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FLEXURAL STRENGTH BEHAVIOUR OF WOVEN GLASS-EPOXY FILLED WITH COMPACT DISC PARTICLE COMPOSITES

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Abstract

The Electronic wastes are one of the major problems faced by the world due to its unregulated accumulation. The recycling and reusing are the effective ways to reduce the E-waste accumulation in the environment. The E-waste stream consists of Compact Discs /DVDs wastes. The polycarbonate is the main element used for the manufacturing of Compact Discs. Polycarbonate in landfills is definitely an environmental nightmare since it contains the Bisphenol-A which is a toxic material. So these wastes should be properly recycled and it can be used in polymer composites. Fiber-fortified polymeric composites have across the board applications including designing ideas, because of main properties of light mass, solidness and high quality weight proportion. While dealing with the polymer composites the reinforcement used is glass fiber due to its availability and cost effectiveness. The effect of addition of Compact Disc particles as filler in woven glass fiber-epoxy composites has been investigated. The hand lay-up and vacuum bag moulding processes are used for the preparation of the test specimens. The tensile and flexural strength was improved with the filling of Compact Disc particles in the woven glass fiber composites.

Keywords: Glass Fiber Reinforced Polymer composites, woven glass fiber, E-waste, recycling, polycarbonate, hand lay-up, vacuum bag moulding.

I. Introduction

Polymer framework composites are progressively utilized in a scope of uses in various ecological conditions. Polymer network composites have indicated to adjust customary behavior, for example, simplicity of procedure capacity with the quality and firmness of strengthening specialists. Engineered fortification synthetic filaments have great physio-mechanical properties. Silica based E-glass strands are broadly utilized because of their ease, accessibility and great protection appropriate ties up with E-glass fiber fortification is frequently an appealing method to enhance the behavior of composite [I],[II],[III],[V], which turns out to be all the more delicate when warmed and hard when cooled., the enhancement being credited to incredible behavior of filaments and to the improved attachment sandwiched between the strands and the polymer encompassing the material when surface treated filaments are utilized.

There are many forms of glass fibers are available such as unidirectional, woven and random mat. Many researches were going on using these different forms of glass fibers. The addition of fillers in fiber reinforced composites helps to improve the mechanical properties of the material.

The variety in the behavior in composite, because of the alter in filaments and the grid support. The materials functioned under various loading scenarios and the performance of the composite depends upon the loading conditions. The main properties include the tensile strength and flexural strength of the composite. The researchers proved that the addition of the filler materials improves the functionality of the composites. Apart from strength requirements of composite, specifically high-energy dissipation per unit mass is also possible with composite materials by initiating and maintaining proper failure mechanisms during the crack event. Material assimilate vitality through plastic twisting, while glass fiber fortified retain vitality through failure mechanisms involving delamination, interply cracking, and fiber fracture, energy absorbency of a structure is directly dependent on the failure mode that occurs, and the failure mode is a function of the loading history and environment. The use of Glass Fiber Reinforced Polymer (GFRP) composites constitutes many advantages related to considerations such as physical properties of higher strength, Lighter weight Space systems. As indicated by European Union, E-squander is on the expansion at a pace of 3-5% per annum or roughly multiple times quicker than other waste technology in the strong recycling division. Joined Nations approximations the world generate twenty to fifty million tons of E-squander each year. The administration of E-squander situation will get significant issues of worry for strong waste networks because of the volumes of waste being created and the potential natural effects related with the poisonous synthetic substances found in the most electronic gadgets [VI],[VII]. Whenever oversaw inappropriately, the transfer of WEEE can antagonistically influence the earth and human wellbeing. In most of the electronic equipment consist of the toxic materials which may affect directly or indirectly to the human beings and living organisms.

As plastic innovation are getting progressively explicit and regularly consists high-esteem parts whose worth would be lost when the item turns into a waste. In this way, unique strategies for recuperation of high innovation plastic waste are required. Polycarbonate (PC) is a superior material that has not just high warm opposition and high effect quality yet in addition great optical clearness and astounding electrical obstruction. PC is utilized in many differed technologies, for example, in car parts, building and development, bundling, wellbeing gear. PC is likewise utilized in stockpiling gadgets and additionally utilized as a meager intelligent metal covering.

