Modeling explosive events using the CESE method

MODELING EXPLOSIVE EVENTS USING THE CESE METHOD

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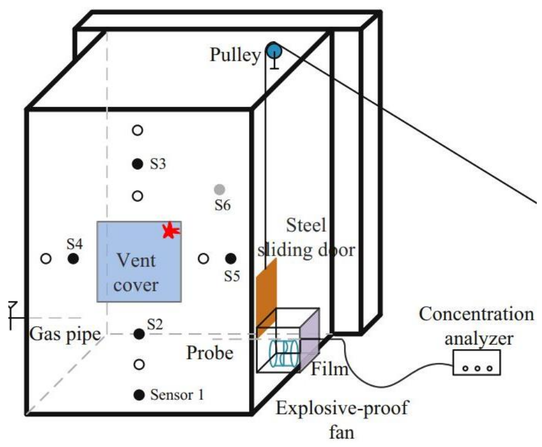
INTRODUCTION

Although gas explosive phenomenon is increasingly studied, it is quite difficult to predict accidental explosions. These events need to be prevented by starting from the design of the structures, with the aim of making environments as safe as possible. This work will study the behavior of a gas explosion model using the new chemistry module of the CESE solver of Ansys-ls-dyna. This approach can be considered innovative as it allows to use the real chemical compositions of explosive mixtures together with the powerful CFD calculation tools.

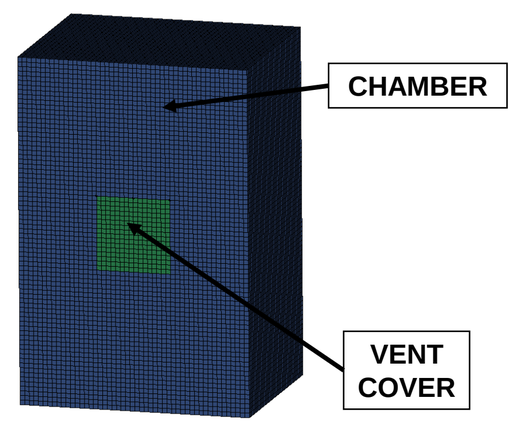
VENTED EXPLOSION

The simulated experiment is a Vented Explosion, an explosive event within a closed vessel where an explosive gas mixture of methane and air is ignited by a spark, placed in the centre of the chamber. It causes an overpressure wave that vents outside the vent cover. On the right, there is the CAE model of the experimental chamber of 12 m^3 created using the software LS-PrePost.

- **EXPERIMENTAL SET-UP**



- **FEM MODEL**



RESULTS AND CONCLUSIONS

FLUID VELOCITY VECTORS AFTER METHANE-AIR MIXTURE IGNITION

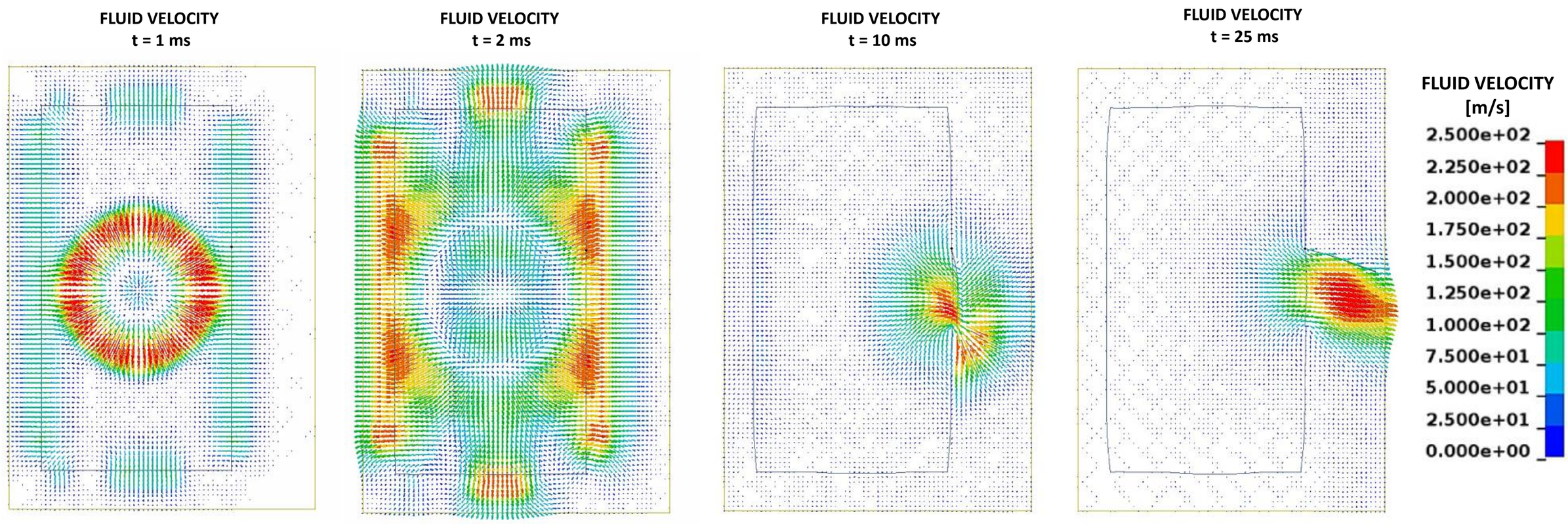
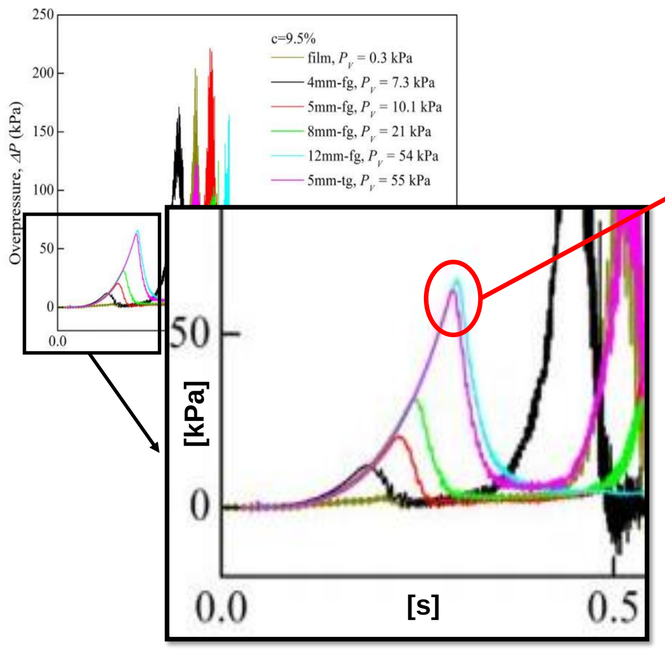


