

**REWE Group Detox Program  
Hazardous Substances Fact Sheet**

**Per- and Polyfluorinated Compounds  
(PFCs)**

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## 1 Background

All kinds of PFCs are prohibited to be used in REWE Group products. Thus not only long chain PFCs (like PFOA and PFOS) with more than 8 carbon molecules are covered by this use ban, but also short chain PFCs with usually 6 or less carbon molecules (for further information see definition below).

The latest list of hazardous substances that shall be phased out in the production including limit values can be found in the REWE Groups MRSL (Manufacturers Restricted Substance List).

## 2 Definition of PFC

Perfluorinated compounds (PFCs) are a group of manmade organic chemicals containing fluorine. The most important classes of PFCs are Fehler! Textmarke nicht definiert..

### a) Definition by chemical functional groups

- Perfluoroalkyl sulfonates (PFASs) (the best-known is PFOS)
- Perfluorinated carboxylic acids (PFCAs) (the best-known is PFOA)
- Fluoropolymers (the best known is polytetrafluoroethylene (PTFE), marketed as Teflon and widely used in clothing, being the basis of waterproof fabric and for non-stick cookware)
- Fluorotelomer alcohols (FTOHs)

### b) Definition by chain lengths

PFCs are also frequently clustered into long chain PFCs (like PFOA and PFOS) short chain PFCs, as defined by the OECD<sup>1</sup>:

A distinction is made between long-chain perfluorinated compounds (LC PFCs) and short-chain perfluorinated compounds (SC PFCs), based on the toxicity and bioaccumulation differences between LC PFCs and SC PFCs.

"Long-chain perfluorinated compounds" refers to: Perfluorocarboxylic acids with carbon chain lengths C8 and higher, including perfluorooctanoic acid (PFOA);

Perfluoroalkyl sulfonates with carbon chain lengths C6 and higher, including perfluorohexane sulfonic acid (PFHxS) and perfluorooctane sulfonate (PFOS); and

Precursors of these substances that may be produced or present in products.

For definition purposes "precursor" means a substance that has been recognized as having the potential to degrade to perfluorocarboxylic acids with a carbon chain length of C8 and higher (including PFOA) or perfluoroalkyl sulfonates with a carbon chain length of C6 or higher (including PFHxS and PFOS)"

Various PFCs are in use for textile products, for example (name, CAS-number):

<sup>1</sup> <http://www.oecd.org/ehs/pfc/>, <http://detox-outdoor.org/en/faq/>

Name	CAS Number
Perfluorooctansulfonate (PFOS),	CAS 1763-23-1
Perfluorooctanoic acid (PFOA)	CAS 335-67-1
Fluorotelomer alcohols	CAS 865-86-1

### 3 Legal Aspects

Suppliers of the REWE Group must assure that they produce in full accordance with the legal requirements of the country where the production takes place, and the legal provisions of the European Union regarding final products. A comprehensive list with international regulation for individual hazardous substances can be found on the website of the American Apparel & Footwear Association's (AAFA).<sup>2</sup>

PFOS have been classified as persistent organic pollutants (POPs) under the Stockholm Convention, a global treaty to protect human health and the environment.<sup>3</sup> PFOS and its salts are covered by EU REACH Annex XVII. For textiles or other coated materials, the concentration shall not be higher than 1 µg/m<sup>2</sup>.<sup>4</sup> Even where regulation of PFOS in textile products is in place, no such limits are currently in place for other PFCs.<sup>5</sup> But tighter restrictions are on the way. The European Chemical Agency suggested a comprehensive ban of PFOA in September 2015 with a limit value of 0,0002 mg/kg<sup>6</sup>.

### 4 Hazardous Properties and Exposure

#### 4.1 Hazardous Properties

Studies indicate that PFCs can cause adverse impacts on humans, both during development and during adulthood. PFOA showed developmental toxicity and carcinogenicity in laboratory animals Fehler! Textmarke nicht definiert.. PFCs, including PFOA, may act as endocrine disruptors, and studies have suggested that PFOS and PFOA exhibit reproductive toxicity. Other known detrimental effects are reduced female fertility and reduced male sperm quality, reduced birth weight, deficit hyperactivity disorder (ADHD), increased total and non-HDL (bad) cholesterol levels, and changes in thyroid hormone levels.<sup>7</sup> Impacts on the immune system have also been reported.<sup>8</sup> PFOS and PFOA have both adverse effects on the liver. Increased levels of PFOA and PFOS in the blood of men in Denmark were associated with reduced sperm counts. Fehler! Textmarke nicht definiert.

