RATIO PYROMETRY OF FIREBALL TRANSMISSION BETWEEN TWO CHAMBERS

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ABSTRACT

Two-color ratio pyrometry of the fireball resulting from the detonation of an aluminized explosive mixture within a two-chamber system has been performed. The latter comprised two steel chambers, a 26 m^3 donor and a 23 m^3 receptor, where the explosive was initiated within the donor chamber and the resulting products allowed to vent into the receptor chamber through a variable diameter orifice. A non-metalized explosive (C4) was also tested under similar configuration in order to determine a baseline for comparison. The pyrometric sensor used in the donor chamber indicated that within the first 5-7 blast reverberation cycles, temperatures reached levels above 2800 K, exceeding the melting temperature of aluminum oxide (≈2300 K) for the aluminized explosive. In the case of C4, the corresponding dynamic temperatures generally increased to 2000-2500 K, in excess of the constant volume explosion temperature for the mixture of C4 with air. Both cases suggest that afterburning reaction has occurred. When venting was permitted, temperatures within the donor chamber decreased more rapidly to lower values, namely 1750 K and 2500 K for C4 and the thermobaric explosive respectively, which is consistent with observed pressure records. Pyrometric sensors in the venting chamber yielded fireball transmission temperatures consistent with what was observed in the donor chamber; 2100 K and 2800 K for C4 and the aluminized explosive respectively. When afterburning failed to re-initiate in the receptor chamber the pyrometer still provided combustion temperature readings consistent with what was observed in the closed donor chamber, albeit for very short periods of time and with large fluctuations. These results underline the necessity of combining pyrometry and high-speed qualitative imagery in order to understand the quenching or transmission process of explosions between chambers.