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Secretariat of the Stockholm Convention
Attn: POPs Review Committee
United Nations Environment Programme
Geneva, Switzerland

Your Sign	Your Message	Our Sign	date
		FFA-201811	23 November 2018

IPEN 2018/POPRC-14 „*Fluorine Free Firefighting Foams (3F)- Viable Alternatives To Fluorinated Aqueous Film Forming Foams*"

Dear Ladies, Dear Sirs,

EUROFEU as an organisation represents Europe's national trade associations as well as individual member companies of the fire protection industry. It consists of 5 sections covering fixed installations, portable fire extinguishers, sprinklers, mobile equipment and firefighting agents. In that role EUROFEU – represented by its section Firefighting Agents (FFA) was invited to give a short presentation during the podium discussion on firefighting foams at the 14th conference of Persistent Organic Pollutants Review Committee (POPRC)14th Conference of POPRC in Rome in September 2018.

Having been involved in the discussions about Fluorocompounds early on EUROFEU has noticed that more and more the discussions are influenced quite significantly by statements rather than facts. It was and is the intend of EUROFEU to inform objectively and based on facts.

The document referred to above addresses concerns with the use of fluorinated chemicals in firefighting foams. It was particularly provided to the participants of the POP-RC conference.

We do not consider this document suitable to objectively inform the target group of readers about use and background, possible issues and the current situation of fluorochemicals containing firefighting agents. Many of the so-called myths in the document are presented as common statements from members of "the industry", but certainly are not common opinion and not given as quoted. In some cases, they are incorrect and cannot present the point of view of the businesses we represent.

Considering the type and magnitude of the possible effect the aforementioned document may have on authorities, legislators and groups like the POPRC, and not least on the public as well, we want to clarify and correct some statements in the following highlighting some weaknesses in argumentation found in the text.

General comments to the document:

- Many statements seem to be not very well substantiated by peer-reviewed publications.
- Publications discussing an opinion contrary or not in line with the author's opinion are left aside. That way readers are not provided with an objective information basis.
- Technical terms of firefighting or foam technology are used throughout the document without giving their definition nor other explanation enabling non-experts understanding the subject.
- The article repeatedly puts information in misleading or even wrong causal connection.
- Several key terms such as "the industry" or even more important "*Fluorine free*" are widely used throughout the document yet are left undefined. Hence it is not clear which businesses belong to the convoluted reference named as "the industry" and which is accused of incorrect behaviour several times throughout the text. Also, the term "Fluorine free" would deserve a closer discussion in the light of presence of Fluoroorganic compounds in Fluorine free foam agents in concentrations at or below effective levels.
- The article blends references to outdated states (e.g. use of PFOS, …) into descriptions of the current in a way that readers – particularly those who are not very experienced in the subject have limited to no chance to separate the one from the other.

The following addresses some of the most critical findings:

Page 7, Firewater runoff:

"*Operational releases of fluorine-free foam runoff will degrade naturally in soils, waterways or groundwater. Discharges to sensitive hydrological or aquatic environments like enclosed waterways can cause limited, localised, short-term effects but will largely self-remediate. On the other hand, fluorinated foam releases have caused widespread, long-term pollution; runoff must be contained, collected and treated at significant cost as regulated industrial waste under many jurisdictions.*"

The requirement to retain firewater runoff is not limited to those fire waters containing fluoroorganic compounds but is applicable to any firewater runoff. Fire waters generally contain hazardous combustion products which this way shall be blocked from entering the environment.

Page 8, Leftovers from Fluorine free foams:

"*Fluorine-free foams do not need complex, expensive and time-consuming remediation; if limited environmental damage occurs it is rapidly ameliorated, and very importantly, vital assets and amenities such as societal infrastructure, livelihoods, food supply, drinking water, public health, agriculture and livestock production, industrial continuity, recreational activities, etc., will rarely be under threat and if they are at all impacted will become normalised far faster with a minimal risk of long-lasting infrastructural, political and reputational damage.*"

The statement in its generality is not correct as the author/-s themselves indicate later in the IPEN document that Fluorine free foams may also contain chemicals which are persistent or have long term negative effects. Particularly Silicon-based materials, certain surfactant types or persistent acrylic polymers fall within this category of compounds with potential long-term effects on the environment. See also page 20, chapter 1.3.

Page 21, various:

Performance comparability

"*Thus, certain fluorine-free F3 foams can meet all the requirements and are comparable in performance to some of the better fluorine-containing AFFFs, without the environmental disadvantages inherent in extremely persistent perfluorinated end-products with known (such as PFOA or the longer chain PFCAs) or potential toxicity and bio-accumulative potential*."

