International Journal of Current Advanced Research
ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: 6.614
Available Online at www.journalijcar.org
Volume 7; Issue 6(D); June 2018; Page No. 13363-13366
DOI: http://dx.doi.org/10.24327/ijcar.2018.13366.2380

Research Article

A PEDANTIC REVIEW ON MECHANICAL BEHAVIOR OF FIBER SANDWICHED COMPOSITE MATERIALS

Harshal Rane[1*]., SushilKumarBagga[2] and Sanjay Purkar[3]

[1,2]Bhagwant University, Ajmer, Rajasthan, India
[3]TSM Engineering College, Burhanpur, Madhya Pradesh, India

A R T I C L E   I N F O

Article History:

Received 11th March, 2018
Received in revised form 6th April, 2018 Accepted 26th May, 2018
Published online 28th June, 2018

Key words:

Strength, Composite Materials, Sandwiched Composite Materials, Fiber Sandwiched Composite Materials, etc.

A B S T R A C T

In present day, there is demand of high class materials having good strength, light weight and low cost investment for many engineering applications. However, this demand is satisfied by composite materials but they are useful in some applications only. So, development of newly generated sandwiched composite materials which are applicable to almost all engineering applications is the need of this century.
The present work includes the theoretical review on the development of fiber sandwiched composite materials and studied their mechanical Testing. The literature presents an explanations about natural fiber and polymer fiber. Several materials and methodology have discussed and the Conclusion have discussed.

INTRODUCTION

The application of composite materials like Fiber Reinforce Polymer (FRP), Carbon Fiber Reinforce Polymer (CFRP) and Glass Fiber Reinforce Polymer (GFRP) are increasing rapidly in industrial use. This is because of characteristics of these materials including high strength, low cost investment and minimum weight. In aerospace industries, these materials are most useful in past thirty years. Composite materials helping us in combination with different materials to achieve the desired properties. In general, these materials has taken a part of sheet metal in many automobile industries. Every type of such composite material has its own properties and can be change or adopted easily by changing either percentage of content or change of content. The composite is the combination of two constituents one is reinforcing (in form of sheet, fiber) and other is matrix (in form of continues structure). The figure 1 represent a type of composite sandwich material. It consist of face sheets at top and bottom integrated by core material like honeycomb foam jointed by some adhesives or epoxy resin.The face sheets generally takes planer and bending load wile core materials takes transverse loading. Such sandwich materials have more strength, they are widely used in aero plane, satellite, automobile, transportation and many polymer industries.

Corresponding author:* **Harshal Rane
Bhagwant University, Ajmer, Rajasthan, India

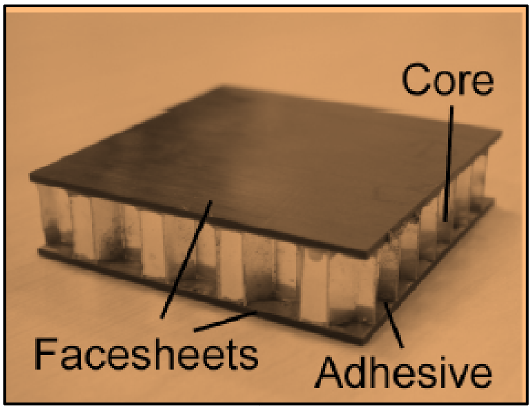

Figure 1 Composite Sandwich Material

Simple metals and their alloys are not sufficient to meet the demands of today's competitive world. An automobile company has a demand to have more performance of vehicle, there should be requirement to replace existing material by different material. Combination of two or more material are most common in such industry. Thus, by this way the demand of composites are increasing. The paper presents the pedantic view of composite materials used in industrial sector to develop a new technology in world.

LITERATURE SURVEY

Nobuo et al describes the recent developments in smart technologies to inspect the reliability of smart structure having composite face sheets. They focused on sandwich technology in aerospace area. The damages in the composite structure were identified and damage detection techniques like dynamic response, optical fiber and wave propagation were explained. The authors' proposed new type of sandwich structure which may fabricated for meeting the demands of aerospace area.[1]

Nunna et al made a review on the mechanical characteristics of natural fiber based hybrid composites. The hybrid composite materials were applicable to enhance the mechanical properties. The hybrid composite materials were made by combining single or double matrix form. The properties of hybrid materials were improved by changing their fiber layer, volume fraction of mixture and different orientation of fibers. The mechanical properties of such hybrid materials also depends on the treatment given them like natural fiber with NaOH improves the properties. [2]

