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Experimental Investigation on the Properties of Polymer Matrix Composite Using Single-Use PET Bottle Scrap

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A B S T R A C T

Evolution of Biodegradable Plastics had brought down the usage of non-biodegradable plastics, but still there is no proper solution provided for the toxic plastics that we were using all these days. The background for carrying out this work is to eradicate the dumping of waste plastics. Nonbiodegradable plastics are abandoned without any reuse, making it as a landfill. The use of Pulverization methodology for processing the waste plastics eliminates the possibility of pollution ensuing from the heating of plastic material. Waste plastics are dropped into the pulverizing machine that converts the plastic flakes into granules or powders. Then these powders are mixed with epoxy resin and hardener so that it can be poured into the required cavity for providing shape to the plastics (polyethylene terephthalate.

Keywords: Fibre-reinforced polymer composites; PET bottle; Pulverization; Mechanical testing

1. Introduction

Plastics are reasonable, simple to shape, lightweight and solid materials, which can promptly be formed into an assortment of items that discover use in a wide scope of uses. Almost 60 million tons of waste is arranged yearly in agricultural countries like India which is becoming 2.5 to 4% quickly. The global production of PET is expected to increase from 42 million tons (2014) to 72 million tons by 2020. During 2015-16, 900 kilotons of PET was used in India. Our research will provide an appropriate way to transform the used PET bottles into usable reinforcement for home appliances by pulverizing it followed by mixing resin and hardener with it. Mixing of the powdered plastics with the resin facilitates shaping the plastics to intended profile / geometry. The use of Pulverization methodology for processing the waste plastics eliminates the possibility of pollution ensuing from the heating of plastic material. Recycling of PET bottles by using pulverization technology also results in the reduced consumption of virgin crude oil and natural gas; and reduces the associated carbon dioxide emissions. Mechanical properties like tensile strength, flexural strength, impact strength and hardness and thermal properties such as thermal conductivity and thermal expansion coefficient are ascertained for various compositions of the newly developed products

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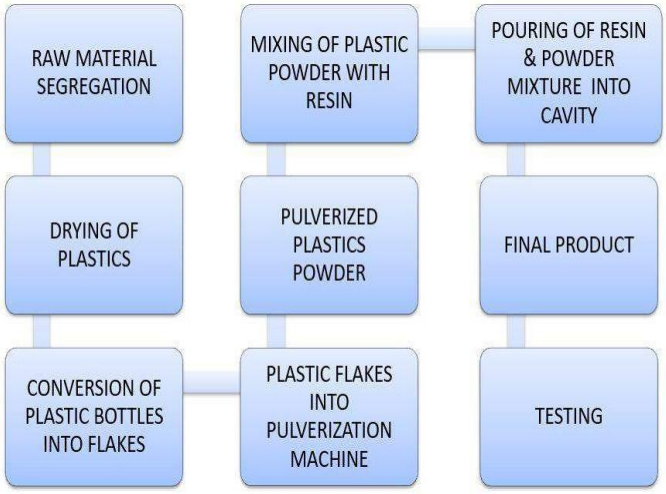
2. Methodology



3. Materials Used

Materials used are

1. Single use PET Bottle Plastics powder
2. Epoxy resin (LY-556) and
3. Hardener (HY-951)

Plastic Powder:
Single use plastics are converted into powders by pulverization methodology, pulverizing the used plastics helps to reduce material cost recover value, and improved product quality so that it provides a prolonged life before failure.

Advantages of Plastic Powder:
Comparing to standard reinforcing fibers like glass, carbon & Kevlar, natural fiber single use plastic powder has the subsequent advantages.

- High toughness
- Low cost
- Free from Hazard
- Sensible thermal properties

EPOXY RESIN (LY-566):
Starting materials for epoxy matrix are low-molecular-weight organic liquid resin containing several epoxide groups, which are three- member rings of one oxygen atom and carbon atoms, Epoxy resin is Reliable in use has good mechanical properties.
Epoxy resins contribute strength, toughness and compound protection from a composite, Epoxy comes in fluid, strong and semisolid structures and regularly fix by response with amines or anhydrides.

