

## Sustainability and High Performance – the Challenge for new fire fighting foam generations

8th International Conference for Fire Brigades in the High Hazard Industry - Nov 2015

Dr. Rosvita Milo-Rieks · Dr. Sthamer Hamburg

Fire extinguishing is a process with complex interactions depending on different parameters. Fast and safe extinguishing results when all the parameters fit together. Combustible materials, fire surface area and depth, available equipment, tactics, environment, health and safety requirements are only a few parameters that have an impact on the successful operation of extinguishing (picture 1).

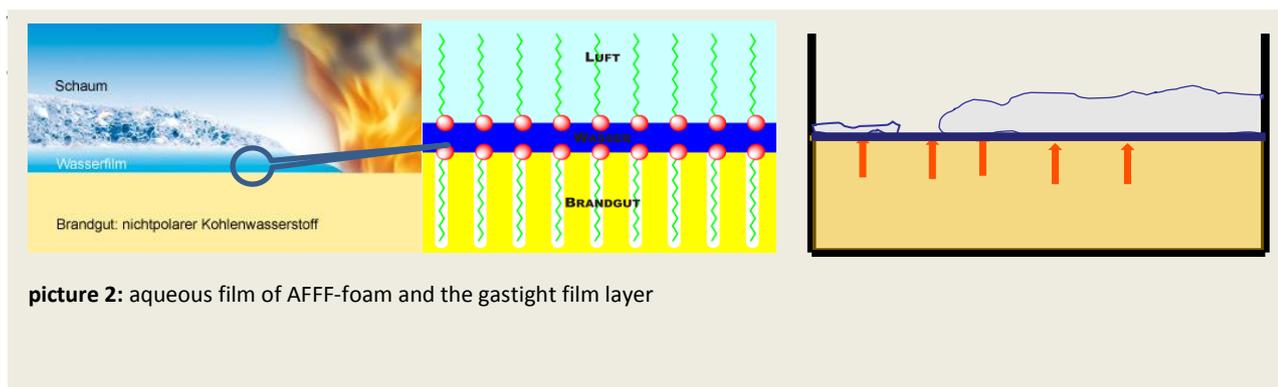


Picture 1 : Parameters for efficient fire extinguishing

Besides the safety aspects of fire fighting, another issue arises in the discussions. It is the environmental impact of fluorinated surfactants!

The ubiquitous geographical distribution of PFOS and PFOA worldwide is a serious concern. PFOS and PFOA are man-made substances belonging to the large group of per- and poly-fluorinated substances (PFAS)<sup>1</sup>. These substances, with their outstanding hydrophob/oleophob and very low surface tension properties, can be found in a wide range of industrial applications. Very high thermal and chemical stability of the molecules result in high resistance against biodegradation in the environment. For PFOS and PFOA PBT (persistent-bioaccumulating-toxic) characteristics have been observed. The use of PFOS based foams is restricted in Europe since 2006 (EU 2006/122/EC and regulation No. 757/2010 EG<sup>2</sup>). PFOA based products will be legislated in the near future<sup>3</sup>.

PFAS can be manufactured by two different synthesis methods: electrochemical fluorination ECF (PFOS, PFOA etc) and telomerisation (PFOA). New fire fighting foam generations contain telomere based fluorosurfactants. In general most of the foams are not PFOA based products but in most cases contain impurities of PFOA or C-8 chains.



picture 2: aqueous film of AFFF-foam and the gastight film layer

Based on this gas tight film forming property a new fire fighting foam generation was established in the 1970's. In special the high hazard industry emergency alarm plans includes fixed or mobile extinguishing systems often containing AFFF foaming agents.

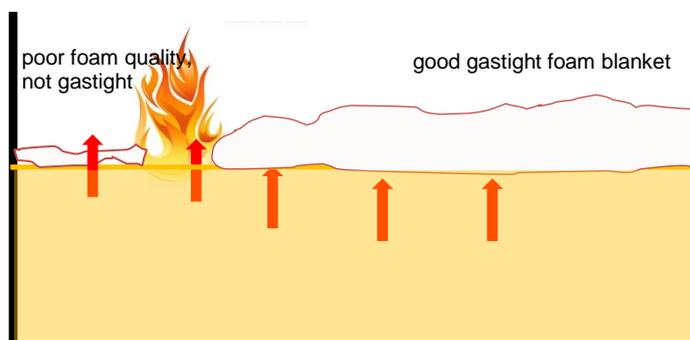
Due to environmental concerns the assessment for the replacement of non biodegradable AFFF foaming agents is mandatory. The best fire fighting emergency plan should be evaluated for each site depending on the best environmental mitigation impact. The environmental risk management may include the use of fluorine - free foams for training purposes, Class A fire risks and the preferential use of lower risk high purity  $\leq C6$  PFAS foams, as far as possible. Retainment of run of water is as well important for non biodegradable fluorinated foam compounds, as well as for toxic residues of the combustible material.

