Tatiana RIGOULET – PhD Thesis

Title: Blast protection with fluids

Keywords: Blast load, Protective equipment, Experimental

Abstract: Following the detonation of an explosive charge, such as a buried mine or an improvised explosive device, under a vehicle floor, two main effects occur: the rupture or deformation of the vehicle floor due to the loading transmitted by the blast wave and a global vertical acceleration leading in the worst-case scenario to the overturning of the vehicle, due to the impulse being transmitted. For protection purposes, numerous studies have been conducted in literature regarding load transmission in order to reduce target deformation but very few studies focus on impulse transmission, and thus change in momentum. The use of fluids, and in particular water, has been identified as a possible means on acting on impulse transmission. However, the few studies available in the literature focus on the effects of water being included in the protective structure. Therefore, they evaluate the reduction in transmitted impulse to a target by its reduction in deformation. The aim of this work is to identify the phenomena taking place in the fluid itself acting on impulse transmission, placing the investigation upstream of a potential target. Experimental investigations using an explosive driven shock tube allowing the transmission of a blast wave similar to that of a buried mine to a fluid filled container were carried out. These experimental studies were supplemented by numerical simulations, allowing to overcome certain limitations such as the number of measuring points. It was shown that the use of a fluid in a protection against the effects of blast allows the impulse to be spread out, and therefore its local reduction. A link was established between the free surface allowing the fluid to be ejected out of the protection and this impulse spreading. For a more global comprehension of the phenomenon, a blast pendulum was used to observe the effects of fluid filled protection on momentum. This second experimental setup was used to study the effect of the direction of fluid ejection in relation to the origin of the blast loading.