A Review Paper on Manufacturing and Analysis of Composite Lever Clutch for Two Wheeler

Yuvraj P. Patil  
PG Student  
Department of Mechanical Engineering  
D.K.T.E’s Textile & Engineering institute, Ichalkaranji (M.S.), India

V. R. Naik  
Professor  
Department of Mechanical Engineering  
D.K.T.E’s Textile & Engineering institute, Ichalkaranji (M.S.), India

Abstract

Increasing competition and innovation in automobile sector tends to modify the existing products by new and advanced products. Today composite materials have changed all the material engineering. The evolution of composite materials has given an opportunity to various designers to use new and better materials resulting in cost reduction, increase in efficiency and better utilization of available resource. Most of the industries are using composite materials such as Epoxy resin, glass fiber and epoxy carbon. In this paper, the objective is to manufacture the composite lever clutch to replace the conventional aluminium lever clutch. The composite lever clutch will be compared the results with conventional lever clutch under different mechanical testing with evaluating of different mechanical properties such as tensile strength, bending strength, impact strength, fatigue strength by using appropriate experimental technique.

Keywords: Bending test, Composite, Fatigue test, Glass Fiber Reinforced plastic (GFRP), Impact test, Lever clutch, Pultrusion, Tensile test

I. INTRODUCTION

Composite materials are commonly used in structures that demand a high level of mechanical performance. Their high strength to weight and stiffness to weight ratios has facilitated the development of lighter structures [1] which often replace conventional metal structures. Glass fibers are used to increase the mechanical and physical properties of the material. Particulate glass fiber tend to be much weaker and less stiff than continuous glass fibers, so pultrusion process is used to manufacture the component which creates continuous composite profile. In glass fiber material damage can easily detect which is important to identify the factor that contributes to permanent deformation, it would be very dangerous in some application such as automobiles. Because of all these factors, comparative test has to be carried out. Epoxy resin is one of the excellent thermosetting polymer resins. The cost-to-performance ratio of epoxy resin is outstanding. Epoxy resins possess characteristics such as high strength, low creep and good adhesion to most of the substrate materials, low shrinkage during curing and low viscosity. Bisphenol A, more commonly known as BPA, is a chemical widely used to make epoxy resin. This resin uses a 2:1 hardener. Mixing 2 parts epoxy to 1 part hardener will give you the appropriate final mixture. The 2:1 hardener has a pot life of 35-40 minutes at 80 0 F, set time of 5-6 hours and a drying time of 24-48 hours.

A. Problem Statement

Manufacture the composite lever clutch using composite material of epoxy resin and glass fiber and compare the results with conventional aluminium lever clutch under different mechanical testing with evaluating of different mechanical properties such as tensile strength, bending strength, impact strength, fatigue strength by using appropriate experimental technique.

B. Objective

– To study and understand performance of the two wheeler lever clutch.
– To detail study of literature survey and design the lever clutch.
– To suggest new and improved material for the same lever clutch.
– To manufacture a composite lever clutch.
– To compare the results of composite lever clutch and conventional aluminium lever clutch.

