Numerical Simulation of Detonation Wave Propagation of Suspending Aluminum Dust in a Space Connected by Channel

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Abstract: To study the problem of detonation and effect for suspended aluminum dust, the development propagation process of detonation wave for suspended aluminum dust with a concentration of 0.304 kg · m^{-3} for the equivalence ratio of aluminum dust and air as 1 and a radius of 2.0 μm for the aluminum particles in the space connected by channel were numerically investigated by the two-phase flow model. The ignition initiation of detonation wave and the pressure and temperature distribution of the propagation, reflection and diffraction processes of detonation wave were achieved by numerical simulation. Results show that the detonation wave is reflected at the wall to form a 6.5 MPa local high pressure zone in the left side of enclosed space in simulated area, whereas the interaction of detonation wave with the reflected waves generated by the two walls can form a local high pressure zone of 18 MPa. Through diffraction, the detonation wave can propagate into the channel and reach the speed of 1571 m · s^{-1} and the pressure of 2.85 MPa near the exit of channel, closing to the stable propagation state. Through diffraction, the detonation wave can propagate into the right side of space and form a symmetrical low-pressure low-density area at the exit of the channel, the pressure of detonation wave and detonation velocity decrease, continue to spread in the right side of space. The temperature of the most of the region behind detonation wave in calculation area remains above 3400 K.

Key words: explosion mechanics aluminum dust; two-phase flow; dust detonation; numerical simulation

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