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Tensile and Flexural Properties of Aramide/Glass/Onion Fibre Reinforced Epoxy Composites

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Abstracts

Fiber-reinforced Epoxy Composites have played a dominant role for a long time in a variety of applications for their high strength, light weight, cost effectiveness and degradability. The fiber which serves as a reinforcement in reinforced plastics may be synthetic or natural. In this connection, an investigation has been carried out to make use of Aramide/Glass/Onion fibers. The present work describes the development and characterization of mechanical properties of Aramide/Glass/Onion fiber based composites consisting of reinforcement and epoxy as matrix. Epoxy having good mechanical properties and it is very cheap. Experiments are carried out to study the effect of fiber on mechanical properties of these composites. In the present work, epoxy, Aramide/Glass/Onion fiber reinforced composites are developed and their mechanical properties are evaluated and then compared. Investigation of interfacial bonding between Aramide/Glass/Onion fibers reinforced epoxy composites will be carried out. Tensile and Flexural properties are determined using Universal Testing Machine (UTM), Chemical resistances will be done to these composites. And also comparison of Scanning Electron Microscope (SEM) analysis is carried out.

Keywords: Aramide fiber, Glass fiber, Onion fiber, Epoxy resin, SEM Flexural properties, Chemical resistance, tensile properties, Reinforced composites

Introduction

Several studies on the composites made from epoxy matrix and natural fibers onion, jute, wood, banana, sisal, cotton, coir and wheat straw were reported in the literature. Jindal (1) reported the development of bamboo fiber reinforced plastic composites using araldite (CIBA CY 230) resin as matrix. Though bamboo is extensively used as a valuable material from times immemorial (because of its high strength and low weight), the studies on this fiber reinforced plastics re meager. In the present work, the aramide, onion & glass fiber reinforced high performance epoxy reinforced composites were developed and their Flexural and tensile properties with fiber content were studied. The author investigated the interfacial bonding between aramide, onion, glass reinforced epoxy composites. The effect of bonding between aramide, onion, glass composites was also studied.

Materials and methods

Materials

High performance epoxy resin LY 556 and the curing agent hardener HY 951 system were used as the matrix. Onion fibers were procured from local area. Some of these fibers were soaked in 1% NaOH solution for 30 min. to remove any greasy materials and hemi-cellulose, washed thoroughly in distilled water and dried under the sun for one week. The fibers with a thickness of 0.3mm were selected in the mat form. The glass chopped strand mat was used in making the reinforced composite percentage.

Preparation of mould

For making the composites, a moulding box was prepared with glass with 200mmx200mmx3mm mould (length x width x thickness)

Preparation of the composite and the test specimens

The mould cavity was coated with a thin layer of aqueous solution of poly vinyl alchol (PVA) which acts as a good releasing agent. Futher a thin coating of hard wax was laid over it and finally another thin layer of PVA was coated. Each coat was allowed to dry for 20 min at room temperature. A 3mm thick plate was made from the epoxy and hardener taken in the ratio of 100 and 10 parts by weight respectively. Then the moulding box was loaded with the matrix mixture and onion & glass fiber in random orientation (with varying percentage) and was placed in a vacuum oven which was maintained at 100^{o}c for 3 hours to complete curing. After curing the plate was removed from the moulding box with simple tapering and it was cut in to samples for flexural test with dimensions of 150mmx20mmx3mm are cut as per ASTM specifications. For comparison sake the specimen for matrix material were also prepared in similar lines. For Scanning electron microscope analysis the cryogenically cooled and fractured

