INFLUENCE OF INTER-BLOCK VENTING ON COMPLEX ENERGY TRANSFER TO PROTECTIVE STRUCTURES FROM EXPLOSIONS IN COARSE GRANULAR MATERIALS

BUECKING,P.W.

Two different methods and codes were applied to compute the effects of a big detonating charge in coarse granular rock material. First the finite difference code Sharc was used. The rock material (granite) is described in the hydrodynamic approximation using the Tillotson equation of state based on Hugoniot data. The progress of the detonation along a long cylindrical charge with steel casing is computed. The interaction of the generated shocks in gas with arbitrarily distributed rock blocks is investigated. High velocity jets between blocks of marked roughness are observed. The material around the detonation is severely disrupted with a tendency to close all gaps and ducts, thus forming a closed detonation cavity for a while.

Other computations were done with the Autodyn 2D-hydrocode. The gas-solid interaction is handled by Euler/Lagrange coupling. The interior of the rock blocks is discretized using the ALE option (Arbitrary Lagrange/Euler). By defining Lagrange/Lagrange interactions blocks accelerated by the detonation crash into each other and hit a wall-roof structure. The rock material is assumed to have a Mie-Grueneisen equation of state using Hugoniot data for the linear shock-velocity relation of the material. A Von Mises strength model is applied, combined with a failure model for stress and strain.

The computations show shocks progressing through gas and blocks, plastic deformation, bulk failure and a velocity (momentum) gradient of blocks. Strong shocks induced in the coarse granular material are partially captured inside the blocks. They lose energy when material cracks under tension upon reflection of the shocks at free surfaces. Complete failure of rock material is found in an extended region around the explosion.

The size of voids between blocks (venting) is a parameter influencing the ratio of energy in the gaseous fluid between blocks and the level of the remaining pressure in the close-in detonation region and its potential to accelerate rock material thus increasing its momentum.

The information gained from the calculations shows that it seems to be possible to optimize the effectiveness of coarse granular material by an appropriate Arrangement of blocks making use of pressure and velocity gradients between the point of explosion and structures. Suggestions are made.