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DESIGN AND ANALYSIS OF SPUR GEAR BY USING PALM FIBRE AND E-GLASS COMPOSITE MATERIAL AND EVALUATE THE MECHANICAL PROPERTIES

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Abstract - *Hybrid Composite material have evoked a keen interest in recent times for potential applications in aerospace and automotive industries owing to their superior strength to weight ratio and temperature resistance. The widespread adoption of particulate metal matrix composites for engineering applications has been hindered by the high cost of producing components. Achieving a uniform distribution of reinforcement within the matrix is one such challenge, which affects directly on the properties and quality of composite material.This paper discuss the Spur Gear model made by Aluminium wire and palm,e-glass fiberfibre composite material and to evaluate the Hardness, Impact Strength of the Composite Material.*

1. INTRODUCTION

Introduction of composite materials

Here we are fabricated the model f composite material of spur gear using palm fibre , e-glass and epoxy. 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.

II. LITERATURE REVIEW

The history of natural fiber reinforced polymer composites can be traced back to the advent of synthetic polymers in the early twentieth century. In 1850s, shellac was compounded with wood flour. Research on natural fiber composites has existed since the early 19th century but has not received much attention until late in the 1980's.During 1920s, 1930s and early 1940s, a good deal of research was carried out on natural fiber reinforced composites. Caldwell and Clay carried out their research work on natural fiber reinforced composites for lighter materials to be used in aircraft primary structures.

Composites, primarily glass but including natural reinforced composites are found in countless consumer products like boats, agricultural machinery and cars.A major goal of natural fiber composites is to alleviate the need to use expensive glass fiber, which has a relatively high density and is dependent on non-renewable sources. Recently, car manufacturers have been interested in incorporating natural fiber composites into both interior and exterior parts.

This serves a two-fold goal of the companies that is to lower the overall weight of the vehicle thus increasing fuel efficiency and to increase the sustainability of their manufacturing process. Many companies such as Mercedes Benz, Toyota and DaimlerChrysler have already accomplished this and are looking to expand the uses of natural fiber composites. The gear stress analysis, the transmission errors, and the prediction of gear dynamic loads, gear noise, and the optimal design for gear sets are always major concerns in gear design. The polymer gear wear rate will be increased, when the load reaches a critical value for a specific geometry.

The gear surface will wear slowly with a low specific wear rate if the gear is loaded below the critical one. The possible reason of the sudden increase in wear rate is due to the gear operating temperature reaching the material melting point under the critical load condition. Actual gear performance was found to be entirely dependent on load. A sudden transition to high wear rates was noted as the transmitted torque was increased to a critical value.

This is to be associated with the gear surface temperature of the material reaching its melting point. That is for a given geometry of actual gear, a critical torque can be decided from its surface temperature calculation. [K. Mao, 2006] The detailed analysis of the flash temperature for polymer composite gears and the heat partition between gear teeth problem is treated as an unsteady one where the intensity distribution and velocity of heat source changes as meshing proceeds.

A numerical approximation is adopted using finite different method and the results are shown to be close to those found using semi-analytical method assuming no internal hysteresis and the material properties are constant. Blok's solution can be used to provide a quasisteady approximation that is for mean flash temperature estimation. A numerical method has been developed in the current paper for polymer composite gear flash temperature prediction. [K. Mao, 2007] Load carrying capacity and occurring damages of gears which are made of PC/ABS blends were investigated. PC is hard material and ABS is soft material. The usage of materials limits these drawbacks. However PC and ABS polymers combine each other, the PC/ABS blends have suitable mechanical properties for gear applications in the industrial areas. In this study, usability of PC/ABS composite plastic materials as spur gear was investigated. PC/ABS gears were tested by applying three different loading at two different numbers of revolutions on the FZG experiment set. [R. Yakut, 2009]

They have performed a theoretical analysis of a procedure to determine the Lewis Factor and also performed the contact analysis of spur gears to find the stress distribution between gear teeth. [J.L. Moya, A.S. Machado, 2007] It is to establish a characterization method for seven polyamide (PA) grades to determine the major material to manufacture an automotive worm gear. The composite properties were measured according to the worm gear loadings: tensile strength, Young's modulus, abrasion and impact resistance. They were also correlated to the PA moisture absorption and its glass fiber (GF) reinforcement.

3. SELECTION OF MATERIALS

PALM FIBER

These fibers are known for their high durability and their resistance to sea water. Traditionally, palm fibers were used to make ropes for ship cordages which were proven to have good properties in sea water.

The use of palm fiber has moved to another successive level specifically to various engineering applications. For example, it has been used in road constructions for soil stabilization as a substitute for geo textile fiberglass reinforcement. Apart from that, in certain circumstances, it is also being used for underwater and underground cables. Fibers in random original orientation mean that they are in their original layered shape straight from the tree trunk.

