International Journal of Research (IJR) Vol-1, Issue-5, June 2014 **ISSN 2348-6848**

Effect Of Recycled Rubber Filler On The Mechanical Characteristics Of E-Glass/Epoxy Hybrid Composites

Avinash N V [1],Pramod Kumar N [2],Sudheer K V[3]and Umashankar K S[4]

Abstract:

A hybrid composite material is being prepared using recycled rubber as filler, epoxy resin as matrix with woven glass fibre as reinforcement.Two types of composites are preparedby adding without any filler and with recycled rubber filler.Hand layup technique is used for preparing the composites. 400 gsm glass woven fabrics are used in both cases. The flexural test was carried out by three point bending method. Additionally, the modulus of elasticity E was found out in tensile test in case of both Plain and new hybrid composite.The 6 % rubber filled composites shown the higher flexural strength and the elasticity is increased with increase in the filler addition.

Keywords:

Glass fibre, Recycled rubber, Flexural test, Tensile test,Epoxy

[123] *PG Students., Dept. of Mechanical Engineering, KVGCE, SULLIA, DK – 574327 VTU, Belgaum. Karnataka, India,[1]E-mail:nvavinash50@gmail.com*
[4]Professor., Dept. of Mechanical Engineering
KVGCE, SULLIA, DK – 574327, VTU, Belgaum, Karnataka, India ,[4]E-mail:ukskvgce@gmail.com
[2]E-mail:pramodnk90@gmailcom, [3] E-mail: sudheerkv21@gmail.com

Introduction

In this modern era, road transportation is highly increased, the utilisation of tyres in the vehicles taken a prominent role. After a certain period, these tyres will be worn out and it can't be used. The disposal of waste rubber from the tyres is a big problem in most of the deloped and developing countries [1]. The present work is one such attempt to reuse the rubber for some special purpose applications. Rubber filled concrete is used in Highway medians, sound barriers and other transportation structures where high strength is not required [2]. The manufacturing methods and experimental results concerning to the mechanical behaviour in case of the composite materials filled with wood flour obtained by recycling of the wood wastes is shown in the works [3,4]. The recycled materials from vegetable waste in a matrix based on polymer-modified cement were used in the civil engineering field [5]. The research [6] shows the thermo-mechanical recycling of post-consumed plastic bottles, and its use as composite materials for engineering applications. The particles obtained from recycling of CDs DVDs were used to make composite materials [7]. The aluminium wastes could be used to manufacture a hybrid sandwich as core material and aluminium as skin [8, 9] showed that adding rubber particles as aggregates in cement composites gave good result in terms of compressive and to tensile strengths. It also induced a significant decrease of the modulus of elasticity.

Materials and Methods Used

The main materials used are,1)Epoxy resin (araldite GY250), 2)Glass fiber (400 gsm), 3)Recycled rubber (microns).

Epoxy is the cured end product of epoxy resins, as well as a colloquial name for the epoxide functional group. Epoxy resins, also known as polyepoxides are a class of reactive prepolymers and polymers which contain epoxide groups. Epoxy resins may be reacted either with themselves through catalytic homopolymerisation, or with a wide range of co-reactants including polyfunctional amines, acids. These co-reactants are often referred to as hardeners or curatives, and the cross-linking reaction is commonly referred to as curing. Glass fiber is a material consisting of numerous extremely fine fibers of glass. It is most commonly used as reinforcement material because of is exceptional properties. Although not as strong or as rigid as carbon fiber, it is much cheaper and significantly less brittle. In this work 600 micron size recycled rubber is used as filler. In this work 600 micron sized recycled rubber filler is used. By using a sieve of micron the required size rubber filler was carefully taken.

Figure 1. Milled recycled rubber filler.

Figure 2. Die arrangement

As per the calculations 16 layers of 250x250 sized glass fiber was cut. The required amount of Epoxy resin was weighed. Calculated amount of recycled rubber filler of microns was added. The different percentages of recycled rubber used are: 3%, 6%, 9%. 3% of hardner was mixed and thoroughly stirred. Then by using Hand layup technique the glass fiber along with resin was compressed and cured in the die for 24hours.

Figure 3. Cured sample

Figure 4. Test specimen

Then, the specimens were cut from the plates for the flexural test (three-point method), tensile test according to the ASTM standards. The speed of loading was 1.5 mm/min during both the bending (flexural test) and tensile test. Before each test of a specimen, the dimensions of its cross-section were accurately measured.

