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MECHANICAL PERFORMANCE OF CARBON FIBRE REINFORCED EPOXY COMPOSITES (CFRP) FABRICATION WITH SEAWEED

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ABSTRACT

In this paper three different samples of reinforced carbon fibre carried out with different weight percentage composition of seaweed. This composite sandwich made from the above materials with suitable and sufficient epoxy resin.. The sandwich composite materials undergone through non-destructive test like as vibration analysis and destructive tests such as tensile test, hardness survey and impact test. In this study predict the quality of the above composite material using by destructive and non-destructive testing methods. These test results are compared of the three compositions of composite materials then determined the good quality samples among the three.

Key Words: Composite, Carbon Fibre, Epoxy, Resin, Tensile Test, Vibration Analysis.

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1. INTRODUCTION

Composite materials are blend of at least two materials. The material used here is carbon fibers are about 5–10 micro-meter in diameter and composed mostly of carbon atoms. Carbon fibers have several advantages including high stiffness, high tensile strength, low weight, high chemical resistance, high temperature tolerance and low thermal expansion and seaweed is added to the carbon fibres in different composition to give the material strength and flexibility.

The application of polymeric composites as materials for structural design of vehicles and other constructions has led to maintain them in safe and effective manner [1-3]. A special attention has been paid to the aircraft structures, which is lightweight and reveals superior mechanical properties in order to fulfil the growing demands in the industry. Thus, the non-destructive testing techniques applied for such materials have been evaluated in several categories: effectiveness in detection, localization and identification of damage in possible early phase of their development, complexity of application and a cost of inspection. In his study the author experimentally tested three composite structures made of glass fibre-reinforced plastic, hybrid composite with a core made of the same material and face sheets made of aluminium alloy and a carbon fibre-reinforced plastic structure extracted from the vertical stabilizer of a military aircraft with barely visible impact damage and delamination. The tests were performed utilizing different strategies including PZT detecting, ultrasonic, thermography and vibration-based investigation so as to examinations the pertinence of these techniques in the ecological states of assessment of flying machine components. The performed analysis allows concluding about effectiveness of the applied methods and their specific applications in non-destructive testing of composite elements'. Investigated on the effect of carbon fibre hybridization on carbon/epoxy laminates when subjected to low velocity impacts[4-6]. In this regard, inter-ply hybrid specimens with four different stacking sequences (sandwich-like and intercalated structures) are tested and compared to non-hybrid reference laminates made of either only carbon or only glass fibre layers[7]. The response to low velocity impact tests is assessed through the evaluation of the impact and residual velocities of the projectile and the ballistic limit, determined utilizing test information, is contrasted and the outcomes given by a scientific model, appearing great understanding. The harm in composite overlays is examined by dangerous (optical microscopy) and non-damaging (ultrasonic staged exhibit) methods. Advanced fibre composite materials exhibit elastic properties and fracture mechanisms are distinguished from metals [8-9]. Consequently, the mechanics of impact resistance differs for these materials. Carbon-epoxy and aluminium-epoxy composites can exhibit brittle modes of fracture. In concentrates to improve the effect opposition of carbon-epoxy materials, customary effect tests gave next to no comprehension of the issues included. However, instrument Charpy-type tests provided considerable insight into the mechanisms associated with impact resistance. Load versus time response records can be partitioned into regions corresponding to events occurring sequentially in time. Energy absorbed by a composite specimen through the various fracture mechanisms is seen to be the distinguishing characteristic between composite systems. Two mechanisms to improve the carbon-epoxy system's impact resistance are shown to be the modification of the fibre-resin interfacial strength and hybridization with a second fibre of high strength and lower modulus[10].

The main aim of this study, the quality determine by mechanical testing and non-destructive testing method such as vibration analysis applied on the reinforced carbon fibre carried out with different weight percentage composition of seaweed.

