Extinguishment of Cup Burner Flames of Propane and the FAA Aerosol Can Simulator Fuel by CF$_3$Br and C$_2$HF$_5$

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Abstract

The fire suppressant CF$_3$Br has been banned for most applications except critical applications such as the suppression of cargo-bay fires in aircraft. Recently, the halon replacement agents, including C$_2$HF$_5$ (pentafluoroethane, HFC-125), have been evaluated in a mandated Federal Aviation Administration (FAA) test, in which a simulated explosion of an aerosol can, caused by a fire, must be suppressed by the agent. Unfortunately, unlike CF$_3$Br, the other agents, when added at approximately one half their inerting concentrations, created a higher over-pressure in the test chamber and thus failed the test. Similar combustion enhancement has been described in other experiments for certain conditions; however, explanation of the phenomena is lacking. In this work, calculations have been performed for co-flow diffusion flames of propane and the FAA Aerosol Can Simulator fuel mixture (mole fractions: propane, 0.159; ethanol, 0.454; and water, 0.387), in the cup-burner configuration, with added CF$_3$Br or C$_2$HF$_5$. The time-dependent, two-dimensional numerical code, which includes a detailed kinetic model (177 species and 2986 reactions) and diffusive transport, has predicted the minimum extinguishing concentration of each agent in normal earth and zero gravity.

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