Critical Density Needed for a Deflagration to Detonation Transition

Abstract

In 2005, a truck carrying 36,000 pounds of explosives overturned in Spanish Fork Canyon, Utah. Although the explosives should have only burned (deflagrated), three minutes after the truck caught fire, a deflagration to detonation transition occurred, leaving a crater 70 feet deep and 30 feet wide. We hypothesize inertial confinement caused by deflagration contributed to the massive explosion that resulted. In this work, the accidental detonation of explosive materials during transport is simulated using the Material Point Method (MPM) and a multi-material CFD approach through the Uintah Computational Framework. These meter-scale simulations were run and analyzed in parallel on XSEDE's Stampede machine. In particular, the two-dimensional deflagration to detonation transition of PBX9501 is analyzed in a configuration that replicates typical transport conditions for explosive materials. In order to avoid transportation accidents of explosive materials in the future, this work will propose a relationship between the diameter of the cylindrical explosives and the critical density (spacing) required to transition from deflagration to detonation. This relationship will be combined with current large-scale research to suggest a safer packing configuration for future transportation of highly explosive materials.