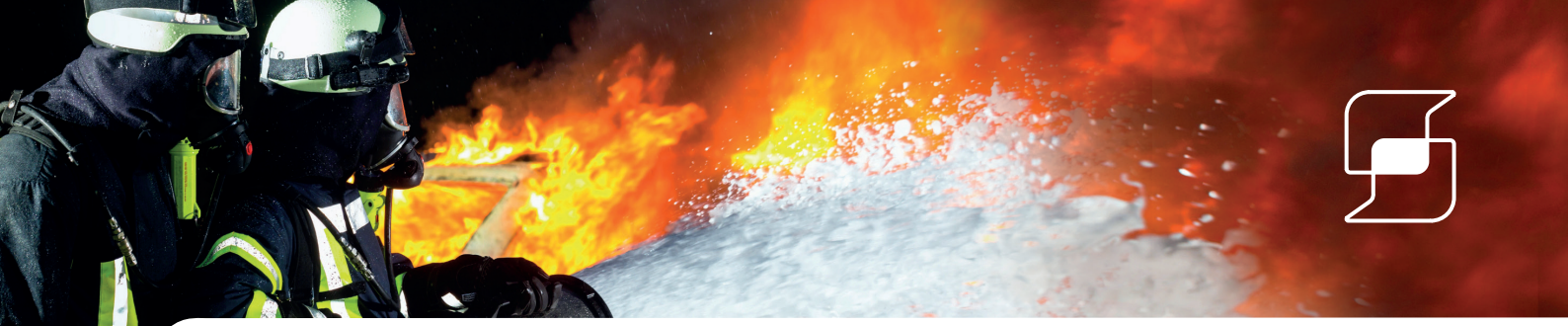

PFAS: TIME IS RUNNING OUT – THE CLOCK IS TICKING

Ban on PFAS in Fire Extinguishing Foams
Challenges Faced when Switching to New Fire Extinguishing Agents

PRELIMINARY REMARKS

Extinguishing liquid fires or plastic fires poses a particular challenge to firefighters and places high demands on fixed fire extinguishing systems with regard to the extinguishing agents to be used. Due to their excellent extinguishing effect, foam extinguishing agents offer remarkable advantages over other extinguishing agents, especially when fighting fires in Class A (solid materials) and Class B (liquid materials or liquefiable substances). Foam extinguishing agents of the AFFF group have been in use for many years.

However, given the environmentally problematic and harmful properties of fluorine-based ingredients in foam extinguishing agents, it must be assumed that, irrespective of their undeniable advantages in firefighting, the use of foam extinguishing agents will be severely restricted or even completely banned in the future.

Foam extinguishing agents are used by fire departments for defensive firefighting, are widely used in conventional hand-held fire extinguishers and are found as extinguishing agents in numerous stationary extinguishing systems. Moreover, the type of extinguishing agents used in fixed extinguishing systems, is usually relevant for insurance policies and regulatory approval. In this respect, the ban not only affects fire departments, but also has far-reaching implications for all companies that protect their facilities with foam extinguishing systems or use hand-held fire extinguishers with extinguishing foam.

All operators converting an existing extinguishing system to a new type of fluorine-free extinguishing agent, faces the challenge that the replacement of the extinguishing agent could entail structural conversion measures and technical system adjustments. This, in turn, may require new approval procedures and proof that the effectiveness of the extinguishing system is not impaired by replacing the extinguishing agent. In addition to possible changes to the extinguishing system infrastructure, the disposal of the old extinguishing agent stocks affected by the ban must also be organized in good time. The fact that the complex technical adjustments required for the replacement of the extinguishing agent and any necessary conversion measure must be completed by July 4, 2025 at the latest (i.e. in less than one year) means that companies are under severe time pressure.

WHY FOAM IS USED FOR FIREFIGHTING?

