Transition from PFAS containing firefighting foams to Fluorine Free (SFFF), and the removal of PFAS from systems

There have been several questions raised regarding the transition being made from PFAS containing foams to fluorine free ones and how any residual PFAS can be removed from the foam tanks and the systems. Specific questions relating to the legal requirements for firefighting foam and how timescales for transition vary depending on the sector that the end user is operating in, as well as the type of PFAS that the firefighting foam has in it's formulation.

On the market today, many companies offer solutions to "remove PFAS from system", based on a number of different technologies. **It is important to remember that achieving 100 % removal of PFAS is impossible.** Fomtec do not recommend or endorse any specific technology, or supplier. Fomtec only present some of the technologies that we are aware of at the time of writing this document.

Before starting a transition project, it is important to find out the legal requirements, as these can vary depending on where you are. The member countries within the EU have stricter regulations compared to many other countries. ECHA are responsible for these regulations, however, Non-EU countries that have signed the Stockholm Convention relating to Persistent Organic Pollutants (POP's) abide by these regulations. Remember that each country, or in fact legislative region within a country, can also have their own National, or Regional, regulations that need to be followed. What specific regulations that need to be followed are determined by the end user sector. For example, within the EU PFAS containing foam used in the offshore oil and gas sector, has a transition time of ten (10) years compared to a Municipal Fire & Rescue Service where the same foam can only be used until April 2027.

Several scientific papers have found issues with removing PFAS. The main issue is that it can stick to all surfaces especially porous material that has been exposed for a long time. This is due to the nature of the PFAS molecules which can be both hydrophilic and hydrophobic and can have both a positive and negative charge. PFAS enters the materials pores, both on a macro and micro scale, making it difficult to remove. Regardless of what the material the system is built with, it is very hard to completely remove PFAS because it will enter and adhere to the pores in the material, therefore, porous material e.g. fiberglass or plastic are considered the most difficult ones. PFAS can adhere to a surface in three ways the tail can bind to the surface, the charge of the molecule can attach to the surface and a micelle can form. The stable multilayered PFAS supramolecular assemblies can remain on the tank surfaces and after time they will rebound to your SFFF.

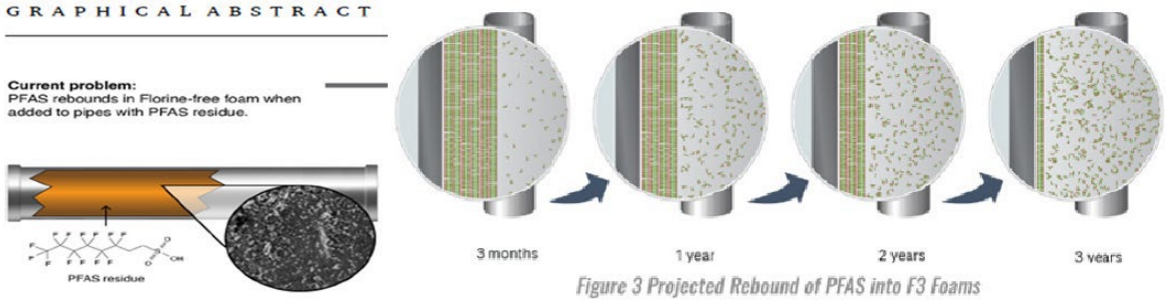

Figure 3 Projected Rebound of PFAS into F3 Foams

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EN 1568

There are various cleaning concepts available on the market, this paragraph will discuss some of these different technologies.

- The first one uses a high-pressure washer to clean with water and thermal disposal high temperature incineration of the waste products
- The second technique also cleans with water but adsorbs the PFCs (perfluorochemicals) by means of activated carbon. Thereafter, the activated carbon is disposed with high temperature incineration. Activated carbon is an effective adsorbent because it is a highly porous material and provides a large surface area to which contaminants may adsorb.
- The third method mixs additives into the water which binds the PFCs (perfluorochemicals) and creates microflocs. They are then removed by filtration. The remaining water is purified using activated carbon and discharged into the sewer system. The microflocs and the PFC containing activated carbon are disposed of thermally.
- The forth method is using different kinds of cleaning fluids known as super sauce, mostly containing different types of glycols and surfactant that remove the PFAS from the system.

