SESSION BD: SHAPED CHARGES

Tuesday morning, 18 June 1991; Room 18 at 9:00; M. Held, presiding

Invited Paper

9:00

BD 1 Shaped Charges and Shock Waves. W. P. WALTERS, *Ballistic Research Laboratory*

The collapse, formation and penetration of a jet from a shaped charge liner results in extremely high strains (>10), strain rates (10^7/s), hydrostatic pressures (up to 200 GPa) and temperatures (500-600°C). The jet tip velocity exceeds Mach 25 in air. However, the flow velocity must remain subsonic (with respect to the liner sound speed) during the jet collapse process for the jet to be coherent. This paper describes the shaped charge concept; the history of shaped charges; applications of shaped charges; and explains the influence of shock waves on the jet collapse and formation concept.

Contributed Papers

9:30

BD 2 Designing a Cutting Charge to Cut the Shaped Charge Jets. WILLIAM LAWRENCE AND ROBERT E. FRANZ, Ballistic Research Lab. - The cutting charge was used to selectively cut the jet produced by the conical shaped charge so that different velocities or lengths could be directed to the targets. The cutting charge was designed to cut a jet and to deflect the remaining jet and the slug so that they would miss a hole in a armor steel plate. The charge was designed using a liner with semi-circular cross section. The liner was made by cutting the copper tubing into two halves. The tubing had a wall thickness of 1.57 mm, an outside diameter of 34.9 mm, and a length of 50.8 mm. The charge was a cube of Comp B explosive 50.8 mm on a side with a cavity for the liner in the middle of one face. This design yielded a usable leading particle with velocity of 3.16 km/s. Experiments were then performed to cut the regular conical jets. Different lengths of jets can be cut by changing the position of the cutting charge with respect to the path of the jet or by changing the timing of the detonation of the charges.

9:45

BD 3 Jet Ejecta Mass upon Oblique Impact. W. YANG[1], T. J. Ahrens[1], G. H. Miller[1*], and M. B. Petach[2], [1]Lindhurst Laboratory of Experimental Geophysics, Seismological Laboratory 252-21, California Institute of Technology, Pasadena, CA 91125. [2]TRW, Redondo Beach, CA 90278. *Present address: Dept. of Geology and Geophysics, U. of Calif., Berkeley, CA --- Although theoretical models in the jetting regime for symmetric impact which predict the mass and velocity of jetted material upon oblique impact, have long been available, experimental constraints on the amount of material which form jets upon oblique impact are unstudied. A series of preliminary experiments conducted in which tungsten flyer plates at speeds of 1.5 to 2.0 km/sec were obliquely impacted into carbon targets at 30° in the regime of jetting, yielded radiation temperatures in the ~3000° K range. Although both framing camera and flash x-ray imaging were conducted, we found the broad cm-sized craters induced by jet ejecta on 2024 Al witness plates are useful to infer jet energy and mass. We observed that jet masses in the range of 0.01 to 0.05 g for a 30 mm diameter W impactor are produced. This is some 10^{-2} times the estimates of jet masses inferred from simple application of Birkhoff's formula.

10:00

BD 4 Computational-Experimental Investigation of Wave Processes in Metal Balls under their Loading by Spherically Converging Shock Waves. G. V. KOVALENKO, E. A. KOZLOV, V. F. KUROPATENKO and G. N. SAPOZHNIKOVA, Research Inst. of Techn. Phys. -- The experimental set-up and experimental data concerning the size of the vacuum cavity formed in spheres of copper, iron and lead under their loading by spherically converging shock waves in systems with different overall dimensions are presented. Numerical simulation of wave processes in the recovered spheres and in the scattered material of the heavy case surrounding a layer of high explosive has been carried out. Calculations of the size of the cavity forming in the center of the full spheres have been carried out in hydrodynamic and elasto-plastic approximations. Comparison of calculation results for different models as well as with available and newly obtained experimental data has been done.

10:15

BD 5 Obtaining and Investigation of Sub-microcrystal Structure Materials in Experiments on Loading of Metal Spheres by Spherical Converging Shock Waves. E. A. KOZLOV, B. V. LITVINOV, I. G. KABIN, N. D. MATUSHKIN, V. K. MYAKIN, R. H. CHINKOVA and I. K. GORNOVAYA, Research Inst. of Tech. Phys. -- Methods of explosive loading of full metal spheres by spherical converging shock waves with realization of pressures up to 200.....1000 GPa on the recovered samples have been developed. The loading was done by a spherical system, having the explosive exterior radius equal to 40 mm and the thickness of the explosive TNT/RDX 3/7 layer equal to 8 mm. While conducting metallographic investigations of the copper core in the material layer with the thickness 2...3 mm adjacent to the vacuum cavity the radius of which is equal to 12 mm there has been discovered the essential compression of a grain (by 2 - 3 orders relative to the initial one). The vacuum cavity in the center of the sphere is formed while reflecting the spherical converging shock wave from the center. Formation of the layer with unique properties, essentially of a new structural material.

SESSION BE: HIGH STRAIN RATE EFFECTS II

Tuesday morning, 18 June 1991
Lounge D at 9:00
W. Holt, presiding

9:00

BE 1 On New Mechanism for Plastic Flow in Shock-loaded Solids. I. A. OVID'KO, Leningrad Branch I. Machine Sciences. -- A new microscopic mechanism for plastic flow in shock-loaded metallic solids, which has been briefly discussed earlier[1], is theoretically examined in detail. This mechanism is related to two successive processes which are as follows: (1) A crystal-to-glass transformation occurs in local regions of a shock-loaded solid, in which case the special configurations of crystal defects serve as being the amorphous-phase-nucleation centers, and (2) the "amorphous" dislocations move under mechanical load resulting in high-strain deformation of the local amorphous regions. In this event the deformation of the shock-loaded solid is inhomogeneous with plastic flow being localized in the amorphous bands.

[1]I. A. Ovid'ko, Mater. Sci. Eng. A 128, L5 (1990).