Water is an excellent extinguishing agent and has proven itself for numerous fuels in a wide range of damage scenarios. However, quite a number of fuels have so-called hydrophobic (= water-repellent) properties. It is therefore impossible to wet (or, at best, soak) these fuels with firefighting water. On burning plastics, for example, the firefighting water simply roll off, and the water properties required for the extinguishing (cooling by evaporation, displacement of atmospheric oxygen due to formation of water vapor, pre-wetting or soaking of the burning material, etc.) cannot take full effect. Many burning liquids do not mix with water. Burning oils, for example, will float on the extinguishing water surface and spread over a large area with the firefighting water (triggering secondary fires).

Adding certain chemical substances (surfactants) enables wetting with water even on hydrophobic material surfaces. Used as additives in extinguishing agents, surfactants coming into contact with water will form a foam, wetting the fuel with a thin aqueous film. This improves the extinguishing effect in several ways:

- **SEPARATING EFFECT:** The thin aqueous film formed by the surfactants forms a gas-tight separating layer between the fuel and the ambient air. This prevents the fire from receiving the oxygen required for combustion from the ambient air.
- **COVERING EFFECT:** The closed water film also prevents a flammable liquid from evaporating (reduction of the evaporation rate). This suppresses the formation of explosive gas/air mixtures.
- **SPREADING EFFECT:** With its smooth surface structure, the aqueous film also acts as a sliding layer. This supports the rapid, flat spreading of the foam.
- **COOLING EFFECT:** During the extinguishing process, bursting foam bubbles generate tiny water droplets that evaporate and absorb heat, thereby removing additional energy (heat) from the fire.
- **INSULATING EFFECT:** As a water/air mixture, foam has only a low thermal conductivity, which allows it to contain the radiant heat generated in the event of fire and reduces the speed of fire spread.

Among the large number of surfactants, fluorine-containing foam agents of the AFFF group (**A**queous **F**ilm **F**orming **F**oam) are by far the most commonly used foam agents for firefighting. However, these extinguishing agents contain so-called PFAS compounds, which are the focus of worldwide attention due to their environmentally problematic and harmful properties.

WHAT DOES PFAS STAND FOR?

The generic term refers to the group of fluorine-containing surfactants and stands for per- and **p**oly-**f**luoro**a**lkyl **s**ubstances, a group of several thousand different chemical compounds. Irrespective of their, in some cases, very different chemical properties, PFAS surfactants are classified as environmentally problematic and harmful to health.

WHY ARE PFAS BEING CRITICIZED?

PFAS have detrimental effect on human and animal health and the environment. PFAS are problematic because they can cause a multitude of serious diseases, weaken the immune system, may negatively impact fertility and can cause reduced birth weight. PFAS are also suspected of damaging the liver and the thyroid gland and causing cancer. The problematic substances are ingested by human beings through food and potable water, accumulating in the body. Studies, conducted by the German Environment Agency across Germany, have show that in some cases worrying concentrations of harmful PFAS were detected in the blood of the persons examined.

PFAS belong to the group of POP (**P**ersistent **O**rganic **P**ollutants). Owing to their chemical stability, they cannot be biologically degraded and are therefore known as eternity chemicals. As a result of lacking biological degradation processes and the inevitably continuous accumulation of PFAS in the environment, these problematic substances are now ubiquitous and have even been detected in remote areas such as polar, desert, and mountainous regions. The fact that these fluorine-containing compounds do not occur in nature, but originate exclusively from industrial manufacturing processes, proves that the worldwide spread of these problematic substances is a type of so-called “anthropogenic contamination of the entire globe” (anthropogenic = caused by humans).

WHICH FOAM AGENTS ARE OR WILL BE BANNED?

In light of the far-reaching adverse effects on human and animal health and the environment, almost all nations worldwide have committed themselves, under the auspices of the Stockholm Convention, to strictly regulating persistent organic pollutants. This also includes PFAS. With the aim of preventing further PFAS from entering the environment, regulations are currently being adapted at the international level with regard to bans on use. In the European Union, various PFAS have meanwhile been banned or are strictly regulated by very low limit values.