These PFAS removing technologies often combine with high temperature (50 -60 °C) and mechanical "scrub" technique. There are also techniques based on chorine gas (method to remove bacteria in hospital environment) in combination with surfactants.

In general, all the methods presented are suitable for cleaning foam systems. In any case, it is recommended to take a sample from the last flush to have the PFAS concentration determined by a laboratory analysis. **Remember that PFAS cannot be 100% fully removed**, however the legal limit within the EU, after cleaning is 50ppm (mg/kg) of total PFAS, due to re-bound and cleaning difficulties.

Transitioning your foam system from PFAS containing foam to fluorine free alternatives might feel like a complex task, but it's best approached as a structured transition project.

- The first step would be to contact the appropriate authorities to establish the local and national legislation that applies to your company.
- Develop a comprehensive plan with a detailed cost breakdown and determine what steps need to be taken, such as purchasing new parts. The general recommendation is that all loose parts in your system that have been in contact with foam concentrate, for example pipes, gaskets, pump and proportioner, should be exchanged for new parts/devises.

- The first physical step with the transition is the removal of the existing PFAS foam from the foam tank. This must be stored and sent to the approved treatment facility.
- We recommend that next the tank is rinsed with hot water so that no foam residue is left in the tank.
- Once that has been removed, use a high-pressure washer to spray hot water on the

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inside of the tank and leave for 24 hrs. Sample the remaining water in the tank and send it for PFAS analysis, making sure to follow the analytical lab instructions on collection and handling. (Fomtec offers PFAS analysis, and more information can be found on our website.) The lab will establish the mixture of different PFAS (PFAS cocktail) is in your tank.

- Once you know the scale of the decontamination problem you can get in touch with Suppliers that offer the most suitable cleaning technology for your specific PFAS cocktail and foam system.
- Once you have completed the transition it is imperative to monitor and perform PFAS analysis of your SFFF at least once a year to keep track of any potential rebound.

It is very important as part of the plan for transition that evaluation of how to dispose / handle the wastewater and "old foam" takes place to ensure that the most sustainable and cost-effective method is chosen, without compromising the wanted results.

For more information about transition pls see EU_guidance_for _transitioning_to _fluorine-free_ firefighting_foams_en on our website .

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It is important to note that once you have cleaned out the system and installed the new SFFF, you need to make sure that it does not exceed the legal limit (in the EU) of total pfas which is 50 ppm (mg/Kg). In addition to this legislation, you need to comply to current legislation already in place, (in the EU) which are;

- **PFOA** (C8 → C6) - UTC (unintentional trace contaminants)10 mg/kg (ppm) PFOA and its salts and 10 (mg/kg) ppm PFOA related substances (valid for three years then 25 ppb PFOA and its salts and 1000 ppb PFOA related substances)
- **PFOA** (C8→ FF) - UTC 10 mg/kg (10 ppm) for the sum of PFOA, its salts and PFOA-related compounds
- **PFOS** - UTC (unintentional trace contaminants) 25 ppb and its salts and 1000 ppb PFOS related substances
- **PFHxS** - UTC (unintentional trace contaminants) 25 ppb and its salts and 260 ppb PFHxS related substances
- **C9-C14 PFCAs** - UTC (unintentional trace contaminants) 25 ppb and its salts and 1000 ppb C9-C14 related substances
- **PFHxA** - 25 ppb and its salts and 1000 ppb PFHxA related substances

Another important step is to dispose of the old foam and wastewater after emptying and cleaning the tank. There are a few techniques available for this, one of them being incineration where you burn the old foam and wastewater at 1100 °C. A different method is sending your wastewater to PFAS cleaning. Some water treatment plants can receive PFAS water and clean it through a process called supercritical water oxidation. Note that when you are shipping the wastewater and the old foam, it must be clearly labeled >1 ppm PFAS. Regardless of what method you choose it is required to check with local authorities which regulations apply to you.

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