Properties of LY556:

- High resistance to chemical & atmospheric attack
- High dimensional stability
- Free from internal stress
- Negligible shrinkage

HARDENER (HY-951):
The HY-951 (Tri-ethylene-Tyramine) hardener could be a activity agent to be properly and completely mixed with Epoxy resin to gain a good mechanical properties. Epoxy resin (or) polyester requires hardener to initiate curing, it's conjointly known as catalyst, the substance that hardness the adhesive once mixed with organic compound.

Properties of HY951

- Good mechanical strength.
- Good resistance to atmospheric to atmospheric and chemical degradation.
- Excellent electrical properties

4. Preparing the specimen for testing and Result

Cutting the specimen as per ASTM size for different testing and image of the specimen for testing is shown below. Cutting the Specimens in dimensions as per the ASTM Standards is

- **Tensile Test ASTM D-3039**

  Length = 250mm, Wide = 25mm, Thickness = 1cm

- **Flexural Strength Test ASTM D-790**

  Length = 125mm, Wide = 13mm, Thickness = 1cm

- **Impact Test ASTM D-256**

  Length = 125mm, Wide = 13mm, Thickness = 1cm

Figure 4: Testing Specimen 1 (Single use PET Plastic Waste powder)

Figure 5: Testing Specimen 2 (Virgin plastic powder)

As a result of our project, we expect better performance characteristics of reusing plastics in the form of Polymer Matrix composite and also increased lifetime of the product. By using single-use PET bottle waste, we can actively contribute to the avoidance of environmental hazards caused by waste plastics caused by conventional method of recycling plastics and also we can drastically reduces the dumping of plastics letting it as an landfill.

Recycling of PET bottles by using pulverization technology also results in the reduced consumption of virgin crude oil and natural gas; and also reduces the associated carbon dioxide emissions. Mechanical properties like tensile strength, flexural strength, impact strength and hardness and thermal properties such as thermal conductivity and thermal expansion coefficient are ascertained for various compositions of the newly developed products and the results were found to be satisfactory.

- **Bending testing**

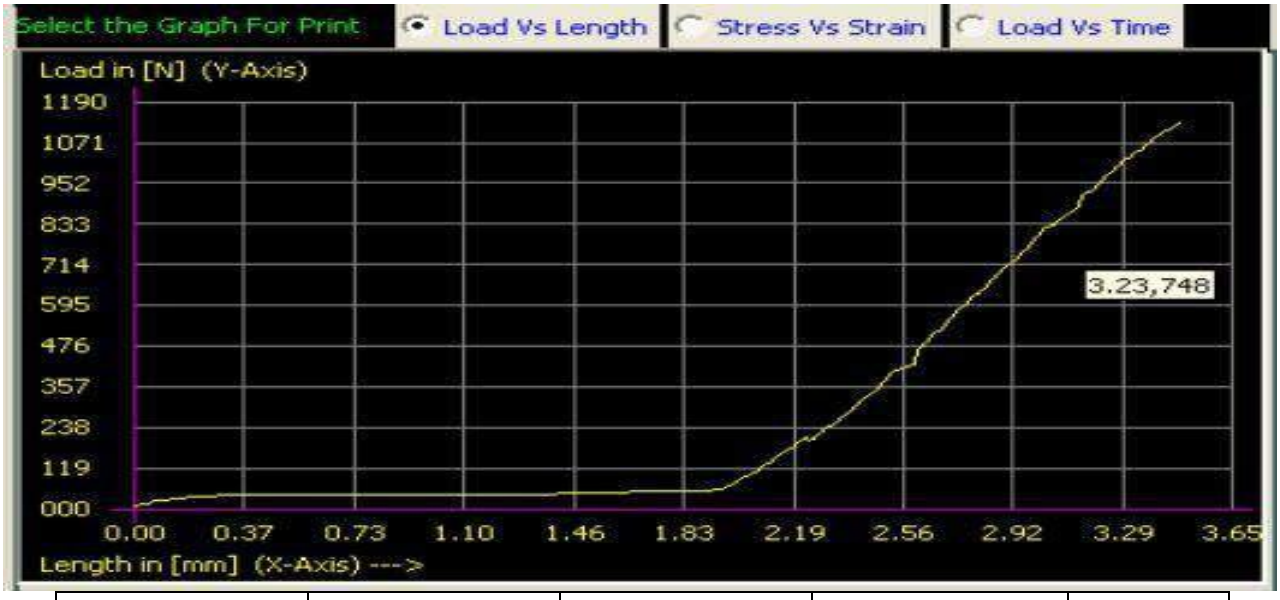
Sample No.	**CS Area [mm²]**	**Peak Load N]**	**Flexural trength (MPa)**	**Flexural Modulus (GPa)**
1	195.000	490.353	14.507	428.921
2	195.000	373.790	11.059	283.388

