APPLICATION OF THE SMOOTHED PARTICLE HYDRODYNAMICS METHOD TO STUDY THE TRIGGER EFFECT OF ROCK FAILURE BY EXPLOSION WITH COMPOSITE SIMULATION MODELS

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An explosion as a trigger effect is often responsible for triggering one or another process that radically changes the geomechanical state of the developed rock massive. Trigger effects in studies of the action of detonating explosive charges consist, in particular, in the failure or disruption of contacts between individual blocks of rocks, which are considered in conjunction with an increase in the level of stresses in the massive under the influence of the energy of the explosion. The features of the impact on the rock of the impact of a "sparing"explosion with the use of ANFO-6 explosives and the crushing action of TNT explosive charges are considered. The relevance of research is due to the need to expand the possibilities of controlling the action of an explosion in order to increase the safety of blasting and obtain a rational fragmentation of the rock massive. To study the regularities of controlling the impact of explosive failure of blast-hole and borehole explosive charges having different designs and explosive characteristics, three types of approaches for numerical simulation of the processes of initiation of dynamic events and interpretation of observed data were tested - these are the solutions of a number of problems of plane deformation with layer symmetry; an axisymmetric problem, as well as three-dimensional problem of failure within the area of the blasted block of rock. Calculation charts axisymmetrical and flat tasks allow from one side in detail enough to describe behavior of the real simulation models, from other - substantially simplify the calculation analysis of process. Boundary-value problems were formulated within the framework of the model of an elastic-plastic body of continuum mechanics, which were solved by the Smoothed Particle Hydrodynamics method, which positively recommended in solving dynamic problems of geomechanics. Gridless ideology of the method make it possible, when using it, to reveal the features of wave processes and the nature of the failure and fragmentation of the geo-environment under large deformations and expansion of detonation products.

The solution of the problem of the impact of an explosion of charges with air gaps made it possible, in particular, to establish the effect of the gap between the charges of TNT and the charging cavity on the yield of fractions less than 1 mm, and also to reveal the nature of the change in the yield of a fine fraction with a change in the gap between the charge and the wall of the charging chamber and when replacing individual high-energy explosives with mixed compositions containing ammonium nitrate.

The functions of changing the fragmentation of individual sections of explosive media were obtained depending on the change in tangential and radial stresses at characteristic points when solving problems of the action of borehole charges under plane deformation conditions, on the nature of the change in the first invariant of the stress tensor when using 3D models.

An important part of the research is the study of the effect of energy saturation of charges on the kinetics of fragmentation of failured rocks.