2. MATERIALS AND METHOD

2.1. Materials Used

A total of 2 layers were fabricated using a hand lay-up technique has there is very less pultrusion industry. Composite plate is carbon fibre reinforced with seaweed. The used composite plate is carbon fibre reinforced with seaweed system shown in Table 1. Where carbon fibre, sea weed and epoxy are used as the binding matrix. The composite plate is made with the dimensions 500 mm x 50 mm x 3mm. In this work carbon fibres reinforced epoxy composites (CFRP) were fabricated with different amount of seaweed (phaeophycean) fillers with 5 Wt. %. Using hand lay-up process. Then the plate is cut according to the ASTM standard for destructive testing method using EDM. Mechanical properties such as tensile, hardness and ductility will be evaluated. The composite material used for the present study consists of unidirectional carbon fabric as reinforcement. Epoxy resin (LY556) with hardener (HY951) mix was employed for the matrix material. The filler material used is seaweed (marine algae) powder of particle size in the range of 25 to 30 µm. The materials used in this work for fabrication of composites are given below:

- Resin used: Epoxy((LY556)
- Hardener used: HY951
- Reinforcement: carbon fibre
- Filler material: Seaweed
- Specimen plate dimension: 500 mm x 50 mm x 3mm

2.2. Test Specimen

For the preparation of the composite Materials are shown in Table.1

Table1. Composite Materials Weight Percentage

S. No	Materials	Carbon fibre (%Wt.)	Seaweed (%Wt.)	Epoxy (%Wt.)
1	Sample 1	5	25	70
2	Sample 2	5	15	80
3	Sample 3	5	20	90

Figure.1. Carbon Fibre Reinforced Epoxy Composite Sample

2.4. Tensile Testing

Tensile testing uses the traditional coupon test geometry as appeared and comprises of two areas: a focal district called the measure length, inside which disappointment is relied upon to happen, and the two end locales which are braced into a hold system associated with a test machine. These finishes are normally selected with a material, for example, aluminium, to shield the example from being pounded by the grasps. This test example can be utilized for longitudinal; transverse, cross-handle and edge employ testing. It is a smart thought to clean the example sides to expel surface blemishes, particularly for transverse tests.

2.5. Hardness

Hardness can be portrayed as the capacity of a specific material (particularly inflexible plastic) to be indented. There are numerous strategies to use for deciding the hardness of composite material, for example, Rockwell Hardness, Barcol Hardness and so forth. Higher number of hardness show that the material is more diligently, which implies it have more protection from infiltration by other material. Barcol Hardness of a specific composite material is dictated by squeezing the Barcol Hardness Impresser to the composite utilizing hand. The hardness is demonstrated in the check meter at the impresser. This Barcol Hardness test is essential to screen the condition of fix of the pitch in a composite framework. In the event that the gum isn't completely fix, this will influence the execution of that composite item. Consequently, move ought to be made to totally fix the gum, for example, the season of the post-restoring ought to be longer.

2.6. Impact Testing

Usually to allude to the effect obstruction of a material. Nonetheless, this is a comprehensive term that can allude to numerous very various parts of a materials conduct in a given example. The effect obstruction of a composite may allude to the capacity of the composite to withstand a given blow with no harm , the greatest power important to break or separate a composites structure, independent of the procedure dimension of harm , (the effect quality), the measure of vitality that is consumed by a given mass of the composite or maybe the dimension of harm that a composite can continue amid effect stacking without enduring undue decrease to some essential basic capacity after the effect occasion (harm resistance).

2.7. Flexural Test

Flexural tests are commonly used to decide the flexural modulus or flexural quality of a Material. A flexure test is more reasonable than a tractable test and test outcomes are marginally unique. The material is laid on a level plane more than two points of contact (lower bolster range) and afterward a power is connected to the highest point of the material through possibly a couple of purposes of contact (upper stacking length) until the example falls flat. The greatest recorded power is the flexural Strength of that specific example.

2.8. Non-Destructive Testing

Non-destructive testing (NDT) is the way toward examining, testing, or assessing materials, segments or congregations for discontinuities, or contrasts in attributes without crushing the usefulness of the part or framework. As such, when the examination or test is finished the part can at present be utilized.

