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Water Mist Interaction with Flame Spreading Against Gravity
CHENTHIL KUMAR, AMIT KUMAR, IIT Madras — Water mist fire-suppression systems have gained importance since chemical agents like Halons are being phased out for environment preservation. The present study focuses on the effect of water mist droplet size and concentration in inhibiting the flame spreading downward over thin solid fuel at different gravity levels. The water droplets are introduced into the air stream at pre-specified concentration and droplet size. An Eulerian-Eulerian two phase model is used for this particular study. The polydisperse spray is modeled using the moments of the droplet size distribution function. The gas phase is modeled by full Navier-Stokes equations for laminar flow along with the conservation equations of mass, energy & species. A one-step Arrhenius reaction between fuel vapor and oxygen is assumed. The gas radiation equation is solved using DOM. The solid fuel considered is assumed to burn ideally to form fuel vapors without melting. The thin solid fuel is modeled by equations of continuity and energy. The pyrolysis of fuel is modeled as one-step, zeroth-order Arrhenius kinetics. For the dilute sprays, droplet sizes below $100\mu m$ are increasingly effective in reducing the flame temperature.

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