Modeling cup burner flame extinction by sodium bicarbonate powder

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Abstract

Dry suppression agents are of interest for aircraft cabin fire safety since they are easily stored and transported and may not permenantly damage other items in the compartment. This work examines the capabilities within the NIST Fire Dynamics Simulator (FDS) to model flame extinction by sodium bicarbonate powder. Since FDS models combustion using the eddy dissipation concept (mixed is burnt), ad hoc models based on an empirical threshold ignition temperature and a critical flame temperature are used to determine the state of burning within a grid cell. A Lagrangian particle solver is used to model liquid droplets or dry powder. The particle model is connected to a 1-D spherically symmetric, thermally thick heat transfer and pyrolysis model to describe the thermal degradation of the material, kinetics, and flux of volatile gases from the liquid or powder. The work presented here starts with verification of the sodium bicarbonate pyrolysis model by comparison with an analytical solution for the particle diameter with time. Next, we examine the minimum extinguishment concentration needed for water mist suppression of a heptane cup burner, comparing against the experimental data of Shilling et al. (1998). Last, we model the sodium bicarbonate powder suppression of the Hamins (1998) cup burner.

Keywords: Cup burner, Sodium Bicarbonate, Flame Extinction, Fire Dynamics Simulator

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