Porras and Maranon investigated that the eco-friendly sandwich cores panels were produced from both renewable and biodegradable sources by enhanced fabrication. The in-plane compressive loading applied to identify the mechanical behavior of sandwich panel. Experimental testing has performed to obtain the stress-strain curve and linear elastic region. It conclude that the sandwich panel is improving the mechanical behavior. [3]

Shama, rana and fangueiro concluded that the natural fiber composites are most useful in structural applications. The goal considered here that a review on recent developments in composite structures. Several characteristics of natural fiber and their limitation have been discussed. [4]

Patil and Chawla investigated the performance of ZnS and TiO_2 filler composite. It was found that, the mechanical characteristics of ZnS filler composite have better performance than TiO_2 filler composite. The Impact toughness has been identified and compared to explained composites and found that the unfilled glass composite have more characteristics. The ultimate aim was found that the ZnS filler composite is more useful than TiO_2 filler composite material. [5]

Alagarraja et al fabricated and tested the Sisal-Glass Fiber Reinforce Polymer (GFRP) composite samples. For that purpose, several testing like tensile, flexural and impact were carried out to obtain the characteristics of different fabricated materials. It was found that Sisal-Glass Fiber Reinforce Polymer (GFRP) composite is much more strength as compared to single metal and their alloys.[6]

Roslan et al investigated the performance of honeycomb sandwich structures with changing various configurations by applying tensile and compressive test. The effect of fiber orientation on tensile strength were determined for unidirectional bamboo-epoxy composites and found that 0^0orientation is much more strengthful than other orientations. [7]

*Sudhir Mathapati and Shivukumar Mathapati*i nvestigated that 3% volume fraction of glass fiber holds better tensile strength as compare to 1% and 2%. The compressive strength is considerably less for 1% fiber. The results of experimental tests were validated by FEA approach. The certain errors have considered such as matrix mixture and air bubbles during fabrication. [8]

Uthirapathy, Loganathan and Kayaroganam fabricated the specimens of carbon fiber reinforce aluminium sandwich material and tested tensile, flexural and shear failure. It was concluded that tensile and flexural strength increases to certain limit and then decreases. The fracture surfaces were analyzed by Scanning Electron Microscopy (SEM). [9]

MATERIALS AND METHODOLOGY

Materials

Fiber is a long substance significantly short in width. It forms a micro wired structure. Fibers are mainly classified into two types one is Natural Fiber and other is Synthetic Fiber. The Natural Fibers are those fibers which are obtained from natural resources like plants, animals, etc. The examples of natural fibers are Jute, Sisal, Cotton, and Hemp. While the Synthetic fibers are those which are manufactured by artificial ways like Nylon Fiber.[10]

Jute is the most important vegetable fiber after cotton due to its abilities.Jute is used chiefly inmaking cloth for wrapping, the fibers are also hotter into curtains, chair covers, carpets. Today jute is being replaced by synthetic fibers in many of their applications, some applications take advantage of jute's biodegradable characteristics, where synthetic fibers would be unsuitable. The fibers are used independently or blended with other types of fiber to obtain twine and rope.

Sisal Fiber is extracted by a decortication process, where leaves are crushed and brushed away by a rotating wheel with knives, so that only fibers remain. For more production, the leaves are transported to a central decortication plant, where water is used to wash away the wastage materials.The fiber is then dried, brushed for export. Drying is important as fiber quality depends mostly on moisture content. Fiber is cleaned by brushing. Dry fibers are sorted into various grades.

Aluminium is white coloured metal obtained by electrical processes from alumina, which is produced from a bauxite.It has a light weight and having specific gravity 2.7. The tensile ability of the metal varies from 70 MPa to 130 MPa. In its pure state, it is weak and soft.But when mixed withother alloys, it becomes hard and rigid. The main property of aluminium used widely is good electrical conductivity.

Steelis an alloy of iron and 1.5% Carbon. The carbonoccurs in the form of iron carbide, because of its nature to increase the hardness and strength of thesteel. Other elements like silicon, Sulphur, phosphorus and manganese are also present to certain amount to impart certain desired properties to steel. Most of the steel generatedtoday's is Plain Carbon Steel.