PFOS and PFOA have been detected in a wide range of human tissues, including blood serum, umbilical cord blood, liver tissue, seminal fluid, and breast milk. Because they cross

<sup>2</sup> <https://www.wewear.org/rsl/> [https://www.wewear.org/assets/1/7/RSL\\_v16\\_final\\_UPLOAD.pdf](https://www.wewear.org/assets/1/7/RSL_v16_final_UPLOAD.pdf)

<sup>3</sup> Greenpeace 2014. Hazardous chemicals in branded luxury textile products on sale during 2013. Online available: <http://www.greenpeace.org/international/Global/international/publications/toxics/2014/Technical-Report-01-2014.pdf>

<sup>4</sup> Chemical Inspection and Regulation Service (CIRS). PFOS/PFOA Testing. Online available: [http://www.cirs-reach.com/Testing/PFOS\\_PFOA\\_Testing.html](http://www.cirs-reach.com/Testing/PFOS_PFOA_Testing.html)

<sup>5</sup> Greenpeace 2014. Hazardous chemicals in branded luxury textile products on sale during 2013. Online available: <http://www.greenpeace.org/international/Global/international/publications/toxics/2014/Technical-Report-01-2014.pdf>

<sup>6</sup> <https://www.ecotextile.com/2015091621707/dyes-chemicals-news/eu-chemicals-agency-proposes-pfoa-restrictions.html>

<sup>7</sup> National Collaborating Center for Environmental Health 2010. Potential human health effects of perfluorinated chemicals (PFCs). Online available: [http://www.nccceh.ca/sites/default/files/Health\\_effects\\_PFCs\\_Oct\\_2010.pdf](http://www.nccceh.ca/sites/default/files/Health_effects_PFCs_Oct_2010.pdf)

<sup>8</sup> Greenpeace 2014. Hazardous chemicals in branded luxury textile products on sale during 2013. Online available: <http://www.greenpeace.org/international/Global/international/publications/toxics/2014/Technical-Report-01-2014.pdf>

the placenta, the developing fetus is exposed to these chemicals *in utero*. Exposures to the fetus, infants, and children are of the greatest concern as these are the most sensitive stages of human development.<sup>9</sup>

Information regarding the toxicology of FTOH is scarce, though some studies indicate that 6:2 FTOH and 8:2 FTOH act like endocrine-disrupting chemicals. In addition to direct hazards, FTOH have the potential to transform into other PFCs, including PFCAs and thus pose an additional hazard.<sup>10</sup> Precursor PFCs, such as FTOHs, are volatile and have frequently been detected in air samples, even to remote areas.

PFCs are highly persistent organic contaminants that also bioaccumulate in the food chain and in the human body.<sup>11</sup> The durability of these chemicals also leads to potentially devastating consequences for the environment, as it means that they persist for long periods in nature once they are released, whether as a result of manufacturing or disposal operations or during the lifetime of a product. PFOS, for example, is a compound so resistant to degradation that it is expected to persist for very long periods in the environment<sup>Fehler! Textmarke nicht definiert.</sup>,<sup>12</sup>. PFASs (especially PFOS) and PFCAs (especially PFOA) have been reported as contaminants in almost all environmental media, including freshwater, groundwater and seawater sediments, and soils.<sup>Fehler! Textmarke nicht definiert.</sup><sup>13</sup> In 2002, PFOS was classified as persistent, bio-accumulative and toxic (PBT) in the 34th OECD Chemical Committee meeting.<sup>14</sup>

## 4.2 Exposure to PFCs

PFCs mainly reach the environment through industrial emissions, as well as from consumer products containing PFCs.<sup>15,16</sup> Precursor PFCs, such as FTOHs, are volatile and can be released from products under ambient conditions, and later be transformed into PFCs.<sup>17</sup>

Previous Greenpeace research found PFCs in the wastewater of Chinese textile factories, in wild fish that are caught for consumption in China and in eels from eleven European countries. In other studies, PFCs were even detected in drinking water.

