FFFC

AFFF Update . . .

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April 2019 Special Edition

Response to the IPEN Paper on Fluorine-free Foams

A paper entitled "*Fluorine Free Firefighting Foams (3F)-Viable Alternatives To Fluorinated Aqueous Film Forming Foams (AFFF)*" was submitted by IPEN to the Stockholm Convention POPs Review Committee at their 14th Conference in September 2018, and has since been further distributed. Although the paper claims to have been prepared by "eminent, independent experts," it nevertheless contains numerous inaccuracies, omissions and misleading statements.

Foam manufacturers that are members of the Fire Fighting Foam Coalition (FFFC), all of whom sell both fluorinated and fluorine-free foams (F3), do not agree with many of the conclusions contained in the IPEN paper on the efficacy and environmental impact of firefighting foams. They specifically reject the general conclusion that current-day F3 foams can provide an equivalent level of performance to AFFF agents for <u>all</u> class B applications and hazards, and thus the continued use of AFFF agents is no longer necessary.

FFFC does not consider the IPEN paper suitable to objectively inform regulators, legislators, environmental authorities or the public about the current situation regarding the use of fluorochemical-containing firefighting foams and their alternatives. Publications discussing an opinion contrary or not in line with the author's opinions are left aside so readers are not provided with an objective information basis. Technical terms of firefighting or foam technology are used throughout the document without providing any definition or explanation that would enable non-experts to understand the subject.

Some of the more serious problems with the paper are highlighted below.

Foam Standards

The IPEN paper states that F3 foams are capable of meeting all standard firefighting certifications applicable to AFFF other than the US military specification. This statement omits important context on the differences in testing protocols and use parameters between AFFF agents and F3 foams within some of these standards. Foams are developed to meet specific standards requirements and the diversity of international testing requirements prohibits one type of foam from meeting them all.

For example, the UL 162 standard encompasses many class B foam applications and is used throughout the world. Under the UL 162 standard the test protocol for non-film forming foams such as F3 requires an increased application rate (50% higher than film-forming foams) and application density (250% higher than film-forming foams) such that all non-film forming products use 15 gallons of foam solution to achieve the same level of extinguishment as 6 gallons of film-forming AFFF. The net result is that while both AFFF agents and F3 foams can claim to be UL 162 listed, the testing criteria for topside hydrocarbon fire tests are substantially different.

The US military specification (milspec) is one of the most rigorous and respected standards for firefighting foams in the world. It is more difficult to meet than other standards such as EN and UL, and many foam products that meet the performance requirements of those standards do not meet the performance requirements of the milspec. Unlike the ICAO foam standard that is based on the results of a single fire test, the milspec requires foam to pass multiple fire tests using both fresh and salt water. Included in those fire tests is the requirement to pass one of the tests at half strength to account for potential problems with the operation of proportioning equipment in the field. No other foam standard includes this rigorous half-strength requirement.

The milspec includes a requirement that foams contain fluorochemicals and as a conformance test to ensure the foam contains the active ingredients it did when it was approved, fluorine levels are measured. The IPEN paper suggests that F3 foams can meet the performance requirements of the milspec and it is only this fluorochemical requirement that keeps them from being approved. This is not correct. The Naval Research Labs (NRL) has published and presented multiple testing results showing that F3 foams are currently unable to pass the required milspec fire tests. NRL continues to support research on the development and performance of F3 foams, and the US Navy has stated that if an F3 foam is developed that can meet milspec performance it will revise the specification to eliminate the fluorochemical requirement.

The Federal Aviation Administration (FAA) Reauthorization Act of 2018 contains a requirement that FAA change its standards to no longer require the use of fluorinated foam. One of the key reasons that FAA had previously cited for requiring the use of milspec AFFF in ARFF vehicles at US airports is that all milspec AFFF agents are compatible. Compatibility with the other concentrates allows resupply from many sources in times of emergency or competitive bids, prevents foam mixing and storage issues, and avoids potential operational problems. Current-day F3 foams are incompatible with AFFFs and with other F3 agents.

Foam Performance

The IPEN paper states that there are "significant firefighting performance issues" with AFFF agents containing only short-chain (C6) fluorosurfactants as compared to legacy AFFF containing some long-chain fluorosurfactant content. This statement is patently false, as proven by extensive performance and approval testing. It also shows a basic lack of understanding of the use of C6 fluorotelomer fluorosurfactants in foam, which dates back to the late 1970s. There have been AFFF agents on the market for 30 years that contain greater than 98% C6 fluorosurfactants and meet the most challenging foam industry standards. The performance of AFFF depends much more on the formulation as a whole than on whether C6 or C8 fluorosurfactants are used.

