Fabrication And Experimentation of FRP Helical Spring Filled with Cenosphere

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***Abstract*— Recently, the automotive industry's interest in reducing the car's unspring weight has risen and thus the quality of fuel has improved. The composite materials are highly specialized, low density and have high absorption ability for strain energy relative to steel. The typical steel helical sprockets are replaced by fiber helical fiber sprockets. This job means making helical spring made of glass fiber using the guideline of a constant fiber winding cycle. It is a technique for assembling composite materials in which controlled measurement of tar and composite filaments is injured around a mandrel that turns. The high quality comparison between the composite materials groups and other customary materials. Glass strands are of high quality, and have excellent network holding properties that can enhance the composites by and large properties. The thermoset pitch for the fiber support fills in as a fastener and is added during the winding stage. Glass fiber is used as a fortification material, epoxy resin and cenosphere used as a network in this current undertaking work. These materials are, at specific pace, injured to the shape. After the production work is done, the spring is cured for 4 days in the sunlight relief, which then undergoes a compressive test to detect the spring's stiffness.**

Keywords—(Galss fiber, epoxy resin, cenosphere, composite materials, spring)

I. INTRODUCTION

Springs are designed mainly to consume, store and release energy. The energy of the material is a crucial factor when designing the springs. Basic strain power potential of the materials with lower modules and densities is improved. The composite materials are also good components for such applications. The replacement of steel material with composite materials results in a substantial reduction in weight. However, problems of design and processing will also occur with the implementation of new materials. Anisotropic materials are the main explanation for FRP composites. So compared with conventional materials, they are special. The use of composite in spring production is therefore not very common. Car manufacturers are making tremendous efforts to minimize vehicle weight in order to save fuel.

II. MATERIAL SELECTION AND FABRICATION PROCESS

A. material selection

In the present work the selected material is spinning glass fibers and applying cenosphere to epoxy resin as matrix. For fiber-reinforced plastic spring output the normal spring construction technique is considered. Rigidity and discomfort are the biggest concern for architecture. The cumulative loads are on the spring string. The spring rate should be standard-specific. The list of products preferred Table 1 displays properties.

Table 1.1 properties of material

Property	E- glass fiber	Epoxy resin	Cenosphere
Density(kg/m^3)	2500	1700	742
Compression strength (kg/cm^3)	350	340	180

B. Fabrication

The composite helical spring was produced using the prepared reusable mandrel, developed "Spring Winding" setup & selected materials.

In this the reusable mandrel is fixed between the centers of the lathe which has the profile similar to the appropriate helical spring. If Silicone-Gel is to be smeared evenly on the mandrel surface for quick removal of the spring, the continuous glasses fibers from the bobbins are dipped in the bath of epoxy resin are wounded on the mandrel. The estimated volume of epoxy resin and cenosphere is taken and mixed with a K-6 hardener ratio of 10:1. After dipping the fiber tape with epoxy and cenosphere and winding to the Mould. This winding process is continued until the necessary dimension is obtained. After the necessary dimension is obtained, the mandrel is wrapped by a shrink rubber tape to avoid contamination of the atmosphere. The processed spring is left for 4 days to recover. The spring is subsequently separated from the mandrel & measurements are noted down. The dimensions of Gl/Ep/Ceno FRP helical spring is L= 124mm, D_o=85mm, D_i=43mm, h=15mm, b=12mm, n=6

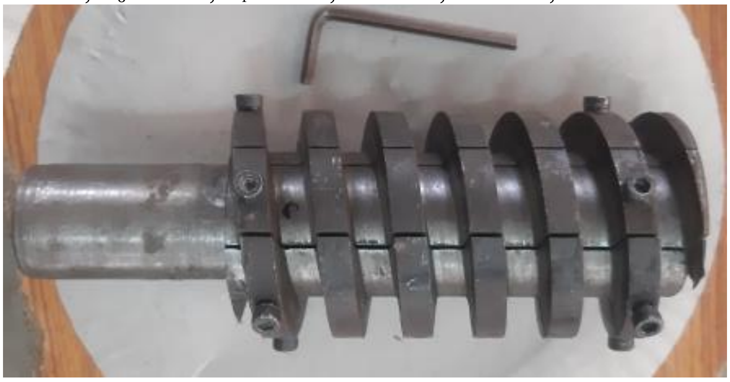

Fig.1 Reusable Mandrel

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 9 Issue 09, September-2020

Fig. 2 Fabricated Gl/Ep/Ceno FRP helical spring

III. EXPERIMENTAL METHODS

C. density measurment test for Gl/Ep/Ceno FRP helical spring

The main aim to conduct the burning test is to find out the exact percentage of glass fibre in the fabricated frp helical spring.

