P29 Prediction of the Gas Pressure in Confined and Partially Confined Blast Scenarios

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Abstract:

Confined and partially confined explosions may occur due to various reasons and their effects may be extremely severe and may lead to serious damage to structural elements and even to structural collapse. Explosion pressure venting may considerably reduce the enormous pressure build-up in an enclosed space due to an internal explosion. The loading from an explosive charge detonated within a vented structure consists of two almost distinct phases. The first phase presents the reflected blast loading. As the blast waves reflect within the structure and as unburned detonation products combine with the available oxygen, a long-term pressure rise occurs and the second phase of loading takes place. These pressures are termed "quasi-static pressures" because they can last long enough to apply essentially static internal gas pressure loads to the structure. In order to predict accurately the residual gas pressure obtained due to an internal explosion, a thermodynamic model is proposed. This model takes into account the variation of the total energy released and the specific heat capacity depending on the relation between the charge weight divided by the volume of air around the charge. The suggested model is based on the ideal gas EOS which gives the relationship between the volume, pressure, quantity and temperature of the gas mixture in a given state. This model provides the gas pressure obtained for each value of W/V (charge weight divided by the internal air volume where it explodes). In addition, a method for calculating the adiabatic index variation with W/V is presented based on the mole fraction of the explosion gases. A very good agreement is obtained between the test results, the UFC curve and the thermodynamic model results for the gas pressure through all the range of W/V.

The above-described gas pressure prediction has found use in an effective simplified model with lumped parameters based on the Bernoulli equation. The model has been developed for the quasi-stationary phase of the detonation products outflow from the room through the venting openings. In this model, the initial internal gas pressure induced by the very short non-stationary phase is predicted by the above approach. The model yields very good agreement with experimental data and with numerical analysis results.

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