The IPEN paper badly misrepresents the results of testing by NRL of AFFF agents and F3 foam on a 28 ft^2 pool fire (Williams et al., 2011). The testing was done using four fuels - gasoline, heptane, isooctane, and methylcyclohexane (MCH) – instead of the three mentioned in the paper. One of the fuels – isooctane – was chosen specifically because AFFF agents will not form a film on it. The point of the testing was to measure the impact of film formation on foam performance. Not surprisingly, AFFF agents performed significantly better than F3 foam on gasoline (77% faster extinguishment), heptane (70% faster) and MCH (88% faster) where they are able to form a film, and similar to F3 foam on isooctane where there was no film formation. The IPEN paper incorrectly states that the results were "indistinguishable" for heptane and MCH, and makes no mention of the results for gasoline. Results of additional testing by NRL presented in 2016 showed that an AFFF agent achieved extinguishment in less than half the time (18 seconds) compared to F3 foam (40 seconds). Both of these testing programs confirmed that the F3 foams tested were unable to meet the performance requirements of the milspec.

AFFF agents contain fluorosurfactants that are oleophobic (fuel repelling), and this enhances their effectiveness. Because they are inherently oleophillic (fuel attractive), F3 foams can easily pick up fuel and the contaminated foam can degrade quickly and become "flammable." Without a comprehensive understanding of modern F3 foams, this fuel contamination problem compromises the fire performance and limits the application of some F3 foams. This can be especially true in the case of forceful application on fuel in depth fires, such as in a large tank fire. Deploying F3 foam in this situation may require more planning, more logistics, more intense pre-testing more care on application techniques, and may still leave a higher remaining risk of failure. In turn the ecotoxicological benefit of using F3 foam may be reduced significantly by extended extinguishing times and other co-factors.

The IPEN paper does not adequately address the potential changes in equipment and procedures that can be required to successfully transition to the use of F3 foams, which are currently being evaluated by NFPA and UL. Instead it characterizes legitimate performance issues for F3 foams as "myths" as a way to discredit appropriate concern about them.

Environmental Impact

PFAS is a term used to describe a broad category of fluorochemicals (polymers and non-polymers) of different carbon chain lengths, physical and toxicological properties, and environmental impacts. It includes long-chain PFAS such as PFOS and PFOA that are considered to be persistent, bioaccumulative and toxic (PBT). It also includes short-chain PFAS such as the C6 fluorotelomer fluorosurfactants used in current-day AFFF agents. Short-chain (C6) fluorosurfactants do not contain or breakdown in the environment to PFOS or PFOA and are currently considered lower in toxicity and have significantly reduced bioaccumulative potential than long-chain PFAS. (Foams made with only short-chain fluorosurfactants likely contain trace quantities of PFOA and PFOA precursors as an unavoidable byproduct of the manufacturing process.)

The IPEN paper incorrectly states that all AFFF agents contain fluorosurfactants that are toxic and bioaccumulative. It does not acknowledge the clear differences in environmental impact between legacy AFFF agents that contain some long-chain fluorosurfactants and current-day AFFF agents that contain only short-chain fluorosurfactants. It also omits mention of PFAS regulations in the European Union, Canada and the United States that ban or restrict the sale of products containing long-chain PFAS while allowing for the continued sale of products containing short-chain PFAS.

Best Environmental Practice

Legacy contamination from the use of firefighting foams in certain locations may largely be the result of past practices by users where foam was discharged uncontrolled to the environment during training and testing of foam equipment. Current best practice calls for the containment and treatment of foam discharges and the use of non-fluorinated fluids and methods for testing and training. As fires are relatively rare (yet potentially catastrophic), implementing best management practices for all foam users has the potential to significantly reduce discharges of fluorochemicals to the environment from foam.

The IPEN paper does not acknowledge the significant efforts made by foam manufacturers and users over the last decade to implement best practices and reduce discharges of foam to the environment, or the impact these changes in practices are likely to have on the potential for future environmental contamination from foam. Instead it falsely accuses foam manufacturers of misinforming users that the fluorochemicals in AFFF are removed by passage through a wastewater treatment plant. In reality, best practice guidance published by FFFC clearly states that this is not the case.

The IPEN paper seems to suggest that because they do not contain fluorochemicals, firewater runoff from the use of F3 foams does not need to be contained and treated in the same way as firewater runoff from the use of AFFF. This suggestion is incorrect and in conflict with current best practice. Firewater is likely to contain hazardous combustion products and needs to be blocked from the environment regardless of what type of foam, if any, was used to extinguish the fire. As acknowledged in the IPEN paper, F3 foams may also contain chemicals that can impact the environment such as silicon-based materials or persistent acrylic polymers.

The IPEN paper states that remediation of PFAS contamination, especially short-chain PFAS, is difficult if not impossible. In fact there are peer-reviewed publications showing that PFAS found in AFFF can be extracted or destroyed using existing treatment technologies (Baudequin et al., 2011 and 2014). Industrial scale remediation techniques for short-chain PFAS are already available.

Conclusion

Foam users currently have available to them two alternatives to the use of legacy foams with long-chain PFAS content: Modern fluorinated foams such as AFFF that contain only short-chain (C6) fluorotelomer fluorosurfactants and fluorine-free foams. Foam manufacturers support the use of both of these products in appropriate applications and feel strongly that both products are necessary to adequately provide for the fire protection needs of society.

No single type of foam meets all needs encountered by end users. It is incumbent upon foam users to choose the type of foam product that best meets their needs based on fuel type, size and geometry of the fire, environmental concerns and legislative requirements.