AFFF foams shouldn't be used for Class A fires and training purposes. Small scale hydrocarbon fires (spill fires etc.) could be extinguished by fluorine free foams. The replacement of AFFF/-AR foams for fixed installation systems sites is depending on many technical parameters are predicted on the unique properties of film forming foams (picture 3). A drop in replacement of fluorine free foams should be assessed responsibly considering safety requirements.

Application	AFFF/-AR	Fluorinefree
Foam- application - non polar (small)	possible	„possible“
Poor/non foaming direct application	possible	not possible
EN 1568 (foam application) Heptane - 4,5 m <sup>2</sup>	IA possible	I possible
Last fire - non aspirating	Good results	?!
Experiences tank fire fighting	Good results	?!
300 m <sup>2</sup> Kerosine - gentle application	Good results	Good results

Picture 3: comparison of different foam types

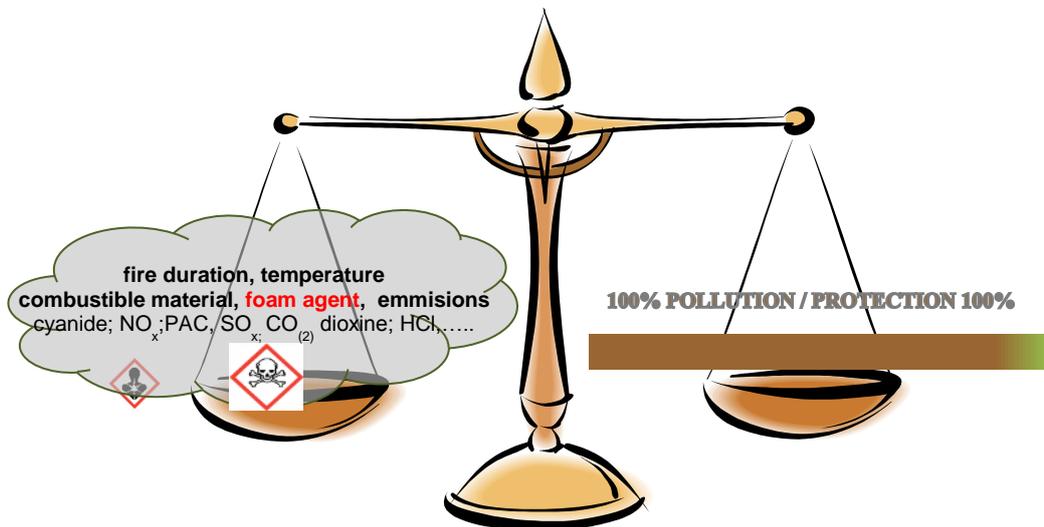
The technique and tactique for fire fighting operations with non film forming fluorine free foams are often different to those of AFFF-foams. Non film forming fluorine free foams need a good gastight foam blanket for successful extinguishing on hydrocarbon liquid fires (picture 4)!



Picture 4: Extinguishing process of non film forming fluorine free foam type! **No foam – no extinguishing!**

At the end the total environmental impact of the fire should be balanced properly. Fast extinguishing contributes the environmental health by reducing high toxic emissions.

### Environmental impact – make the total account!



#### References:

<sup>1</sup> Buck, R. C., Franklin, J., Berger, U., Conder, J. M., Cousins, I. T., de Voogt, P., Jensen, A. A., Kannan, K., Mabury, S. A. and van Leeuwen, S. P. (2011), Perfluoroalkyl and polyfluoroalkyl substances in the environment: Terminology, classification, and origins. *Integr Environ Assess Manag*, 7: 513–541. doi: 10.1002/ieam.258

<sup>2</sup> Guidance for the inventory of perfluorooctane sulfonic acid (PFOS) and related chemicals listed under the Stockholm Convention on Persistent Organic Pollutants - UNEP-POPS-GUID-NIP-2012-PFOS-Inventory

<sup>3</sup> ECHA – European Chemical Agency – Annex XV Restriction Report – Proposal for Restriction of Perfluorooctanoic acid (PFOA), PFOA salts and PFOA-related substances – October 2014