Analysis of Leak and Explosion from an Underground Pipeline in Kaohsiung, Taiwan

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Abstract

On 23:57 July 31st, 2014, a catastrophic vapor explosion occurred in the downtown of Kaohsiung city. The incident was initiated from a leak of an underground pipeline transporting pressurized propylene liquid. Analysis of pipeline operation logs and pipeline break release modeling suggested that at least 90,000 kg of propylene leaked, entered the underground trench and spread 4.5 km in distance before meeting an ignition source three hours later. The ignition caused a significant confined vapor explosion which blew out the road above the underground trench, damaged more than one hundred vehicles on the road with thirty two fatalities and more than three hundred injuries.

This incident bears similarity to two previous incidents: the explosion in Guadalajara, Mexico, in 1992, owing to a gasoline leaked into sewer through a corroded pipeline which resulted in 252 fatalities and more than 1500 injuries (Andersson and Morales, 1992); and the explosion in Qingdao, China, in 2013, owing to a leak of crude oil from a corroded pipeline into the city storm drains which resulted in 62 fatalities and 136 injuries (Zhu et al., 2015), and. Key factors contributing to the large number of fatalities and injuries in these incidents are due to the very large quantity of flammable mass leaked, the confinement in the sewer or drain, and they occurred near or inside the well-populated communities. There was however a subtle difference in the present case in that the leak source was a pressurized, flashing liquid which would vaporize completely upon leak into ambient environment while the other two cases dealt with flammable liquids with only partial vaporization. Challenges and recommendations in addition to detailed analysis of the incident are given to prevent and mitigate the occurrence of similar incidents.

Keywords: pipeline, leak, propylene, vapor explosion