Simulation of the polymeric materials high speed impact

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Polymer materials, in particular, polymethyl methacrylate (PMMA) are widely used as structural elements in the study of shock wave and detonation processes in various materials. In this regard, mathematical modeling of the behavior of polymer materials under conditions of high strain rates is relevant. Various empirical models are used to describe plastic flows. In this work, a mathematical model of an elastoplastic medium is built on the basis of the Prandtl–Reis model of plasticity [1, 2], a distinctive feature of which is the absence of empirical constants. Namely: in the Prandl–Reis model, the equations for the stress deviator tensor components have the same form as the equations for stresses in the Maxwell model of a viscoelastic medium [3], however, unlike the Maxwell model, the Prandtl–Reis model does not require the introduction of an additional fitting parameter—viscosity. Also, a low-parameter equation of state in the Mie–Grüneisen form is constructed, which adequately describes the behavior of a polymer material under dynamic loads. For the numerical solution of the proposed mathematical model, a semi-analytical method was used [4]. The verification of the mathematical model was carried out on the basis of experimental data [5], which showed that the constructed mathematical model gives a correct description of shock-wave processes in polymer materials.

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