E-GLASS FIBER

E-Glass Fiber E-Glass fiber (“E” stands for electric) is made of alumina borosilicate glass with less than 1 wt% alkali oxides. Some other elements may also be present at low impurity levels. A typical nominal chemical composition of E-glass fibers is SiO2 54 wt%, Al2O3 14 wt%, CaO + MgO 22 wt%, B2O3 10 wt% and Na2O+K2O less than 2 wt%. Some reported advantages and disadvantages of E-glass fibers are listed in Table 2.

PROPERTICE OF E-GLASS FIBER

PROPERTICE	VALUE
Density, gm/cc	2.58
Elongation%	4.8
Annealing point ‘C (‘ F)	657(1215)

EPOXY RESIN

Epoxy Resins Epoxy resins have been commercially available since the early 1950’s and are now used in a wide range of industries and applications. Epoxies are classified in the plastics industry as thermosetting resins and they achieve the thermo set state by means of an addition reaction with a suitable curing agent.

Properties of epoxy and polyester resins.

Property	Epoxy
Viscosity at 25 °C μ (cP)	12000-13000
Density ρ (g.cm⁻³)	1.16
Heat Distortion Temperature HDT (°C)	50
Modulus of elasticity E (GPa)	5.0
Flexural strength (MPa)	60
Tensile strength (MPa)	73
Maximum elongation (%)	4

The curing agent used will determinewhether the epoxy cures at ambient or elevated temperatures and also influence physical properties suchas toughness and flexibility

Epoxy Resin Hardeners

Property	Value	Unit
Molecular weight	198.27	
Grade	Purum	
Flash point	230	°C
Melting point	88-92	°C
Color	Brown	

PROCESS

Gel coat is first applied to the mold using a spray gun for a high quality surface. When the gel coat has cured sufficiently, roll stock fiber glass reinforcement is manually placed on the mold. The laminating resin is applied by pouring, brushing, spraying, or using a paint roller. FRP rollers, paint rollers, or squeegees are used to consolidate the laminate, thoroughly wetting the reinforcement and removing entrapped air. Subsequent layers of fiber glass reinforcement are added to build laminate thickness. Low density core materials such as end-grain balsa, foam, and honeycomb, are commonly used to stiffen the laminate. This is known as sandwich construction.

MOLDS

Simple, single cavity molds of fiber glass composites construction are generally used. Molds can range from small to very large and are low cost in the spectrum of composites molds.

MECHANICAL PROPERTY TESTS

Tensile Strength

The tensile test of the composites was performed as per the ASTM D3039 standards. The test was done using a universal testing machine (Tinius Olsen H10KS).The specimen of required dimension was cut from the composite cast. The test was conducted at a constant strain rate of 2 mm/min. The tensile test arrangement is shown in figure

	Thickness (mm)	Width (mm)	CSA (mm2)	YL (N/mm2)	YS (N/mm2)	TL (KN)	TS (N/mm2)	IGL (mm)	FGL (mm)	%E
1	9 to 10	39.10	351.9	5.45	364.67	8.93	456.86	102.82	109.83	7.01

Tensile test is used to determine the tensile strength of the specimen, % elongation of length and % reduction of area. Tensile test is usually carried out in universal testing machine.

HARDNESS TEST

This gives the metals ability to show resistance to indentation which show it's resistance to wear and abrasion. Hardness testing of welds and their Heat Affected Zones (HAZs) usually requires testing on a microscopic scale using a diamond indenter. The Vickers Hardness test is the predominant test method with Knop testing being applied to HAZ testing in some instances. Hardness values referred to in this document will be reported in terms of Vickers Number, HV.

Identification	Impression
1	38.7,41.8,42.3

TOUGHNESS TEST

The principal measurement from the impact test is the energy absorbed in fracturing the specimen. Energy expended during fracture is sometimes known as notch toughness. The energy expended will be high for complete ductile fracture, while it is less for brittle fracture. However, it is important to note that measurement of energy expended is only a relative energy, and cannot be used directly as design consideration. Another common result from the Charpy test is by examining the fracture surface. It is useful in determining whether the fracture is fibrous (shear fracture), granular (cleavage fracture), or a mixture of both.

Identification	Impact values in joules
1	7

APPLICATION

- Automobile components
- corrosion resisting areas
- Tidal power plant components

CONCLUSION

The literature survey of fiber composite spur gear was performed.

Then the study in weight reduction and stress distribution of spur gear for aluminum wire and fiber composite materials has been done. On the basis of that study, the analysis of both cast AL and fiber composite materials are analyzed in the application of gear which is used in automobile vehicles. From the analysis we got the hardness and impact values for fiber composite materials weight and cost is less. So from these analysis mechanical behavior results.

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