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Jetting Instabilities of Particles from Explosive Dispersal
ROBERT RIPLEY, LAURA DONAHUE, Martec Limited, FAN ZHANG, Defence R&D Canada - Suffield — The formation of post-detonation 'particle' jets, which are characterized by ballistic conical structures followed by billowing wakes, is widely observed in particle dispersal from explosives. This paper analyzes experimental observations to examine the mechanism for formation and growth of such particle jetting instabilities, and to propose a model to address the issues of jetting growth at a macroscopic level. Cylindrical charges employed a range of central explosive masses for dispersal of dry solid powder, pure liquid, or a hybrid mixture of solid powder and liquid. The results demonstrate that the jets form very early, and that the number of jets is dependent on shock pressure at the charge perimeter, within the range of particle sizes studied. The jetting instabilities may therefore be initiated by shock interaction with the dense solid particle interfaces near the charge surface, followed by transverse particle motion from the interaction of shocked and turbulent wake flow around the particles. From the experiments, a macroscopic model is proposed, in which an edge perturbation on a scale proportional to the number of jets is employed, and the subsequent transverse particle motion is controlled by an attraction function. The model is implemented in the Chinook hydrocode and is capable of modeling the initiation and growth of particle jetting structures in large-scale dispersal, and the results are validated against experiments.

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