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Turbulent Mixing and Afterburn in Post-Detonation Flow with Dense Particle Clouds[1]

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Reactive metal particles are used as additives in most explosives to enhance afterburn and augment the impact of the explosive. The afterburn is highly dependent on the particle dispersal and mixing in the post-detonation flow. The post-detonation flow is generally characterized by hydrodynamic instabilities emanating from the interaction of the blast waves with the detonation product gases and the ambient air. Further, influenced by the particles, the flow evolves and develops turbulent structures, which play vital role in determining mixing and combustion. Past studies in the field in open literature are reviewed along with some recent studies conducted using three dimensional numerical simulations of particle dispersal and combustion in the post-detonation flow. Spherical nitromethane charges enveloped by particle shells of varying thickness are considered along with dense loading effects. In dense flows, the particles block the flow of the gases and therefore, the role of the inter-particle interactions on particle dispersal cannot be ignored. Thus, both dense and dilute effects must be modeled simultaneously to simulate the post-detonation flow. A hybrid equation of state is employed to study the evolution of flow from detonation initiation till the late time mixing and afterburn. The particle dispersal pattern in each case is compared with the available experimental results. The burn rate and the energy release in each case is quantified and the effect of total mass of the particles and the particle size is analyzed in detail. Strengths and limitations of the various methods used for such studies as well as the uncertainties in the modeling strategies are also highlighted.

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