The partially failed cases are marked with circles which aids in understanding the impact of opening type on near-field overpressure. Observations indicate that cases with a 100 % fill level experiencing partial failure showed lower peak overpressure [T1, T32, T11, T12]. However, the type of opening does not consistently correlate with lower peak overpressure across all partial failures. Notably, Test 25 and 17 depicted in Figure 5b. yield distinct lead peak overpressure despite experiencing similar degree of vessel opening and operating conditions (failure pressure and weakened length). This difference stems from the different fill levels, 20 % and 50 %, respectively. The lower fill level, in this case, resulted in a higher lead peak overpressure. This underscores the high contribution of the vapor phase in the formation of lead peak overpressure and, crucially, the inverse relationship between fill level and lead peak overpressure.
These findings obtained from small-scale experiments, suggest that while the type of failure does not significantly alter overpressure magnitude, it does affect the overpressure directionality. Lead peak overpressure overprediction is achieved through Friedman-Whitham approach, wherein formula integrates shock tube equations, accounting for failure pressure and fill level. In certain scenarios, the maximum lead peak overpressure occurs between 15 cm and 20 cm vertically, highlighting the importance of overprediction.

5. Conclusions

In conclusion, the Laamarti et al.(2024) small-scale propane BLEVE experiments were conducted to replicate real-world BLEVE scenarios under varying initial conditions. The investigation revealed diverse failure modes, including hydrostatic failure and rupture under saturation conditions, with different types of failure such as partial and complete opening of the vessel walls. The study demonstrated a pronounced correlation between controlled variables and the type of failure, particularly for failure pressure and weakened length. The liquid full cases at hydrostatic conditions did all fail partially, likely attributed to phase change responsible of vessel opening. While partial failures from the test campaign exhibited the lowest peak ground load, they did not all consistently yield to lower lead peak overpressure. Indeed, the liquid fill level played a crucial role, as the vapor phase contributes to the overpressure. Reducing the BLEVE hazards through partial failure is feasible, but a trade-off must be considered in operating conditions. For example, reducing the failure pressure may decrease risks from BLEVE but may increase the likelihood of BLEVE occurrence. Liquid full cases showed an interesting behaviour which requires a further in-depth investigation of the underlying dynamics.

Nomenclature

P_{fail} – Failure pressure, Barg
σ_{UTS}– – Ultimate material tensile strength, MPa
φ – Fill level, %
t_w– Weakened length thickness, m
L_c – Weakened length, m

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