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VOLATILIZATION OF FLAME RETARDING COMPOUNDS FROM FIREFIGHTER BUNKER GEAR USED IN SOUTH AFRICA DUE TO THERMAL EXPOSURE

Firefighting bunker gear provides the first line protection for firefighters during fire conditions. The protective garment is fabricated from superior performance fibres and enhanced by the addition of flame retardants (FRs), which resist ignition and delay flame spread. Flame retardants have been attributed to 15-fold greater escape time for occupants. However, concerns have been emerging on the potential harmful effects of some flame retardants, particularly the brominated flame retardants (BFRs). The BFRs usage have been banned in many countries and are also listed in international treaties as harmful to human and the environment. This study investigated the presence of BFRs concentration in bunker gear, particularly polybrominated diphenyl ethers (PBDEs) and their congeners in the garment and evaluate their impact on thermal performance.

Five different types of bunker gear were tested for the volatilization of the BFRs due to heat exposure. The cone calorimeter was used to expose samples to heat flux of 3, 5, 6 and 8 kW/m² and polyurethane-foam (PUF) disks were suspended above the samples to capture evolving flame retardants. The PUF disks were extracted with solvents and analysed for the target compound with the gas chromatography mass spectrometry (GCMS). In the GCMS, samples were analysed for a number of PBDEs namely BDE-28, -47, -99, -100, -153, -154, and -209. Of the seven congeners analysed, PBDE congeners -28, -47, and -99 were detected in all five sample materials with concentrations from 0.02 to 0.1 ng/g, 0.03 to 0.34 ng/g and 0.18 to 0.86 ng/g, respectively. Congeners -100 and -153 were detected in 80% and -209 in 40% of the samples. BDE-99 was the most abundant compound detected, with concentration ranging between 0.183 and 0.866 ng/g, followed by BDE-47, ranging from 0.03 to 0.34 ng/g. BDE-209 was the least detected in the samples with concentration, ranging from 0.02 to 0.023 ng/g. The results from this study indicates the volatilization of BFRs from the firefighter bunker gear during heat exposure.

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