EXPLOSIVE FORMATION OF COHERENT PARTICLE JETS

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Key words: Particle jet, shaped charge, smoothed particle hydrodynamics

When a spherical or conical shell of a packed bed of particles is explosively dispersed, instabilities typically cause the formation of particle jet-like structures. Aerodynamic forces maintain the integrity of the jets in the spherically expanding flow, although they erode and decay by the stripping of fragments from the head of the jet. The formation of a particle jet may be facilitated by the use of a shaped-charge configuration in which particles within a cone are accelerated by the detonation of a layer or volume of explosive lining the outside of the cone. Experiments have been carried out to determine the velocity history and the coherency of a particle jet formed using this shaped-charge arrangement. Important parameters include the cone angle, the ratio of the masses of the explosive and particles, and the particle size and density. Dense particles (e.g., iron) form thin, stable, coherent jets (see Fig. 1), whereas lighter particles (e.g., Al) lead to more diffuse jets. Increasing the cone angle causes the jet to become more coherent within the range of angles tested. Solid fragments of compacted particles were recovered after some trials, particularly for ductile particles. The shape of the largest compacted fragment suggested it was formed near the apex of the cone. The effect of various parameters on the jet formation and development was also explored with mesh-free computations using the smoothed-particle-hydrodynamics (SPH) formulation (see Fig. 2). These simulations demonstrated similar trends to those seen experimentally, i.e., increasing the cone angle lead to increased coherency of the particle jet.

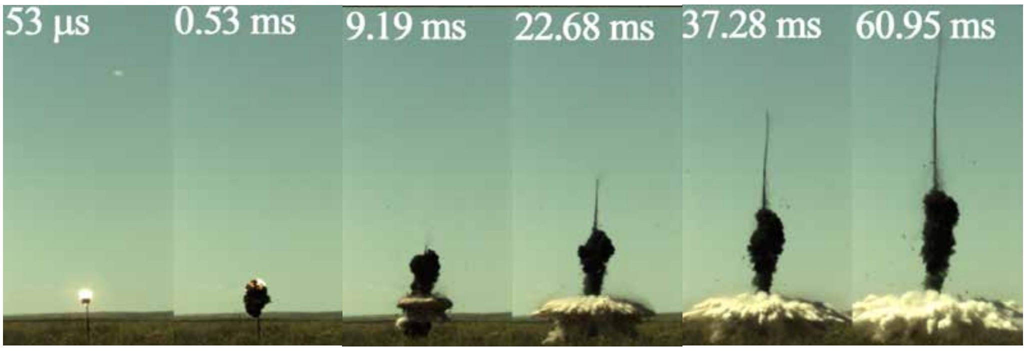

Fig. 1 Development of a jet of 0.5 mm iron particles in a 60° cone and dispersed with detasheet explosive. Total mass of iron powder was 2.4 kg, 14 times more than the mass of explosive.

Fig. 2 Early time development of a jet of iron particles computed with the SPH method. Cone angle is 60° and $m_{iron}/m_{explosive} = 14$.

Presentation preference: Oral session