3. RESULTS AND DISCUSSION

The Present study has been done on three samples made of with carbon fiber and Epoxy was formed using uniform composition of seaweed. Once the composite samples are formed, the quality of the composite material sample is determined using destructive test methods such as tensile test, impact test and hardness survey, then samples undergone through the nondestructive testing method (vibration analysis). The results are given below

3.1. Tensile Strength

The strength of the composite material determined by tensile test. The test specimen

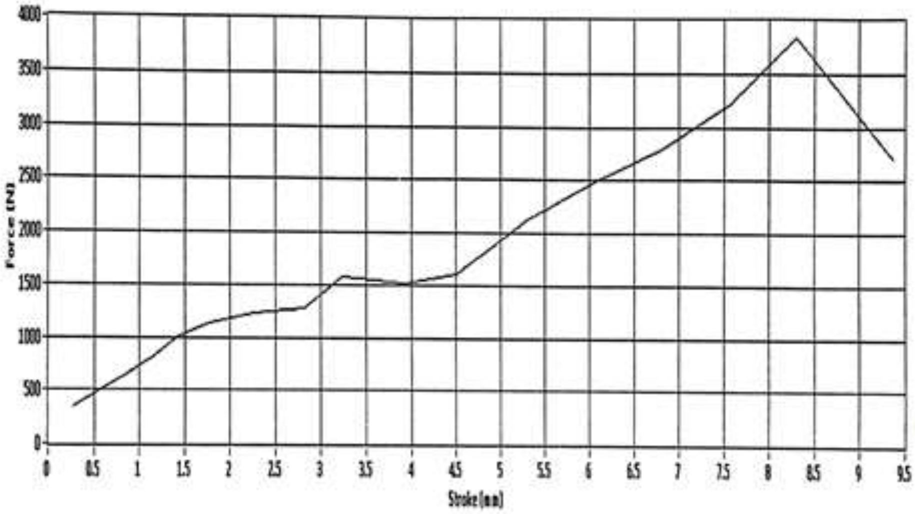

Figure.2. Tensile Test Plot

designed, according ASTM D 638 standard and test conducted by under the room temperature. The sample 2 is given good strength comparing the other samples(Fig.2). The strength value is 3800N observed in this test.

3.2. Hardness Survey

The hardness value obtained from barcol hardness. Hardness value followed according ASTM D 2583 standard. The Fig. 3 shows the hardness value of three samples. Each sample hardness value measured in three different places. The result shows that the sample 3 has the highest value and sample 1 has the minimum barcol hardness value because the reason of seaweed content. The sample 2 has nearly equal to base materials value among the three samples. The sample 2 is seen as the better sample here because the barcol hardness value shouldn't be too high or too low.

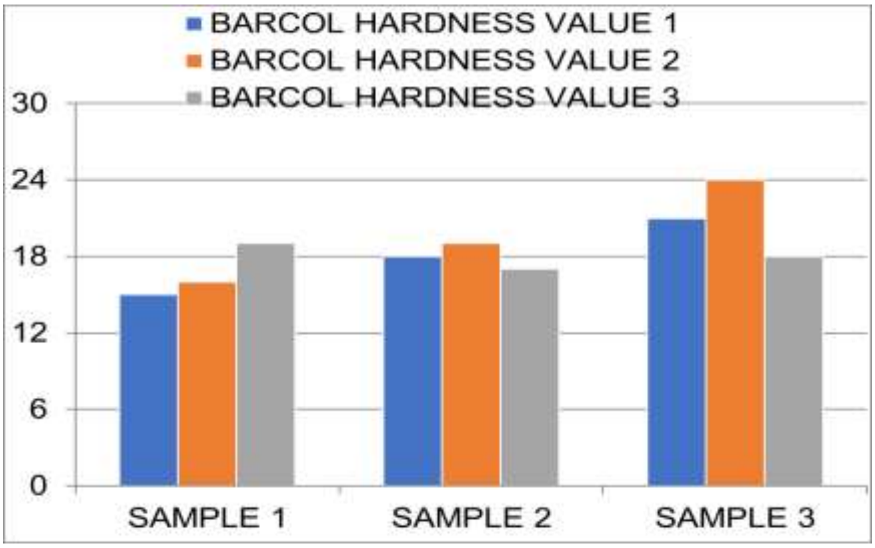

Figure.3. Hardness Survey

3.3. Impact Testing

Impact test is conducted in room temperature using ASTM D 256 standard. Impact strength is observed almost equal in 2 Joules in all the three samples.