Please note that today, most Fluorine containing foams are no longer using PFOS or any other long chain PFAS but are based on pure C6-formulations.

Approvals and certifications

"*These approvals and certifications remain just that, somewhat artificial hurdles that manufacturers have to jump through before being able to sell their products on the market*."

Norms have been developed in all advanced economies of the world because market participants figured there is a need to standardise on a) properties and performance of products and b) the testing thereof. It does not seem to make sense to question the general existence of internationally acknowledged standards for performance evaluation of firefighting foams.

Page 22, various:

"*It is these myths in particular that must be controverted for what they are: marketing hype, misrepresentation of test conditions, frank untruths or only partial truths, criticism of a competitor's product, and an exhibition of vested interests*."

This statement should only be constituted if it applies to either of the parties involved in the discussion. Also promotors of F3 foams lived well on unsupported statements and still do.

In the table following the above cited text dealing with myths verses reality the myths statements are not substantiated by providing a source. It cannot even be excluded that the myths listed were worded by someone not being an expert in the field. Many of the statements cannot be perceived as a common sense and are not supported by known facts nor by experts in the matter.

Examples:

"*Fluorine-free foams do not work at higher-than-normal ambient temperatures on hot fuel.*"

This statement makes no sense at all since a) "*higher than normal*" is not specified and b) a foam's performance typically doesn't disappear all of a sudden but degrades more continuously at raising temperatures.

Ambient temperature has an influence on the quality of a foam. Since the performance of F3's is much more linked to the foam quality than with AFFF an adverse effect of elevated temperatures on performance is likely if the foam quality is affected negatively by such temperatures.

"*Fluorine-free foams cannot be used for vapour suppression of chemically reactive liquids/vapours such as ammonia.*"

Ammonia is a water soluble substance which dissolves readily into the water contained in the foam blanket hence penetrates through. This effect is intrinsic to Ammonia and has nothing to do with the foam type used to generate the blanket. Therefore, this statement does not seem to come from an expert in the field.

"*F3 products do not throw as far and cannot be used on deep tank fires.*"

Assuming that with the statement "*and cannot be used on deep tank fires*" the author/-s solely refers to the throwing distance of a foam as indicated by the first half of the sentence this line still mingles two

different important aspects of foam application: the quality of a foam blanket as is needed to successfully extinguish a fuel surface fire and the distance of application.
Since F3s extinguish as a foam blanket only (no chemical help from Fluorocompounds) foam quality – meaning a certain expansion ratio and stability of foam - becomes more crucial than with AFFFs. If the foam solution on its way to the target doesn't pick up enough air to give the minimum foam quality needed for a given F3 to successfully extinguish, it simply will not do the job.
It is also quite obvious that the throwing distance of a liquid follows the density of what is being thrown: the higher the density is, the longer the distance will be. So water or a non-expanded foam solution will give higher distances than a foam having a much lower density.

Page 25, drainage time of foams:

"*More recent measurements of burn-back times for later generation F3 products give drainage times far exceeding AFFF indicating a stable foam blanket. A proprietary current generation F3 gave far longer drainage times compared to AFFF and AFFF-AR under the conditions of the UL162 protocol on n-heptane:*"
And
"*F3 foams do not have the same long drainage times as AFFFs.*"
It is common knowledge amongst foam experts that AFFF never had particularly long drainage times as their performance does not require longer drainage times than they actually have. Long drainage times are in almost any case caused by using polymers in the foam formulations and have nothing to do with a foam being fluorine free or not. For instance, many alcohol resistant AFFFs use polysaccharides to make the foam alcohol-resistant. Foams generated from those agents have significantly longer drainage times compared to a polymer-free AFFF.
The first line "*burn-back times for later generation F3 products give drainage times far exceeding AFFF indicating a stable foam blanket*" mingles drainage time (a datum measured under lab conditions following a test protocol from an internationally acknowledged standard such as UL162, EN1568 or similar) and burn back resistance (a datum measured under fire testing conditions). While lab conditions are very much standardised and controlled, a fire test always is subject to influence from ambient conditions. Key influences affecting the burn back resistance are the application type (gentle or forceful) and the interaction between fuel and the foam itself.