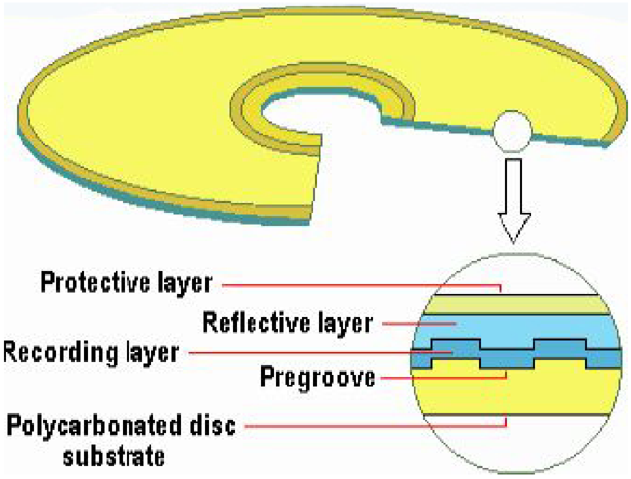

Fig.1.1. Compact Disc cross section

II. Experimental Details

Bi-directional woven glass texture fortified plastic composite of 3.2 mm thickness was utilized for leading the investigations. The strengthening material utilized was bi-directional woven glass texture. The network utilized was epoxy sap LY-556 and the hardener HT 917. The epoxy tars have lower shrinkage than different saps. The Compact Disc particles were used as fillers. The three compositions were used to prepare the specimens. The laminates were made by hand lay-p method and vacuum bag moulding processes. The laminates were cured by atmospheric room temperature for about 24 hours. The post curing of the laminates were done at 1000 C for 2 hours. Hand lay-up is a modest and simple strategy for the manufacture of glass fiber strengthened composites. So Hand lay-up method is selected for the specimen fabrication.

Tensile test

The experiments are conducted by ASTM D 638-03 utilizing a UTM with a speed of 2.5 mm/min. For per composites, three experiments are conducted and the results are accounted.

Flexural Test

Static flexural experiments are conducted according to ASTM D 790-00 [IV] using a UTM with a cross-head speed of 2.5 mm/min. The flexural strength and modulus were calculated.

III. Results and Discussion

Tensile strength of the composites

Woven glass strands reinforced Compact Disc particle filled epoxy composites were made by hand layup. The tensile test of the composite is increased and then decrease due to the addition of filler content.

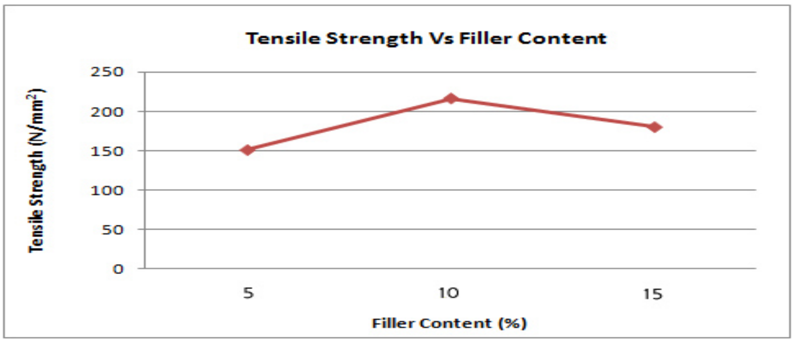

Fig 3.1: Tensile Strength Vs Filler content

Flexural strength of the composites

Woven glass fiber reinforced Compact Disc particle filled epoxy composites were made by hand layup. The flexural quality of composites were assessed and analysed. All the 3 distinct composites increased a huge improvement of the flexural properties because of the expansion of filler content. It was found that flexural strength decreased 1.16% and then suddenly increased 32.27% due to the filler content. The ultimate stress is increased while increasing the filler content and the maximum displacement is decreased gradually. The breaking load Vs the filler content is shown below. The three compositions are noted as Series1, Series2 and Series3. For each composition three values are taken and finally the average value is calculated.