D. Burning test for Gl/Ep/Ceno FRP helical spring

The main aim to conduct burning test is to identify the exact percentage of glass fiber in the FRP helical spring. This test is conducted using the small flame slowly the spring is heated and the epoxy reinforcement and cenosphere is burned at 300^0c. It is done for the 3 samples .

E. Measuring spring stifnees and max compression

The spring rigidity usually depends on size, material characteristics and shape. The corresponding displacement & load-displacement graph has been used in today's digitalized UTM which automatically collects the value of the applied load. B2704 spring constant (Stiffness – k) is calculated by knowledge of deflections at 30% and 70% of full load in a load-based VS deflect curve obtained by the compression test according to the Japanese Industrial Standard (IN) B2704. The fig.3 and fig.4 shows the testing of Gl/Ep/Ceno FRP helical spring and the results are tabulated in table 2

Fig. 3 testing of fabricated Gl/Ep/Ceno FRP helical spring on UTM

Fig. 4 Solid length of Gl/Ep/Ceno FRP-Helical spring

Table 2 properties of Gl/Ep/Ceno FRP helical spring

Property	**Values**
Spring rate (n/mm)	20
Maximum compression (mm)	30
Load at maximum compression (N)	1160
Glass fiber volume fraction (%)	70
Weight of spring (g)	477.07

IV RESULTS AND DISCUSSION

This work is intended to create a composite material helical spring for light- weight cars with the newly developed “spring winding” configuration and the recycled mandrel. In addition, mechanical properties should be calculated and compared. Testing and values were tabulated for the properties of spring in the graph.

Table 3 values of Gl/Ep/Ceno FRP helical spring

DEFLECTION in mm	LOAD in N
0	0
2	220
4	380
6	500
8	640
10	660
12	700
14	740
16	760
18	780
20	800
22	820
24	860
26	900
28	920
30	1160

Spring stiffness for fabricated spring

The force required to compress the spring by 1 millimeter is known as the spring constant. The spring rate depends on the number of coils in the spring, the material rigidity module, and the spring dimensions. The stiffness of the present manufactured spring is obtained according to the specifications of JIS B2704 and its value is 20 N / mm.

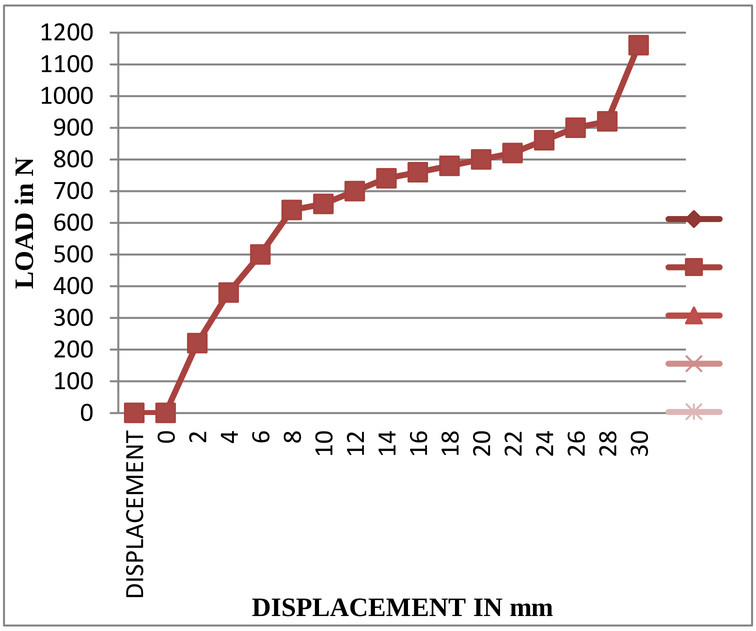

Fig 4 load v/s deflection values for Gl/Ep/Ceno FRP helical spring

V .CONCLUSION

Based on the fabrication process and the experimental results obtained, the following conclusions can be made

- Mild steel reusable mandrel is simple to produce a composite helical spring.
- The "Spring Winding" system for fabricating helical spring is suitable to achieve required mechanical properties.
- As compared to Steel Spring, FRP Helical Spring weighs 50 per cent less. Although the composite spring's cost is higher, due to light weight the cost of fuel can be reduced.
- The load carrying capacity and stiffness of Gl/Ep/Ceno FRP helical spring is 15% higher than Gl/Ep FRP helical spring.
- There is less stress developed in FRP springs, as compared to steel springs. Hence improved fatigue life.

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