Key Findings of Liquefied Natural Gas Pool Fire Outdoor Tests with Expansion Foam Application

Geunwoong Yun, Dedy Ng, and M. Sam Mannan

Mary Kay O’Connor Process Safety Center, Artie McFerrin Department of Chemical Engineering, Texas A&M University System, College Station, Texas 77843-312

ABSTRACT

The unique properties of expansion foam in blanketing the surface of most hydrocarbon fuels have made it possible to be used as a mitigation measure against a boiling and evaporating pool of flammable gases and subsequent pool fires. Because of this fire suppression characteristic, the liquefied natural gas (LNG) industry has identified expansion foam as one of its safety provisions for pool fire suppression. However, the effectiveness and key parameters of foam in controlling LNG fires have not been thoroughly investigated from previous field tests. In this paper, we investigated the effects of foam application on LNG pool fires through outdoor spill experiments at the Brayton Fire Training Field. The primary objectives of this study are to identify the foam effectiveness in suppressing LNG pool fires and to determine the thermal exclusion zone, by investigating temperature changes of foam and fire, profiles of radiant heat flux, and fire height changes with foam. Additionally, a schematic model of a LNG–foam system with fire for theoretical modeling was also developed. Results showed that expansion foam has positive effects on reducing flame height and radiant heat flux by decreasing heat release and radiant heat feedback from the LNG pool fire, ultimately reducing the safe separation distance. Through extensive data analysis, we also identified several key parameters, such as the minimum effective foam depth and the mass-burning rate of LNG with applied foam. Results from this study can be used to design an effective expansion foam system as well as to develop defensive measures and emergency response plans for mitigating the consequences of LNG releases.