COMPARATIVE STUDY OF BLAST LOADING ON SOLID AND POROUS STRUCTURES

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The characteristics and parameter dependences of blast loading on solid and porous structures subject to explosions in a confined space are numerically investigated based on a shock tube configuration wherein the explosive source is approximated by a section at the closed end of tube filled with high pressure gases. Using a four-way coupling compressible gas-solid numerical method, the present work reveals the explicit correlations between the wave dynamics and the characteristic features of blast loading during the shock impinging transient state and the long-time steady state. Upon the shock impingement, the blast loading on the solid and porous structures both exhibits impulsive features caused by the reciprocating shock and rarefaction waves with moderate and considerable amplitude declines, respectively. The imprints of first several impulses manifest the complex wave propagations between the closed end of tube and the surfaces of solid or porous structures. The pressure profile on the solid structure soon transitions into a shape consisting of periodic triangular waves with sharp jump fronts and unvaried amplitudes. By contrast, the peak overpressure and amplitude of impulses experienced by the porous structure undergo a significant decay so that a gradual declining loading defines the long-term blast loading. The differences of blast loading between the solid and porous structure can be attributed to the substantial energy loss due to the gas filtration inside the porous structure which becomes more intensive as the porosity is increased. Compaction of porous structure also plays a significant role since the receding porous surface contributes to the marked dissipation of reflected waves. We further investigate the parameter dependences of the defining features of the blast loading on the solid and porous structure, including the explosion energy, the space between explosion source and the structure, and the porosity as well.

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