Many PFCs are highly persistent which has led to their ubiquitous presence in the environment, even in remote sites like the Arctic and high mountain.<sup>12,18</sup>

<sup>9</sup> National Collaborating Center for Environmental Health 2010. Potential human health effects of perfluorinated chemicals (PFCs). Online available: [http://www.nccceh.ca/sites/default/files/Health\\_effects\\_PFCs\\_Oct\\_2010.pdf](http://www.nccceh.ca/sites/default/files/Health_effects_PFCs_Oct_2010.pdf)

<sup>10</sup> Greenpeace 2014. Hazardous chemicals in branded luxury textile products on sale during 2013. Online available: <http://www.greenpeace.org/international/Global/international/publications/toxics/2014/Technical-Report-01-2014.pdf>

<sup>11</sup> German Federal Institut for Risk Assessment 2009. Perfluorinated organic compounds in our diet (PERFOOD). Online available: [http://www.bfr.bund.de/cm/349/perfluorinated\\_organic\\_compounds\\_in\\_our\\_diet.pdf](http://www.bfr.bund.de/cm/349/perfluorinated_organic_compounds_in_our_diet.pdf)

<sup>12</sup> Cobbing, M. et al: Footprints in the snow. Amsterdam, 2015 [http://detox-outdoor.org/assets/uploads/Report%20RAE/RAE\\_report\\_08\\_2015\\_english\\_final.pdf](http://detox-outdoor.org/assets/uploads/Report%20RAE/RAE_report_08_2015_english_final.pdf)

<sup>13</sup> Greenfacts, undated. Perfluorinated compound. Online available: <http://www.greenfacts.org/glossary/pqrs/perfluorinated-compound.htm>

<sup>14</sup> Chemical Inspection and Regulation Service (CIRS). PFOS/PFOA Testing. Online available: [http://www.cirs-reach.com/Testing/PFOS\\_PFOA\\_Testing.html](http://www.cirs-reach.com/Testing/PFOS_PFOA_Testing.html)

<sup>15</sup> German Federal Institut for Risk Assessment 2009. Perfluorinated organic compounds in our diet (PERFOOD). Online available: [http://www.bfr.bund.de/cm/349/perfluorinated\\_organic\\_compounds\\_in\\_our\\_diet.pdf](http://www.bfr.bund.de/cm/349/perfluorinated_organic_compounds_in_our_diet.pdf)

<sup>16</sup> Greenpeace 2014. Hazardous chemicals in branded luxury textile products on sale during 2013. Online available: <http://www.greenpeace.org/international/Global/international/publications/toxics/2014/Technical-Report-01-2014.pdf>

<sup>17</sup> US Environmental Protection Agency 2014. Emerging Contaminants – Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA). Online available: [http://www2.epa.gov/sites/production/files/2014-04/documents/factsheet\\_contaminant\\_pfos\\_pfoa\\_march2014.pdf](http://www2.epa.gov/sites/production/files/2014-04/documents/factsheet_contaminant_pfos_pfoa_march2014.pdf)

<sup>18</sup> German Federal Institut for Risk Assessment 2009. Perfluorin US Environmental Protection Agency 2014. Emerging Contaminants – Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA). Online available:

The risk of a chemical for human health and the environment is not only determined by its toxicity but by the degree of exposure, too.

#### a) Workers

Workers in a facility that manufactures PFCs or in the various formulating and production facilities that use products containing PFCs are exposed during

- handling chemical preparations
- getting in contact with processing liquids
- waste water or treated products or
- when carrying out maintenance, sampling, testing, or other procedures.

#### b) Consumers

PFOS and other PFCs have been found in blood and breast milk from people living in many countries around the world, even in remote areas such as the Canadian Arctic

Consumers take up PFCs or PFOS through

- fish (It has been suggested that sea fish and other seafood may account for the majority of human exposure in China<sup>Fehler! Textmarke nicht definiert.</sup>),
- ingestion of food and water, use of commercial products or inhalation.<sup>19</sup> (Among consumer products, for example, pre-treated carpeting, treated home textile products and upholstery are thought to be the most important sources of PFOA. Exposure may occur directly by touching consumer products followed by hand to mouth contact, or indirectly by ingesting indoor dust<sup>20</sup>. PFCAs, PFSAAs and FTOHs were repeatedly reported in outdoor clothing, swimwear and footwear.<sup>21</sup>).

## 5 Sources of PFCs in production of textiles

In the textile industry, PFCs are mainly used as stain and water repellents and as finishing with all-weather functions, high stability, and the ability to repel both water and oil.

They are used on clothing (textile and leather) as well as in stain repellent home textile, ties, sportswear (e.g. swimming suits, winter sports equipment), carpets and upholstery.<sup>22</sup>

PFCs are also commonly used for all kind of outdoor products with waterproof and dirt-repellent finishes.

PFCs have been used since the 1950s in a large number of household products, for instance in Teflon and stain resistant products.