These developments have particular implications for the use of foam extinguishing agents. Extinguishing foam containing fluorine has been identified as one of the main causes of PFAS contamination in soil and water. Particularly in places where large quantities of extinguishing foam had been used to fight major fires or on fire service training areas, alarming PFAS concentrations were found. A significant example is Düsseldorf Airport in Germany, now being considered a PFAS hotspot, following a major fire in 1996. Large areas of soil and groundwater were contaminated by the use of extinguishing foam containing PFAS. In the German state of Baden-Württemberg, the use of PFAS-containing extinguishing foam led to such extensive groundwater contamination that a municipal waterworks had to be shut down permanently.

The ban currently applies to a number of PFAS that are widely used in extinguishing agents, e.g. perfluorooctane sulfonic acid (PFOS), perfluorooctanoic acid (PFOA) and long-chain perfluorocarboxylic acids (C9-C14 PFCA), as well as perfluorohexane sulfonic acid (PFHxS). The bans affect, in particular, fluorine-containing AFFF foam agents, especially if purchased before 2015. International organizations are currently working hard on banning other PFAS.

However, there are also AFFF foam agents that are not affected by the previous bans and comply with all limit values. There is no general answer to the question of which foam extinguishing agents are affected by the far-reaching restrictions and bans. Whether, and if so, which PFAS are contained in a particular foam agent, and whether or not the set limits are exceeded, cannot be determined on the basis of the type of foam agent or the product name. Only a qualified laboratory analysis can provide reliable answers. Since the trend is moving towards a general ban on the use of PFAS, it can be assumed that the use of fluorine-containing foam compounds will be even more restricted or banned completely in the future.

It should be remembered, in this context, that the extinguishing agent HALON was widely used in the past but, despite its excellent extinguishing effect, as a CFC (= **c**hloro**f**luoro**c**arbon) it has been banned worldwide, particularly because of its damaging effects on the protective ozone layer.

WHAT TRANSITION PERIODS APPLY UNTIL THE GENERAL BAN ON PFAS?

In preparation for a general ban on use, and thus a ban on AFFF foam agents, stringent transition periods are already in place for certain PFAS compounds under exceptional approvals. The production and sale of certain PFAS compounds, as well as their use for training purposes (fire drills), has been banned since 2020. In technical fire protection (stationary extinguishing systems), the stockpiling of these foam agents has also been banned since 2020. A transition period applies until July 4, 2025, being part of an exceptional regulation with strict rules. A general ban on the use of these PFAS will come into force thereafter.

Until the transition periods expire, reporting requirements are strict, stocks of more than 50 kg of foam agent have to be reported to the responsible supervisory authority. Where special approvals have been granted and transitional regulations apply, the conditions require that firefighting water contaminated with PFAS be collected and disposed of professionally. Foam extinguishing agents containing PFAS and firefighting waters contaminated with PFAS must be disposed of as hazardous waste in hazardous waste incinerators. This applies not only to the extinguishing water used by firefighters, but also to waters released by an activated extinguishing system, and also involves the regular inspection procedures on foam extinguishing systems.

It should also be noted that the aforementioned special approvals and the related transitional provisions only apply to fire extinguishing foam used for fighting fires in the Class B fires (liquids or liquefiable substances). The transitional arrangements do not apply to extinguishing agents used to fight fires in fire class A (solids, e.g. plastic fires). PFAS-containing extinguishing agents have been banned completely in this field. A general ban on the use of mobile hand-held fire extinguishers containing PFAS is also expected in 2024.

WHAT ALTERNATIVES TO FLUORINE-CONTAINING FOAM AGENTS CAN BE USED?

A wide range of fluorine-free foam agents are now available on the market, including VdS Approved, FM Approved and UL Listed products. However, these approvals are subject to partly wide-ranging restrictions and exclusions. For example, they may only apply to foam agents used in combination with certain sprinklers, and may require adjustments of the water supply. There are other restrictions due to special requirements concerning the admixture of the foam agent, or with regard to frost resistance.

WHAT NEEDS TO BE CONSIDERED WHEN SWITCHING TO A NEW TYPE OF EXTINGUISHING AGENT?

