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Blast Hazard Mitigation through Vented Suppressive Shields

Vented Suppressive shield (VSS) containers have been used for the storage of hazardous materials, especially explosives. The role of VSS containers is to attenuate the blast pressure and impulse outside the container and to eliminate primary fragment hazard associated with accidental explosions. Most VSS containers are typically designed from experience of previous container testing programs or lessons learned from previous accidents. Another method that is used to analyze and design VSS structures is using Computational Fluid Dynamic (CFD) software packages such as AUTODYN that are expensive, has long computational time as well as requires special expertise to get the best use of it.

The aim of this study is to develop a reliable design methodology that may be used to design the elements of the VSS containers without using CFD software packages. The study begins with defining the vent area ratio for different VSS sections. AUTODYN was used to calculate the pressure outside VSS containers with different scenarios. The obtained data were utilized to develop a set of equations to predict the pressure and impulse outside the container. The pressure values obtained from the equations showed a good correlation with the results obtained from previous experimental results.

The second part of the thesis was studying the pressure profile on the sidewalls of the containers. The pressure profiles on the sidewall of the containers were studied using 2D AUTODYN models. Some modifications were made to the Friedlander's waveform equation in order to take into account the effect of internal explosion. The single layer plate configuration was chosen as a control configuration and geometric coefficients were introduced in order to take into account the effect of different geometric sections. The pressure profiles obtained from the developed equations were compared to those obtained from AUTODYN.

Finally, a single degree of freedom (SDOF) model was developed to study the structural response of the VSS elements due to internal explosion. The SDOF model was able to predict the structural behaviour of steel VSS elements. The results were compared with those obtained from AUTODYN software and a good correlation was found between the two responses.

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