CHARACTERIZATION OF THERMOBARIC BLAST EFFECTS INSIDE A TUNNEL CONFIGURATION

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ABSTRACT

The effects of thermobaric explosive compositions are presently being investigated at ISL. Tests presented in this paper were conducted using simplified charges containing a large amount of metal particles in two different environment configurations. Different fine metal powders were mixed with various liquid oxidizers. The role of the metal particles is to increase the potential overall energy release. Depending on their size and nature, they may affect different stages of the explosion. Small sized particles will react rapidly, leading to possible shock wave enhancement. Large sized particles are dispersed almost non-reacted and will start burning inside detonation products mixed with surrounding air. In confined area, multiple reflected shock waves mix and compress the hot detonation gases and metal particles. This phenomenon increases global energy release and can enhance the late-time pressure effects on surrounding objects.

The first part of this paper describes the free field experiments. Side-on pressure evolution was recorded for each explosion. In addition, a ballistic pendulum was used to measure the total loading generated, taking into account the kinetic energy transferred by the projected metal particles. The second part of the paper describes the effects of the reference thermobaric charges in a $40m^3$ tunnel-type structure. Pressure evolution was recorded on the tunnel walls and total impulse was measured at the tunnel entrance using a ballistic pendulum. The values of total momentum, maximum overpressure and impulse are compared with results obtained in free field and with numerical simulations conducted for high explosive charges. Depending on particle nature and size, we discuss the characteristic features of thermobaric blast in a semi-confined environment.