
Study of Static and Fatigue Analysis of Flax/epoxy- Leaf Spring

In automobile field, the present situation is to exchange the current material used in the vehicles to advanced bio material. To make it eco-friendly and improve in energy, weight reduction plays major role in it. For the suspension in heavy vehicles leaf spring is used where it is upgraded at regular interval of time to reduce the weight of it. The main benefit of leaf spring is end of the spring is moved along a particular path to absorb the shocks and also act as support member of the structure. This is the major sign of using leaf spring compared to helical spring which carries axial loads, lateral loads and brake torque in the entire suspension. Widely suspension is used for the purpose of storing energy and then release it. For the design factor strain energy is important to design it. So the relationship of the strain energy is given by

$$U = \frac{1}{2} \sigma \epsilon V$$

Here

σ -strength,

ϵ -density

E -Young's modulus of the spring material

Nowadays composite material is used for different application for weight reduction, where leaf spring also the major one. But it is showcased without reduction in load carrying capacity and stiffness of the suspension. It should have the capacity of storing potential energy as strain energy and release it out slowly which helps in absorbing the vertical loads and impact of road causing vibration in spring deflection. For the leaf spring it is suggested that fiber reinforced plastics (FRP) which has high strength and elastic property in longitudinal direction also the less weight factor. Due to these qualities FRP are replaced instead of steel and multi leaf spring.

To predict the fatigue life of material the theoretical formula used is formulated by fatigue modulus and its degrading rate is explained by the strain failure creation. In present days it is main to concern about ecological factor, recyclability and environmental products which makes our society to free from pollution, global warming issues. . The interesting factors of natural fiber are lower density, high specific mechanical properties, CO₂neutral etc.

Need help with the assignment?

Our professionals are ready to assist with any writing!

[GET HELP](#)

Fig.1 Natural fiber life cycle

In alternative to glass fiber among the natural fibers, flax fiber have the good mechanical properties of promising one.

Here the flax fibers made up of micro fibrils which gives strength. To get the greater effect of mechanical properties, flax fibers are reinforced in composite materials. It also gains more durability. By increasing the cellulose content in the flax fiber gives higher mechanical strength. The cellulose and the lignin represent respectively 71% and 2.2% of the flax fibers. Chemical constituents like high content in cellulose provides also and decrease the resistance of moisture flax.

In the present work, the conventional mono and multi-steel leaf spring is analyzed. Results obtained from the analysis are compared with the model of bio composite material leaf spring. These springs are designed using CAD software and simulated. The results are analyzed only on the basis of reports that generated in simulation software.

II. DESIGN PARAMETERS OF STEEL LEAF SPRING

Material chosen for the analysis is 60Si7 where the composition is 0.56 C%, 1.80Si%, 0.70 Mn%, 0.045 P%, 0.045 S%.

A. Parameters in 60Si7

- Rear Suspension -TATA SUMO vehicle.
- Total Length of the spring-1150 mm
- No. of Master Leaf-02
- No. of graduated or slave Leaf- 05
- Thickness of leaf spring - 34mm
- Width of leaf spring - 5.5 mm
- Arc height at axle seat - 175 mm
- Spring weight-13.5 kg

Leaf spring is considered as a simply supported beam under bending stress and transverse shear stress.

III. SELECTION OF COMPOSITE MATERIAL

For the comfortable working of suspension it should have the ability to absorb and store the

Need help with the assignment?

Our professionals are ready to assist with any writing!

GET HELP

potential energy in more amount. But still the major problem is heavy weight of suspension. To overcome this problem composite material is introduced instead of steel leaf spring. Researchers mentioned that the results of flax/epoxy is the better solution for glass fiber which gains more potential energy in it. Based on its quality flax/epoxy is selected as material for the spring. Parameters of flax/epoxy given in the below table 1.

Table 1. Flax/epoxy properties

Parameters Values

Young's modulus E_{11} - 70 Gpa

E_{22} 8.27 Gpa

shear modulus G_{12} - 4.14 Gpa

Poisson ratio 0.27

tensile strength σ_t 1500 Gpa

compressive strength σ_c 610 Gpa

In the spring the energy stored will changes with respect to the young's modulus in both directions. So the flax/epoxy will give the good capacity of storing strain energy. To achieve this characteristics, fibers are layer up in unidirectional along the longitudinal direction.

Need help with the assignment?

Our professionals are ready to assist with any writing!

GET HELP