Fabrication and Characterization of E-Glass Fiber, Epoxy, and Fly Ash Composites for Automobile Applications: Connecting Rod

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Abstract— There are many scientists and engineers working for the research on composites for various applications in engineering sectors. In this paper we are also going to see composite from E-Glass Fiber, Epoxy & Fly Ash for automobile application. We are going to fabricate connecting rod for two wheel vehicles. In this we have selected Epoxy as a casting material and added E-Glass fibre and Fly Ash in different proportions. Further we are going to conduct various tests to characterize the material and conduct comparative study with respect to existing materials.

Keywords: E-Glass Fiber, Epoxy, and Fly Ash Composites

I. INTRODUCTION

Connecting rod is a mechanical element used for transmitting the power or torque from piston to the camshaft. This is also used to convert reciprocating movement in to the rotating movement. There are number of forces exerts on the connecting rod during the operation. So considering these factors we are going to add E-Glass fibre in the composition to increase the overall strength of the composite and also help to reduce the weight of material. The reduction in weight results in the minimization of vibrations. We are also going to add fly ash for to improve thermal resistance and atomic structure within high temperature ranges.

In this project, we are going to fabricate number of samples with different compositions and then these samples will undergo tests to determine the characteristics of each. In general there are basically three materials are used as material for connecting rod and theses are Forged Steel, Powder Metal and Steel Alloys. We are gong to compare the properties of this composite material with these three materials. In order to conduct tests, we must have to design connecting rod and understand the forces exerts on it.

II. LITERATURE REVIEW

Mr. Shrikant Devidas Sakhare, Miss. Araju Alam Patel [1] Conducted experimental on in this research work we manufactured two helical springs of rectangular cross-section with different materials known as GLARE and CLARE to get which composite spring is better to replace with steel spring. Here we are going to manufacture E-glass fiber, epoxy and carbon epoxy spring with the reinforcement of aluminum wire mesh. We take 50%epoxy and 50% glass fibers for glass spring and 20%carbon, 30%glass, 50%epoxy for carbon spring. We concluded that cost of CLARE spring is 57% more than glass spring but the weight 13% less than GLARE spring and other factors of Clare spring are better than glass epoxy spring i.e. shear stress, failure load.

D. Abdul Budan and T. S. Manjunatha [2] Determines the feasibility of replacing metal coil spring with composite coil spring. Three different types of springs were prepared using glass fiber, carbon fiber, and combination of fiber and carbon fiber. Objective is to reduce weight of spring. According to investigational results, spring rate of carbon fiber spring is 34% more than glass fiber spring and 45% more than glass fiber/carbon fiber spring. Weight of carbon fiber spring iso18% a reduced amount than glass fiber spring, 15% less than Glass fiber/carbon fiber spring and 80% less than steel spring.

Mr. Chavan V. B., Prof. Gaikwad M. U. [3] the present study is an attempt to take an overview of the work done in the area of characterization of Glass Fiber/Epoxy composite material. Different manufacturing processes are used for making Glass Fiber/Epoxy composite. Based on comprehensive literature review of various aspects in developing Glass Fiber/epoxy composite material, it is observed that extensive work has been done related to manufacturing and mechanical characterization of current material, whereas limited studies carried out to analyses tensile, shear and flexural strength by varying volume fraction of Glass Fiber and epoxy materials. The behavior under tensile, shear and flexural loading and different manufacturing processes of laminated Glass Fiber/Epoxy.

Manoj Singla and Vikas Chawla [4] there has been significant increase in use of glass fiber reinforced composites as structural materials in naval mine countermeasure surface ships. Sea mines when detonated emit underwater shock waves, which could impart severe loading to naval ship structure; there are attempts to model the response of a ship structure to this loading. For the model to be accurate & useful material property data determined experimentally by taking different weight percentage of glass fibers (E-300, mat form) with epoxy resin & comparison with fly ash reinforced composite. Specimens in the form of cube of size 10X10X10 (mm's) are used & results are presented. Fracture behavior of composite can also be studied using SEM. SEM analysis is done to observe distribution of fly ash particles in matrix, resin fly ash interface, glass fiber matrix interface, glass fiber distribution etc.

Ankita Srivastava, Amit Krishan[5] This article addresses the quantity, characteristics, recycling potential and effective management of fly ash with specific reference to the processes and technologies developed in India. In India major source of electrical energy is fulfilled through coal based thermal power plants resulting in the generation of approx 175 million tons of fly ash as solid waste annually. Considerable efforts have been made in the country to utilize the fly ash in huge quantity for road construction, land filling and producing building materials e.g. bricks, block, cement and clinkers etc. No one would have imagined about two decades back that fly ash will generate revenue. Today, fly ash has become an essential

ingredient for many of the industries like cement manufacturers, ready mix concrete plant, asbestos industries, construction industries etc. These segments are now ready to pay the price for the quality. Fly ash utilization has increased from approx 5% in the nineties to 50% during the last few decades in various applications such as cement and asbestos industries, bricks, blocks, lightweight concrete blocks, binder in concrete, embankments, road construction, land reclamation, agriculture, and reclamation of abandoned mines. Indeed fly ash is considered to be a resource material rather as waste which may contribute to saving the natural resources leading to a reduction in carbon dioxide sequestration and global warming resulting to sustain the clean and green environment.

