The ToxGuide™ is developed to be used as a pocket guide. Tear off at perforation and fold along lines.

Sources of Exposure

General Populations

- The major sources of exposure to perfluoroalkyls, especially perfluuorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS), is contaminated food and drinking water.
- Industrial releases of perfluoroalkyls in ambient air or surface water may also be a source of exposure for the general population.
- The general population may also be exposed to PFOS from mill treated carpets and to PFOA from migration from paper packaging and wrapping into food and inhalation from impregnated clothes.

Occupational Populations

- The production of perfluoroalkyl and use of perfluoroalkyl containing products are sources of occupational exposure.

Toxicokinetics and Normal Human Levels

Toxicokinetics

- Limited data indicate that perfluoroalkyls are absorbed from the respiratory tract. Studies in animals suggest that many perfluoroalkyls (including PFOA and PFOS) are almost completely absorbed from the gastrointestinal tract.
- The available data suggest that perfluoroalkyls are not metabolized or undergo chemical reactions in the body.
- Perfluoroalkyls are primarily excreted in the urine.
- There are substantial differences in the elimination half-times across perfluoroalkyl compounds and animal species. The estimated elimination half-times for PFOA, PFOS, perfluorohexane sulfonic acid (PFHxS), perfluorobutane sulfonic acid, and perfluorobutyric acid in humans are 3.8 years, 5.4 years, 8.5 years, 665 hours, and 72 hours, respectively. Much shorter half-times have been estimated in experimental animals.

Normal Human Levels

- Perfluoroalkyls appear to be ubiquitous in human blood based on the widespread detection of these substances in human serum samples.
- Mean serum concentrations of PFOA and PFOS, and PFHxS in the U.S. were 3.07 and 9.32 ng/mL, respectively, PFHxS levels were <4 and other perfluoroalkyls were generally <1 ng/mL.

Biomarkers/Environmental Levels

Biomarkers

- Measurement of serum or whole blood perfluoroalkyl concentrations is the standard accepted biomarkers of exposure to perfluoroalkyls.

Environmental Levels

Air

- Mean PFOA levels ranged from 1.54-15.2 pg/m^3 in urban air samples in the U.S., Norway, and Japan. PFOS levels in ambient air are generally <5 pg/m^3 and levels of other perfluoroalkyls are generally <1 pg/m^3.

Water

- Perfluoroalkyl levels in surface water samples are generally below 50 ng/L.

Soil

- Background levels of perfluoroalkyls in soil and sediment have not been located.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2015. Toxicological Profile for Perfluoroalkyls (Draft for Public Comment). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

ToxGuide™ for Perfluoroalkyls

August 2015

U.S. Department of Health and Human Services
Public Health Service
Agency for Toxic Substances and Disease Registry
www.atsdr.cdc.gov

Contact Information:
Division of Toxicology
and Human Health Sciences
Environmental Toxicology Branch

1600 Clifton Road NE, F-57
Atlanta, GA 30329-4027
1-800-CDC-INFO
1-800-232-4636
www.atsdr.cdc.gov/toxpro2.html

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Chemical and Physical Information

Perfluoroalkyls are Solids or Liquids

- Perfluoroalkyls are a class of anthropogenic chemicals.
- Perfluoroalkyls repel oil, grease, and water and have been used in surface protection products such as carpet and clothing treatments, coating for paper and cardboard packaging, and fire-fighting foams.
- Companies have stopped production or have begun changing manufacturing practices to reduce releases and the amounts of these chemicals in their products.

Routes of Exposure

- Inhalation – Most likely route of occupational exposure. Minor route of exposure for the general population.
- Oral – Most likely route of exposure for the general population; food is expected to be the primary source.
- Dermal – Potential route of exposure particularly among workers who handle perfluoroalkyl-treated products. -

Perfluoroalkyls in the Environment

- Perfluoroalkyls are very stable in the environment and are resistant to biodegradation, direct photolysis, atmospheric photooxidation, and hydrolysis.
- Perfluoroalkyls are persistent in water and soil. They are mobile in soil and leach into groundwater.
- Perfluoroalkyls biomagnify in the food web and the highest concentrations are found in apex predators. The bioaccumulation potential of perfluoroalkyls appears to increase with increasing chain length.
-

Relevance to Public Health (Health Effects)

Health effects are determined by the dose (how much), the duration (how long), and the route of exposure.

Minimal Risk Levels (MRLs)

Inhalation

- No acute-, intermediate-, or chronic-duration inhalation MRLs were derived for perfluoroalkyls.

Oral

- No acute-duration oral MRLs were derived for perfluoroalkyls.
- An intermediate-duration (15-365 days) oral MRL of 2 x 10^{-5} mg/kg/day was derived for PFOA.
- An intermediate-duration (15-365 days) oral MRL of 3 x 10^{-5} mg/kg/day was derived for PFOS.
- No chronic-duration oral MRLs were derived for perfluoroalkyls.

Health Effects

- A large number of studies have examined the possible relationship between levels of perfluoroalkyls in blood and adverse health effects in workers, residents living near manufacturing facilities, and in the general population. Although statistically significant associations have been found; the studies do not establish causality. Additionally, the results were not always consistent across studies.
- Consistent findings were found for associations between serum PFOA and PFOS levels and increases in serum lipid levels, increases in uric acid levels, and alterations in biomarkers of liver damage.
- The primary effects observed in animals include liver toxicity, developmental toxicity, and immune toxicity. There are profound differences in the toxicokinetics and mode of action of perfluoroalkyls between humans and experimental animals. Many of the observed effects in animals result from the ability of PFOA and PFOS to activate peroxisome proliferatory-activated receptor α (PPAR-α). Humans are much less responsive to PPAR-α than rodents and thus may not be as susceptible to these types of effects.

Children's Health

- Children exposed to perfluoroalkyls would be expected to experience effects similar to those expected in adults.
- Human studies suggest an association between serum PFOA and PFOS levels and decreases in birth weight. However, the decreases in birth weight are small and may not be biologically relevant.