EXPLOSION TRANSMISSION FROM A METALIZED EXPLOSIVE

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Problems of explosion transmission are encountered in multiple confined spaces including building rooms, bunkers and channels. This requires a fundamental understanding of critical conditions for explosion quenching or transmission from one confined space to another. An explosion transmission takes place if the fuel in the detonation products of an explosive in a "source" room is transmitted into a "receptor" room (initially filled with air only) beyond combustion quenching or self-ignition conditions. The objective of this paper is to investigate these critical conditions for explosion transmission of a metalized explosive. The experimental facility consists of two steel chambers connected with an orifice plate between them. The source chamber is 26 m^3 in volume and 3 m in diameter and the receptor chamber is 23 m^3 in volume and has the same internal diameter. The venting orifice plate is interchangeable for various hole diameters up to 1.22 m corresponding to a venting area of 1.169 m^2. The experiments are conducted using an aluminized heterogeneous explosive and a baseline C4 charge having 1.1 kg and 4 kg masses. The explosive is contained in a 2.5 mm thin-walled PVC cylindrical casing whose length/diameter ratio has been maintained at $L/D \approx 1$. The charge is vertically suspended in the center of the source chamber and detonated from the charge top. High speed photograph results show that a quenching process takes place for a 1.1 kg metalized explosive charge with an orifice diameter of 0.305 m. A jet structure is formed downstream from the orifice and flames are completely quenched as they propagate through the orifice due to expansion cooling. Increasing the charge mass to 4 kg results in a re-initiation of flames downstream of the same orifice. In this case, high pressure ratios across the orifice result in the jet flow consisting of an expansion followed by a recompression in the form of a shock, which overcomes the expansion cooling and enhances the lateral shock and turbulent mixing at the jet boundary between the products and air, thus resulting in an increase in reaction rate and re-initiation near the jet boundary behind the shock. A critical charge mass for flame quenching at a given orifice diameter is therefore the competitive result of expansion with shock recompression and mixing. Unlike the premixed combustible gas mixtures where a quenching orifice diameter can be a few millimeters, the explosion quenching diameter in this case can be of the order of one meter. Due to the oxygen rich condition for the mixture of detonation products and air in the source chamber, pressure records show very slight reduction in long-time quasi-static pressure (QSP) in the two chambers when comparing the explosion quenching cases with the transmitted cases at larger orifice diameters. Thus, caution must be taken for the pressure loading even when the explosion is quenched. CFD calculations are conducted to provide flow details and to correlate a relationship of critical charge mass with orifice diameter or venting area.