DISTRIBUTED SDF-CHARGES IN A TUNNEL

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At the 18th MABS symposium in 2004 we introduced the concept of shock-dispersed-fuel (SDF) charges which are designed to deliberately exploit after-burning with ambient air as a source of additional energy release. To generate significant after-burning in laboratory-scale tests we surround an explosive PETN booster by a powdered fuel (e.g., flake aluminum).

In previous investigations we have shown that, in the case of interior detonations, the completeness of the combustion and its rate strongly depend on the chamber geometry. Due to the strong lateral confinement and its impact on the mixing between the dispersed fuel and the ambient air, a particularly low performance was observed in tunnel-like environments. However, this should not be misconstrued to indicate that after-burning phenomena are in general of minor importance in tunnel systems. A substantial change of the dynamics can be effected if we replace a single localized SDF charge by a number of smaller units, which are distributed throughout a segment of the tunnel.

We have investigated such a scenario in the small-scale model of a long, closed tunnel section. The model had a length of 600 cm and a square cross-section of 8 cm x 8 cm. In a first series we detonated single localized SDF charges at a number of distances ranging from 30 to 150 cm from one end of the tunnel. The effects were diagnosed by means of the pressure loads at the opposite end of the tunnel. In a further test series the single localized charges were replaced by four sub-units which added up to the same total booster and fuel masses. The sub-units were positioned at distances of 30, 70, 110 and 150 cm and detonated simultaneously. The experimental results indicate a significant increase in peak overpressure and overpressure impulse.

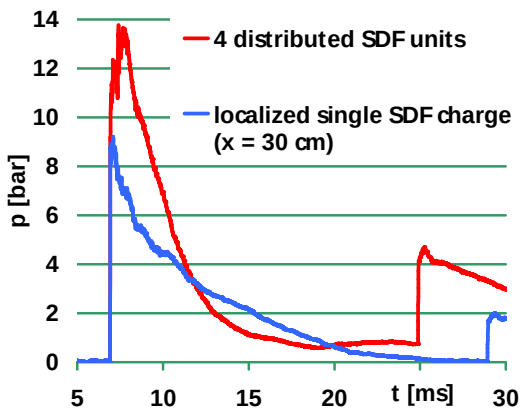

Figure 1
Blast loads at the tunnel end due to four distributed SDF units compared to the effect of a localized single charge.