Abstract

Study on damage prediction in explosion accidents of chemical materials (Focused on Flammable gas)

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Objectives : Accident prevention measures for the reduction of explosion damage should be examined sufficiently to minimize the damage before the accident. In this study, the prediction of explosion damage of chemical substances was investigated to reduce the explosion accidents due to leakage, diffusion of flammable gas, especially.

Methods : The explosion models (TNT Equivalent method, TNO Multi-Energy method, Baker-Strehlow method) based on experimental results was investigated and compared the results of analysis on explosion scenario. Explosion properties in methane-air mixtures were conducted to compare the experimental data with the calculation of explosion pressure and temperature. Also, the 3D explosion simulation was investigated to predict the damage of humans and structure in a 3D virtual experimental space.

Results : The chemical equation considering the combustion gases of 11 species was proposed and calculated the adiabatic flame temperature and explosion pressure with concentration of methane. Experimental data of explosion pressure in methane concentration of 8~12 vol% was nearly consistent with the calculated value. For the explosion overpressure at a distance of less than 200 m, Multi-Energy model and Baker Strehlow model was in 0.24~0.25 bar and the calculated result of Equivalent TNT Mass model was 0.06 bar. The explosion damage assessment was performed by the methane leakage in the target sites of the 3-dimensional space. The present study was conducted by using explosion simulation to predict the damage of humans and structure in a 3D virtual experimental space similar with the methane gas explosion accident. For this purpose, the TNO Multi-Energy method model was used to calculate the overpressure distribution at any given distance from methane gas explosion source. And Analysis of the damage to the building and the people in accordance with the distance from explosion source was carried out by the explosion overpressure. As the result, we found that the estimations of percent damage versus distance from the explosion source for each human and building take advantage of the accident prevention and safety measures.

Key Words : Chemical materials, Gas explosion, Explosion pressure, Flame temperature, Flame velocity, Explosion simulation