Modeling of punching processes of the textile composite ballistic shield

© Yu.I. Dimitrienko, I.D. Dimitrienko

Bauman Moscow State Technical University, Moscow, 105005, Russia

The objective of this research is to propose a mathematical model of deformation of textile composite materials based on aramid fabric under shock action. The model takes into account the following deformation parameters of composite materials of the specified class: the ability to change their forms without destruction at finite deformations, a considerable difference between stress-deformation diagrams under tension and under compression, dependence of these diagrams on a loading rate, pseudo-plastic properties of materials caused by pulling out threads from fabric, anisotropy of nonlinear-elastic and viscous-plastic properties and other effects. Additionally, we took into consideration viscous-elastic properties of the aramid fibers, damageability and fiber breakage when punching the textile materials. Thus, we stated the problem of dynamic deformation of textile composite materials. In order to solve the problem, we applied the method of band-adaptive grids in a two-dimensional case. We give an example of computational solution of the problem, which involves a high-speed action of a striker onto a textile composite material. In conclusion, we compare the computational modeling and experimental results in punching the aramid textile composite materials.

Keywords*: textile composite materials, dynamic processes, impact, punching, computational modeling, finite deformations, plastic deformations, viscous-elastic deformations, aramid fibers.*

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Dimitrienko Yu.I. (b. 1962) graduated from Lomonosov Moscow State University in 1984. Dr. Sci. (Phys.&Math.), Professor, Head of the Computational Mathematics and Mathematical Physics Department, Director of Scientific-educational Center of Supercomputer Engineering Modeling and Program Software Development of Bauman Moscow State Technical University. Member of the Russian Academy of Engineering Science. Author of over 300 publications in the field of computational mechanics, gasdynamics, thermomechanics of composite materials, mathematical simulations in material science. e-mail: dimit.bmtstu@gmail.com.

Dimitrienko I.D. (b. 1962) graduated from Lomonosov Moscow State University in 1984. Cand. Sci. (Phys.&Math.), Leading Scientist of Scientific-educational Center of Supercomputer Engineering Modeling and Program Software Development at Bauman Moscow State Technical University. The author of over 40 publications in the field of gasdynamics of solid propellant combustion, shock wave interaction with condensed matter, computational mechanics. e-mail: irina.dimit@gmail.com