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Investigation of Flame and Soot Propagation in Non-Air Conditioned Railway Locomotives

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Abstract : Propagation of fire through a non-air conditioned railway compartment is studied by virtue of numerical simulations. Simultaneous computational fire dynamics equations, such as Navier-Stokes, lumped species continuity, overall mass and energy conservation, and heat transfer are solved using finite volume based (for radiation) and finite difference based (for all other equations) solver, Fire Dynamics Simulator (FDS). A single coupe with an eight berth occupancy is used to establish the numerical model, followed by the selection of a three coupe system as the fundamental unit of the locomotive compartment. Heat Release Rate Per Unit Area (HRRPUA) of the initial fire is varied to consider a wide range of compartmental fires. Parameters, such as air inlet velocity relative to the locomotive at the windows, the level of interaction with the ambiance and closure of middle berth are studied through a wide range of numerical simulations. Almost all the loss of lives and properties due to fire breakout can be attributed to the direct or indirect exposure to flames or to the inhalation of toxic gases and resultant suffocation due to smoke and soot. Therefore, the temporal stature of fire and smoke are reported for each of the considered cases which can be used in the present or extended form to develop guidelines to be followed in case of a fire breakout.

Keywords : fire dynamics, flame propagation, locomotive fire, soot flow pattern, non-air-conditioned coaches
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