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EXPERIMENTAL INVESTIGATION OF FIBERGLASS REINFORCED ALUMINIUM

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Abstract – *In the present work, an experimental investigation on fiberglass reinforced aluminium has been carried out. Fiberglass reinforced aluminium is a hybrid composite material. Composite materials are made by combining two materials in which one material is reinforced (fiber) and other material is matrix. The combination of fiber and matrix provide superior characteristics. Here, we are performing various tests on Fiber Metal Laminates (FMLs) which is a type of hybrid composite material in which we use fiberglass as fiber fragment and aluminium.*

Key Words: Hybrid composites, Fiber Metal Laminates, fibreglass, composite materials, structural composite.

1. INTRODUCTION

Composite materials are made by combining two materials where one of the materials is reinforced and other material is matrix. The combination of the fiber and resin (matrix) provide superior characteristics compare to the each material alone. Composite products are ideal in applications where high performance is required such as aerospace, race cars, boating, industrial applications, in defense application, etc. Now a day, hybrid fiber composite materials are used in wide range of applications. So we are working on Fiber Metal Laminates in which we are making Fiberglass reinforced aluminium. In most of industrial and structural applications the important parameters in material selection are specific strength, weight and cost. Fiber Metal Laminates (FML) is a family of hybrid composite structure formed from the combination of metal layers sandwiching a fiber-reinforced plastic layer. The metal currently being used is either aluminium, magnesium or titanium and fiber-reinforced layer is either glass fiber, carbon fiber, aramid fiber reinforced composite. Hybrid nature from two different constituents (Metal and fiber) gives excellent mechanical properties like high corrosion resistance, outstanding strength to weight ratio compared to conventional composites. These laminates consist of thin high strength metal sheets bonded together with alternating unidirectional composite layers. These layers are aramid, carbon or glass fibers reinforced in an epoxy resin. We are using fiberglass and aluminium. In this present study we are producing the fiberglass reinforced aluminium and going to perform number of tests.

1.1 Fiber Metal Laminates

Aluminium based FML's mainly classified into followings:

ARALL: It is aramid reinforced aluminium composite,

GLARE: It is fiberglass reinforced aluminium composite,

CARALL: It is carbon fiber reinforced aluminium composite.

Here, we carry out experimental investigation on GLARE.

2. LITERATURE REVIEW

Tamer Sinmazçelik et al. discussed the classification of Fiber Metal Laminates and performed various surface bonding treatments like mechanical, chemical, dry surface treatments, etc to improve bonding between the metal surfaces and fiber layers. Mechanical properties of FMLs are being enhanced by improving the interface bond between composite and metal plies, [1].

Leslie Lamberson et al. performed high velocity impact test on high performance fiberglass panels. Thin phenolic laminates of plain-weave glass cloth impregnated with synthetic thermosetting resins, one melamine and the other epoxy, were impacted by a 1.6 mm diameter nylon sphere using combustion less two-stage light-gas gun. The resulting impact and ejector was captured using high-speed imaging, and the perforation characteristics and damage zone were examined post-mortem using optical microscopy. Both composites had a fiber volume fraction of an estimated 56% and identical fibers weave so that the role of the matrix on impact performance could be comparatively investigated, [2].

O. Laban et al. applied chemical treatments, surface treatments like, etching and anodizing, plasma, etc on fiberglass/aluminium laminates for improving fracture toughness of the laminates. This paper shows that surface roughness also an important factor which affects the bonding of the layers, [3].

Amal A.M. Badawy et al. investigated the impact behavior of glass fibers reinforced polyester (GFRP) by using notched Izod impact test specimen. The experimental program was carried out on unidirectional laminate of GFRP in directions 0, 45 and 90in addition to cross-ply laminate. The effect of

fiber volume fraction, Vf % (16%, 23.2% and 34.9%) was considered. The impact specimens were tested after exposure to temperatures of -10°C, 20°C, 50°C and 80°C for exposure time of 1 h and 3 h. Test results showed that the effect of exposure temperature and fiber volume fraction on impact strength of GFRP composite depends on the parameter controlling the mode of failure, i.e. matrix or fiber. The failure characteristic changed from fiber pull-out to fiber breakage with increasing the exposure temperature, [4].

S.K.Singh et al. carried out experimental investigation on the E- glass fiber composite with epoxy resin and nanoclay in which natural ingredient nanoclay is added in the epoxy resin by stirring for reinforcement of glass fiber polymer. Various tests were carried out on the composite shows that by adding proper amount of nanoclay in epoxy resin can improve the performance of the composite, [5].