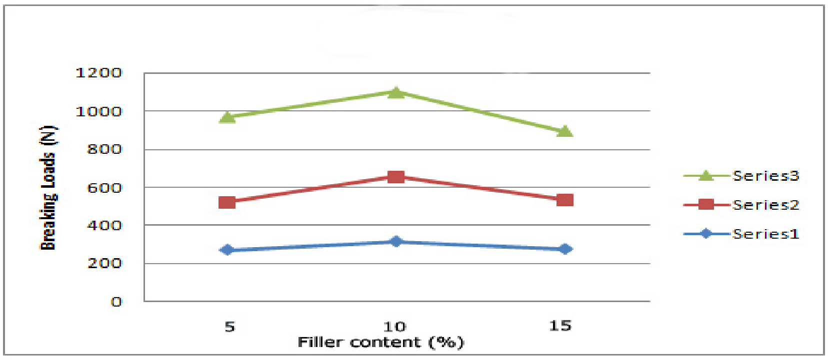

Fig 3.2: Breaking Load Vs Filler content

The Flexural Strength Vs Filler Content is shown below. For all the three different compositions the flexural strength is varying due to the filler content.

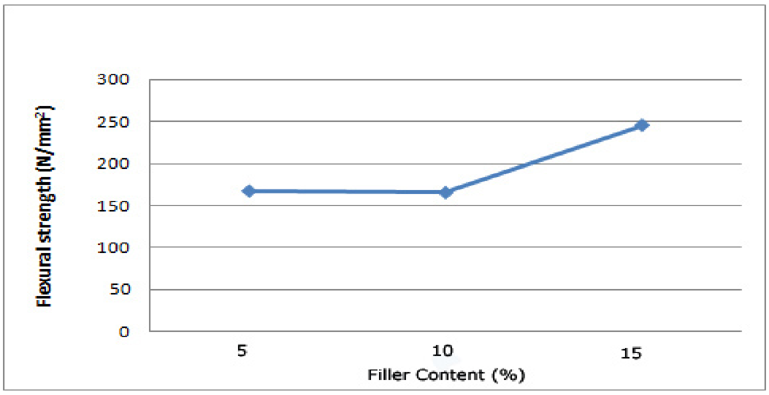

Fig 3.2: Flexural Strength Vs Filler content

IV. Conclusion

The properties of the Glass Fiber Reinforced Polymer were researched. The accompanying ends can be drawn based on the examination.

- The addition of filler improves the tensile and flexural properties of the GFRP.
- There will be a slight decrease in the properties of the composite due to filler content and also an increase is noted after that.
- With the addition of the Compact Disc particles the E-wastes can be reduced up to an extent.

References

I. A. G. Ganeshkumar, G. Ranganath, Channankaiah, Y. Libin, "Experimental Analysis of Exhaust Fan Blade by using E-Glass Fiber Reinforced E-waste Polycarbonate: Review Paper" EM International Pollution Research, Vol.: 33, Issue: 02, pp. 353-358, 2014.

II. A. G. Ganeshkumar, G. Ranganath, S. S. H Jose, M. Sakthivel, B. Pounraj, "Experimentation Of E-Glass Fiber And Flyash Reinforced With Recycled E-Waste Aluminium Alloy Hybrid Metal Matrix Composites" International Journal of Advanced Engineering Technology, Vol.: VII, Issue: I, pp. 410-412, 2016

III. A. G. Ganeshkumar, G. Ranganath, B. Pounraj, S. S. H. Jose , M. Sakthivel, "Experimental analysis of E-Glass fiber and Fly Ash reinforced to E-Waste aluminium, Journal of Chemical and Pharmaceutical Sciences, Vol.: 1 Issue: 4, pp. 138-140, 2014.

IV. ASTM (American Society for Testing and Materials) Standard D 790 – 00: Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials, Annual book of ASTM standards,. ASTM, West Conshohocken, pp. 01–09, 2001.

V. C. Fischer, "The development and achievements of EU waste policy". J Mater Cycles Waste Management, Vol.: 13, Issue: 1, pp. 2–9, 2011.

VI. F. Ronkay, "Effect of Recycling on the Rheological, Mechanical and Optical Properties of Polycarbonate". Acta Polytechnica Hungarica, Vol.: 10, Issue: 1, 2013.

VII. R. P.Singh, "India: A Matter of Electronic Waste; the Government Initiatives". Journal of Business Management & Social Sciences Research (JBM&SSR), Vol.: 2, Issue: 4, 2013.