

BLAST MITIGATION BY GRANULAR MATERIALS AND LIQUIDS IN SPHERICAL GEOMETRY

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ABSTRACT

The attenuation of a blast wave from a high explosive charge surrounded by a layer of inert material is investigated experimentally in spherical geometry. The mitigant material consisted of either a packed bed of particles, a particle bed saturated with water, or a homogeneous liquid. A large number of different types of particles (iron, steel, brass, aluminum, sand, glass, sugar, and silicon carbide) and liquids (water, glycerol, ethanol, vegetable oil) were tested. For some trials, the blast overpressure history was recorded with side-on pressure transducers at several locations. The decay of the peak blast overpressure in the near field of the charge was determined by using image analysis to determine the shock trajectory and the corresponding Mach number. The Rankine-Hugoniot relation was then used to infer the shock pressure. The transfer of momentum to the mitigant material reduces the strength of the air blast and the reduction in maximum blast pressure scales with ratio of mitigant mass to explosive mass as a weak power law. When the decay of the blast pressure is plotted as a function of scaled distance, the dry powders exhibit greater blast attenuation performance than the liquid mitigants, suggesting that the energy loss during compaction of the powders plays an important role. In addition, near the explosive charge, the rate of decay of blast overpressure for both liquid and solid mitigated charges is slower than for a bare explosive charge, suggesting that the particles and liquids effectively act like a porous piston which supports the near-field propagation of the blast wave.