

Case Study Phase out of Perfluorinated Compounds (PFCs)

H&M Group April 2017

Introduction

Perfluorinated Compounds (PFCs) are a group of substances, commonly used to make outerwear more resistant to oil, stains and to make clothes more water repellent. These substances have been found to have many unwanted properties; being persistent, bio-accumulative, having a slow elimination time from the human body and therefore hazardous to human health.

Since 1995, H&M has been working actively to reduce the use and impact of hazardous chemicals. With the Restricted substance list (RSL), the company limits the use of chemicals that are potentially harmful to health or the environment.

The H&M RSL is based on the strictest country standards and precautionary principle. Due to the hazardous properties, Perfluorooctane Sulfonate (PFOS) was added to the RSL in 2002 and Perfluorooctanoic Acid (PFOA) in 2005.

In 2009, H&M took the initiative to investigate PFCs-free alternatives to achieve water repellent property in functional outerwear. Focus was put on a water repellency function only, as it was concluded that oil and stain repellency functions was not needed in the company's product range.

During that time, a decision to work towards a completely phase out of PFCs in the company's product range was taken in consistency with the precautionary principle.

As a first step, the winter wears for kids were targeted, a product where water repellency function is needed. Then sportswear was targeted more in general. Later on also other products in the assortment were found to contain water repellent finishes such as umbrellas, shower curtains and rain clothes.

In the end of 2010, the first product with PFCs free finishing was introduced. From January 2013 the H&M Group put a global ban on Perfluorinated Compounds (PFCs).

Before enforcing the ban, H&M wanted to have more than one alternative solution and started creating a positive list that was published at the same time as the ban. Having a positive list was also a way to openly search for alternatives in order to make sure the company would not have to rely on only one or two chemical suppliers. In connection with the creation of the positive list, internal routines for eliminating Perfluorinated Compounds (PFCs) in H&M production and guideline on Evaluating Alternatives for PFCs were created.

Timeline Phase out PFCs



Perfluorinated Compounds in the scope

The compounds in the scope of phase out are included with concern to the intrinsic properties such as Bio-accumulative and Persistent and regardless of the length of the Carbon backbone.

Chemical name	CAS no	Length Carbon backbone
Perfluorobutane Sulfonate (PFBS)	29420-49-3	C4
Perfluorohexane Sulfonate (PFHxS)	3871-99-6	C6
Perfluoroheptane Sulfonate (PFHpS)	375-92-8	C7
Perfluorooctane Sulfonate (PFOS)	56773-42-3	C8
Perfluorodecane Sulfonate (PFDS)	126105-34-8	
Perfluorooctane Sulfonamide (PFOSA) 1H,1H,2H,2H H4PFOS; 6:2	754-91-6	C8
Perfluorobutane Acid (PFBA)	375-22-4	C4
Perfluoropentane Acid (PFPA)	2706-90-3	C5
Perfluorohexane Acid (PFHxA)	307-24-4	C6
Perfluoroheptane Acid (PFHpA)	375-85-9	C7
Perfluorooctanoic Acid (PFOA)	335-67-1	C8
Perfluorononane Acid (PFNA)	375-95-1	C9
Perfluorodecane Acid (PFDA)	335-76-2	C10
Perfluoroundecanoic Acid (PFUnA)	4234-23-5	C11
Perfluorododecanoic Acid (PFDoA)	307-55-1	C12
Perfluorotridecanoic Acid (PFTrA)	72629-94-8	C13
Perfluorotetradecanoic Acid (PFTeA)	376-06-7	C14
Perfluoro-3,7-dimethyloctanoic Acid (PF-3,7-DMOA)	172155-07-6	C8
7H-Dodecanefluoroheptane Acid (HPFHpA)	-	
2H,2H-perfluorodecane Acid (H2PFDA)	-	
2H,2H,3H,3H-Perfluoroundecanoic Acid (H4PFUnA)	34598-33-9	C11
1H,1H,2H,2H-Perfluorooctylacrylate (6:2 FTA)	17527-29-6	C6

1H,1H,2H,2H-Perfluorodecylacrylate (8:2 FTA)	27905-45-9	C8
1H,1H,2H,2H-Perfluorododecylacrylate (10:2 FTA)	17741-60-5	C10
1H,1H,2H,2H-Perfluoro-1-hexanol (4:2 FTOH)	2043-47-2	C4
1H,1H,2H,2H-Perfluoro-1-oktanol (6:2 FTOH)	647-42-7	C6
1H,1H,2H,2H-Perfluoro-1-decanol (8:2 FTOH)	678-39-7	C8
1H,1H,2H,2H-Perfluoro-1-dodecanol (10:2 FTOH)	865-86-1	C12
2-(N-methylperfluoro-FASE 1 octanesulfonamido)-ethanol (MeFOSE)	2448-09-7	
2-(N-ethylperfluoro-1-octanesulfonamido)-ethanol (EtFOSE)	1691-99-2	C8
N-methylperfluoro-1-octanesulfonamide (MeFOSA)	31506-32-8	C8
N-ethylperfluoro-1-octanesulfonamide (EtFOSA)	4151-50-2	C8
All other Perfluorinated or Polyfluorinated compounds (fully or partially fluorinated compounds)	Various	

