Numerical Study on the Oblique Shock Wave in a Surrounding Fluid and Detonation in a Cylindrical PETN

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In this paper, the oblique shock wave in a surrounding fluid and the detonation in a cylindrical PETN were studied, and the two-dimensional axisymmetric simulation of the detonation in the PETN with infinite length were conducted. The surrounding fluid is modeled as the ideal gas equation of state in which the specific heat ratio is a parameter. The detonation in a PETN showed the steady propagation with curved front. The oblique shock wave in a surrounding fluid is attached at the detonation wave at PETN/ideal gas interface when the specific heat ratio is smaller than a critical value. We measured the detonation/shock angle and the contact-surface angle between the detonation products and the ideal gas. To understand the flow properties near the detonation, we modeled the flow as the planar CJ detonation in a cylindrical charge and oblique shock wave in a surrounding fluid, and theoretically estimate the flow properties behind them as 1) Prandtl-Meyer expansion of the detonation products from CJ state with zero degree of the deflection angle from the center axis, and 2) conical flow of a surrounding fluid by the Taylor-Maccoll equations. Detonation products reduce its pressure with increasing the deflection angle from the center axis. Taylor-Maccoll equations show the relation between the half-cone angle and the oblique shock angle for ideal gas. Since the half-cone angle denotes the deflection angle of the ideal gas behind the oblique shock wave, we obtained the point at which the pressure equilibrium and parallel flows between the detonation products and ideal gas. The theoretical oblique shock angle and the deflection angle agreed with the numerical results.