Dynamic Response of Vertical Tank Impacted by Blast Fragments in Chemical Industrial Parks

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Abstract

The adjacent vessels may be impacted and/or destroyed by blast fragments in chemical industrial parks or plants, which could lead to the domino effects. Based on the analysis of common parameters of blast fragments including the shape, quantity, mass, and impact velocity, the numerical model of vertical storage tanks impacted by blast fragments was developed with LS-DYNA. Considering deformation of the fragment itself, the law of the dynamic response of vertical tank was described quantitatively. The results showed that there were 3 collisions during the impact process, the maximum plastic deformation occurred at the impact center, the plastic strain was mainly distributed in the range from the impact center to the tank bottom, and there were 4 plastic hinge lines in the deformation region. There was linear relationship between the residual displacement of impact center and the impact velocity of the fragment, and the tank wall had entered plastic deformation stage. With the horizontal impact angle in the range from 15° to 30°, the plastic deformation energy of the tank increased with the horizontal impact angle evidently; with the horizontal impact angle in the range from 30° to 35°, the impact mode of the fragment was changed from penetrating the tank wall to sliding along the tank wall; with the horizontal impact angle in the range from 35° to 60°, the deformation energy of the tank decreased linearly with horizontal impact angle, and the influence of vertical impact angle on the deformation energy of the tank was greatly reduced.