THE PHYSICAL PROPERTIES OF THE BLAST WAVE PRODUCED BY A STOCHIOMETRIC PROPANE/OXYGEN EXPLOSION

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The physical properties of a blast wave produced by a stoichiometric propane/oxygen explosion have been determined using a spherical-piston-path method suggested by Taylor (1946). The blast wave produce by an expanding spherical piston can be calculated using a suitable numerical code, such as the random choice method (RCM). For several decades, this technique has been used successfully to determine the physical properties of blast waves produced by various explosives, using piston-path trajectories determined by high-speed photogrammetry of smoke tracers initiated close to the charges immediately before detonation.

The trajectory of the primary shock produced by the explosion of a nominal 20 tn hemispherical propane/oxygen charge was analysed by Dewey (2005) to provide the physical properties immediately behind the shock, but gave no information about the time-resolved properties in the rest of the wave. Smoke tracers were deployed on this test, but a technical failure precluded the determination of time-resolved particle trajectories that could be used to provide a suitable piston path.

The primary shock trajectory was known from an extensive array of Air Blast Time-of-Arrival Detectors (ABTOADs). A generic piston-path trajectory was used in a RCM code to calculate a shock trajectory that could be compared to the measured trajectory. The piston path was adjusted iteratively until an optimum match between the observed and calculated shock trajectory was obtained. This piston path was then used to determine the hydrostatic pressure, density and particle velocity as functions of radius and time throughout the flow field from a scale radius of approximately 1 $m/kg^{1/3}$ to 10 $m/kg^{1/3}$. From the three physical properties, above, other properties such as dynamic pressure, temperature and energy density can be calculated. A user friendly interface is being developed to display these blast properties as functions of time and radius for any user selected charge mass and atmosphere.

References

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