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MECHANICAL EFFECT AND SHIELDING EFFECTIVENESS OF THE INSERTION OF METALLIC SCREEN IN GLASS AND CARBON COMPOSITE

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INTRODUCTION

Warships are equipped with more and more electronic equipments which generate electromagnetic fields of various intensity. The superstructures support several contributors such as radar antennas, high frequency antennas and electronic warfare equipment... each being susceptible to interfere or hinder the other equipments but also perturb the operation of the equipment installed in the living spaces. It is also susceptible to impair the health of the personnel living in these spaces. In the case of Glass Reinforced Plastics, the structure does not conduct electricity and is particularly transparent to electromagnetic radiation. In the case of Carbon Reinforced Plastics, the structure is not enough conductive to obtain a good Shielding Effectiveness. Therefore one of the ways considered is to insert a metallic screen in the composite material.

The present work presents the electrical and mechanical influence due to the insertion of this material. The objective of this study is to increase the electrical conductivity, then to show the effect on the mechanical behaviour of the insertion of the metal screen compared to the original structure. Experimental and numerical effects of the position of the metallic screen in composite materials will be described.

STRUCTURE PRESENTATION

The first composite material was manufactured from a Glass/vinylester composite. The second was manufactured from Carbon/Vinylester composite.

To increase the conductivity of the material, we propose in this study to integrate metallic screen in the structure. These metallic screen are made of a polyester coated copper or bronze and are inserted in several levels between two layers in the thickness of the structure. Figure 1 shows a screen embedded in a Glass composite.

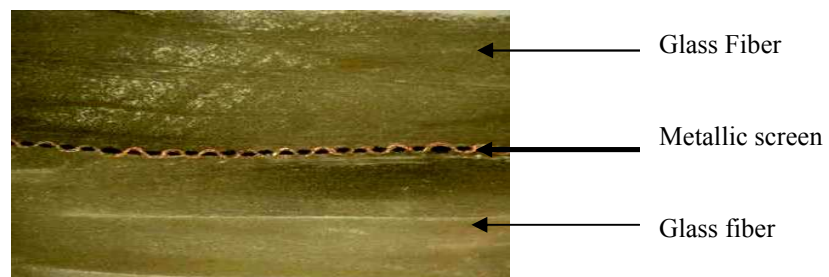


Fig. 1: Metallic screen embedded in Glass composite

SHIELDING EFFECTIVENESS

The surface impedance of the composite material is measured using a specific probe developed by ONERA [1]. The surface impedance is measured using a data acquisition system and ranges from 5 to 20 $m\Omega/sq$ according to various composite materials and screen.

The electromagnetic shielding efficiency (SE) is defined [2, 3] as the ratio of the incoming and outgoing waves power by the relation (1)

$$SE = 10 \log \left(\frac{P_i}{P_0} \right) = 20 \log \left(\frac{E_i}{E_0} \right) \quad (\text{Expressed in dB}) \quad (1)$$

Here, P_i, P_0 are the electromagnetic power and E_i, E_0 are the electric field of incoming and outgoing waves, respectively.

The electromagnetic shielding efficiency is measured in an anechoic room. The frequency band of measurement ranges from 500MHz to 3GHz. The first results (Figure 2) show the SE for a composite carbon material and the SE increases with the frequency.

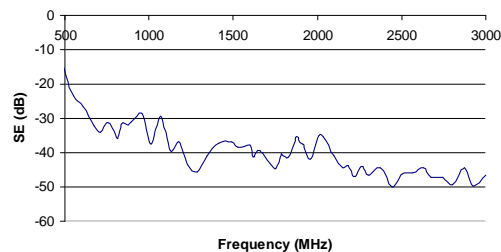


Fig. 2: SE of Carbon material.

MECHANICAL EFFECT

The mechanical tests performed include: Tensile Test, Short Beam Shear Test and Impact Test.

The purpose of these tests is to show the mechanical influence of the insertion of these screen compared to the original materials. Moreover, the position of the screen in the composite will be mechanically studied in order to determine the best position in the structure. The first tests of short beam shear showed a 10-15% loss compared to the original material.

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