3.4. Flexural Testing

Flexural test is conducted in given three samples. The sample 2 is high strength value comparing other sample. Fig. 4 is shown the flexural strength of the given three samples. The flexural load is observed almost 0.44 KN.

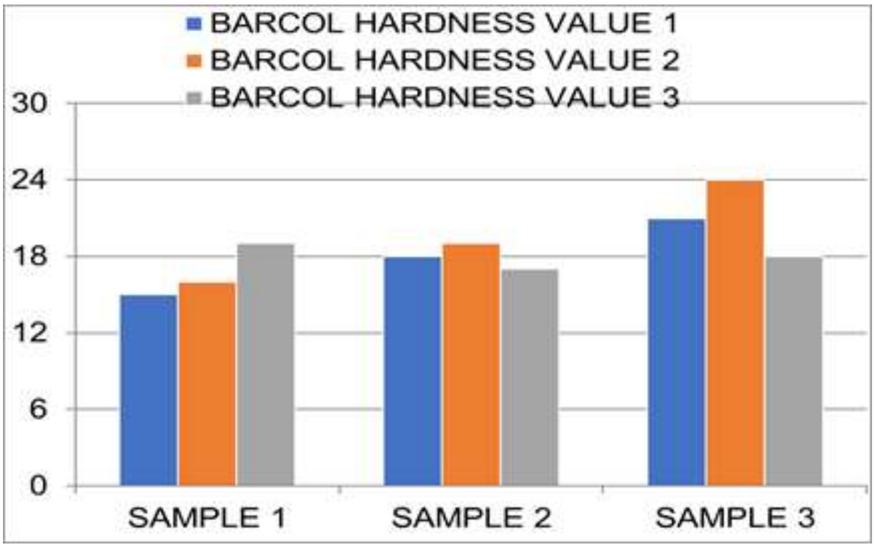

Figure.4. Flexural Test Plot

3.5. Vibration analysis Testing:

Now the strength of the bond between seaweed and carbon fiber mesh with epoxy resin as binder is analyzed using vibrational analysis testing. This test determined the quality of joints or binding between given materials. The sample undergone with a frequency of 376Hz. It is shown is fig.5. Due to the frequency sent through the probe the echo signal is produced. This testing method determined adhesive and non-adhesive behaviour of composite material using echo signal display by A-scan method. In general, the echo signal get on the composite material is low, then it means there is good adhesive behaviour between the two material other hand, high echo signal get on the composite material it means the adhesive is not good between the material. In this study, the sample 2 is get lower echo amplitude comparing other samples is observed from this testing method.

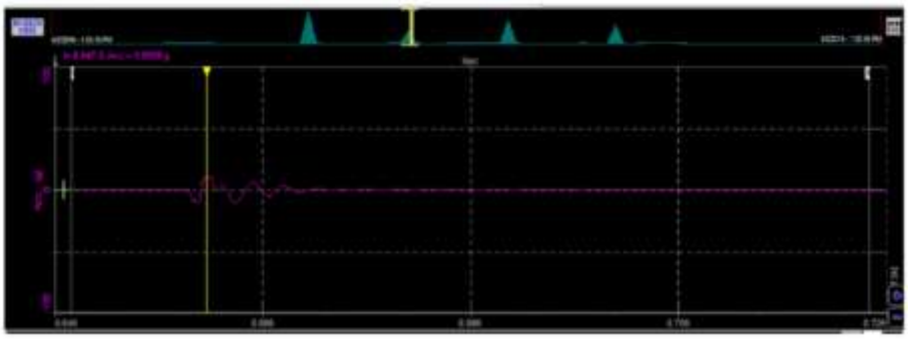

Figure.5. The plot between thickness versus amplitude in vibration analysis test using frequency of 376 Hz.

4. CONCLUSION

In this study, the mechanical properties and vibration test of three sandwich composite samples of seaweed and carbon fiber mesh is found and compared to find the better composite sample with the best results. The obtained results are concluded that the following results

- Tensile strength of sample 2 = 520
- Impact strength of sample 2= 2J
- Flexural strength of sample 2= 19 KN

The sample 2 is found that the good adhesion comparing other samples using vibration analysis testing method.

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