II. LITERATURE REVIEW

Mr. P. A. Pandav, Dr. V. R. Naik, [1] “Use of composite material for replacement of steel in conventional two wheeler axle”, In this paper, the aim is to manufacture the composite wheel axle and compare the results with conventional steel axle under different mechanical testing with evaluating of different mechanical properties such as tensile strength, bending strength, impact strength, fatigue strength by using appropriate experimental technique. The replacement of composite materials has resulted
inconsiderable amount of weight reduction about 64% when compared to conventional mild steel shaft. Kavitha N. S. and Raghu V. Prakash, [2]“Size scale effects a past-impact residual strength of hybrid glass/carbon/epoxy neon-composites.” This paper presents the effect of size-scale of composites obtained through two methods of scaling: a) ply-level b) sub-laminate level. The hybrid glass/carbon/epoxy composite and Nano-composite (1.5% Nano-clay of weight of epoxy) specimens were prepared using compression molding technique. The ultimate tensile strength of thickness scaled composite and Nano-composite specimen was examined. The reduction in residual strength is more in Nano-composite specimens compared to plain-composite material. The damage developed in the ply-level scaled specimen is more compared to sub laminate level scaled specimens. Wasim Akram, Sachin Kumar Chaturvedi, Syed Mazhar Ali [3] “Comparative Study Of Mechanical Properties Of E-Glass/Epoxi Composite Materials With Al2O3, CaCo3, SiO2 AND PBO Fillers.” In this comparative study of the mechanical properties of E-glass/Epoxide composite materials with fillers (Al2O3, CaCo3, SiO2 and PbO) has targeted to investigate the materials added to the matrix help improving the mechanically operating properties of a composite. The mechanical characteristics of these composite materials, is examined by Tensile Strength Test by UTM, Torsion Strength Test by Torsion Testing Machine, Hardness Test by Vickers Hardness Testing Machine and Charpy Test by Impact Testing Machine.R. Murugan, R. Ramesh, K. Padmanabhan [4] “Investigation on Static and Dynamic Mechanical Properties of Epoxy Based Woven Fabric Glass/Carbon Hybrid Composite Laminates.” Balanced mechanical properties within the fabric plane and excellent formability have rendered the woven glass fabric composite laminates popular in automobile, automobile, marine and civil structures. In practice, while preferring glass woven fabric layers in fabrication, to achieve the required design strength, the nominal size of the component was increased. This increased the total weight of the component. In the present work, glass laminate is strengthened and stiffened by interplying high modulus carbon fabric layers for attaining better specific properties. Paolo Giani, Mara Tanelli, Sergio M. Savaresi, and Mario Santucci [5] “Launch control for sport motorcycle: A clutch based approach.” “Launch control is an innovative active system which offers an appealing automatic feature for sport motorcycles. Due to the high power of the engine and to the complexity of the torque transfer dynamics driving a smooth and safe start from a standstill might be difficult for non-expert riders in some working conditions. As such, an active controller capable of safely managing the vehicle acceleration from a standing start might effectively support the rider as far as both safety and performance are concerned. Pazilvaras V., T Perameshwaran Pillai,[6] “Comparison of performance of glass fiber reinforced plastic leaf spring with steel leaf spring.” The main objective is to present a general study on the performance comparison of composite (Glass Fiber Reinforced plastic - GFRP) leaf spring and conventional leaf spring. Under the same static load conditions deflection of composite leaf spring is less as compared to steel leaf spring, bending stress is also less in composite leaf spring. Conventional steel leaf spring is also found to be heavier than E-Glass/Epoxide mono leaf spring. Composite leaf spring can be used on smooth roads with very high performance expectations. Patil Deogonda, Vijay Kumar N Chalwa, [7] “Mechanical property of glass fiber reinforcement epoxy composites.” The present work describes the development and mechanical characterization of new polymer composites consisting of glass fibre reinforcement, epoxy resin and filler materials such as TiO2 and ZnS. The newly developed composites are characterized for their mechanical properties. Experiments like tensile test, three point bending and impact test were conducted to find the significant influence of filler material on mechanical characteristics of GFRP composites. Mhajan G.V., Aher V.S. [8] “Composite material: a review over current development and automotive applications.” Composites have attractive mechanical and physical properties that are now being utilized in automotive industry and aerospace on ground scale world-wide. The availability of polymers with higher temperature rating, the relative ease of fabrication and the fair cost. PMCs are being utilized more in structural and wear resistant applications whereas CMCs will be increasingly be used for high temperature, oxidation resistant, and wear and abrasion resistant applications where good corrosion resistance is also required. Velu .S, Srinivasan .R, [9] “Glass-Jute Fiber Reinforced Epoxy Composites.” In this study the Tensile , Bending and Impact test over jute-glass-epoxy composite has been carried out, the jute-glass-epoxy composite specimen consists of 4 layer based on change of stacking sequence of yarn jute and woven glass fiber as reinforcement with epoxy adhesive as matrix. The natural jute glass epoxy composites are made by hand lay-up method with weight ratio of fiber to resin 60:40. The natural jute glass epoxy composite plates are tested on universal testing machine has been employed to accomplish this investigation. The failure modes of natural jute glass composite plates have been investigated. Hakim S. Sultan Aljibori, [10] “Energy system and crushing behavior of fiber reinforced composite material.” In this paper, Effect of geometry on crushing behavior, energy absorption and failure mode of woven roving jute fiber/epoxy laminated composite tubes were experimentally studied. Investigations were carried out on three different geometrical types of composite tubes (circular, square and radial corrugated) subjected to axial compressive loading. It was observed in axial crushing study that the load bearing capabilities significantly influenced by corrugation geometry.

