

STUDY THE TENSILE, IMPACT AND BENDING PROPERTIES OF STEEL/ALUMINIUM/GLASS REINFORCED POLYMER HYBRID COMPOSITES (FML)

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INTRODUCTION

Fiber metal laminates (FMLs) are new hybrid materials, consisting of bonded thin metal sheets and fiber/adhesive layers which are newly developed as a good replacement for metal structures, particularly in aerospace and aircrafts applications [1]. These laminated structures which are combined of composites and metals, provides excellent fatigue, impact and damage tolerance while having a low weight. The existence of fibers in the composite layers will act as a barrier against crack propagation and increase the burn through resistance as well as damping and insulation properties, while the metal layers help the ductility and impact resistance and damage tolerance [2, 3]. In the present study a new type of FML laminates, consisting of bonded aluminium, steel and glass fiber/epoxy layers had been introduced and its mechanical properties were tested.

SPECIMEN PREPRATION AND TESTS

Four types of 3/2 FML laminates: 1)Al/GRP/Al/GRP/Al, 2)Al/GRP/St/GRP/Al, 3)St/GRP/St/GRP/St, 4)St/GRP/Al/GRP/St are made by hand lay up technique. These specimens are respectively coded as FML1, FML2, FML3 and FML4. The GRP layers are made from unidirectional E-glass fiber and EP502-H15 epoxy resin. The average fiber content is set about 30%. The aluminium sheets used in the lay up are Al 2024-T3 and the stainless steel sheets are St-316L. The fabrication, preparation and testing of the FMLs for mechanical properties were reported earlier [4]. Specimens for the tensile, bend and impact tests were prepared according to the ASTM standards.

RESULTS

Tensile Test Results

According to ASTM D3039-76 all specimens were prepared and tested by “INSTRON 8502” and the results are shown in Figure 1. As it can be seen, the properties such as ductility, toughness, specific tensile stiffness and energy absorption for FML specimens were better as compared to GRP, metals and epoxy specimens. As far as the specific properties are concerned, the specimen FML1 that contains three aluminium layers is the best among others.

Bend Test Results

According to ASTM D70-M-93 three point bend test was done with “Zwick005” machine on all specimens and the results are shown in Figure 2. It can be seen that the FML1 has shown better properties in comparison with other specimens.

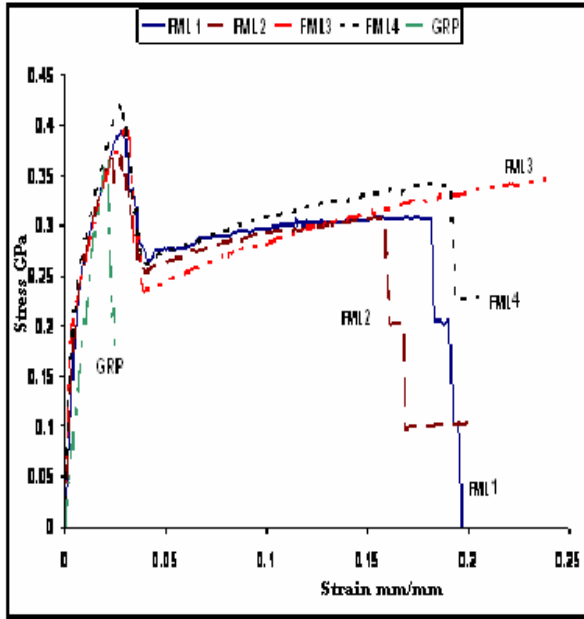


Fig.1. Tensile test results

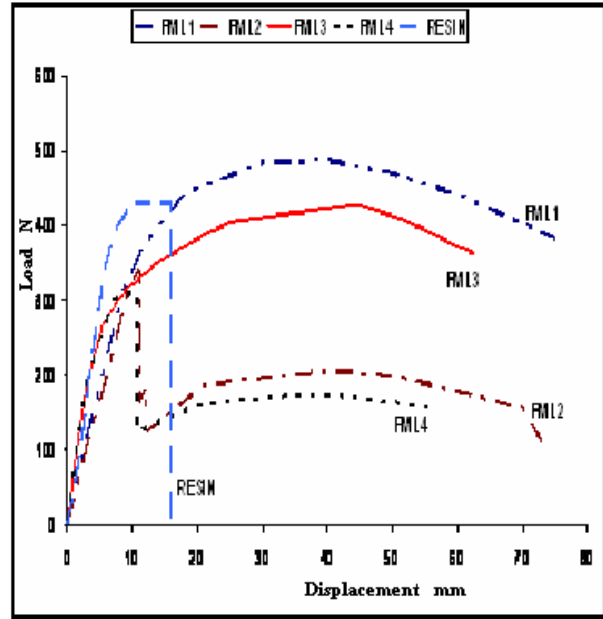


Fig.2. Bend test results

Impact Test Results

The Charpy test was done according to ASTM D 256-78 with “IVORY” machine. The results are shown in the Table 1.

Table.1. Charpy test results

Specimen	FML1	FML 2	FML 3	FML 4	GRP	RESIN
Energy (kJ/m ²)	621.60	1021.1	1001.21	1180.05	195	85.617

Among the two main impact factors, i.e. energy per impacted area and bending angle after impact, the specimen FML4 had shown better results.

The complete description of the results and diagrams are presented in the full length paper.

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