Aniket Salve et al. performed various test like bending test, tensile test, drop weight test on Fiber Metal Laminates. And also the carried out numerical modeling of it, [6].

M. Sadighi et al. carried out on the glass fiber metal laminates in which simultaneous and two successive repeated impacts were carried out on the composite. Results shows that glass fiber laminates offer better energy absorption than carbon fiber metal laminates. The inspection of the impact damage is carried out by visual inspection and by ultrasonic C scan, [7].

Ming-mingXu, Guang-yan Huang et al. performed high velocity impact on the Carbon Fiber Reinforced Polymers (CFRP) and Carbon Fiber Reinforced Laminates (CARLL). They used 2/1 and 3/2 lay up of 0.8mm thick carbon fiber composite and 0.8 mm thick Al 2024 T3. The results shows that the CARLL has better resistance to penetration compare to CFRP. It also shows that in the test of flat nose high velocity impact, the performance of CARLL is better compare to the Al 2024T3 having same thickness around 8% higher, [8].

B. Yu et al. performed the experiments on Carbon Fiber Reinforced Polymer (CRFP) and aluminium plates. This paper shows the performance of the CFRP plates and aluminium alloy plates against the ballistic and Quasi-static loading. In the experimental set up aluminium alloy (AA1050A) plates are placed in front of the CFRP plates in order to protect it from the impact by spherical projectiles, [9].

3. CONCLUSIONS

From the research papers in this classification, it is observed that some work done on the Carbon Fiber Reinforced Polymers (CRFP) and also carbon fiber reinforced metal laminates in which manufacturing and testing methods of both material as well as comparison of the performance of both material, etc. And also lots of work has been carried out on Fiberglass Reinforced Polymers (FRP). We observed that there is some work done on the Fiberglass Reinforced Aluminium. So, we are focusing on fiberglass reinforced aluminium for strength based application and also there is less work done on the comparative study of different patterns of the fiberglass reinforced aluminium. So we are focusing on the above criteria.

4. EXPERIMENTAL WORK

From the literature we concluded that we are focusing on fiber reinforced aluminium for strength based application, as well as we are considering the different patterns which could be produced on the fiberglass reinforced aluminium.
So we are going to produce the mainly two types of pattern. And varing the thickness of aluminium metal sheets. After that we will carry various test like impact test, bend test on the number of specimens comparing the performance of the specimens based on their pattern as well as on the thickness of the metal sheets.

REFERENCES

[1] Tamer Sinmazçelik, EgemenAvcu, Mustafa Özgür Bora a, OnurCuban “Fiber metal laminates, background, bonding types and applied test methods” Materials and Design 32 (2011) 3671–3685

[2] Leslie Lamberson “Investigations of High Performance Fiberglass Impact Using Combustion less Two-Stage Light-Gas Gun” Procedia Engineering 103 (2015) 341 – 348.

[3] O. Laban, E. Mahdi “Enhancing mode I inter-laminar fracture toughness of aluminum/fiberglass fiber-metal laminates by combining surface pre-treatments” International Journal of Adhesion and Adhesives 78 (2017) 234–239.

[4] Amal A.M. Badawy “Impact behavior of glass fibers reinforced composite laminates at different temperatures” Ain Shams Engineering Journal (2012) 3, 105–111

[5] S.K.Singh, S.Singh, S.Sharma “Strength degradation of mechanical properties of unidirectional E-glass fiber with epoxy resin composite” Procedia Materials Science 5 (2014) 1114 – 1119

[6] Aniket Salve, Ratnakar Kulkarni and Ashok Mache “Fiber Metal Laminates (FML’s) - Manufacturing, Test methods and Numerical modeling” IJETS.6.2016.10.2.1060

[7] M. Sadighi, M. YarmohammadTooski, and R.C. Alderliesten “An experimental study on the low velocity impact resistance of Fibre Metal Laminates under successive impacts with reduced energies” Aerospace Science and Technology S1270-9638(16)30303-0

[8] Ming-mingXu, Guang-yan Huang, Yong-xiang Dong, and Shun-shan Feng “An Experimental Investigation into The High Velocity Penetration Resistance of CFRP and

CFRP/Aluminium Laminates" Composite Structures S0263-8223(17)32911-2

[9] B. Yu, V.S Deshpande, and N.A. Fleck "Perforation of Aluminium Alloy-CFRP Bilayer Plates under Quasi-static and Impact Loading by" International Journal of Impact Engineering S0734-743X(18)30157-X