Page 26, realistic versus laboratory testing:

"*Under more realistic conditions Williams et al (2011) showed that the sample of re-healing foam (RF6 outlined below) was essentially indistinguishable from the two AFFFs tested across the three hydrocarbon fuels tested, i.e., iso-octane, heptane and methyl-cyclohexane. This exemplifies the importance of using realistically scaled test scenarios and not relying overly on laboratory scale testing.*"
The author/-s again do not define key elements of the statement such as "*realistically scaled*". Earlier in the document (see page 20, paragraph 1.3) the author/-s mention that F3's "*are capable of meeting the following specifications as do the better AFFF formulations*" referring to standards such as ICAO, UL 162, EN 1568 and Lastfire. While none of these standards is considered a "*laboratory scale testing*" they are not considered "*realistically scaled test scenarios*" either!

Discharging PFAS to the sewer

"*…mislead users that PFAS can be discharged to sewer for standard wastewater treatment. PFAS are not captured or degraded in wastewater treatment plants (WWTPs) and will ultimately pass through to contaminate effluent irrigated or released to waterways and bio-solids used for soil and crop application.*"
The statement that PFASs can be discharged to the sewer is plainly wrong. Like any chemical products these as well should be disposed of properly. If someone ever recommended otherwise this is clearly not

common sense nor practise. On the contrary many suppliers of firefighting foam concentrates offer to take back unused agents to avoid improper disposal.
It should be noted that some of the largest cases of contamination have been caused by illegal declaration of sewage sludge as "*bio-fertilizer*" and its according use on agricultural areas.

Case of environmental pollution in Baden-Wuerttemberg, Germany

"*Remediation and control costs for a fire at which 43,000 litres of AFFF concentrate were used are assessed at 1-10 million Euros, whereas an ongoing case in Baden-Wurttemberg involving soil exchange are likely to be as high as 1-3 billion Euros.*
http://www.faz.net/aktuell/wissen/badenwuerttemberg-chemische-abfaelle-aufdemacker-14419295.html "
This is presented in a way to make readers conclude that the link between those cases are fluorine containing firefighting foams respectively their use. Clearly with the intention to shock readers by the enormous remediation cost caused by that use.
As a matter of the fact the case in Baden-Wuerttemberg (Germany) was caused by compost containing waste from paper industries and literally has no connection to firefighting foams whatsoever. Obviously only German speaking readers would be capable to figure by reading the linked press reference.

Page 27, various

Fuel Pick-up:

"*F3 foams suffer from fuel pickup and reduced burn-back caused by the presence of hydrocarbon surfactants when used operationally.*"
And
"*Although fuel pickup can be demonstrated under artificial laboratory conditions, firefighters are trained to avoid the use of a 'plunging jet' which disturbs the foam fuel interface and to use normal application methods in which the foam solution is allowed to flow over the burning liquid surface.*
Proper application is achieved by bouncing the foam off a vertical surface such as a wall or tank."
While it is fully correct that firefighters try as much as possible to apply the foam indirectly (e.g. by bouncing it off a wall) onto a liquid fuel fire this isn't always possible. Often safety measures or access constraints do not allow for it as well as the height of storage tanks. This is why particularly industrial firefighters of the petrochemical and chemical industry request direct (forceful) applicability of a foam agent.
F3s - lacking of the fuel repelling properties delivered by Fluorosurfactants - do show a significantly higher tendency to emulsify[1] fuels. This emulsification not only destroys the foam bubbles but also makes the foam blanket itself "flammable". Both actions reduce the overall performance of a foam agent.

Appplication techniques:

"*Flammable liquid fires in depth, such as occur with storage tanks, require the use of a technique referred to as 'top pouring' in accordance with EN13565-2 (2009) or subphase injection to apply foam in a gentle manner without disturbing the fuel surface, in particular for water-miscible fuels - mainly polar solvents like alcohols, e.g., methanol, ethanol, isopropanol, and ketones such as acetone or methyl-ethyl ketone (MEK). Although gasoline (vehicle fuel) is itself not water-miscible, the high-ethanol blends such as E5, E10, E15 and E85 are in part. They contain, respectively, 5%, 10%, 15% and 85% denatured ethanol.*"
It should be noted that flammable liquid fires of non-water miscible fuels must be differentiated from those of water miscible fuels: while a gentle foam application on non-water miscible fuels is recommended it is normally a must on water miscible fuels. Subphase injection (also referred to as sub-surface injection) is

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[1] Emulsification is what surfactants do by encapsulating micro-droplets of carbon hydrate fuels with a shell of surfactant molecules so that the droplets become "soluble" in water.

only possible with AFFFs due to their uniquely low fuel pick up and only in non-water miscible fuels. For water-miscible fuels sub-surface application of foam is generally technically not possible.
A different technology is the so called semi-sub-surface injection which injects the foam into a special hose system at the bottom of and inside the tank. With the foam entering into the hose the latter floats up to the surface and releases the foam directly at surface level onto the fuel.
The present article omits to clearly differentiate between the two technologies sub-surface and semi sub-surface and in particular leaves out any mentioning of the specifics of water miscible fuels which on the other hand are crucial for successful extinguishment.