In the same manner, the testing machine recorded pairs of values during the tensile tests: tensile force F and elongation of the tensile specimen. It may note that to obtain more data about mechanical behaviour in

tensile test, an extensometer is initially mounted on each tensile specimen tested. The extensometer is a strain-measuring device used to record data concerning to the changing of the normal strain during testing. The software of the testing machine allows the statistical calculus of the average values of some quantities: elastic modulus E (Young's modulus).

The UTM machine used for tensile test and flexural test is as shown in Fig. 5. The maximum capacity of the machine is 100KN.

Figure 5. Universal Testing Machine

Result And Discussions

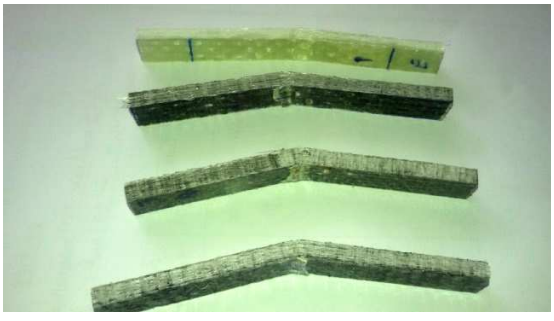

Figure 6. specimen after flexural test

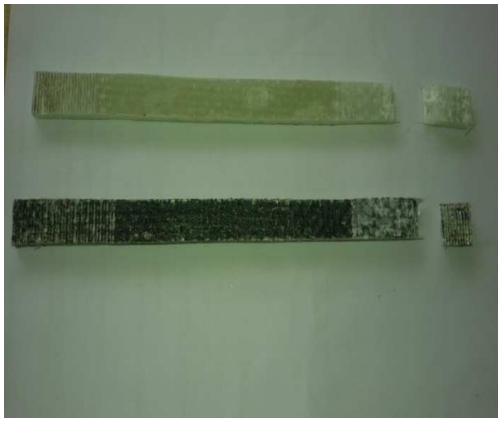

Figure 7. Specimen after tensile test

The variations in young's modulus and Flexural strength are shown in Fig.8 & 9.

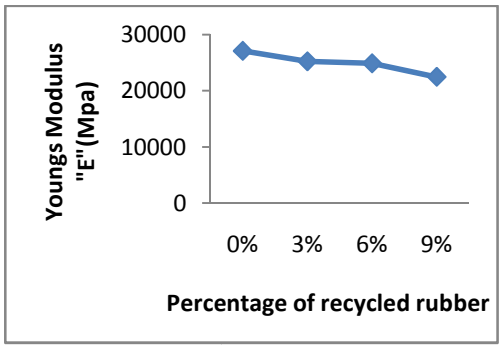

Figure 8. Values of Young's modulus E (MPa)

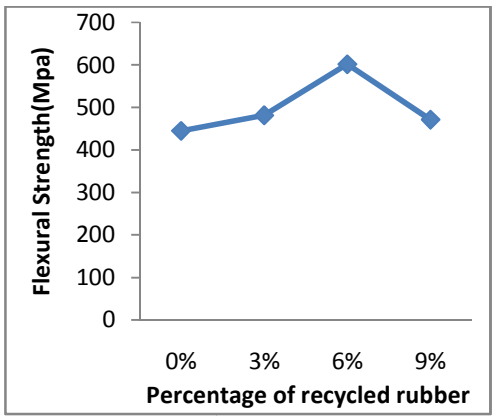

Figure 9. Values of Flexural Strength in (Mpa)

From Fig.8 it is clear that the Young's Modulus 'E' goes on decreasing with the increase in the percentage of filler. This means that the elasticity of the material goes on increasing as we increase the filler percentage.

It is clearly seen in Fig. 9 that in the Flexural test the Flexural strength is the best at 6% Recycled rubber filled specimen. This may be due to the better uniform distribution of the filler.

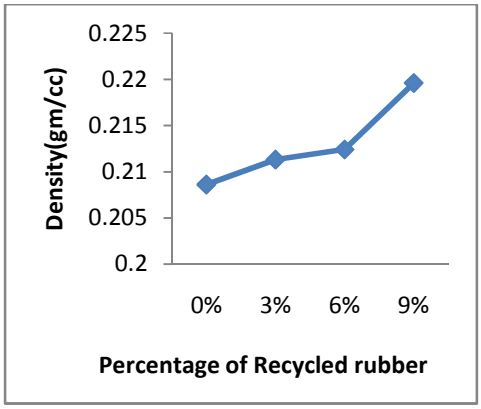

Figure 10. Values of Density (gm/cc)

According to Archimedes Principle the density is being calculated. It is found that the density goes on increasing with the increase in the percentage of recycled rubber filler. It is confirming the uniformity in the filler presence and distribution.

