Effect of Surface Coatings on Submersible Structures Exposed to Underwater Shock

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ABSTRACT

The dynamic response of a submersible vehicle to an underwater explosion is a complex problem due to the interaction between the fluid and structure. In the past, extensive reseach was conducted in the field of underwater shock to better understand the effects of blast damage on shock hardening of vehicle structure. The study has involved both physical testing and numerical modeling of uncoated metal cylinders of various configurations such as unstiffened, stiffened, corrugate pressure vessel to toroidal vessel, single shell layer and double shell layer models. In a recent study, when subjected to an underwater shock water, damage to a vehicle structure increased when it was covered with a low density layer of glass microspheres suspended in water. An early work showed that resilent scatterers can attenuate the new-field pressure if they behavior like a cavity-like boundary. Such an attenuation will certainly change the dynamic response of the structure. The objective of this study was to examine the response of a square plate, a metal cylinder and a metal sphere coated and uncoated with rubber material, when subjected to an underwater explosion, utilizing a numerical analysis technique. Rubber coated aluminum and steel structures were analyzed and a parametric study of various coatings was performed to gain a better understanding of the coating effect on the structures. These results show that under certain conditions, when subjected to underwater shock, surface coatings appeared to concertrate wave energy within the structures for longer duration, resulting in significantly higher magnitudes of stress and strain. Instead of a gradual release of energy into surrounding water medium, most of the energy was retained in the metal meterical structures response was most influenced by changes in rubber shear modulus and rubber thickness. Both parameters are related to the coating stiffness and it is this property that most likely governs the extent of the energy transfer in the structure and the surrounding water medium, and consequently the dynamic response of the structures results point to the existence of threshold values for both coating shear modulus and coating thickness, values below which lead to adverse and erratic structures responses.

Keywords : underwater, coated, rubber

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