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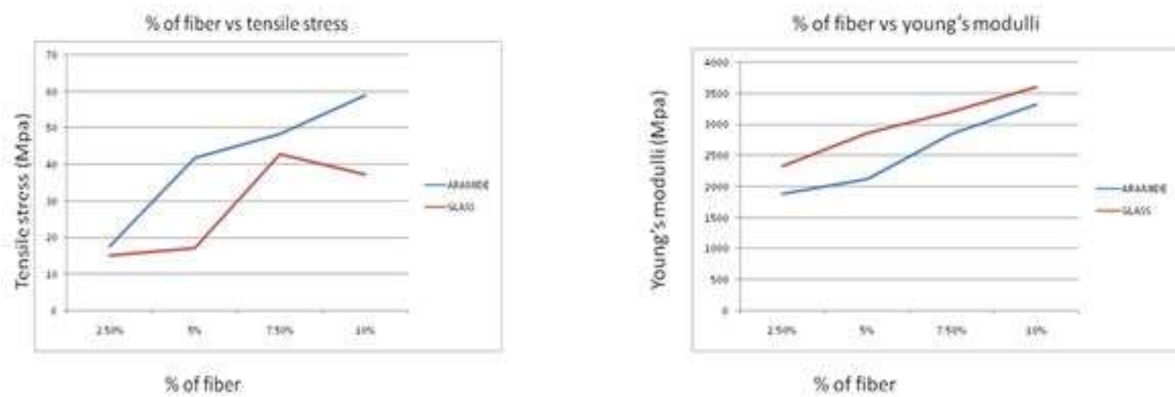
specimen surfaces were gold coated and the fractures surface was observed using scanning electron microscope.

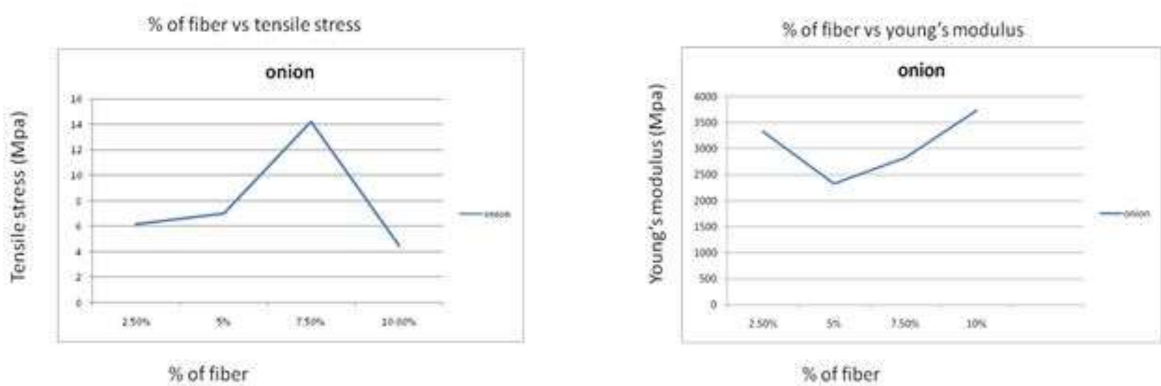
Tensile and flexural load measurement

The tensile and flexural modulus were determined using M/S Instron 3369 Model UTM. The cross head speed for flexural test was maintained at 10mm/min respectively. In each case 5 samples were tested and the average values are reported.



The variation of Stress with the ratio of Aramide and Glass fiber Reinforced Epoxy composites

The variation of Flexural modulus with ratio of Aramide and Glass fibers reinforced Epoxy composites



The variation of tensile stress and young's modulus of onion fiber reinforced Epoxy composites

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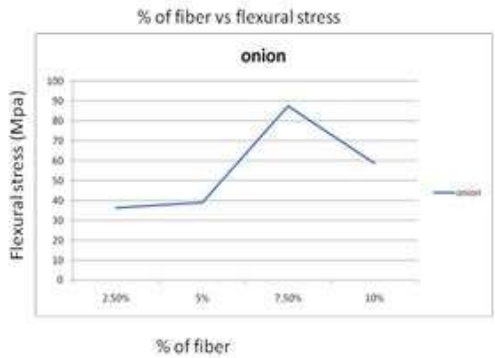
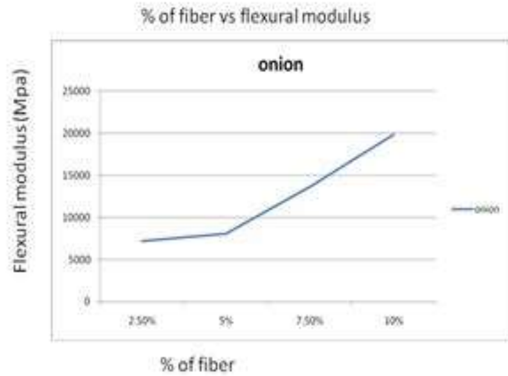