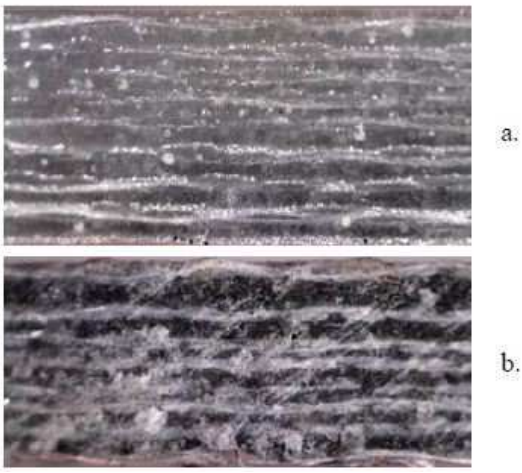

Figure 11. Photos (by using a digital microscope) of a cross-section of the composite material: a. without recycled rubber; b. with recycled rubber.

The image of the cross-section of the specimen made of Recycled rubber filler composite (Fig. 11.b) shows that two layers reinforced with glass woven fabric are separated with a layer made of recycled rubber and epoxy.

Microscopic view of the material fibre pullout is as shown in the Fig. 12.

Figure 12. Fibre pullout and breakage in tensile test.

It could be clearly seen that in case of the composite material additionally reinforced with recycled rubber, Flexural strength is the best at 6% Recycled rubber filled specimen.

Conclusions

From the flexural test results it is observed that the flexural strength is increased with the addition of recycled rubber. The maximum flexural strength is observed at 6% recycled rubber reinforcement indicates that addition of above 6% filler affect on bonding strength between matrix and reinforcement. Young's modulus of the recycled rubber reinforced composites showed decreasing with the increase in the filler percentage.Thus proving that the hybrid composite prepared is more elastic than the plain specimen. The density is increasing with the increase in the percentage of filler.

Acknowledgment

AOLE Sullia and VGST-Govt of Karnataka are gratefully acknowledged for the facilities and financial support.

REFERENCES

1. D.RAGHAVAN, H.HUYNH. "Polymer science division", *Dept of chemistry, Howard University, washington* DC 20059, USA.
2. K. B. Adhikary, S. Pang, M. P. Staiger, "Dimensional stability and mechanical behaviour of wood–plastic composites based on recycled and virgin high-density polyethylene (HDPE)". *Composites:* Part B, 39, 2008, pp. 807.
3. C. Cerbu, I. Curtu, V. Ciofoaia, I. C. Rosca, L. C. "Effects of the wood species on the mechanical characteristics in case of some E-glass fibres/wood flour/polyester composite materials*". Mat. Plast,* ISSN 0025 / 5289, 47 / 1, 2010, pp.109.
4. A.C. Stancato, A.K. Burke, A.L. Beraldo, "Mechanism of a vegetable waste composite with polymer-modified cement (VWCPMC)". *Cement & Concrete Composites,* ISSN 0958-9465, 27, 2005, pp.599.
5. A.F. Avila, M. V Duarte, "A mechanical analysis on recycled PET/HDPE composites". *Polymer Degradation and Stability,* ISSN 0141-3910, 80, 2003, pp.373.
6. C. Cerbu, H. Teodorescu-Draghicescu, "Bending behaviour of the composite materials made by recycling of the CDs and DVDs". *In: Proceedings (ISI) of The World Congress on Engineering WCE 2009, vol. 2, London, 1-3 july,* 2009, ISBN 978-988-18210-1-0, pp.1753
7. G. Xepapadaki, G. C. Papanicolaou, P. Keramidas, G. Jiga, Gabriel, "Effect of Hygrothermal Fatigue on the Mechanical Behaviour of Polymeric Composite Laminates and Sandwich Structures". *Mat. Plast.,* 47 / 2, 2010, pp: 153
8. Turatsinzea, S. Bonneta, J.-L. Granju, "Mechanical characterisation of cement-based mortar incorporating rubber aggregates from recycled worn tyres". *Building and Environment,* ISSN 0360-1323, 40, 2005, p.221.
9. Hadăr, I.N. Constantinescu, G. Jiga, D.S. Ionescu, "Some local problems in laminated composite structures". *Mat. Plast,* ISSN 0025 / 5289, 44 / 4, 2007, pp.354.