

Selection of nanostructured material parameters of the bainitic steel for the numerical model of the passive armour

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Abstract.

Numerical model of 12.7 mm type B-32 projectile and high-strength samples of NANOS-BA bainitic steel with hardness of 47 HRC were developed, tested and verified with experiment. The basic criterion of the numerical model correctness was the shape and depth of penetration of the Armox 500T armour plate on which the bainitic steel samples were placed and fired with the 12.7 mm type B-32 projectile with velocity of 850 m/s.

Johnson-Cook model was used for description of the strength properties of the projectile, samples and armour plate, and the values of model coefficients for Armox 500T steel were adopted in accordance with the literature data. The parameters of the steel projectile material models and steel samples were determined by optimization of computer simulation and continuous verification of theory with experiment. Also information on the hardness and yield strength of the bainitic steel samples was used.

A satisfactory agreement was obtained of the theoretical results with firing tests of the samples, i.e. size and shape of craters in the Armox 500T plate.

Computer codes were adapted and modified using the free points method in version with so-called markers. It referred to a new method of maintaining of the calculation stability and proper selection of weighting factors for calculation of velocity gradients and stresses in the contact areas of materials with different properties.

It was examined that the biggest impact on the results of computer simulation in the Johnson-Cook strength model of high-strength bainitic steel have values of A , α_Y and α_σ parameters.

Parameter A significantly determines the yield strength, while the parameters α_Y and α_σ describe value of boundary equivalent plastic deformation, above which dynamic yield strength begins to fall strongly. The presented results show clearly that the higher is the value of the A parameter (higher yield strength), the lower is the depth of penetration of 500T Armox plate fired with 12.7 mm type B-32 projectile, thus the protective properties of high-strength bainitic steel are better. Increasing values of parameters α_Y and α_σ , results with reduction of the depth of penetration of the plate.

Key words: nanostructured material, bainitic steel, numerical model, passive armour