SHOCK05-2005-000308
Abstract for an Invited Paper
for the SHOCK05 Meeting of
the American Physical Society

Explosively Driven Combustion of Shock-Dispersed Fuels

PETER NEUWALD, Fraunhofer-Institute for High-Speed Dynamics, Ernst-Mach-Institut, Freiburg i. Br., Germany

Since the eighties our working group has been studying classical blast effects in small-scale experiments using custom-made miniature charges of 0.2 g to 1.5 g PETN. However, in the recent years the interest has shifted towards the performance of non-ideal explosives and the importance of secondary reactions such as after-burning. Thus we have designed an additional charge type, called Shock-Dispersed Fuel (SDF) charge. It consists of a lightweight, small paper cylinder filled with about one gram of a flammable powder (e.g., flake aluminum) surrounding a spherical PETN booster of 0.5 g. We have tested the SDF charges in a number of different environments, realized as closed steel vessels of simple geometry (barometric bombs). Three of the bombs vary in volume (6.6 l, 21.2 l and 40.5 l), while their aspect ratio L/D is kept constant at about 1. Two further bombs are comparable to the smallest bomb in volume (6.3 l), but provide different aspect ratios: L/D = 4.6 and 12.5. In addition, we have also performed tests in a tunnel-model with an L/D = 37.5. Our basic goal is to assess the performance of the charges by means of the combustion-related pressure built-up. Thus we contrast experiments on SDF charges in air with tests in nitrogen, to inhibit combustion, and with tests on conventional charges. Experiments and theoretical estimates on the expected overpressure allow one to formulate various indicators for the observed combustion performance. For SDF charges these indicate that the combustion efficiency decreases not only with increasing volume of the barometric bomb, but also with increasing aspect ratio at constant volume. This bears importance to the performance of SDF charges in tunnel environments. The performance losses reflect – at least in part – geometry-specific constraints on the mixing between fuel and air.