# EFFECT OF FIBRE SIZING ON THE EXPLOSIVE BLAST DAMAGE RESPONSE OF CARBON FIBRE COMPOSITES

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## ABSTRACT

Carbon fibre reinforced polymer composites are used in naval ship structures due to their high specific strength, stiffness, corrosion resistance and other properties. An understanding of the effect of explosive blast loading on carbon fibre materials is required to evaluate the vulnerability of composite ship structures to weapon strikes. In this study, the influence of the sizing agent used on carbon fibres on the explosive blast loading response of composite materials is experimentally investigated. The sizing agent is a thin organic-based coating applied to carbon fibres to promote bonding to the polymer matrix. Composite panels containing one of two types of woven carbon fabric with different fibre sizing agents were evaluated. One fabric contained carbon fibres coated with a sizing agent that was chemically compatible with the polymer matrix, and this promoted strong fibre-matrix interfacial bonding. The other fabric contained carbon fibres with an incompatible sizing agent which provided relatively weak interfacial bond strength. The two types of composites were identical in every way (e.g. vinyl ester polymer matrix, fibre volume content, ply orientation, thickness, etc); the only difference was the type of fibre sizing agent. Panels of the two types of carbon fibre composites were subjected to impulse blast loads of increasing intensity generated by plastic explosive (PE4) charges. A high-speed digital image correlation (DIC) technique was used to measure the dynamic deflections and strains generated in the composite panels under blast loading, and it was found that the deformation was much higher in the composite panels containing the fibres with the chemically incompatible sizing agent. Following blast testing, ultrasonics and X-ray computed tomography (CT) were used for non-destructive evaluation (NDE) of the blast-induced damage. It was found that the amount of damage, which included delamination cracking, fibre-matrix debonding, and fibre fracture, was greater for the composite containing carbon fibres with the chemically incompatible sizing agent. This study reveals that the fibre sizing agent used on carbon fibres plays an important role in controlling the explosive blast response of composites, and it is essential that an agent with high chemical compatibility with the polymer matrix are used.