Switching from PFAS-containing foam agents to a fluorine-free foam extinguishing system concept may be accompanied by extensive technical system modifications. Conventional sprinklers have system-related limitations with regard to the foaming process. In addition, fluorine-free foam agents cannot form a water film due to the specific substance properties. While manufacturers of extinguishing agents are working hard to optimize their foam agents for use in sprinkler systems, some of them still recommend converting extinguishing equipment to special low-expansion foam sprinklers. Under certain circumstances, switching to fluorine-free foam agents may also require increasing the water flow. In this context the question arises as to whether the performance of the water pump and the pipe cross-sections of the extinguishing system are suitably designed for this purpose. Modified viscosity properties of fluorine-free foaming agents can lead to insufficient pump performance in the proportioning system, making it necessary to purchase a new proportioning system. Furthermore, any change in the composition of the extinguishing agent may require increasing the admixture rate of the foaming agent, which, in turn, requires extending storage capacity for the foam agent.

IS THE EXISTING EXTINGUISHING SYSTEM CONCEPT STILL VALID AFTER SWITCHING TO FLUORINE-FREE FOAM AGENTS?

When switching from a PFAS-containing foam agent to a fluorine-free extinguishing agent, structural and technical modifications may become necessary due to the requirements described above. If operationally relevant changes are made to an existing fire extinguishing system, it is crucial to ensure that these do not impair its proper function. Therefore, fundamental risk re-assessment will often become necessary for the entire fire extinguishing system. The fire extinguishing concept must be subjected to a comprehensive review and may need to be fundamentally revised.

HOW TO CLEAN A FIRE EXTINGUISHING SYSTEM CONTAMINATED WITH PFAS?

In order to reliably rule out exceeding the limit values and thus contamination with PFAS after switching from a PFAS-containing to a fluorine-free foam agent, extensive and complex cleaning work on the entire extinguishing system is usually required. When storing foam agents in tanks of fire engines or extinguishing systems, strict limit values could even be exceeded by fluorine-free foaming agents if these have been contaminated with PFAS-containing residues due to insufficiently cleaning of the storage tanks.

To achieve the best possible cleaning effect for all system components with the smallest possible amount of rinse water requires proven expertise of the cleaning staff. This is because the rinse water from the cleaning process expectedly contains PFAS and, like the foam agent itself, must be disposed of at great expenses as contaminated hazardous waste in a special waste incineration plant. Therefore, only suitable specialist companies should be contracted to carry out the cleaning work. These companies have the appropriate qualifications and can provide laboratory evidence that

the cleaning was carried out successfully in compliance with all relevant PFAS limit values. At this point at the latest, an economic analysis can come to the conclusion that, for economic reasons, replacing certain system components is preferable to cleaning.

WHAT LIABILITY CONSEQUENCES CAN THE USE OF EXTINGUISHING AGENTS CONTAINING PFAS RESULT IN?

The use of PFAS-containing extinguishing agents can not only pose significant risks to human health and the environment, but also may result in extensive economic damage and liability issues. Anyone who violates the ban by using foam extinguishing agents that are subject to this ban, runs the risk of being held liable for any resulting soil and groundwater contamination. Acting against the strict ban rules will at least be treated as a severely fined administrative offense. If considered an environmental offense in accordance with the criminal law, this would even give rise to criminal prosecution. Criminal law would apply, for example, if soil were contaminated or groundwater polluted due to illegal use of foam extinguishing agents.

CONCLUSION – TIME IS RUNNING OUT, THE CLOCK IS TICKING:

Owing to the consequences and effects of the ban rules, companies find themselves under a great deal of pressure (time pressure, deadline pressure and pressure to act). A general ban on PFAS-containing foam agents in hand-held fire extinguishers is expected as early as 2024. Where already existing fire extinguishing systems fall under the ban, there is not much time left until the end of the transition period in July 2025 for planning and implementing the complex adjustments for the switch to fluorine-free extinguishing agents. In addition to possible changes to the infrastructure for providing extinguishing foam, the complex cleaning work and disposal of old stocks containing PFAS must also be organized in good time.

SÜDVERS risk engineers recommend starting to review the concept of fire extinguishing systems immediately and initiating any necessary adjustments as soon as possible. Extinguishing systems and extinguishing devices using foaming agents containing PFAS, as well as their storage, have to be checked without delay, and any affected system components have to be converted or replaced as quickly as possible where required.

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