ABSTRACTS AND INFORMATIONS

I C D E R S

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The Effect of Inert Particle Evaporation on the Chemical Reaction in a Combustible Medium

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Abstract

Dispersions of various solid or liquid materials are often used as a fire safety measure in chemical processing plants or mine galleries. In this paper the effect of inert particles evaporation on the pre-self-ignition chemical reaction in a gaseous combustible medium is investigated. It is shown that under certain conditions the evaporation process may promote the chemical activity and may become a reason of strong secondary shock or detonation wave onset.

In the first part of the paper, monodisperse particles uniformly distributed in a combustible mixture were considered. A quenching criterion was derived indicating the amount of particles required for the suppression of the mixture self-ignition. A comparison was made between the quenching ability of H_2O, $Pl(C_2H_5)_4$ and KBr particles. It was shown that self-ignition can be promoted, if particle inertia effects in the fluid flow were taken into account. The latter is due to momentum losses during vapor accelaration and drag forces.

Nonuniformly distributed evaporating particles produce temperature and dilution ratio nonuniformities in the reactive mixture. Under conditions close to self-ignition this may become a reason for strong shock or detonation wave generation in accordance with the Zeldovich mechanism. Detailed calculations were carried out indicating characteristic regions of spontaneous detonation onset. A comparison was made between the calculated results and predictions obtained on the basis of an analytical criterion.