

# PFOS, PFOA, AND OTHER FLUOROchemicalS

Fluorochemicals are used in water-repellent finishes and waterproof membranes in outdoor apparel. These fluorinated compounds also can be found in a wide variety of other consumer goods, including nonstick cookware, paints and coatings, and stain-release treatments for carpet. We do our best to monitor the health, safety and environmental impacts of chemicals used in the manufacture of our products by reviewing information published by U.S. government agencies responsible for regulating these chemicals, and by discussions with the companies that make the materials used in our products. Based on what we have learned to date, we are not aware of information linking skin contact from the routine use of apparel to an uptake of fluorochemicals into the human body and any potential for harm. But because we are concerned about the persistence of these chemicals in the environment, we have been working over the past decade to find alternatives to two fluorinated compounds: perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA).

## Are Fluorochemicals Bad?

There are potential health and safety concerns with both PFOS and PFOA. Both are toxic and persistent, meaning they do not break down or “go away.” Scientific reports indicate increasing levels of these chemicals accumulating in the environment, in animals and in humans around the globe. The European Union banned PFOS years ago and is now taking similar action with PFOA. In the United States, the Environmental Protection Agency (EPA) initiated a voluntary industry phase-out of PFOA, whereby the major global fluorochemical companies eliminate PFOA by the end of 2015.

## Fluorocarbon-Based Water Repellents

Water repellency is achieved by lowering the surface energy of the fabric so that water will bead on the surface and won’t “wet out” the garment. This can be achieved with many types of finishes, including waxes, oils and silicones. But these compounds can be penetrated by oil, including lotions and oils from skin. Since

fluorocarbons are the most effective at repelling both oil and water they are commonly used in water-repellent finishes on outerwear clothing.

PFOS and PFOA can occur in water repellents as impurities or by-products of degradation. Due to legislation and changes in the way chemical companies make these fluorocarbons, many water repellents on the market today are PFOS-free. There also are some “PFOA-free” water repellents made with perfluorinated molecules that have shorter carbon chains than the 8-carbon chain structure (C8) that is typically used. The benefit? By-products from shorter-chain compounds also have shorter chains, and break down faster in the environment than PFOA. Unfortunately, the shorter-chain structure also tends to perform less effectively in repellency tests.

Other fluorinated chemicals, like fluorotelomer alcohols (FTOH), may have some of the same health and safety issues as PFOS and PFOA. FTOH is a by-product of most water repellents, even those that are PFOS-free and PFOA-free. So instead of removing individual fluorochemicals as potential health and safety concerns are identified, it may be preferable to search for a fluorocarbon-free water repellent as a long term solution.

Patagonia has been investigating PFOA-free water repellents for the past decade. We’ve worked with chemical companies to suggest and test improvements in the repellency and durability of both short-chain (C6) and fluorocarbon-free finishes. We have arranged application trials with textile manufacturers, and tested fabrics in our own lab against standard formulations. Over time we have seen significant improvements in performance. As some of these new finishes were able to meet the Patagonia standard, we began using them in more new products every season. The transition out of using C8 chemistry is complete starting with the spring 2016 product line. The majority of our products that are treated with DWR (durable water repellent) now use short-chain C6 fluorocarbon-based water repellents. These are PFOS-free and PFOA-free, but PFOA is still likely to be detectable on the treated fabric at very small amounts.

## Fluorochemicals in the Waterproof Membrane

Waterproof membranes are thin films or coatings attached to the back of fabrics to prevent water from passing through. These barriers are also engineered to be “breathable,” meaning that water vapor can pass through in one direction while water is being repelled. GORE-TEX® is the best-known branded membrane and is made using PTFE (polytetrafluoroethylene). But other materials, such as polyurethane or polyester, can also be used.

PTFE membranes are made from the same material as Teflon® coatings on cookware. Although PFOA was historically used as a processing aid to make PTFE, it was difficult to find any trace amounts in the final product. Never-the-less, fluorochemical companies have developed PTFE formulations that do not use PFOA in the manufacturing process. PFOA-free versions of PTFE are now available and we use them in our Patagonia GORE-TEX® products.

We have chosen to use several types of membranes to make durable, high-performing waterproof/breathable fabrics, including PTFE, polyurethane and polyester. All of these barrier technologies have varying combinations of advantages and disadvantages in terms of manufacturability, performance attributes, aesthetics and environmental characteristics. Regardless of which technology we employ, all of our waterproof/breathable garments are safe for their intended use and meet our high performance standards – keeping water out under high pressure while allowing water vapor to escape. By working with multiple membrane technologies, we strive to be on the cutting edge of waterproof/breathable material development.