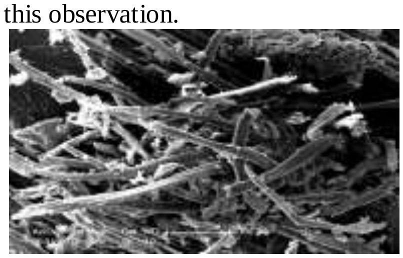
The variation of flexural stress and flexural modulus of onion fiber reinforced Epoxy composites

EPOXY composites
SEM ANALYSIS

To probe the bonding between the reinforcement and matrix, the Scanning electron micrograms of fractured surfaces of aramide, onion, glass reinforced epoxy composites were recorded. These micrograms were recorded at different magnifications and regions. The analysis of the micrograms of the composites prepared under different conditions is presented in the following paragraphs.

Untreated onion fiber

The micrograms of fractured surfaces of untreated onion fiber are presented in figure (a),(b),(c&d). Figure (a)&(b) represents the fractograms at two regions with a magnification of 100X. Figure (c)&(d) and the fractograms at these regions at magnification of 200X. From all these micrograms it is evident that fiber pullout is observed, indicating a poor bonding between the fibers. When the interfacial bonding is poor, the mechanical properties of the composites will be inferior. All the mechanical properties of the glass/onion/aramide fiber composites studied indicate that these properties are the least for these composites with untreated onion fibers. The poor adhesion is indicated in figure 2 supports this observation.



(a)

(b)

Fig: SEM of untreated Onion fiber (a) and (b) at two regions 100x magnification

The fractograms of onion are presented in fig (a),(b).these fractograms were recorded at two different regions and 100X and 200X magnifications. From these micrograms it is clearly evident that the surface of the fiber. The elimination of hemi-cellulose from the surface of the onion fiber may be responsible for the roughening of the surface. Here, though the bonding is improved, fiber pullout is reduced. Thus the treatment improved the bonding. This is in accordance with the mechanical properties of these composites.

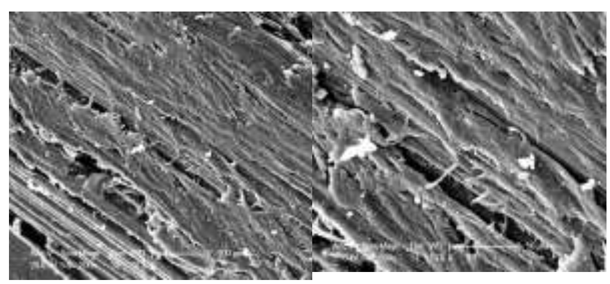


Fig: SEM of treated Onion fiber (a) and (b) at two regions 100x magnification

Chemical resistance of composites

The chemical resistance of the composites was studied as per ASTM D 543-87 method. For chemical resistance test, the acids namely concentrated hydrochloric acid (10%), concentrated nitric acid (40%) and glacial acetic acid (8%), namely aqueous solutions of sodium hydroxide (10%), ammonium hydroxide

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(10%) and sodium carbonate (20%) and the solvents-Benzene, carbon tetra chloride, toluene and water were selected. In each case, ten pre-weighted samples were dipped in the respective chemicals under study for 24 hours, removed and immediately washed thoroughly with distilled water and dried by pressing them on both sides by filter papers. The final weight of the samples and % weight loss/gain was determined. The resistance test was repeated for ten samples in each case and the average values reported.

