Flammability and Combustion Behaviors of Aerosols by Industrial Heat Transfer Fluids

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ABSTRACT

Existence of flammable aerosols creates fire and explosion hazards in the process industry. Flammable aerosols can be formed by pressurized release of hydrocarbons from the operation unit. Because of the complexity in the aerosol formation and combustion process, behaviors of flammable aerosols in the process industry have not been fully understood. In this work, flammability of aerosols is studied. Monodisperse aerosol droplets of industrial heat transfer fluids are generated using electrospray. Aerosol droplet size and number density are controlled by the liquid flow rate in the nozzle and the applied voltage in the electrospray. Ignition and combustion of the aerosol happened when a flame appears in the aerosol from the ignition source, and is capable of propagating through the aerosol system upward upon reaching the spraying nozzles. Frequency of the flame appearance in the aerosol system depends on properties of the aerosol, including aerosol droplet size, droplet number density, and droplet moving velocity. Frequency of the flame appearance also depends on the physical properties of the fluids, and the environmental factors, such as turbulence in the air and the humidity. For a single flame, there different stages of its development were observed during its propagation process. Knowledge from the current work provide understanding on flammable behaviors of aerosols which can be formed in the industry, so as to take relevant measures for prevention of fire hazards from flammable aerosols.