NUMERICAL SIMULATION OF INTERACTION OF THE NORMALLY INCIDENT SHOCK WAVE WITH A LAYER OF PARTICLES USING BAER–NUNZIATO SYSTEM OF EQUATIONS

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Abstract: The work presents the results of numerical simulation of the experiment on interaction of a shock wave with a loose layer of particles near the impermeable wall. The mathematical model is based on the solution of Baer–Nunziato system of equations and takes into account compaction of the solid phase of particles. The numerical algorithm is based on Godunov method with the pressure relaxation procedure for the stable computation of explicit interfacial boundaries. The shape of the pressure curve, obtained on the wall under the layer, is explained from the point of view of ongoing wave processes in the layer. A quantitative comparison of the experimental and simulated pressure curves is carried out. Parametric studies of the influence of compaction law parameters on the simulation results are conducted. The simulation results are quantitatively compared with the calculations of others researchers performed using the equations of Nigmatulin. The differences in results are discussed using two models of two-phase medium flow.

Keywords: shock wave; compaction wave; particles layer; Baer–Nunziato equations; Godunov method; pressure relaxation; numerical simulation

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Figure Captions

Figure 1 Schematic statement of the problem. Dimensions are in millimeters

Figure 2 The initial stage of interaction of the shock wave with the layer of particles: *1* — $\overline{\alpha}$; *2* — $\overline{p}$; *3*— p; and *4* — β

Figure 3 Pressure recorded by a sensor near the wall: *1* — $\overline{p}$; *2* — p; *3* — p_{mix}; *4*— p_{calc}; and *5* — p_{exp}

Figure 4 Pressure p_{mix} obtained for different values of parameter $\overline{P}_0$: *1* — $\overline{P}_0 = 0.1$ GPa; *2* — $\overline{P}_0 = 2.6$ GPa; and *3* — experiment

Figure 5 Pressure p_{mix} obtained for different values of parameter a: *1* — $a = 10^4$ J/kg; *2* — $3 \cdot 10^4$; *3* — $a = 10^5$ J/kg; and *4* — experiment

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