Experimental and Numerical Investigations on Traveling Charge Gun Using Liquid Fuels

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Abstract

The traveling charge (TC) concept is theoretically capable of producing higher muzzle velocities without a large increase in maximum operating pressure, compared with the conventional charge. This work presents experimental and numerical studies on a 35mm test gun system using liquid fuels as traveling charge. 8 firings with 2 different configurations of booster charge and traveling charge are performed in this paper. The firing experimental results indicate that the liquid traveling charge configuration performs better, in terms of increased muzzle velocity, than a conventional propellant charge by approximately 94m/s, corresponding to an about 8% velocity increase. A mathematical model for the two-phase flows in the 35mm test gun system using liquid fuels as traveling charge is established and simulated by using the two-phase flow method and computational fluid dynamics technology. The mathematical model for the two-phase gas-dynamical processes consists of a system of first-order, nonlinear coupled partial differential equations. An adaptive grid generation algorithm is developed to account for the expansion of the computational domain due to the motion of the system's payload in the tube. The numerical code is well validated by comparing its predictions with the experimental results. The calculated pressure-time profiles and projectile muzzle velocity are in good agreement with the experimental data. The numerical results show that the developed mathematical model gives the correct trend and can provide useful calculated parameters for the structural design of liquid traveling charge.