Figure 6: Bending Test Specimen 1

Figure 7: Bending Test Specimen 2

- **Tensile testing**

Sample No.	CS Area [mm²]	Peak Load [N]	%Elongation	UTS [N/mm²]
1	180.000	1132.927	4.110	6.298



2	180.000	1035.190	4.540	5.749

Figure 8: Tensile Test Specimen 1 (load Vs length)

Figure 9: Tensile Test Specimen 2 (load Vs length)

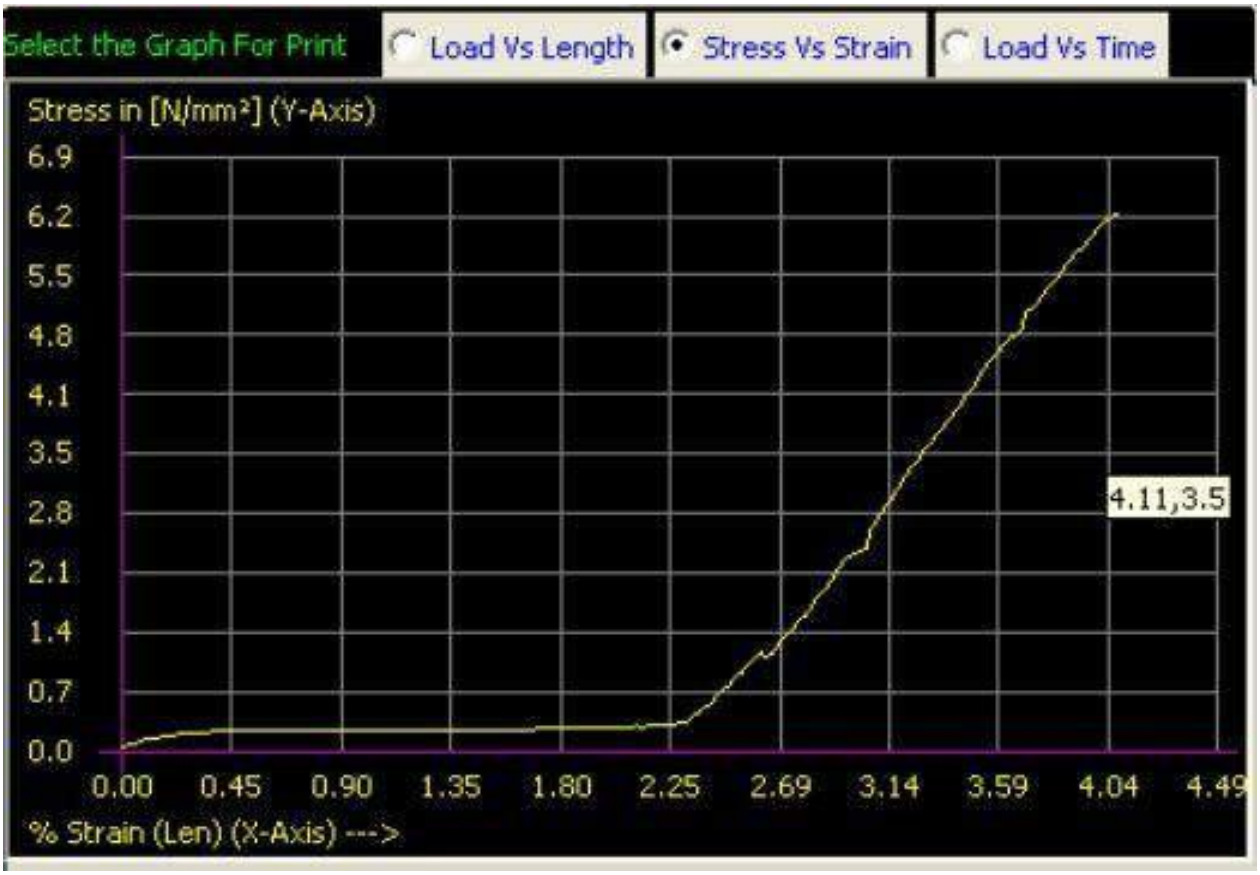


Figure 10: Tensile Test Specimen 1 (Stress Vs Strain)

