



PFCs and Class B Firefighting Foam

What do fast-food packaging, waterproof clothing, stain-resistant carpet, chrome-plating vapor suppressants, nonstick frying pans, aircraft hydraulic oils, and Class B firefighting foams have in common?

They all contain man-made chemicals called perfluorochemicals, commonly referred to as PFCs. PFCs have been used for several decades to make products stain-resistant, water-repellent, slippery, and long-lasting. Without PFCs, grease would seep through our fast-food bags, our carpets would be more stained, and fighting a petroleum fire might be more difficult.

The widespread distribution of PFCs in the environments has led to the investigation of all potential sources. PFCs have been a known ingredient in many firefighting foams. This has prompted the question, is the use firefighting foam a source for the PFCs in the environment?

PFC Manufacturing

PFCs were developed by Minnesota-based 3M Corp. in the late 1950s and were manufactured at its facility in Cottage Grove until 2002. As part of its worker health and safety program, 3M routinely conducted health and blood screening of its Cottage Grove workers. PFCs showed up in these workers' blood, likely due to their contact with the chemicals. However 3M's health monitoring found no significant effects on the health or medical conditions of its workers over many years of monitoring.

In the late 1990s, researchers were surprised to find PFCs in the blood of people who had not been associated with PFC manufacturing. Further research has found PFCs in approximately 98% of all humans, including people in remote areas who have never had contact with the modern world. Animals on every continent have been found to have PFCs in their blood. More recent studies in Minnesota have shown PFCs to be present in some ground and surface waters, air, soil and fish; most notably around waste-storage areas utilized by 3M in Washington County.

The health significance of PFCs in drinking water and in peoples' blood is being investigated at the state and federal levels. So far no acute health problems have been found. However more subtle changes in peoples' physiology have been noted. The Minnesota Department of Health (MDH) has taken the best available toxicological information and developed drinking-water-quality criteria for several of the PFCs.

PFCs in Nature

Nature eventually deals with most natural and organic substances that are released into the environment. When milk, gasoline, or fuel oil are spilled, microbes in the soil and water break them down, turning them into carbon dioxide and water. However, these substances can cause some problems during this decaying process: odors, contaminated water, fish kills or other public-safety hazards.

PFCs do not occur in nature; they are man-made and not organic. Therefore they generally do not break down in the environment. By design, PFCs are slippery and pass quickly through the soil and make it into the water supply. Once in the environment, they may be taken up by living things, and build up (bioaccumulate) within the tissue of plants, animals and people.

Organic substances are primarily made up of chains of carbon atoms with hydrogen atoms connected to them. PFCs consists of chains of four to 12 carbon atoms, with varying numbers of fluorine atoms attached instead of hydrogen. The fluorine-to-carbon bond is very strong; this bond is why PFCs do not break down easily in nature. The various PFCs differ from one another in the number of carbon atoms, the number of fluorine atoms, and other chemical pieces that are also attached to the carbon chain. Several of the PFCs are under intense research, but little is known about many other PFCs. The most commonly investigated PFCs are perfluorooctane sulfonate (PFO), commonly used in firefighting foam; perfluorooctanoic acid (PFOA), used in manufacturing of Teflon; and perfluorobutanoic acid (PFBA), used in photographic film.

PFCs in Firefighting Foam

The use of firefighting foam is vital in protecting lives and minimizing property damages. There are many types and manufacturers of firefighting foam. However due to trade secrets, the exact ingredients in the various patented foams are mostly unknown.

Class A foam has come into widespread use in recent years for wildland, structure and other standard combustibles (Class A) fires. A detergent-like surfactant in the Class A foam makes the firefighting water “wetter” and more able to penetrate combustible material. It is believed that most Class A foams do not contain PFCs.

Class B firefighting foams are used for flammable liquid (Class B) fires. Class B foams, most commonly aqueous film-forming foam (AFFF), are used to put a thin “blanket” on a flammable liquid, separating the fuel from the air, which reduces vapors and heat, effectively smothering the fire. PFCs are used in Class B firefighting foams to increase their effectiveness and make them long-lasting. PFCs help the foam to spread evenly across the liquid and reform if the “blanket” is interrupted by falling debris.

Some manufacturers have been changing their PFC manufacturing processes and materials to eliminate or minimize the PFC content in their firefighting foams; others have changed the type of PFC in their foam to one which is less likely to cause health

problems. However many manufacturers may not know or reveal PFC content of current or past formulations.

The Minnesota Pollution Control Agency (MPCA) is working on many studies to understand the sources and the movement of PFCs in the environment and into living things. By understanding the sources and movement, we may be able to minimize PFCs' effects on the environment and on people. One of these studies involves firefighting foam and its potential as a source of PFCs in the environment.

In the spring of 2008, the MPCA sent a survey to all fire departments in Minnesota requesting information about their use of foam in training and during fire response. Sixty-seven percent of the fire departments responded to the survey. The MPCA thanks the fire service for their cooperation in this effort. This survey was the first phase of the effort to understand firefighting foams' potential as a source of PFCs. Phase 2 of this study involves further investigation of several firefighting-foam training sites which are near drinking-water wells located on permeable soils that allow surface pollutants to easily reach the ground water, or sites where relatively large quantities of foam were used. The MPCA, working with the MDH and in consultation with the State Fire Marshal, will be sampling soil and water near approximately 20 training sites this spring to see whether PFCs are present in the soil and ground water. The MDH will also sample municipal supply wells in many of these communities as well. The fire departments selected for phase 2 have been notified for site access and permission for sampling. Results will be provided back to the departments and the firefighting community later this year.

PFC and Foam Use?

What does all this mean for the fire service? If you have a Class B fuel release or fire, by all means use your Class B foam to mitigate the emergency and protect the public's safety.

Studies are in process to understand how PFCs are affecting our environment. Results from phase 2 should be available sometime during the summer of 2009.

In the meantime, the Fire Chiefs' Association, State Fire Marshal, MPCA, and MDH will be developing some guidance for Minnesota's fire service on training with Class B foams. This guidance will likely include recommendations such as using PFC-free training foams for training, using Class B foams only on flammable liquids such as gasoline and not on combustible liquids such as diesel fuel, and questioning manufacturers and distributors about the PFC content of the Class B foams currently sold. Also fire departments should be aware of where the runoff from their foam training will go. Most towns with municipal wells have a "wellhead protection plan" to help protect their water supply from leaks, spills and chemical use. Fire officers should consult with their local water-utility department to ensure that their training is not in a wellhead protection area.

More information about PFCs and the state's ongoing research is available on the MPCA and MDH Web sites at:

<http://www.pca.state.mn.us/cleanup/pfc/index.html>

<http://www.health.state.mn.us/divs/eh/hazardous/topics/pfcs/index.html>

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