Analytical Study on Physical Mechanisms of LNG Forced Dispersion using Water Spray Application

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ABSTRACT

The liquefaction capacity of natural gas is expect to double by the year 2035 as the demand for cleaner energy source increases (IEA 2011). Security and safety concerns over Liquefied Natural Gas (LNG) facilities promote the need of continuing study of the mitigation systems for the LNG industry. Water curtain systems have been proven to reduce the hazard zone by reducing the concentration below the flammability limits. There are no engineering criteria currently available for designing effective water curtains applicable for LNG facilities, mainly due to lack of understanding of the complex interaction between the water droplets and LNG vapor clouds. This work applies forced dispersion modeling using computational fluid dynamics (CFD) to study two physical mechanisms involved in enhancing the vapor dispersion; the momentum and heat transfer effects. The physical parameters in setting up the forced dispersion modeling are calibrated using experimental data from the Mary Kay O’Connor Process Safety Center (MKOPSC) outdoor LNG spill experiments. The effects of momentum imparting from the droplets to air-vapor mixture, and the thermal effect between the two phases on the behavior of the LNG vapors are investigated. The results from this work will provide a fundamental understanding of the complex interaction of the water droplet-LNG vapor system.