THREAT AGENT DEFEAT MODELING AND TESTING

Numerical Investigation Of Liquid Simulant Response To Blast Wave

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Numerical investigation of liquid simulant response to blast waves was conducted. Burnable liquid simulant was stored in a bottle in a 40cf chamber with a vent. The simulant was dispersed by a small high explosive charge immersed in the bottle. When the liquid jet reached halfway across the chamber, the main high explosive charge, located about 1.5m away from the bottle, was ignited. Some simulant evaporated and reacted inside the chamber, while some simulant droplets and vapor were ejected through the vent. The numerical methodology modeled a large set of very complex physical processes. The key numerical modeling include: 1. Dispersion of the liquid simulant; 2. The simulant jet break-down to droplets (bulk to blob, blob to droplets); 3. Bulk, blobs and droplets break-down under blast wave loading; 4. Simulant evaporation; 5. Simulant advection; 6. Blast wave modeling; and 6. Combustion of the simulant and explosive detonation products (chemical kinetics).

The methodology incorporates structural dynamics solver for modeling the bottle break, an incompressible fluid solver for modeling the liquid simulant dispersion, and a compressible fluid solver for modeling the droplet advection, blast modeling, and chemical reaction performed concurrently. The numerical prediction will be compared with the measurement in the final paper and presentation. The measurement also includes the ejected simulant mass from the chamber, which is very challenging to predict.
Figure 1 shows the numerical setup of the test.
Figure 2 shows the numerically predicted pressure history compared to the measurement.
The detailed analysis, including the ejected simulant mass, will be discussed in the final paper and presentation.