III. RELEVANCE

Types of Composite Materials: composites are classified on the basis of reinforcement used (Glass, Carbon, Amide) & Matrix (Thermoset, Thermoplastic).

A. Arrangement of Composite Materials

1) Based on the type of Matrix

- Ceramic Matrix Composite (CMC)
- Polymer Matrix Composite (PMC)
- Metal Matrix Composite (MMC)

2) Based on Reinforcement

- Fibre Reinforcement Polymer (FRP)
- Particulate Composite
- Structural Composite

B. Fibre Reinforcement Polymer (FRP)

Composite fibers are substantial class reinforcements, anticipated circumstances, and transfer strength to matrix. Mainly, we have different types of fibers namely:

- Glass Fibers
- Carbon fiber
- Silicon carbide fibers
- High silica
- Quartz fibers
- Metal fibers and wires
- Graphite fibers
- Boron fibers
- Aramid fibers

C. Glass Fibre

Glass fiber is white in color its accessible is dry fiber fabric. There are types of glass fiber

- E-Glass: Respectable power
- S-Glass: - Get 40% developed power, which conceding properties at higher temperature.
- C-Glass:-Have deterioration resistance.
- QUARTZ:-Have less dielectric properties, good for antennae.

D. E Glass Fibre

E-glass fiber this is types of glass fibers alkali free, extreme electrically resistive glass prepared by alumina calcium borosilicate. E-glass is recognized its then industry has the general resolve fiber of it strong, electrical resistance. Commonly recycled fiber in fiber reinforced polymer combination manufacturing.

Fig. 1: Woven rowing of E Glass Fibre

They are significantly more exclusive than E-glass. Its benefits contain increase toughness capacity of objects, less price, more chemical resistance; it's very good separating things. Negatives consist of decrease flexible strength, deprived linkage to polymers, more specific gravity, and sensitivity to abrasion less fatigue strength.

E. Epoxy (Thermosetting)

Epoxy is used as matrix material for fabrication of composite. Comprehensive variation of drying agent aimed at epoxy resins exists dependent on procedure its things necessary. Generally recycled smoking agents for epoxies comprise amines, polyamides, phenol resins, anhydrides, isocyanides, and polymercaptans. Selection its resin and hardeners rest on application, procedure certain, and things anticipated epoxy hardener scheme too distresses things of treated material. Using dissimilar kinds and extents of hardener which, incline to controller cross relation density varies construction.

Fig. 2: Epoxy resin and hardener

1) Fly ash

Fig. 3: Fly ash

Fly ash, fine particulate waste material produced by pulverized coal-based thermal power station, is an environmental pollutant; it has potential to be resource material. It is used in cement, concrete and other cement based applications. Generic name waste product due burning of coal or lignite in boiler of thermal power plant is crushed fuel ash. Milled fuel ash can be fly ash, bottom ash, pond ash or mound ash. Fly ash is pulverized fuel ash extracted from fuel gases by any appropriate process like cyclone parting or electrostatic precipitation.

IV. METHODOLOGY

A. Problem Definition:

There are number of forces are produced during every rotations of the connecting rod such as Shear force occurs at gudgeon pin and piston or Shear force at big end and crank pin, compression force due to the expansion of hot gasses during power stroke, tensile force occurs during exhaust or expansion stroke. Also thermal stresses are produces during engine in working. These forces have direct effect on engine speed.

Generally these mentioned forces causes' failure of connecting rod. There are also more reasons for failure such as improper alignment and inappropriate lubrication. Such failure is known as Throwing of Rod.

B. Material Selection:

Material: Epoxy Resin
Role in composition: Casting Element
Major Properties:
- Shrinkage is minimum
- High Strength
- It has very good adhesion ability to any substance
- Less toxic and Cheap in price
- Chemical resistance
- Excellent thermal and electrical insulation

Material: E-Glass Fibre
Role in Composition: Additive, Strengthener
Major Properties:
- Excellent Strength
- Light in Weight
- High temperature range sustainability
- Higher Hardness

Material: Fly Ash
Role in Composition: Additive
Major Properties:
- Good thermal resistance
- Higher strength
- Less weight
- Good stability at high temperature ranges
- Good Bonding Properties

Material: MWCNT
Role in Composition: Additive
Major Properties:
- Excellent Tensile Strength
- Improve dispersibility of composite

Thermal stability above 600^0C
Fabrication Process:
For development of the product, we have to go through a particular steps mentioned as follows,

1) Prepare a die with given dimensions of the product.
2) Make a proper mixture of epoxy resin and hardener with given proportion.
3) Stir it well to become a homogeneous mixture.
4) Add e glass granules to the solution.
5) Further, add fly ash with proposed composition and then add aluminum in powder form in it.
6) Stir the mixture properly again to make it homogeneous mixture.
7) Pour this mixture in prepared die.
8) Keep it to solidify for 24 hours.
9) Then remove the product from die and go for testing.

V. CONCLUSION

The various compositions of the materials lead to the variety of properties which are developed for the betterment of product. In this paper we have observed effect of an alloying element is one of the most important factors to determine the area of application of that product.

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