A Sandwiched Composite Materialis a type of composite materials that is produced by joining two thin face sheets to a lightweight core (Aluminium or Steel core with any fiber face sheet). The core material have normally low strength, but its thickness provides the sandwich composite with high flexural ability with overall minimum density. The examples of core materials are Open-cell and closed-cell foams like polyethersulfone polyvinylchloride, polyurethane, polyethylene or polystyrene foams, balsa wood, syntactic foams, and honeycombs. Laminates of glass or carbon fiber-reinforced plastics (FRP, CFRP, and GFRP) are widely used as face sheet materials. In some practical applications the Sheet metal is also used. The core is joined to the face sheets with a strong adhesives. A type of such sandwich material is shown in figure 2.[11]

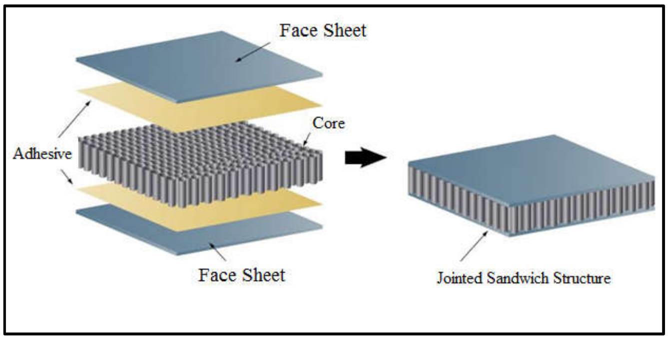

Figure 2 Formation of Sandwich Structure

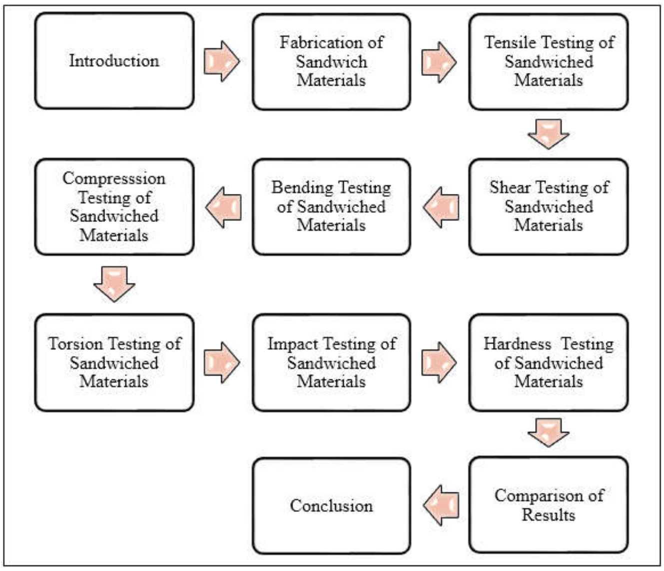

Figure 3 Methodology for Testing of Sandwich Structure

The methodology adopted for sandwich materials is shown in figure 3. It includes fabrication and testing of various specimens having combination of different materials and different fibers with different orientations. [12]

Material Testing

Tensile Test

The tensile test was made by Leonardo da Vinci around 1495. He designed the quality of ropes. A container was hung up with a rope and Leonardo emptied sand into the pail. The sand's mass was estimated as the rope broke. The rope's strength was corresponding with the mass of the sand. He found that if the length of the rope was expanded its strength diminished. This revelation is outstanding these days, in light of the fact that the more drawn out the rope is the more conceivable it is that there are more deformities in the material.The main aim of the tensile test is to determine material characteristics. Several standards exist for the tensile test, which depends onthe temperature, the material of the specimen, etc.Force and elongation will be measured. In tensile test, the specimen has only one axis tensile stress. Test machines are of 3 types: Mechanical, Hydraulic and Electro - Dynamic. This test carried on Universal Testing Machine (UTM) as shown in figure 4.

Figure 4 Universal Testing Machine

Compression Test

When a material is subjected to compressive load, the relationship between stress and strain issameto that obtained for a tensile testing. Up to a certain value of stress, the material behaves in elastic manner, i.e. stress is proportional to strain. Beyond this value, plastic stage starts, i.e. more strainstarts than happening in elastic limit for any increased value of loading. It is seen that a compressiontest is more difficult to be conducted than standard tensile test due to

1. Specimen must have more lateral area to resist any buckling,
2. The specimen may strainhardened as deformation proceeds, and
3. Cross-section of the specimen increases with deformation, thereby requiring substantial increase in the required load.

Flexural Test

Making specimens from brittle materials, such as glasses, for tension tests is difficult because of the problems involved in machining them to accurate dimensions. Furthermore, such specimens are sensitive to certain surface defects and notches, and also clamping specimens for testing is difficult. A mainly used test method for measuring strength of such materials is the bend or flexure test. The test specimen can have anany cross section and is uniform along the whole length. Such a specimen is very less expensive to prepare than a tensile specimen. The test is conducted with the same kind of UTM used for tensile and compressive strength measurements. The test specimen is supported at the ends and the load is applied at the centre. The longitudinal stresses in the specimens are tensile at their bottom surfaces and compressive at their top surfaces. The bend or flexural strength is defined as the maximum uniaxial tensile strength at failure and it is often referred to as the flexural strength or Modulus of Rupture (MOR).[13], [14]

Torsional Test

Like tensile and flexural tests, torsion test is also useful in determining the modulus of rigidity. Many applications require rotary motion such as shafts. Thus, torsion test conducted to inspect the strength of rotary element by twisting or rotation. It gives the relation between the torque and angle of twist or angular deformation.