A. Outcome from literature review

From literature review we found that the composite materials are used for various applications of automotive such as drive shaft, chassis, and two wheeler axle. They have performed composite materials study for higher stiffness, high fatigue strength, impact strength, increased life and flexibility of the components.
A composite material is a combination of two or more constituent material with significantly different physical or chemical properties produce a material with characteristics different from the individual component. Composite materials are finding their applications in aerospace industry, Automobile sector, manufacturing industries etc. Composites are artificially produced multiphase materials having desirable combinations of the best properties of the constituent phases. With this background, it is sure that the composite is the most wanted technology, in the fast growing current trend. Today's key objective for the automotive industry is to develop cars which are clean, safe, energy efficient and affordable. Most composites are formed of two phases: Matrix and Reinforcement. The matrix is a continuous phase material which is usually less stiff and weaker than the reinforcement. It is used to hold the reinforcement together and distribute the load among the reinforcements. Reinforcements in the form of fibers, fabric, whiskers, or particulates are embedded in the matrix to produce the composite. They are discontinuous, usually stronger and stiffer than the matrix and provide the primary load-carrying capability of the composite.

### B. Classification of Composite Materials

Composite materials can be classified as:
- Metal matrix composites
- Polymer matrix composites
- Ceramic matrix composites

Technologically, the most important composites are those in which the dispersed phase is in the form of a fiber. The Design of fiber-reinforced composites is based on the high strength is the ratio between strength and density. Specific modulus is the ratio between strength and density. Specific modulus is the ratio between modulus and density. Fiber length has a great influence on the mechanical characteristics of a material. The fibers can be either long or short. Long continuous fibers are easy to orient and process, while short fibers cannot be controlled fully for proper orientation. Long fibers provide many benefits over short fibers. These include impact resistant, low shrinkage, improved surface finish and dimensional stability. However short fibers allow low cost are easy to work with and have fast cycle time fabrication procedures. The principal fibers in commercial use are various types of glass, carbon, graphite, Kevlar. All these fibers can be incorporated into a matrix either in continuous lengths or in discontinuous lengths. The matrix material may be a plastic or rubber polymer, metal or ceramic. Laminate is obtained by stacking a number of thin layers of fibers and matrix consolidating them to the desired thickness. Fiber orientation in each layer can be controlled to generate a wide range of physical and mechanical properties for the composite laminate.

### C. Properties of Composite Materials

The physical properties of composite materials are generally not isotropic (independent of direction of applied force or load) in nature, but rather are typically orthotropic (depends on the direction of the applied force or load). For instance, the stiffness of a composite panel will often depend upon the orientation of the applied forces and/or moments. Panel stiffness is also dependent on the design of the panel. In contrast, isotropic materials (for example, aluminum or steel), in standard wrought forms, typically have the same stiffness regardless of the directional orientation of the applied forces and/or moments. While, composite materials exhibit different properties in different directions. The relationship between forces/moments and strains/curvatures for an isotropic material can be described with the following material properties: Young’s Modulus, the Shear Modulus and the Poisson’s ratio, in relatively simple mathematical relationships. For the anisotropic material, it requires the mathematics of a second order tensor and up to 21 material property constants. For the special case of orthogonal isotropy, there are three different material property constants for each of Young’s Modulus, Shear Modulus and Poisson’s ratio -a total of 9 constants to describe the relationship between forces/moments and strains/curvatures.

### D. Merits of Composites Over the Conventional Materials

1. High strength to weight ratio
2. High stiffness to weight ratio
3. High impact resistance
4. Better fatigue resistance
5. Improved corrosion resistance
6. Good thermal conductivity
7. Low coefficient of thermal expansion. As a result, composite structures may exhibit a better dimensional stability over a wide temperature range.
8. High damping capacity.

