Numerical Simulation of the Detonation and Combustion of Aluminum Shelled Explosives

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Reactive multiphase flows have been modeled to properly account for variable-size aluminum particles burning behind the blast wave. The governing equations include models for solid evaporation as follows, $\Delta c = (3\phi_s \rho_s / \tau)(1 + 0.276\sqrt{\mathrm{Re}})$ for $T > T_{ignition}$. They are solved in an Eulerian step, while the Al particles are treated in a Lagrangian step, with appropriate transformations between the two. Detailed chemical reaction model may require modeling hundreds of reactions, which would result in excessively long computational time. To reduce CPU time to an acceptable level we select only the most important reactions as follows: (1) Al + ¾ O_2 -> ½ Al_2O_3 (if T < 3500 K), (2) Al + ½ O_2 -> AlO (if T > 3500 K), (3) Al + 1½ H_2O -> ½ Al_2O_3 + 1½ H_2, (4) Al + 1½ CO_2 -> ½ Al_2O_3 + 1½ C, (5) H_2+ ½ O_2 -> H_2O, (6) C + ½ O_2 -> CO, (7)CO + ½ O_2 -> CO_2.

The computed results of heavily aluminized HE without casing showed good agreement with experimental data using this methodology. Currently we are developing this methodology to apply aluminum shelled HE computation. This computation is challenging due to the need to model the fragmentized aluminum shells. In the final paper and presentation, the computed results of heavily aluminized HE and aluminized shell HE will be presented.

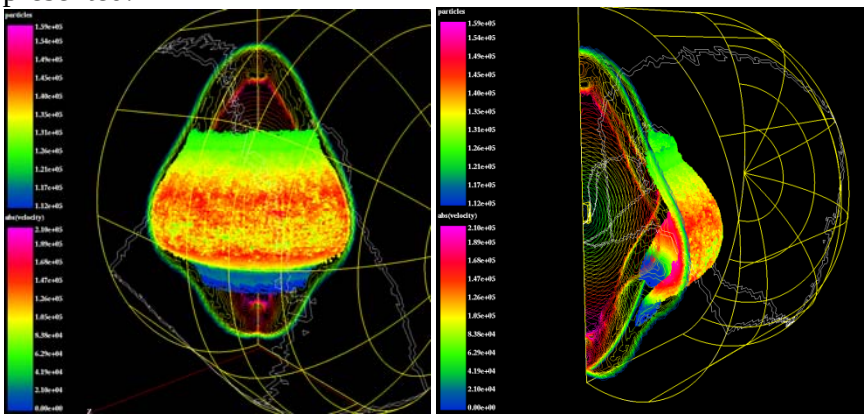

Fig. 1 Computed aluminum shell break by HE detonation.