Page 28, Acute Aquatic Toxicity:

"*Acute aquatic toxicity for firefighting foams has been much vaunted by the fluorochemical industry and trade associations to 'prove' that fluorine-free foams are some "ten times" more toxic that AFFFs. This is a completely disingenuous argument since all firefighting foams, whether F3 or AFFF, exhibit very low acute aquatic toxicities of >100 mg/ml and would therefore be classified under the USFWS system as practically non-toxic or relatively harmless – see table below.*"
The second key statement that "*all firefighting foams, whether F3 or AFFF, exhibit very low acute aquatic toxicities of >100 mg/ml*" does not make sense for two reasons:
The value of 100mg/ml appears unrealistically high (=100g/ltr; =10%w/w) and it isn't mentioned whether the number refers to a concentrate or a working solution (premix)

Page 29, BOD effects:

"*Effectively all firefighting foams share approximately the same extent of acute toxicity and BOD effects.*"
The biological oxygen demand (BOD) is typically either referenced as uninhibited BOD or is limited by a time - BOB_5 for the oxygen demand caused by biological degradation within 5days. To give a number "BOD" without any further details is misleading.
The author/-s explain earlier that BOD "*arises from the high degradable organics content (~30%), such as solvents, detergents, carbohydrates, proteins and saccharides (excluding persistent, non-degradable, organic fluorochemicals of course)*".
Particularly the content of those compounds contributing most to BOD – solvents to achieve different levels of freeze protection and carbon hydrate surfactants – vary most between different foam concentrate types. Consequently, the Chemical Oxygen Demand (COD) of those foam concentrates varies between some low 300.000mg/ltr and high >1.500.000mg/ltr. We leave it to environmental scientists to decide if the delta between those numbers can be qualified as "*approximately the same*".

Page 30, alternative persistent compounds

"*users should also be aware of the possibility that alternative persistent compounds such as silicon-containing surfactants (e.g., siloxanes) may have been substituted in a fluorine-free formulation especially where products claim exceptional performance on polar solvents, e.g., EN1568 1A/1A certification.*"
The link between silicon based chemicals used in firefighting foam concentrates and the performance of such concentrates according to EN1568 (version 2000, 2008 or 2018?) part 4 (foam agents for use on polar = water miscible fuels) is misleading: Silicon surfactants may contribute to the alcohol resistance of the respective foam agent yet the reverse conclusion that agents rated 1A/1A according to EN1568/4 likely contain such silicon based chemicals is not correct. In fact any alcohol resistance of fluorine free agents so far we know is achieved by use of certain polysaccharides – even the one of those also containing Silicon based surfactants.

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Page 33, various

readily degradation of fluorosurfactants

"*The use of firefighting foam is by its very nature highly dispersive. Moreover, firefighting foams account for ~32% of the annual global tonnage of fluorotelomer production (~26,500 tonnes) controverting previous public claims by the industry of less than 5% in support of their claim of minor environmental concern*."

This statement implies that all fluorochemicals contained in firefighting foams end up in the environment. In reality only a small proportion of firefighting foams is actually used during their product life, and only a small proportion of those is not contained.

The vast majority of foam agents is properly disposed in accordance with current regulations.

C6-performance issues

"*Additionally, older fluorotelomer technologies based on predominantly C6/C8 products are being replaced by purer C6 material, although significant firefighting performance issues remain*."

Performance testing of recent formulations basing on pure C6-technology prove this statement wrong as they deliver equal performance compared to the previous C8-based foam agents. The performance of AFFF is much more depending on the formulation as a whole than on the use of C6 or C8 fluorocompunds.