### E. Limitations of Composites

1. Mechanical characterization of a composite structure is more complex than that of metallic structure
2. The design of fiber reinforced structure is difficult compared to a metallic structure, mainly due to the difference in properties in directions
3) The fabrication cost of composites is high
4) Rework and repairing are difficult
5) They do not have a high combination of strength and fracture toughness as compared to metals
6) They do not necessarily give higher performance in all properties used for material Selection.

F. Applications of Composites
1) Automotive: Drive shafts, clutch plates, engine blocks, push rods, frames, Valve guides, automotive racing brakes, filament-wound fuel tanks, fiber Glass/Epoxy leaf springs for heavy trucks and trailers, rocker arm covers, suspension arms and bearings for steering system, bumpers, body panels and doors.
2) Aircraft: Drive shafts, rudders, elevators, bearings, landing gear doors, panels and floorings of airplanes etc.
3) Space: payload bay doors, remote manipulator arm, high gain antenna, antenna ribs and struts etc.
4) Marine: Propeller vanes, fans & blowers, gear cases, valves &strainers, condenser shells.
5) Chemical Industries: Composite vessels for liquid natural gas for alternative fuel vehicle, racked bottles for fire service, mountain climbing, underground storage tanks, ducts and stacks etc.
6) Electrical & Electronics: Structures for overhead transmission lines for railways, Power line insulators, Lighting poles, Fiber optics tensile members etc.

IV. MATERIAL SELECTION CRITERIA

A. High strength:
While not for corrosion resistant equipment high strength does play an important role in the design of FRP equipment for such applications as missiles, protruded shapes, etc. For filament wound pipe and duct the high strength gives the lightweight features discussed earlier. You will often see FRP equipment especially filament wound equipment, FRP’s high strength properties can be a major advantages.

B. Economy:
Often a major advantage of FRP is its lower cost. When comparing materials for corrosion service rubber lining and exotic stainless material are very frequently alternatives to FRP. In these cases FRP may offer both a satisfactory solution to corrosion problems on lowest cost. There is no rule of thumb for comparing costs of FRP with other material. These costs depend entirely upon the application, the design considerations, the pressures involved and the product configurations. FRP is not competitive, however if you simply try to substitute it for a carbon steel in a particular use with minimum design changes. Design for FRP as a material of its own not as substitute for another material of its own as a substitutes for another material.

C. Versatility & flexibility:
Too many people overlook the versatility of FRP. It is best for many applications because you can do things with it that cannot be done economically with other materials. You mold almost any configuration of equipment for which you can build a temporary or permanent mold. On ductwork it is also possible to use FRP to line existing structures.

D. Corrosion resistance:
Prime reason behind using FRP is due to their inherent corrosion resistance. In many cases they are the only materials that will handle a given service environment. In other cases, their corrosion resistance is combined with their economy to make them the most economical acceptable solution. Corrosion resistance of FRP is a function of both the resin content & the specific resin used in the laminate. Generally higher the resin content the more corrosion resistant the laminate. This is why when building the laminate, the surface nearest the corrosive medium is made of layer that is 90% resin and 10% glass (i.e. the surfacing veil layer). For the most corrosive media, this is followed by a layer of approximately 75% resin and 25% glass. High glass content layers such as are achieved with woven roving or by filament winding, are usually limited to those applications where the corrosive service is less severe or where the corrosion medium is separated by means of a layer high in resin.

E. Weight advantages:
Another very distinct advantage of FRP is its low weight to strength ratio. As a rule thumb, for the same strength, FRP will weigh approximately one seventh as much as steel and half as much as aluminium. Light weight properties are important when considering the cost & ease of installation especially for pipe & tanks. FRP’s inherent light weight is an advantage when equipment must be mounted on existing structures such as scrubbers on mezzanines or rooftops and for specialty applications such as FRP tank trailers.
V. METHODOLOGY

![Process flow chart]

VI. CONCLUSION

1) Weight of composite lever clutch should be less than conventional lever clutch by 40% to 60%.
2) Life of lever clutch should be increased.
3) Composite lever clutch should possess high bending strength, impact strength, and higher stiffness.

REFERENCES