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DESIGN AND ANALYSIS OF SPUR GEAR BY USING E-GLASS FIBER AND EPOXY COMPOSITE MATERIAL

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Abstract— Hybrid Composite materials 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. They are used in a range of other applications, including insulation, cladding, surface coating, and roofing raw material, among others. Fiberglass bars are comprised of composite material. Fiber-reinforced plastic (FRP) combines reinforced fibers and liquid resin, then molded into various forms and sizes. In this project discusses the Spur Gear model made by e-glass fiber and Epoxy composite material and to evaluate the Hardness, Impact Strength of the Composite Material.

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.

- Composite is a combination of two or more chemically distinct and insoluble phases.
- Constituent materials or phases must have significantly different properties for it to combine them: thus metals and plastics are not considered as composites although they have a lot of fillers and impurities

- The properties and performance of composites are far superior to those of the constituents
- Composites consist of one or more discontinuous phases (reinforcement) embedded in a continuous phase (matrix)

E-GLASS CHEMICAL PROPERTIES

E-Glass - the most popular and inexpensive. The designation letter "E" means "electrical implies that the it is an electrical insulator". The composition of E-glass ranges from

CHEMICAL COMPOSITION	RANGE
Sio2	52-56%
Al2O3	12-16%
CaO	16-25%
B2O3	5-10%

PROPERTIES OF E-GLASS FIBER

PROPERTIES	VALUE
Appearance	White
Density, g/cc	2.58
Tensile strength	4585 Mpa
Shear modulus	35 Mpa
Elongation at Break %	5.4 %
Melting point	<=1725° C

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 No. curing agent.

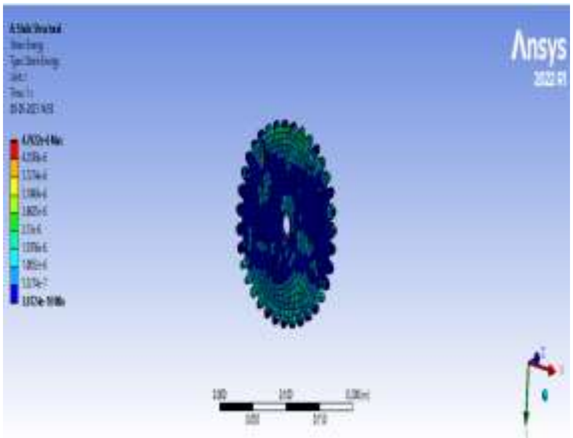
Properties of epoxy and polyester resins.	
Property	Epoxy
Viscosity at 25 °Cμ (cP)	12000-13000
Density ρ (g.cm³)	1.16
Heat Distortion Temperature HDT (°C)	50
Modulus of elasticity 'E' (GPa)	5.0
Flexural strength (MPa)	60
Tensile strength (MPa)	73
Young's Modulus	164
Shear Modulus	2.5
Maximum elongation (%)	4

The curing agent used will determine whether the epoxy cures at ambient or elevated temperatures and also influence physical properties such as toughness and flexibility

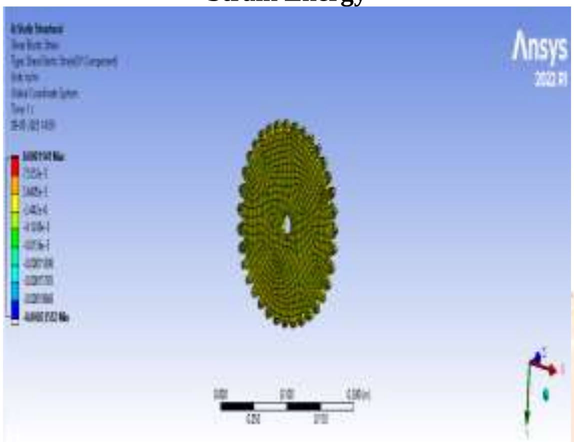
PROPERTIES OF EPOXY

The primary reason for epoxy's popularity is its superb mechanical strength. Welding is often the only alternative. Epoxy is nearly always cheaper and faster than welding. Epoxy also has excellent resistance to chemicals. After setting, there is no worry of a chemical reaction that will weaken the seal. It also resists heat. That resistance makes it ideal for electronics and electrical systems and other industrial applications. Those who use epoxy are aware of the superb mechanical strength and low curing contraction. They also know the epoxy resins are well-balanced industrial materials and suited to a broad range of applications. Engineers are faced with concerns about heat dissipation, electrical insulation, adhering dissimilar substrates, light weighting, sound dampening, vibration, and reduction corrosion. Appearance has to be considered, as well as, assembling costs. Epoxy is an adhesive formulation that meets all of those concerns. Its thermal and electrical properties, strength, and durability are what epoxy is noted for. Those properties along with the resistance to immersion and hostile chemical vapor are the reason epoxy often is chosen by engineers.

