2.2 to 2.75 = persistent)
BIOWIN 6 = 0.0000 (<0.5 = persistent)
PFHxS can, based on the above BIOWIN predictions, be said to fulfil the SVHC P-screening criteria.

All other justification is read across using structural analog PFOS

BIOACCUMULATION

USEPA criteria for bioacumulative = BCF 1000 – 5000 (log BCF 3 – 3.7) and
very bioaccumulative = BCF>5000 (log BCF >3.7) ***But use caution in applying these criteria given different behavior of these surfactants.***

BCF (organism in water, BCF=uptake rate from water/depuration rate)
10 carcass, 76 Blood, 100 liver (*already in EHS sht*) (Martin et al 2003)

BAF – measured in field [biota]/[water]; ww log BAF in fish, not growth correct or normalized to lipid content. May be influenced by both absorption from surrounding water and diet.

European Chub in Orge River, France (Labadie and Chevreuil, 2011):
Plasma 3.3 ±0.2
Liver 2.1 ±0.3
Gills 1.5 ±0.2
Gonads 2.4 ±0.4
Muscle 0.9 ±0.3

South Korea (Naile et al, 2013):
Fish: Whole body 2.58 ±0.55
Liver 3.08
Crab: whole body 2.58 ±0.55
Gastropod: whole body 3.28 ±0.22
Bivalve: whole body 2.61 ±0.41

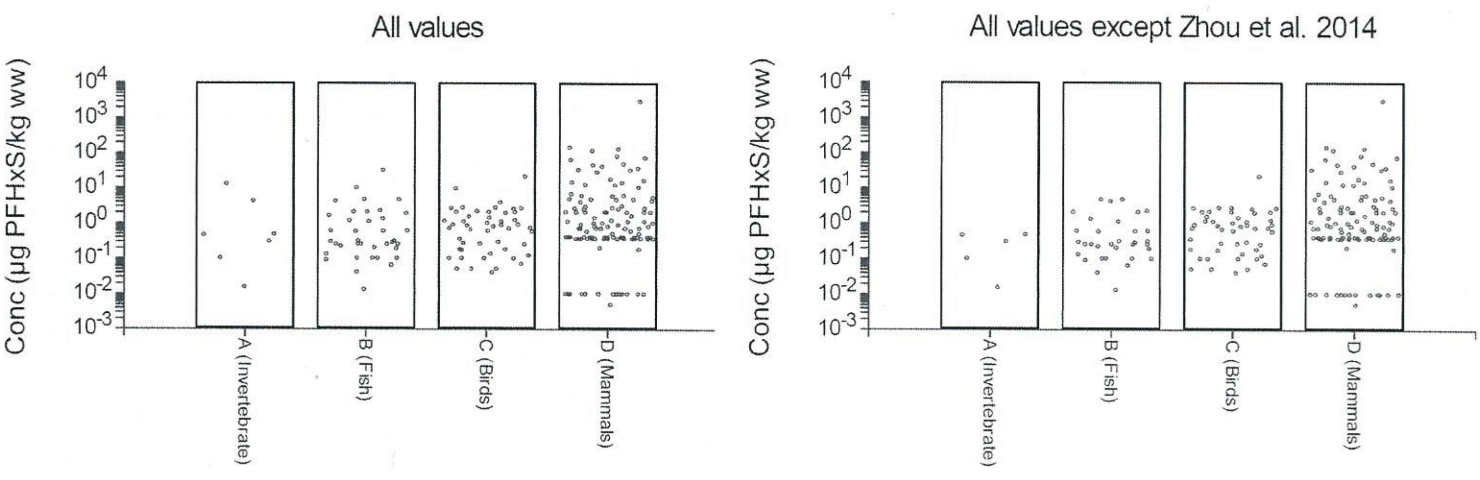
BMF: (predator-prey magnification via diet – for field studies this incl water)
All BMF>1 indicate biomagnification potential – there are significant uncertainties and assumptions included in the following calculated BMFs, but as a whole they indicate a potential for biomagnification.
Rainbow trout, multiple PFAS: whole body BMF = 0.18 (Goeritz et al 2013)
Dolphin/striped mullet: whole body BMF = 4.0 (Houde 2006)

Dolphin/red drum: whole body BMF = 14 (Houde 2006)
Dolphin/spotfish: whole body BMF = 6.0 (Houde 2006)
Dolphin/seatrout: whole body BMF = 3.3 (Houde 2006)
Dolphin/pigfish: whole body BMF = 2.0 (Houde 2006)
Dolphin/pinfish: whole body BMF = 1.8 (Houde 2006)
Pigfish/zooplankton: whole body BMF = 9.1 (Houde 2006)
Pinfish/zooplankton: whole body BMF = 10 (Houde 2006)
Black guillemot/polar cod (liver) BMF = 6.0 (Haukras 2007)
Glaucous gull/Polar cod (liver) BMF = 7.2 (Haukras 2007)
Glaucous gull/black guillemot (liver) BMF = 8.5 (Haukras 2007)
Polar bear/ringed seal (liver) BMF = 251, 373, 163, 285 (depending on location), Canadian Arctic mean=199 (Butt 2008)
Polar bear/ringed seal (liver) BMF =20.1 (Riglet et al 2013)

TMF: Houde et al 2006 also attempted to calculate Trophic Magnification Factors (TMF) for dolphin. *Note very high uncertainty*:
Dolphin (plasma) TMF = 0.2 ±0.9
Dolphin (whole body) TMF = 0.1 ±0.4

MEASURED LEVELS IN WILDLIFE:

The measured concentrations of PFHxS in:
- Wildlife are summarised in Fig 1. The values presented are mean values sampled per species/year/location/author(s). For measurements below the limit of detection (LOD), half LOD is used. Fig 2 includes the same values as in Fig 1, apart from the values on invertebrates, fish and birds from Zhou et al. (2014), which are sampled in a region heavily polluted by perfluorinated compounds.
- Invertebrates, fish and birds are by far highest in the study by Zhou et al. (2014), with reported concentrations of PFHxS ranging from 4.1-18 µg/kg ww in invertebrates, 0.2-74 µg/kg ww in fish and 1.5-27 µg/kg ww in birds. Zhou and coworkers (2014) sampled invertebrates, fish and birds from lake Tangxun, China, which is situated in a region which is heavily polluted by perfluorinated compounds due to a lot of several small-scale fluorochemical manufacturers.



In Zhou (2014) (invertebrates, fish and birds) PFOS is always detected at the highest concentrations (up to more than a factor of ten higher compared to the other PFAS analysed), with PFHxS most often being the PFAS detected at the second highest levels.
With the exception of Zhou (2014), the levels of PFHxS detected in invertebrates are roughly about the same as those of PFOS, sometimes higher, sometimes lower. In fish, birds and mammals the levels of PFOS, with only a few rare exceptions, are always higher to substantially higher than those of PFHxS.
The levels of PFHxS in invertebrates, fish, birds and mammals are sometimes higher and sometimes lower than those measured of PFOA. An observation that can be made is that the concentrations of PFHxS generally are lower than those of PFOA in seals from arctic regions, but the concentrations of PFHxS in polar bears from the same regions are generally higher, which may be an indication of biomagnification.