Chemicals	Matrix	Composite
40 % nitric acid	+0.2876	+0.27541
10% Hydrochloric acid	+0.9365	+0.35491
8% Acetic acid	+0.3365	+2.4679
10% sodium hydroxide	-0.4761	-2.2191
20% sodium carbonate	+0.747	-3.7756
10% Ammonium Hydroxide	- 0.3243	-2.9985
Benzene	-1.321	-1.346
Toluene	-0.491	-2.340
Carbon tetrachloride	-1.124	+4.4858
Water	-1.112	-1.634

Conclusion

These experimental investigation of mechanical behavior of aramide/glass/onion reinforced epoxy composites leads to conclusions. This work shows that successful fabrication of jute and aramide/glass/onion fiber reinforced epoxy composites with different fiber weights is possible by simple hand lay-up technique. It has been noticed that the mechanical properties of the composites such as tensile strength, flexural strength of the composites are greatly influenced by the fiber weights. The mechanical properties of the aramide fiber reinforced matrices show optimum value at 7.5gms weight. Maximum tensile strength is obtained at 7.5gms weight for glass fiber. Maximum flexural stress is obtained at 7.5gms weight for onion fiber. When compare to aramide and glass reinforced epoxy composites tensile stress, young's modulus, flexural stress and flexural modulus is maximum for aramide reinforced epoxy composite. It is observed that the Tensile properties increases and then decreases with varying fiber content. The elimination of amorphous hemi-cellulose leading to higher crystallinity of the Aramide/ Onion/Glass fibers may be responsible for these observations. Chemical resistance test and scanning electron microscope (SEM) analysis of aramide/glass/onion fiber reinforced epoxy composites were also studied.

References

1. Jindal, U.C (1986) development and testing of bamboo fibers reinforced plastic composites journal of composites 20: 19 (1986)
2. Varada Rajulu , A., Narasimha Chary, K., Rama Chandra Reddy, G. Void content, density, weight reduction and mechanical properties of short bamboo fibers/ stryrenated polyster composites.j. Bamboo & Ruttan.,2(2):95-102(2003).
3. Varada Rajulu, A., Narasimha Chary, K., Rama Chandra Reddy, G.,Meng, Y.Z. Void content, density, weight reduction and mechanical properties of short bamboo fibers/ stryrenated polyster composites.j. reinforced plastics and composites, 23(2):127-130.(2004).
4. Varada Rajulu, A., Babu Rao, G ., Lakshminarayana Reddy, R. Chemical resistance and tensile properties of epoxy/poly carbonate blend coated bamboo fibers, journal of reinforced plastics and composites 20(4):335-340.(2001).
5. Varada Rajulu, A., Ganga Devi, L., Babu Rao, G., Lakshminarayana Reddy, R. Chemical resistance and tensile properties of epoxy/unsaturated blend coated bamboo fibers, journal of reinforced plastics and composites 22(11) : 1029-1034. (2003).
6. Varada Rajulu, A., Allah Baksh, S., Narasimha Chary Reddy, G.,Chemical resistance and tensile properties of short bamboo fiber reinforced epoxy composites, journal of reinforced plastics and composites 17(17): 1507-1511(1998).
7. Varada Rajulu, A., Narasimha Chary, K., Rama Chandra Reddy, G., Babu Rao, G.,Ganga Devi, L Thermo gravimetric analysis of dendro calamus strictus bamboo fibers, journal of bamboo and Ruttan I(3): 247-250.(2002).
8. Varada Rajulu, A., Narasimha Chary, K., Rama Chandra Reddy, G., Chemical resistance and tensile properties of stryrenated polyster – coated bamboo fibers, journal of fiber and textile research. 23: 49-51(1998).
9. Varada Rajulu, A., Narasimha Chary, K., Rama Chandra Reddy, G. Chemical resistance and

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

tensile properties of epoxy - coated bamboo fibers, Indian journal of fiber and textile research. 21: 223-224.(1998).

10. Srinivasulu, S., Varada Rajulu, A ., Narasimha Chary, K., Rama Chandra Reddy, G. Chemical resistance and tensile properties of poly carbonate toughened epoxy - bamboo fibers, bulletin of pure and applied sciences. 25(2) :137-142.(2006).