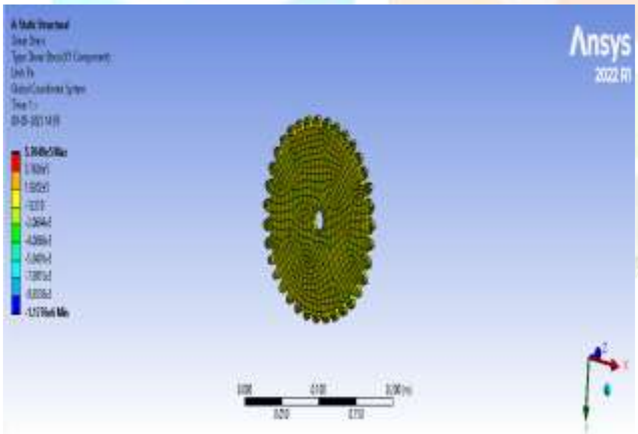
ANALYSIS



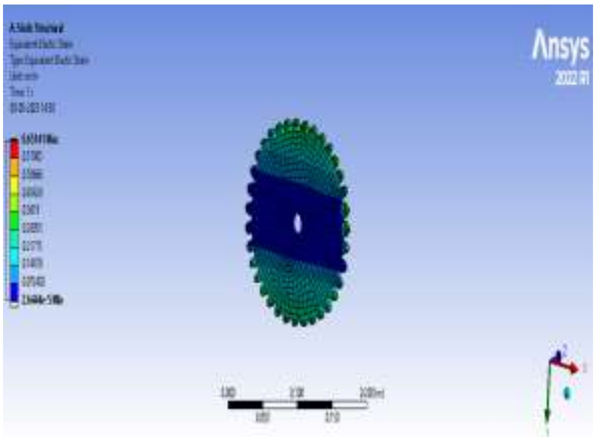
Strain Energy



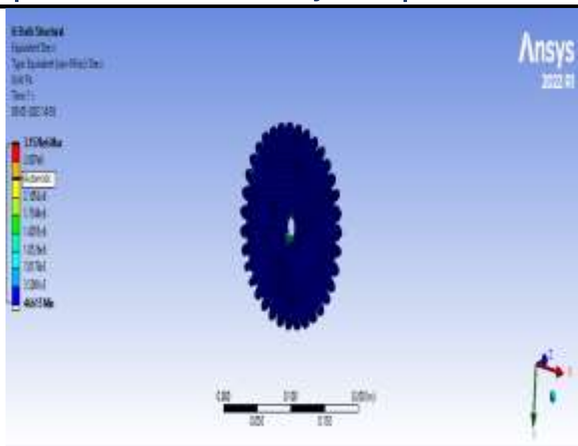
Shear Elastic Strain



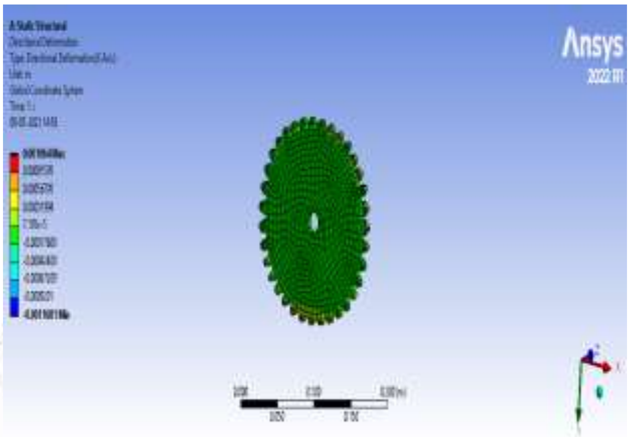
Shear Stress



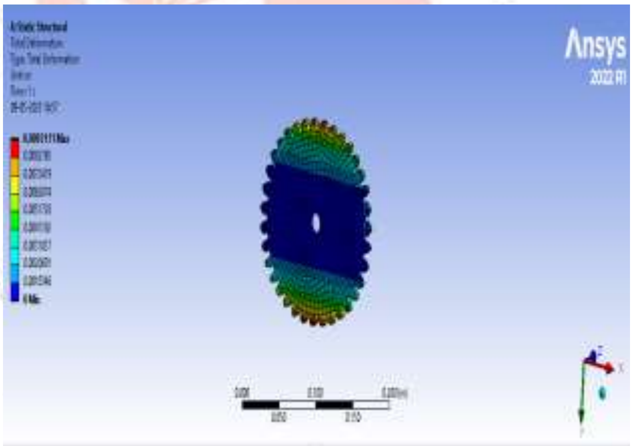
Equivalent Elastic Strain



Equivalent Stress



Directional Deformation



Total Deformation

APPLICATION

Fiber gears are being used increasingly in applications, such as printers, cameras, small household appliances, and small power tools. Instruments, timers, counters and various other products. They are used in a range of other applications, including insulation, cladding, surface coating, and roofing raw material, among others. Fiberglass bars are comprised of composite material. Fiber-reinforced plastic (FRP) combines reinforced Fibers and liquid resin, then moulded into various forms and sizes.

- Automobile components.
- Corrosion resisting areas.
- Tidal power plant components.

CONCLUSION

The Project of Fiber composite spur gear was performed successfully .Then the study in weight reduction and stress distribution of spur gear for epoxy and e- glass Fiber composite materials have been done. Based on the study, the Fiber composite materials are analyzed in the application of gear which is used in transmission in conveyer belt section in the electrical industry where the load applied in the gear is less. From this analysis we got the Tensile Strength (328.84 n/mm2), impact values (8 joules) and Hardness (40.9 & 41.7, 42.9 in HRB (Hardness Rockwell B Scale)) for Fiber composite materials weight and cost is less.

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