

Experimental Investigation of Polymer Composite Spur Gears Reinforced with Lantana Camara Powder

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ABSTRACT - This paper describes about the manufacturing of composite spur gears reinforced with alkali treated Lantana Camara powder (LCP) with different volume fractions as 5%, 10% and 15%. Unsaturated polyester resin selected as matrix material whereas LCP as reinforcement. Finally, 3 gears are machined by gear hobbing process.

KEYWORDS: Lantana Camara, spur gears, polyester resin, polymers and natural fibers

I. INTRODUCTION

Lantana Camara is a species of flowering plant in the verbena family, Verbenaceae that is native to the American tropics. It has been introduced into other parts of the world as an ornamental plant and is considered an invasive species in many tropical and sub-tropical areas. Common names include largeleaf lantana, common lantana, kamara lantana, wild sage, red sage, yellow sage, white sage, and shrub verbena, refer fig.1.

Polymer gears are generally used in light weight, corrosion resistance and noiseless applications. It is lubricant free and easy to manufacture .however the thermal conductivity of plastic gears is very low which



leads to thermal damage in gear tooth surface.[1].K.mao[2] reported that the gear surface will wear slowly with a low specific wear rate if the gear is loaded below the critical value. It was reported that the surface temperature was the dominant factor influencing

the wear rate on acetal and nylon 66 spur gears [3].gear rotational speed affects the performance of gears made of nylon 6 spur gears reinforced with glass fibers at high speeds and high torques [4].Masaya Kurokawa [5] investigated PA12/CF gears, that the gears had excellent wear property and highest load capability.

Natural fibers are replacing synthetic fibers as reinforcement in various matrices [6]. Incorporation of sisal-jute fiber with GFRP can improve the properties and used as an alternate material for glass fiber reinforced polymer composites [7].



Fig.2 Polymer Spur Gear

Seena Joseph [8] in his paper discussed about that banana fibre and glass fibre reinforced composites show a regular trend of increase in properties with fibre loading and interfacial shear strength values obtained from single fibre pull out test reveal that the interlocking between banana fibre and phenol formaldehyde resin is much higher than that between glass and phenol formaldehyde resin .Examining the research work on hybrid composites of jute and banana combination , it shows that the addition of banana fiber in jute/epoxy composites of

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up to 50% by weight results in increasing the mechanical and thermal properties and decreasing the moisture absorption property [9].

II.MATERIAL SELECTION

In this present investigation Lantana Camara powder and Polyester resin are used for fabricating the composites. Lantana Camara plants are available roadside in the Nilgiris district. Isothalic polyester resin, catalyst Methyl Ethyl Ketone Peroxide (MEKP) and Cobalt Napthanate accelerator are obtained from Covai Seenu Fabrics, Coimbatore.

III.PREPARATION OF LCP

Lantana Camara plants are available roadside in the Nilgiris district. It uses for medicines and making furniture's. Diameter of 30mm to 65mm stems of length 20cm are cut from the plants. The stems are dried in sunlight for a week, refer fig.3.



Fig.3 Lantana Camara Plant Stem

Skin can be easily removed by hand, if it's completely dried. The stems are turned using lathe machine until the core part of the plant is reached, refer fig.4.



Fig.4 Lantana Camara stem turned in lathe

The powders are collected from the tray under the chuck. Fine powders are obtained by crushing the powder in mixie. Finally LCP powders are made. Required amount of fibers are weighed for different volume fractions.

IV.MANUFACTURING OF GEARS

Hand layup technique is used to fabricate the composites. A mould size of 70mm x 70mm x 18mm is prepared by OHP sheet. Polyester resin, Catalyst and Accelerator are mixed in the ratio of 1: 0.02: 0.02. Required amount of LCP for example 10g (Specimen-A) are poured into the resin mixture and stirred well using the glass rod. Uniform stirring is essential. Then the complete mixture is poured into the mould very slowly to remove the air bubbles. The mould is allowed to cure for one day. After curing, OHP sheet is removed and the specimen is machined using Lathe for dimension of $\phi 64\text{mm} \times 18\text{mm}$. Plywood sheet of $\phi 64\text{mm} \times 3\text{mm}$ are cut to place at top and bottom surface of the gear blank when it is placed in gear hobbing machine. Finally the required gears are machined by Gear Hobbing process, refer fig.5.



Fig.5 LCP gear

V.VOLUME FRACTION CALCULATION

Volume of the mould = 70mm x 70mm x 18mm

$$= 88200\text{mm}^3 = 88.20\text{cm}^3$$

Density of Polyester resin PE = 1.10g/cm³

$$\begin{aligned} \text{Total mass} &= 88.20\text{cm}^3 \times 1.10\text{g/cm}^3 \\ &= 97.02\text{g} \sim 110\text{g} \end{aligned}$$

Table 1
Volume fraction for LCP

Specimen	% of LCP	% of PE	LCP in g	PE in g	Total mass in g
A	5	95	5.50	104.50	110
B	10	90	11.00	99.00	110
C	15	85	16.50	93.50	110

VI.CONCLUSION

Using Polyester resin and natural fiber Lantana Camara powder, 3 spur gears are manufactured. This paper concludes that even the weed plants can be used for making products in industrial applications.

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