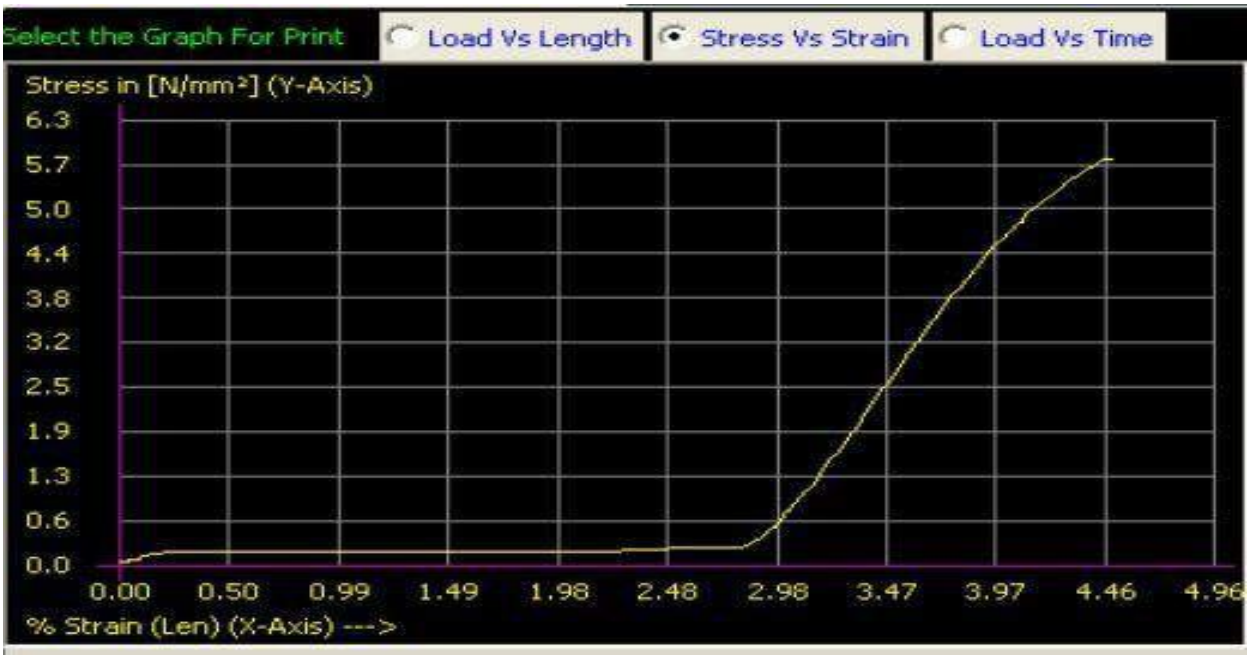


Figure 11: Tensile Test Specimen 2 (Stress Vs Strain)

- **Impact test**

Sample No.	Izod Impact Value In J
1	0.25
2	0.15

In the wake of finishing the testing we presume that specimen 1 (Single use PET Plastic powder) have better rigidity, twisting strength when compared with specimen 2 (Virgin plastic powder)

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