Alternatives with water repellent function

In 2005, H&M approached the chemical industry for possible alternatives to PFCs in functional outerwear, without any success. Alternatives suitable for industrial use could not be sourced at that time.

4 years later when the investigation was resumed, several chemical manufacturers approached H&M with their PFC-free alternatives. The goal from the company side was that any alternative should fit to be used on all type of fabrics that the company normally uses and achieve all levels of water repellency.

The investigated alternatives were based on different chemical techniques such as dendrimers, resin-modifications and silicon chemistry.

One of the alternatives investigated and later approved, was BIONIC-FINISH®ECO supplied by Rudolf Group. The water repellent products of BIONIC-FINISH®ECO are based on fluorine-free formulas with

highly branched; hydrophobic polymers with dendritic structures aligned across the textile and crystallize onto specially adjusted comb polymers.

Hazard assessment

H&M started collaboration and worked closely with one chemical company, Rudolf Group and their product ®RUCO-DRY ECO (= a finishing product of BIONIC-FINISH®ECO). To assess the product, Scientific Expertise on the characterization of the active ingredients in ®RUCO-DRY ECO was requested, as well as Safety Data Sheet (SDS) for all substances included in ®RUCO-DRY ECO.

According to the scientific expertise report, ®RUCO-DRY ECO consists of polymers mainly made from hydrocarbons and minor amounts of polysiloxanes. The type of polysiloxane used in ®RUCO-DRY ECO is linear and the cyclic and persistent siloxanes D3, D4 or D5 are not present in ®RUCO-DRY ECO. ®RUCO-DRY ECO contains small amount polyalkylsiloxanes in comparison to the amount of hydrocarbons.

There is a debate regarding nanotechnology and nano particles and their effect on health. According to the scientific expertise report, ®RUCO-DRY ECO/BIONIC-FINISH®ECO does not contain inorganic nano particles. To assure, that the fluorine free finish poses no negative impact on environment or health, the nano perspective was further investigated and concluded not to consist of nano particles, but on self-assembling polymers.

The Scientific Expertise report and Safety data sheets were thoroughly reviewed by the H&M's team of chemical specialists.

Performance

From the start, it was concluded that the performance and quality aspects should not be affected, except for oil repellency. Oil repellency function was not needed for garments such as kids winter wear. H&M in general, does not have any requirement for oil repellency.

Water repellency was tested according to the standard ISO 4920. Garments were required to fulfil a 4 on the scale before washing and a 3 after washing. There were no requirements on dirt repellency.

Trials were made in production and tested according to H&M Quality standards and requirements. Chemical content were tested according to H&M RSL and it was discovered that the final product contained unavoidable trace impurities derived from the used emulsifier and hence did not fulfill the RSL. A decision to make an exception for this treatment was taken based on the reasoning that the positive sides of ®RUCO-DRY ECO outweigh. The later version ®RUCO-DRY ECO PLUS does not have this problem.

It was concluded after testing that BIONIC-FINISH®ECO (finishing products called ®RUCO-DRY ECO and ®RUCO-DRY ECO PLUS) can be used on all fabrics that H&M normally use and can achieve all three levels of water repellency.

Conclusion/Discussion

The company's chemical vision is safe products produced in a healthy workplace while protecting the environment. To make sure the best available chemistries from an environmental and health perspective is used in H&M products, new internal routines for chemical hazard assessment is under development, which includes new routines for positive lists approval. The company is currently investigating options for third party assessments, like GreenScreen®, Cradle to Cradle Certified™ and U.S. EPA Safer Choice Program as criteria for inclusion on the positive list for approved alternatives to PFCs. H&M has requested 3rd party assessment of BIONIC-FINISH®ECO but none of the above mentioned has received so far.

References

Scientific Expertise on the "Characterization of Active Ingredients in Water-, Oil- and Soil-repellent Textile Impregnations". Prof. Dr. rer. nat. Martin Möller. Direktor des Deutschen Wollforschungsinstituts Inhaber des Lehrstuhls für Textilchemie und Makromolekulare Chemie der RWTH Aachen.