INVESTIGATION OF CASED CHARGE DETONATION IN STONE-LINED PIPES

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ABSTRACT

This abstract describes the application of a coupled CFD and CSD methodology to the simulation of an explosive contained within a thick-cased cylinder, which is then placed inside a pipe composed of either steel or various strength stones. The physical mechanisms controlling the explosive detonation and case fragmentation include: HE detonation initiation, detonation wave propagation through the HE, case expansion under the high pressure, case cracking, detonation products escape through the opening cracks, accelerating fragments and airblast impact on the pipe walls, wall response (debris generation) and airblast, cylinder and wall debris propagation down the pipe. Accurate modeling of these mutually interacting processes requires coupling of computational fluid dynamics and computational structural dynamics codes.

In previous efforts we have focused on the understanding of energy exchange mechanisms between detonation, blast wave and fragment energies. To that end two cases were examined modeling steel cylinder debris rebound from a steel pipe: elastic (100% rebound) and plastic (actual structural response modeling of the pipe). Initial detonation and blast energy spent on breaking and accelerating the cylinder case debris are the same for both. Energy exchange mechanisms between fluid and the debris at later times are significantly different. While for the elastic case, the fast-moving reflected debris recompress the fluid to generate a second, large amplitude compression wave propagating behind the leading blast wave, for the plastic case, a significant portion of the cylinder debris KE has been spent on plastic work upon impact on the steel pipe. Hence, bounce velocity is significantly reduced and energy return to the flow is lower. Here we expand this effort to replace the steel pipe with a variety of softer stones. It is expected that for softer stones, more energy would be spent on plastic work, and less energy would be available to recompress the detonation products.