MODELING AFTERBURNING OF NON-IDEAL ALUMINIZED EXPLOSIVES

P.DesJardin[1], B. Bojko[1], T. Nalesnik[1], M. McGurn[2], D. Swensen[2], N. Davis[3], E. Washburn[3]

[1] *State University of New York at Buffalo (SUNY Buffalo), Buffalo, NY, 14260, USA*
[2] *Reaction Engineering International, Murray, UT, 84107, USA*
[3] *Naval Air Warfare Center Weapons Division, China Lake, CA, 93555, USA*

ABSTRACT

There is a new class of energetic materials, known as thermobarics, which have the potential for greatly enhancing the impulse and thermal output of a blast. These energetic materials are different than the classical FAE (fuel-air explosives) because they are single-event explosions that can spread into confined spaces. In contrast to conventional explosives, whereby all of the energy release occurs at a shock front, thermobarics exhibit a delayed reaction that induces increased pressure during expansion; therefore, traditional scaling laws cannot be used. The challenge in understanding these devices is the role of secondary combustion, which is key to enhancing blast performance. Presently, the recipes for these mixtures remain a black art due to our current lack of knowledge of shock-driven reactive multiphase flows. The goal of this research is to develop a modeling and simulation tool to better understand thermobaric devices and unravel the inter-related processes of particle dynamics (dispersal, heating, phase-change, compressibility), combustion and turbulent mixing. A multi-scale modeling approach will be presented starting with local analytical solutions of particle burning processes of aluminum and hydrocarbon droplets. Predictions are compared to data to show the sensitivity of burn-rates at various oxygen and pressure environments. These local solutions are used in mixed Eulerian and Eulerian-Lagrangian formulations of compressible multiphase flows. System level simulations are conducted and compared to data from the Explosives Components Facility (ECF) at Sandia National Laboratories. Predictions of pressure response and impulse are shown to compare favorably with ECF data.