SHOCK07-2007-000345

Abstract for an Invited Paper
for the SHOCK07 Meeting of
the American Physical Society

Recent Developments In Shear Ignition Of Energetic Materials Using Hybrid Drop Weight-Hopkinson Bar

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The sensitivity and mechanical behavior and of energetic material is highly dependent on its constituents. Cast as well as cured (like PBX) types of explosives have mechanical properties significantly different from metals and the assumption of isotropic behavior may not be valid beyond a finite strain. While Split Hopkinson Pressure Bar (SHPB) can be successfully used to obtain mechanical properties of these soft explosives at strain rates up to 5,000/sec, ignition conditions are seldom achieved in SHPB tests. In very sensitive explosives, if ignition occurs in very small sample at extremely high strain rates, it would be very difficult to calculate the energy and energy rate that led to successful ignition. In contrast to the SHPB test, the drop-weight test, uses gravitational acceleration to impart a nearly constant velocity at the instant of impact. The Drop weight test is intended to obtain ignition, only as a go-no go condition, due to the variation of velocity, either due to change in the initial height or small changes in friction or drag. Due to lack of quantifiable parameters, the result from this test is not suitable for modeling, which is important in development of new explosive formulation. In order to overcome this barrier and allow evaluation of the susceptibility of the different formulations to ignition, a new test was recently developed. This test is called Hybrid Hopkinson Bar Drop Weight test, which overcomes shortcomings of two systems. When an explosive sample is compressed between two rigid flat surfaces and the material freely slides on the rigid plates without pinning, the mechanical energy is uniformly dissipated throughout the sample. In absence of any pressure gradient, pure-shear conditions apply throughout the sample. The ignition in this case, will not be localized at the edges, which is the basis for obtaining ignition condition in the new apparatus. Using this method, hydroxy-terminated poly butadiene (HTPB) bonded explosives, PBXN-110 and PBXW-128, cast TNT and Comp B are compared for their ignition thresholds. This method uses novel approach in diagnostics techniques, data acquisition and reduction methods to simultaneously quantify mechanical properties and ignition conditions.