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The Water Absorption Behaviour Of Coconut Shell Powder Reinforced Epoxy / Jute Fibre Mat And Epoxy / Glass Fibre Mat Hybrid Composites.

Gopal P[1]*, Bupesh Raja VK[2].

[1]Research Scholar, Vels University, Chennai, India
[2]Department of Automobile Engineering, Sathyabama University, Chennai, India

ABSTRACT

The current trend in aerospace, automobile and structure components is to replace metallic components with composites due to their inherent light weight and immune to corrosion. Generally the fibre reinforced epoxy laminated plates are fabricated with several layers of fibre with opposite orientation in an epoxy matrix. In this investigation an effort is made to study the moisture absorption behaviour. This project deals with the studies done on sea water ageing of E glass/epoxy resin composite having different fibre orientation. In this project we are trying to find the effects caused by the sea water treatment on composite's mechanical properties and change in properties due to different fibre orientation in composites. Here first of all we prepare the composites plate by usual hand layup process taking woven fiber and epoxy resin along with a hardener as raw materials. The composite were made of several glass layers in order to acquire required thickness of ASTM Standard of Jute fibre mat and coconut shell powder reinforced composites.
Keywords: epoxy resin, glass fibre mat, jute fibre mat, stitched, unstitched, cross stitched coconut shell powder.

Corresponding author

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INTRODUCTION

When composites are immersed in sea water for long time degrading occurs in it. This is due to hydroxyl or hydrogen ion penetration into the fibers and these ions progressively replace the sodium ions originally present. The misfit strain due to the replacement of ions may introduce cracks into the fiber surfaces. The aqueous solutions may hydrolyze the siloxane groups of the glass and accelerate flaw growth. Failure may occur in the interfacial region due to chemical reactions or to plasticization when water penetrates the interfaces. Moreover the various ions of salts present in sea water (e.g. NaCl, $MgCl_2$) tend to break the bond between carbon and hydrogen present in the epoxy resin and try to get attached to carbon. This also causes strain in matrix due to size change of the atom. Moisture absorption also leads to swelling in matrix. Since swelling of composite lamina is restrained in fiber direction significant residual stresses are induced in multi-directional laminate by moisture absorption. The presence of moisture results in diminution of mechanical properties at elevated temperatures and fatigue life also tend to reduce by moisture absorption.

Literature Survey:

The literature on the influence of the stitched of the glass fibres is very less. The tensile behavior of stitched graphite/epoxy laminates was examined with the aim of evaluating the efficiency of coconut shell powder as a reinforcing mechanism able to improve the delamination resistance of laminates. The investigation, which focused on two classes of cross-ply stacking sequences ([0/90]s and [0/90]3s), showed that the role of coconut shell powder in controlling damage progression of laminates and their capability to reduce the impact sensitivity of specimens are greatly dependent on the impact behavior of base laminates. In particular, coconut shell powder is able to reduce damage area, on condition that the moisture absorption is higher than a threshold level is sufficiently developed. In [0/90]3s laminates, on the other hand, stress concentration regions generated by the stitching process appear to promote the initiation and propagation of fibre fractures, thereby inducing a decrease in the penetration resistance of the laminate. In another study it was observed that whereas stitching does not appear capable of preventing the initiation and spread of delaminations, it initiation of damage area when stitches bridge delaminations sufficiently developed in length. When comparing studies it is apparent that many contradictions exist: some studies reveal that stitching does not affect or may improve slightly the in-plane properties while others find that the properties are degraded.

In reviewing these studies it is demonstrated that predicting the influence of stitches on the in-plane properties is difficult because it is governed by a variety of factors, including the type of composite (eg. Type of fibre, resin, lay-up configuration), the stitching conditions, type of thread, stitch pattern, stitch density, stitch tension, thread diameter), and the loading condition. The implications of these findings for the use of stitching in lightweight engineering structures are discussed.

Experimental Work:

The epoxy resin based Jute fibre mat composites and glass fibre mat composites (with and without the coconut shell powder reinforcement) were prepared by hand layup techniques. The specimens were shown in fig c. They were treated with sea water for 24 hours at a temperature of 60 degrees using the water absorption setup shown in fig a. From this sea water treatment we were able to know the water absorption rate as a function of time as well as fiber orientation. This paper discusses the fabrication of the composite plate and the effect of the stitching of fibre on the tensile strength of glass epoxy composites. The composite plate specimens with different orientations were fabricated by manual method.

