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Evaluation of Blast Mitigation Effects of Cylindrical Explosion Containment Vessels Based on Foam

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ABSTRACT

In order to evaluate the blast mitigation effect of polyurethane foam in cylindrical explosion containment vessels (CECVs), a three-dimensional numerical simulation model was established. The Structured Arbitrary Lagrange-Euler (S-ALE) algorithm was applied in current simulations to define the coupling contact between TNT and Lagrange algorithm. The numerical model was verified by comparing the dynamic deformation and permanent deformation of the experiments. Based on the numerical simulation model after verification, the influence of polyurethane foam filling inside CECVs on the mitigation effect was investigated. The results revealed that compared with the ALE algorithm, the numerical simulations based on the S-ALE algorithm were in good agreement with the experiments without leakage. The fully covered polyurethane foam had a slight negative effect on the deformation of CECV, which may be caused by the reduction of explosion space [1]. However, the bulk polyurethane foam with a specific size can effectively reduce deformation, due to the shadow formed by blast wave diffraction [2,3]. There was a significant positive correlation between the thickness of polyurethane foam and the blast mitigation. The conclusion provides a reference for the numerical simulation and the improvement methods of CECVs subjected to internal blast loading.

KEYWORDS

Blast mitigation; S-ALE algorithm; explosion containment vessels; polyurethane foam

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