TWO-FLUID MODEL OF HIGH-SPEED IMPACT OF METAL PLATES

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Abstract: Two-fluid mathematical model for the calculation of high-speed impact of metal plates of finite thickness is developed. Each of the materials — steel, which is the material of one plate, lead, which is the material of another plate, and ambient air — are considered to be compressible fluids. Baer–Nunziato-like equations are solved. The governing system of equations has the hyperbolic type; for its numerical solutions, HLL (Harten – Lax – Van Leer) method is used. Statement of the problem corresponds to the natural experiment. The lead plate is thrown towards the steel one with the velocity of 500 m/s. Both plates have free boundaries. In calculations, the main features of the process are obtained, namely, the formation of shock waves, their motion towards free boundaries of the plates, their reflections as rarefaction waves, and interaction of the rarefaction waves with the contact boundary of metals. The relative error of the parameters of the shock waves in comparison with the known calculated and experimental data does not exceed 7%. The estimation of the acceleration of the contact boundary of the plates after passing the rarefaction wave from the free surface of the steel plate is obtained.

Keywords: high-speed impact; shock wave; rarefaction wave; two-fluid model; mathematical modeling; hyperbolic system of equations; HLL numerical method

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