The composite was fabricated by hand lay technique and subjected to moisture absorption test. The test specimens were subjected to moisture absorption test in saline conditions. The specimens prepared are weighed before treatment and after treatment using weighing machine as shown in fig b.

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Fig a. Water absorption Test setup

Fig b. Weight analysis of moisture absorption test specimen

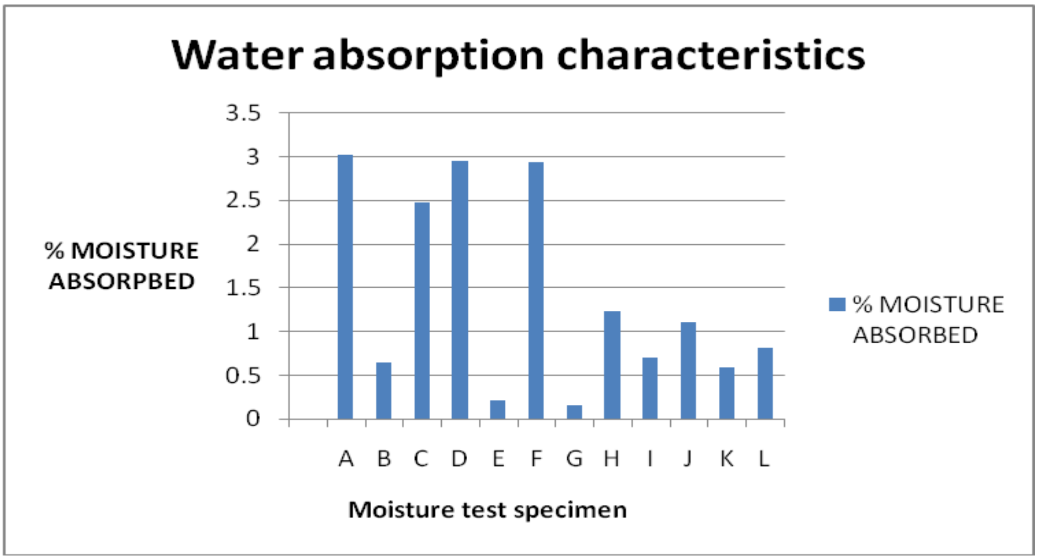
Fig c. Moisture absorption test specimens

Specimen details:

A - Unstitched jute mat fibre + epoxy resin+ coconut shell powder
B - Stitched jute mat (45) fibre + epoxy resin+ coconut shell powder
C - Cross stitched jute mat (45 x 45) fibre + epoxy resin+ coconut shell powder
D - Unstitched jute mat fibre + epoxy resin
E – Stitched jute mat (45) fibre + epoxy resin
F - Cross stitched jute mat (45 x 45) fibre + epoxy resin
G - Unstitched glass fibre mat fibre + epoxy resin
H - Stitched glass fibre mat (45) fibre
I - cross stitched glass fibre mat (45 x 45) fibre + epoxy resin
J - Unstitched glass fibre mat fibre + epoxy resin + coconut shell powder
K - Stitched glass fibre mat (45) fibre + epoxy resin + coconut shell powder
L - Cross stitched glass fibre mat (45 x 45) fibre + epoxy resin + coconut shell powder

Table 1: Test results of moisture absorption of composite specimens

SPECIMEN	INITIAL WEIGHT (gm)	FINAL WEIGHT (gm)	CHANGE OF WEIGHT (gm)	% MOISTURE ABSORBED
A	1.155	1.19	0.035	3.030303
B	1.077	1.084	0.007	0.649953
C	1.171	1.2	0.0296	2.476515
D	1.117	1.15	0.033	2.954342
E	0.926	0.928	0.002	0.215982
F	1.02	1.05	0.03	2.941176
G	1.265	1.267	0.002	0.158102
H	1.136	1.15	0.014	1.232394
I	1.152	1.16	0.008	0.694444
J	1.355	1.37	0.015	1.107011
K	1.203	1.21	0.007	0.581878
L	1.349	1.36	0.011	0.815418



CONCLUSION

It can be concluded that the jute /epoxy composites described in this paper absorb water in spite of the hydrophobic character of jute and coconut shell powder. The rate of water absorption is mainly dominated by the edges of the laminate and the effect may be minimized if the laminate is well compacted, reducing the amount of inter-ply voids is mainly retained in the (open) voids between tapes and not in the internal (closed) voids within the tape itself.

Based on the graph, water absorption of the jute mat with stitching 45^{o} without coconut shell powder is very less. The water absorption character of stitched jute mat with coconut shell powder and stitched glass mat fibre with coconut shell powder is moderate.

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