CONCLUSION

The paper informs the literature on mechanical behavior fiber sandwiched composite materials and concludes following outcomes:

1. The composite materials are useful in today's engineering applications.
2. Natural fibers plays a role in increasing the strength of composite materials.
3. The synthetic fibers are superior to natural fibers for fabricating the materials.
4. The testing and comparison of such sandwiched composite materials is challenge for future study.

References

1. N. Takeda, S. Minakuchi and Y. Okabe, "Smart Composite Sandwich Structures for Future Aerospace Application- Damage Detection and Supression-A Review," *Journal of Solid Mechanics and Materials Engineering*, vol. 1, no. 1, pp. 3-18, 2007.
2. S. Nunna, P. Ravi Chandra, S. Shrivastava and A. Jalan, "A review on mechanical behavior of natural fiber based hybrid composites," *Journal of Reinforced Plastics and Composites,* vol. 31, no. 11, pp. 759-769, 2012.
3. A. Porras and A. Maranon, "Eco Friendly Core Sandwich Panel Reinforce with Manicaria Fiber and Plamatrix," in 15th Europian Conference on Composite Materials, Venice, Italy, 2012.
4. P. Shama, S. Rana and R. Fangueiro, "Natural Fiber Composites for Structural Applications," Mechanics of Nano, Micro and Macro Composite Structures, pp. 1-2, 2012.
5. D. Patil and V. N. Chawla, "Mechanical Properties of Glass Fiber reinforcement Epoxy Composites," *International Journal of Scientific Engineering and Research (IJSER),* vol. 1, no. 4, pp. 6-9, 2013.
6. K. Alagarraja, A. Dhamodharan, K. Gopinathan, R. Mathan Raj and K. Ram Kumar, "Fabrication and Testing of Fiber Reinforced Polymer Composites Materials," in National Conference on Contemporary Approaches in Mechanical, Automobile and Building sciences, Melmaruvathur, Tamil Nadu, India, 2014.
7. S. Roslan, M. Hassan, Z. Rasid, S. Zaki, Y. Daud, S. Aziz, S. Sarip and Z. Ismail, "Mechanical properties of bamboo reinforced epoxy sandwich structure composites," *International Journal of Automotive and Mechanical Engineering*, vol. 12, pp. 2882-2892, 2015.
8. S. Mathapati and S. Mathapati, "Testing And Analysis of Mechanical Properties of E- Glass Fiber Reinforced Epoxy Polymer Composites," *International Journal of Research and Innovations in Science and Technology*, vol. 1, no. 1, pp. 46-53, 2015.
9. T. Uthirapathy, K. Loganathan and P. Kayaroganam, "Mechanical Properties Evaluation of the Carbon Fibre Reinforced Aluminium Sandwich Composites," Materials Research, vol. 18, no. 5, pp. 1029-1037, 2015.
10. V. K., V. R. , S. J. and S. K. S., "Characterization of Epoxy based Natural Fiber Sandwich Composite," *International Journal for Innovative Research in Science & Technology*, vol. 2, no. 5, pp. 187-196, 2015.
11. C. Belkacemi and B. Bezzazi, "Sandwich panels from cork and polyester in presence of epoxy resin as interfacial adhesive," *International Journal of Physical Sciences,* vol. 11, no. 24, pp. 336-346, 2016.
12. F. Kadioglu and H. Puskul, "Effects of Different Fiber Orientations on the Shear Strength Performance of Composite Adhesive Joints," *International Journal of Materials and Metallurgical Engineering*, vol. 10, no. 1, pp. 65-68, 201.
13. S. P. Arora and R. Nirmala, "Study the Effect of Core Design on Mechanical Behaviour of Honeycomb Sandwich Structures under Three Point Bending," *International Journal of Innovative Research in Science, Engineering and Technology,* vol. 5, no. 6, pp. 6444-9449, 2016.
14. F. Fernandes, J. Tavares, R. Alves de Sousa, A. Pereira and J. Esteves, "Manufacturing and testing composites based natural materials," Proceedia Manufacturing, vol. 13, pp. 227-236, 2017.

How to cite this article:

Harshal Rane *et al* (2018) 'A Pedantic Review on Mechanical Behavior of Fiber Sandwiched Composite Materials', *International Journal of Current Advanced Research,* 07(6), pp. 13363-13366.
DOI: http://dx.doi.org/10.24327/ijcar.2018.13366.2380

****