Effectiveness of water extinguishing systems on ammonia absorption in confined spaces

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Abstract

Ammonia, with a higher energy density than hydrogen, presents a promising carbon-free solution for deep-sea shipping. However, the use of this chemical also poses some difficulties and dangers for the health and environment.

In this study, different fixed fire suppression systems were studied in the context of absorbing and dispersing liquid and gaseous ammonia in confined space. The objective was to identify correlations between ammonia concentration by employing different nozzles and different pressures in the water extinguishing system.

A container that was slightly inclined on the inside (dimensions: length=5.87 m, width=2.43 m, height=2.67 m) was prepared with a centrally installed water extinguishing system located in the middle of the ceiling. The container's atmosphere was adjusted to approximately 30% of the lower explosion limit using ammonia bottles. Multiple measurement points were established within the container to monitor ammonia concentration and temperature concurrently at three distinct locations. In the experiments, three suppression systems were used, including a high-pressure water mist system, a low-pressure water mist system, and a sprinkler system.

Results show that the high-pressure water mist system could reduce the ammonia concentration to acceptable levels in approx. 2-4 minutes, whether operating at 50, 60 or 70 bar. In comparison, the time was about 5.5 minutes for the low-pressure water mist system. The tests with the sprinkler system took by far the longest duration (approx. 6.8 minutes for the gaseous ammonia and approx. 15 minutes for the liquid ammonia) to reduce the concentration in the container. Therefore, the high-pressure water mist system was more effective in reducing ammonia concentrations in current test conditions.

KEYWORDS: low-pressure water mist, high-pressure water mist, sprinkler, liquid ammonia, gaseous ammonia

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