Design & Fabrication of Leaf Spring by using Composite Materials - A Review

Mohamed Ajmal Mahasin M.[1] Kesava Moorthy R.[2] Logesh M.[3] Mathankumar R.[4] Poornachandran T.[5]
[1]Assistant Professor [2,3,4,5]UG Student
[1,2,3,4,5]Department of Mechanical Engineering
[1,2,3,4,5]Nandha Engineering College, Erode 52, India

Abstract— In present year's natural fiber composite material locate a major role in industries like aerospace and automobile. The natural fiber is amplified by hook up with plastics. The ample availability of natural fibers are coir, Aloe Vera, Palm fiber ramie, sisal, jute, banana, bagasse etc. Common matrix materials are epoxy, phenolic, polyester, polyurethane vinyl ester etc. The composites formed by fibers gained attention due to their low cost, light weight, renewability, low density, high specific strength, non abrassivity, non-toxicity and biodegradability etc. In this project, we discuss the Composite material leaf spring by using ALOE VERA with Epoxy resin. Fabrication is carried out by hand lay-up technique and to be tested, and to evaluate the Mechanical properties of leaf spring (Tensile strength, Hardness, Toughness Examination). Aim of this project is to reduce the production cost of conventional leaf springs. By using natural fiber composite leaf springs, the efficiency of the springs and performance of the cars get improved.

Key words: Aloevera, Epoxy Resin Palmfiber Tensile Strength, Hardness, Toughness

I. INTRODUCTION

A composite material can be defined as a combination of two or more materials that results in better properties than those of the individual components used alone. In contrast to metallic alloys, each material retains its separate chemical, physical, and mechanical properties. The two constituents are reinforcement and a matrix. The main advantages of composite materials are their high strength and stiffness, combined with low density, when compared with bulk materials, allowing for a weight reduction in the finished part.

The reinforcing phase provides the strength and stiffness. In most cases, the reinforcement is harder, stronger, and stiffer than the matrix. The reinforcement is usually a fiber or a particulate. Particulate composites have dimensions that are approximately equal in all directions. They may be spherical, platelets, or any other regular or irregular geometry. Particulate composites tend to be much weaker and less stiff than continuous fiber composites, but they are usually much less expensive. Particulate reinforced composites usually contain less reinforcement (up to 40 to 50 volume percent) due to processing difficulties and brittleness. A fiber has a length that is much greater than its diameter. The length-to-diameter (l/d) ratio is known as the aspect ratio and can vary greatly.

Continuous fibers have long aspect ratios, while discontinuous fibers have short aspect ratios. Continuous-fiber composites normally have a preferred orientation, while discontinuous fibers generally have a random orientation. Examples of continuous reinforcements include unidirectional, woven cloth, and helical winding. While examples of discontinuous reinforcements are chopped fibers and random mat. Continuous-fiber composites are often made into laminates by stacking single Sheets of continuous fibers in different orientations to obtain the desired strength and stiffness properties with fiber volumes as high as 60 to 70 percent. Fibers produce high-strength composites because of their small diameter, they contain far fewer defects (normally surface defects) compared to the material produced in bulk.

Fig. 2.1: Traditional Leaf Spring Arrangement

The replacement of steel with optimally designed composite leaf spring can provide 92% weight reduction. Moreover the composite leaf spring has lower stresses compared to steel spring. All these will result in fuel saving which will make countries energy independent because fuel saved is fuel produced.

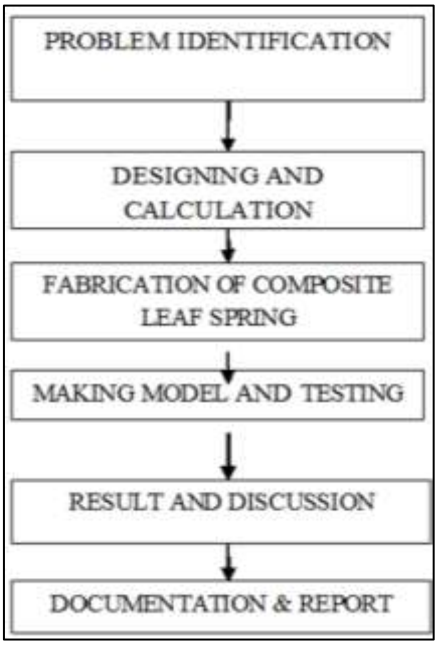
FRP springs also have excellent fatigue resistance and durability. But the weight reduction of the leaf spring is achieved not only by material replacement but also by design optimization. Weight reduction has been the main focus of automobile manufacturers in the present scenario.

II. PROPERTIES OF COMPOSITE MATERIAL

PROPERTIES	VALUE OF ALOE VERA	VALUE OF PALM FIBER
Density	0.85-1.1 g/cm³	1.2-1.3 g/cm³
Tensile strength	175-203 MPa	220-240 MPa
Young's modulus	1.85-3.70 GPa	2.5-5.40 GPa
Elongation	1.92-3.50 %	2-4.50 %

Table 1: Properties of Composite Material

III. METHODOLOGY



IV. FABRICATION

Aluminum mould was prepared with required dimensions of leaf spring. Wax polish applied on mould for better surface finish Number of layers of aloe Vera, palm fiber and epoxy are laminated Mould kept 24 hours for curing.

V. CONCLUSION

As a lot of work has been done in designing of leaf springs which is discussed briefly in this report, on the basis of this study, problems in overall weight reduction by using composite materials are identified. Many of the authors suggested various methods of designing, manufacturing and analyses of composite leaf springs. After studying all the available literature it is found that weight reduction can be easily achieved by using composite materials instead of conventional steel, but there occurs a problem during the operation while using the composite leaf spring i.e. chip formation when the vehicle goes off road. Therefore there is an immense scope for the future work regarding use of (Aloe Vera, palm fiber) composite materials in leaf springs to reduce the overall weight of the vehicle as well as the cost of the vehicle.

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