Fire fighters' exposure to aqueous film forming foams in liquid fire

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Aqueous Film Forming Foams (AFFF) are frequently used as an extinguishing and suppression agents for jet fuel fires. Mechanism of the AFFFs is to simultaneously coat the fire with foam, cool the fire and prevent oxygen contact. In order to achieve this, perfluorinated substances, such as perfluoro-octane sulfonate (PFOS) or prefluoro-octanoid acid (PFOA), have been commonly used as surfactants in the AFFFs. Quite recently, many perfluorinated substances were observed to be environmentally persistent and to bioaccumulate to wildlife and humans. They are also potentially harmful and toxic for both animals and humans. Therefore their use has been banned in EU for majority of the applications including AFFFs. Currently AFFFs containing PFOS are allowed to be used until summer 2012.

Chemical safety of AFFFs has not yet been studied under field conditions. In this study exposure of firefighters from Oulu Airport to perfluorinated substances was assessed during firefighting training. Sthamex 3% AFFF was used as extinguishing foam for jet fuel fires. Standard safety equipment and clothing was used by the firefighters. Serum samples were taken before and after three consequent training sessions separated by month intervals. Sthamex 3% AFFF contains also potentially harmful solvent 2-butoxy ethanol, which metabolite 2-butoxyacetic acid was measured fire fighters' urine samples before and immediately after training sessions. Four perfluorinated substances were at measurable range in serum samples (PFOS, PFOA, PFHxS and PFNA). Average concentrations of perfluorinated substances did increase slightly during three training sessions, but remained within concentrations measured in normal European populations. These concentrations are presumed not to cause any adverse health effects. The average concentrations of 2-butoxyacetic acid were above reference limit value for unexposed population after on two training sessions. Average concentrations after training were 1.4% and 2.3 % of biological action limit. This indicated that small exposure to 2-butoxy ethanol occurred during training sessions, but concentrations were well within safety levels.

In conclusion, firefighters of Oulu Airport were exposed to chemicals present in firefighting foams despite using standard protective equipment and clothing. The exposure was only modest and should not cause health effects. Exposure could be reduced by introducing small changes to the conduct of training sessions, and cleaning and maintenance of the equipment and clothing. In selection of AFFFs, non-fluorine based products should be used in the future in order to avoid exposure fluorinated chemicals.

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