EFFECT OF DIFFERENT NUMERICAL METHODS ON THE MODELLING OF TNT AFTERBURN IN INTERNAL EXPLOSIONS

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Many explosives are fuel rich and on detonation produce excess hydrocarbon species that may subsequently burn with oxygen in the surrounding air. This process is known as afterburning and takes place on relatively long timescales compared to detonation. An example is TNT which releases more than twice as much energy from afterburning as it does in detonation. In the free field the periods for subsequent energy release are in general too long to have major effects. However, in enclosed volumes such as ship compartments and structures, where the products are contained large over-pressures can develop that can form the dominant damage mechanism. Here the pressure rise time and final quasi-static pressure (QSP) are the key defining parameters.

In this paper, we examine high-fidelity modelling methods for detonation and afterburning of a TNT charge within a closed volume using Hydro and CFD codes. In particular we have carried out a systematic study comparing results for rise time of over-pressure using BLAST3D (a single material Flux-Corrected Transport formulation) and EDEN (a multi-material Lagrangian-remap formulation). In general, it is found that the FCT method gives slower afterburning rates, less than those observed in experiments.

We go on to use these numerical tools to investigate this effect when using different methods to model the afterburning process (such as different equations of state, chemistry models, etc.) and for variations in initial conditions (such as the explosive loading density, charge shape, chamber aspect ratio, etc.).