INVESTIGATION OF LIQUID DISPERSAL BY INTERNAL CHARGES

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Presentation preference: Oral

Key words : Liquid dispersal by internal charges, liquid jet break up, Droplet evaporation and combustion

This abstract describes the application of a coupled CFD and CSD methodology to the study of liquid dispersal from bottles by internal charges. A small detonator is placed within a plastic bottle containing liquid. The bottle itself is either placed in a closed chamber or within a holder containing a slot that limits the liquid dispersal to a narrow spray angle.

A critical component of any agent defeat study must include an investigation of agent release from containers impacted by charge fragments. Laboratory tests of such studies may often be emulated by placing a detonator within the container, with about the same energy as the impacting fragment. Upon charge detonation, the liquid is dispersed, and the fast propagating bulk liquid jet breaks down to blubs, which in turn break into larger droplets. The process cascades further as the larger droplets break into ever smaller droplets. The droplet break-down terminates when the drag force between the droplets and the flow about them becomes zero.

The geometry modeled includes a small detonator placed within a liquid contained within a plastic bottle. The plastic bottle itself is placed within a steel holder that has a slot cut, to direct and limit the expanding liquid jet. The numerical simulations modeled the small charge detonation, which was contained within a thin aluminum shell. This coupling of fluid and structure modeling is necessary as experiments have demonstrated significant explosive energy damping, energy required to break the aluminum shell and accelerate the fragments (which may ignite later). Next, the code models the detonation products bubble expansion within the liquid, the shock going through the liquid and its impact on the plastic bottle; the plastic is then sheared under internal pressure upon contact with the slot corners, and the liquid combined with the "slotted" plastic are ejected through the open slot. As the liquid jets out at high speed, the jets thins, breaks down to blubs of liquid that eventually break into large-size droplets, that continue breaking to small size droplets, all slowing down due to aerodynamics drag.

In phase 1 of this effort we intend to study the jet break-up and droplet dispersion, velocity and droplet size. At later stages we will study the droplet vaporization and ignition upon impact by a second blast wave produced by an external charge.