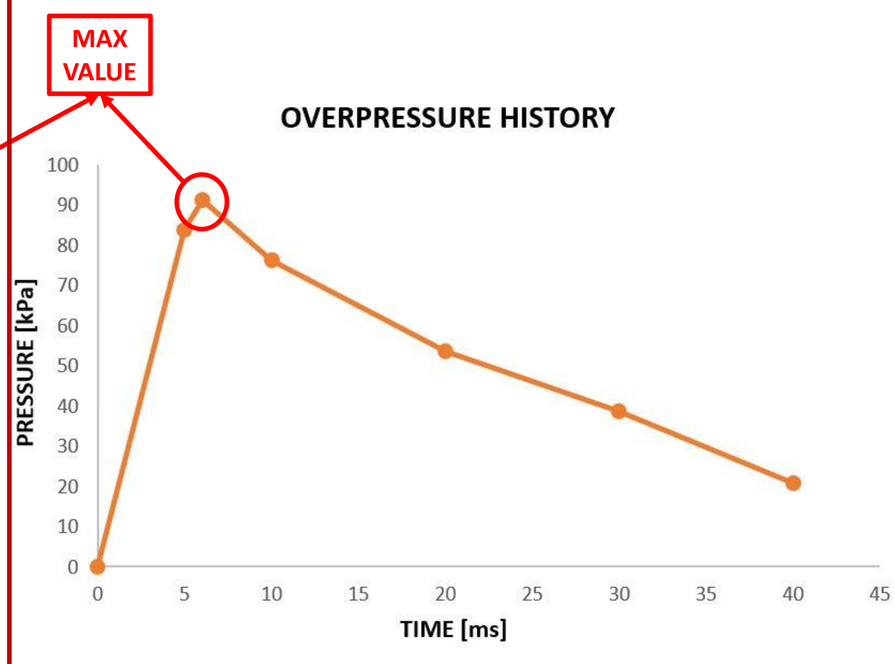
Figure represents fluid velocity development after the ignition of a stoichiometric mixture of methane and air (*9,5%* CH_4) . Overpressure wave, caused by the burnt gas expansion, vents outside the vessel, opening the vent cover after *10 ms* from ignition. Maximum fluid velocity value reached during this simulation is about *250 m/s.*

OVERPRESSURE HISTORY COMPARISON

- **EXPERIMENTAL OVERPRESSURE HISTORY**



- **SIMULATED OVERPRESSURE HISTORY**



Figures represent comparison between experimental and simulated overpressure history in the vessel. Experimenal purple profile in the left figure is similar to simulated orange one, in the right figure. Maximum overpressure value is about *90 kPa* for the simulation, like *70 kPa* of the experiment.

Gas explosive model, created in Ansys-ls-dyna, turned out to be a great tool able to simulate overpressure history of a vented explosion. This model can be profitably applied to structural project development, in order to modify structures, make closed environments safer and prevent explosive disasters.