Environmental-Friendly Fire Suppression System for Cargo using Innovative Green Technology

EFFICIENT

Dinesh. A., Diakostefanis. M., Sampath. S.

Centre for Propulsion, School of Aerospace, Transport and Manufacturing,
Cranfield University, United Kingdom
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Fire suppression and explosion protection have conventionally used halon as the extinguishing agent due to favourable properties like being electrically non-conductive, dissipate rapidly without residue, safe for limited human exposure, and are extremely efficient in extinguishing most types of fires. However, halon is accompanied by high levels of Ozone Depletion Potential (ODP) and Global Warming Potential (GWP). In 1994, The Montreal Protocol (MOP) [1] issued a ban on the production of substances that deplete the ozone to reduce the consumption of these substances. Current estimates are that global halon availability will deplete by the year 2035. This paper discusses the substitutes for halons based on ozone depletion potential, global warming potential, toxicity, flammability, and exposure potential. Nitrogen was selected as the fire suppressing agent based on the literature review and is followed up by computational fluid dynamics (CFD) studies accompanied by a small-scale cup burner test as described in BS ISO 14520 [2] to identify the extinguishing concentration.

The EFFICIENT project is part of the Clean Sky 2 initiative that has developed a potential fire suppression technology for eventual application in the cargo-cabin architecture of existing and next generation aircraft. The objective of the study is to identify the extinguishing criteria for nitrogen which will replace Halon 1301 and be able to qualify and replicate the FAA Minimum Performance Standard (MPS) [3]. Four test scenarios of Bulk-Load and Containerised-Load Fire Test, Surface Burning Test and Aerosol Can Explosion Test will be replicated and conducted in the cargo test cell according to standards mentioned in the above paper. The EFFICIENT Fire Knockdown System (EFKS) will also be capable of operating under a range of environmental conditions (-40°C to +55°C) to ensure the established agent discharge rate at representative flight operating temperature range. CFD simulations revealed that an overall concentration of 40% nitrogen has to be reached corresponding to 12% oxygen concentration to extinguish a fire source in an enclosure. A series of thermocouples have been installed on the demonstrator to monitor to capture the trends of the internal temperature during the suppression agent release. Automated controls have been implemented, so that all the required actions - such as ignition and agent release - follow the specified sequence and ensure safe execution of the experiments without any exposure of Staff members to fire environment. The experimental tests are currently being conducted and the results are expected to be summarised by July 2019.

References:

[1] *United States Congress Senate Committee on Foreign Relations.* "Amendment To the Montreal Protocol on Substances That Deplete the Ozone Layer": Report (to Accompany Treaty Doc. 103-9). [Washington, D.C.]: [U.S. G.P.O.], 1993.

[2] BS ISO 14520 Annex B. *Determination of flame-extinguishing concentration of gaseous extinguishants by the cup burner method*. BS ISO 14520 -Part 1, "Gaseous fire-extinguishing systems - Physical properties and system design," British Standards Institution, 2006.

[3] Reinhardt, J. W. (2003) 'Minimum Performance Standard for Aircraft Cargo Compartment Halon Replacement Fire Suppression Systems', (April). Available at: *http://www.fire.tc.faa.gov/pdf/TC-TN12-11.pdf.*