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[http://www2.epa.gov/sites/production/files/2014-04/documents/factsheet\\_contaminant\\_pfos\\_pfoa\\_march2014.pdf](http://www2.epa.gov/sites/production/files/2014-04/documents/factsheet_contaminant_pfos_pfoa_march2014.pdf). Online available: [http://www.bfr.bund.de/cm/349/perfluorinated\\_organic\\_compounds\\_in\\_our\\_diet.pdf](http://www.bfr.bund.de/cm/349/perfluorinated_organic_compounds_in_our_diet.pdf)

<sup>19</sup> US Environmental Protection Agency 2014. Emerging Contaminants – Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA). Online available: [http://www2.epa.gov/sites/production/files/2014-04/documents/factsheet\\_contaminant\\_pfos\\_pfoa\\_march2014.pdf](http://www2.epa.gov/sites/production/files/2014-04/documents/factsheet_contaminant_pfos_pfoa_march2014.pdf)

<sup>20</sup> National Collaborating Center for Environmental Health 2010. Potential human health effects of perfluorinated chemicals (PFCs). Online available: [http://www.ncceh.ca/sites/default/files/Health\\_effects\\_PFCs\\_Oct\\_2010.pdf](http://www.ncceh.ca/sites/default/files/Health_effects_PFCs_Oct_2010.pdf)

<sup>21</sup> Greenpeace 2014. Hazardous chemicals in branded luxury textile products on sale during 2013. Online available: <http://www.greenpeace.org/international/Global/international/publications/toxics/2014/Technical-Report-01-2014.pdf>

<sup>22</sup> German Federal Institut for Risk Assessment 2009. Perfluorinated organic compounds in our diet (PERFOOD). Online available: [http://www.bfr.bund.de/cm/349/perfluorinated\\_organic\\_compounds\\_in\\_our\\_diet.pdf](http://www.bfr.bund.de/cm/349/perfluorinated_organic_compounds_in_our_diet.pdf)

PFOS is a fully fluorinated organic chemical, widely used for the surface treatment of textiles, leather products, paper, furniture and carpets. It is also used as intermediate chemical for the production of some paints, foam extinguishing agents, floor polish, pesticides and termite control agents.

Fluoropolymers are usually applied in combination with other finishing auxiliaries by a pad-dry-cure process.<sup>Fehler! Textmarke nicht definiert.</sup> Thus PFCs may not be applied in context with wet processes, but near to the (dry) finishing of products.

## 6 Alternative and Substitute Substances

All alternatives used as substitutes for hazardous substances must be free of hazardous properties. Some tools to identify hazardous properties of chemicals and to find safer alternatives are listed in "Factsheet I – Hazardous substances".

Potential alternatives to fluorocarbon finishes and coatings are waxes, paraffins (such as ecorepel®), polyurethane (such as Purtex®), dendrimers (such as Bionic Finish Eco®) and silicones. Also Bionic Finish Eco® from the company Rudolf Chemie is already being used frequently. Other alternatives are still in the trial phase but could be ready for the market in a short time.<sup>23</sup>

The OECD lists several alternatives to replace long-chain PFASs, in particular PFOS and PFOA, e.g.:

- siloxanes and silicone polymers (for impregnation of textiles, leather and carpets or for surface coating, paint and varnish);
- stearamidomethyl pyridine chloride (for impregnation of textiles, leather and carpets);

Also the ZDHC published a report on water and dirt repelling agents<sup>25</sup>.

In order to minimize environmental and health effects and to use resources efficiently the use of best available technology (BAT<sup>26</sup>) in textiles industry is a standard requirement.

Please refer to chapter "Identifying hazardous substances and non-hazardous alternatives" in "factsheet no. 1 – Hazardous substances" for further information on alternatives. In addition the Chemsec Textile Guide offers access to a list of hazardous and safer surfactants and should be taken into account when a chemical inventory is prepared<sup>27</sup>.

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<sup>23</sup> <http://detox-outdoor.org/en/faq/>

<sup>24</sup> UNEP / OECD 2013. SYNTHESIS PAPER ON PER- AND POLYFLUORINATED CHEMICALS (PFCS). Online available: [http://www.oecd.org/env/ehs/risk-management/PFC\\_FINAL-Web.pdf](http://www.oecd.org/env/ehs/risk-management/PFC_FINAL-Web.pdf)

<sup>25</sup> ZDHC: Durable Water and Soil Repellent Chemistry in the Textile Industry – A Research Report, 2012 [http://roadmaptozero.com/df.php?file=pdf/DWR\\_Report.pdf](http://roadmaptozero.com/df.php?file=pdf/DWR_Report.pdf)

<sup>26</sup> European Commission: Integrated Pollution Prevention and Control (IPPC) Reference Document on Best Available Techniques for the Textiles Industry July 2003

<sup>27</sup> ChemSec, undated. Textiles come with a toxic footprint. <http://textileguide.chemsec.org/find/textiles-come-with-a-toxic-footprint/>