Volume of foam agent to fight a tank fire

"*In order to appreciate the very considerable volume of foam solution and cooling water required to control or extinguish a single large tank fire it is necessary to be aware that an 80-metre diameter storage tank with a surface-area of 5000 m2 would require:*

- *nearly 70,000 litres of foam applied per minute*
- *a total of at least 4,000,000 litres of foam*
- *use of ~250 tons (250,000 L) of a 6% foam concentrate"*

The authors state how much foam solution is necessary to extinguish or control one single large tank fire. The way the statement is written an uneducated reader must come to the belief that any tank fire of 5000sqm surface area would need at least that much foam. However, the calculation is difficult to follow as key information impacting the numbers quite significantly is just missing:

- it is not mentioned what application type is used (system, mobile equipment, …)
- the type of fuel is very important for the recommended application rate per application type of a given firefighting foam agent.
- The given volume of foam solution used equals to an application rate of 14ltr/min * m^2 which is extremely high for an AFFF foam and certainly not usual.
- The example references an AFFF with a proportioning rate of 6% v/v. Most common today are foams with a proportioning ratio of either 3% or 1% (this means the concentrate consumption in the example would drop from 250tons to half the number or a sixth). In particular, large tank farms – which is where objects like the referenced 80m diameter tank are most likely – prefer low proportioning foam agents for logistical reasons.
- The authors claim 70.000ltr per minute to be applied on the tank surface. With the total consumption of 4 Mio. Litres of foam solution this would mean an extinguishing time of >57min. Given the extremely high application rate this would be very long.

Page 37, poor management advise on disposal

"*Following very poor product management advice from suppliers and manufacturers the extinguisher service agents and end-users have been dumping PFAS foam wastes directly to the ground (e.g., mining vehicle on-site test firing and wash-out) or to sewer (in the case of service agents refilling retail extinguishers) in the mistaken belief, based on supplier's advice, that the products will fully degrade or that wastewater treatment plants (WWTPs) will be able to capture and/or treat the PFAS wastes.*"

Reportedly the British FIA advised users to discharge portables to the sewer. Any such discharge by professional users is prohibited across the EU as professional owners of waste are obliged to dispose of it through accredited waste treatment companies.

Page 38, various:

Proven alternatives to PFAS containing foams

"*There is now no excuse for not knowing that PFAS pose significant and unacceptable long-term risks making it vitally important to restrict and properly control the use and release of PFAS fluorinated organics given their exceptional persistence and the potential for ongoing and increasing exposure and the ready availability of proven effective and sustainable alternatives*"

This statement seems to be too general – the type of firefighting foam used on a fire is determined by the situation and not for all scenarios F3 products with the same performance as AFFF are available yet. As is also concluded in a study by Javier Castro referenced in the POPRC 14 background document, J. Castro et al. (2017) "Fuel for thought – AFFF verses FFF" Industrial fire Journal_Q2_2017.pdf: "*Based on the comparative data in the present study it is not possible to conclude that both types of products are equivalent in performance. Neither is it possible to conclude that F3 are a valid alternative to all types of fire situations.*"

Contamination of fuels by PFAS

"*PFAS contaminates all other incident materials such as fuels, combustion products and cooling water.*"

The contamination of fuel is not relevant here: petrochemical industries have a high interest in saving as much fuel as possible apart from installations. This is the very reason why many of them still insist on using AFFF as the most effective firefighting agents on their sites.

Overtopping bunds

"*Bund overtopping by excessive firewater generation with release to the environment with permanent pollution of resources by PFAS.*

Firewater generation can be far less with less risk of bund overtopping and only localised and temporary effects if released to the environment."

The overtopping of a bund area in case of a fire incident is predominantly linked to the overall performance of the firefighting measures (performance of foam agent, its application, logistics) and has nothing to do with the presence or absence of PFAS in the first place.

Page 42, regret spend:

"*For fluorine-free foams this is not a consideration as their characteristics and constituent parts are well known, not in doubt, and align with the same or similar substances that have long been in common use and dealt with on a daily basis.*"

The implication that F3's are not subject to "regret spend considerations" is not correct as

a. the authors themselves earlier in the document reference F3 using substances which likely may be of a concern in the near future (e.g. Silicon based compounds) and

b. the fact that as substance as "long been in common use and dealt with on a daily basis" also applies to PFAS and does not at all grant a continuous usability. Particularly under REACH a big number of chemicals is still evaluated for restrictions.

We firmly believe that it is crucial for any party involved in the discussion about fluorocompounds and their use in firefighting to have a solid and objective understanding of the technical issues associated with it. This

is the premise to take sound decisions on regulating PFAS use in full awareness of the implications this might have.
We have no interest to promote either side but to assist bringing the discussion back to rational and creating awareness of the implications. We are open for discussion on this subject and would be glad to assist with any questions you might have. Please do not hesitate to contact us.
Best regards

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Chair EUROFEU Section FFA