EFFECTS OF DETONATIONS ON THE MIXING AND COMBUSTION OF FUEL-AIR COMPOSITIONS

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In previous research projects we have investigated the properties of blast waves caused by internal explosions and their propagation inside typical building structures. The experiments were performed at laboratory scale by means of spherical miniature Nitropenta-charges manufactured by EMI. The continuation of these investigations focuses on a more complex topic: what are the characteristics of the energy release and the related pressure effects, if the system contains an inflammable material (fuel) and the detonation provides mixing with air and initiates combustion. These experiments are carried out in support of a numerical model which handles the problem in the asymptotic limit of infinite Reynolds-, Peclet- and Damköhler-number[1]. Under these conditions turbulent mixing determines the combustion rate.

In general, two situations are of interest: (a) the explosive is rather unbalanced (e.g., TNT) and the detonation products form the fuel[1] [2], or (b) some combustible substance is stored in the chamber structure, which is eventually evaporated (in case of liquids), mixed with air and set aflame by the processes following the detonation.

This paper will focus on topic (b) which bears some resemblance to the problem of a gas or dust explosion/deflagration in a storage facility [3]. The combustible substance stored in the chamber was mimicked as a soap bubble containing acetylene. The diagnostics were highspeed visualization of the flow-field and pressure measurements in the side walls of the chamber system. When subjected to the detonation of a charge, ignition of the acetylene cloud is possible, but - as the tests indicated - not compulsory. Successful initiation brings forward a rapid deflagration of the acetylene which adds to the quasi-static pressure contributing to the loading of the walls.