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ANALYSIS OF EFFECT OF REINFORCEMENT IN FIBER ORIENTATION BY USING HYBRID COMPONENTS

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ABSTRACT

Aluminium hybrid composites are a new generation of metal matrix composites that have the potentials of satisfying the recent demands of advanced engineering applications. These demands are met due to improved mechanical properties, amenability to conventional processing technique and possibility of reducing production cost of Aluminium hybrid composites. The performance of these materials is mostly dependent on selecting the right combination of reinforcing materials since some of the processing parameters are associated with the reinforcing particulates. A few combinations of reinforcing particulates have been conceptualized in the design of Aluminium hybrid composites. This paper attempts to review the different combination of reinforcing materials used in the processing of hybrid Aluminium matrix composites and how it affects the mechanical, corrosion and wear performance of the materials. The major techniques for fabricating these materials are briefly discussed and research areas for further improvement on Aluminium hybrid composites are suggested.

However there are several design and manufacturing challenges to be addressed before practically using them as structural components. In this work we demonstrate the design, manufacturing and testing procedure of variable stiffness vs composite cylinder made by hybrid composites.

Introduction

Metal matrix composites, at present though generating a wide interest in research fraternity, are not as widely in use as their plastic counterparts. High **strength**, **fracture toughness** and **stiffness** are offered by metal matrices than those offered by their polymer counterparts. Theycan withstand elevated temperature in corrosive environment than polymer composites. Most metals and alloys could be used as matrices and they require reinforcement materials which need to be stable over a range of temperature and non-reactive too. However the guiding aspect for the choice depends essentially on the matrix material. Light metals form the matrix for temperature application and the reinforcements in addition to the aforementioned reasons are characterized by high moduli. Most metals and alloys make good matrices. However, practically, the choices for low temperature applications are not many. Only light metals are responsive, with their low density proving an advantage. Titanium, Aluminium and magnesium are the popular matrix metals currently in vogue, which are particularly useful for aircraft applications. If metallic matrix materials have to offer high strength, they require high modulus reinforcements. The strength-to-weight ratios of resulting composites can be higher than most alloys. The melting point, physical and mechanical properties of the composite at various temperatures determine the service temperature of composites. Most metals, ceramics and compounds can be used with matrices of low melting point alloys. The choice of reinforcements becomes more stunted with increase in the melting temperature of matrix materials.

1.1 Advantages of Composites

- High resistance to fatigue and corrosion **degradation**.
- High 'strength or stiffness to weight' ratio. As enumerated above, weight savings are significant ranging from 25-45% of the weight of conventional metallic designs.
- Due to greater **reliability**, there are fewer inspections and structural repairs.
- Directional **tailoring capabilities** to meet the design requirements. The fibre pattern can be laid in a manner that will tailor the structure to efficiently sustain the applied loads.
- Fibre to fibre redundant load path.
- Improved dent resistance is normally achieved. Composite panels do not sustain damage as easily as thin gage sheet metals.

2. Material and method

Aluminium can be severely deformed without failure. This allows aluminium to be formed by rolling, extruding, drawing, machining and other mechanical processes. It can also be cast to a high tolerance.Alloying, cold working and heat-treating can all be utilised to tailor the properties of aluminium.The tensile strength of pure aluminium is around 90 MPa but this can be increased to over 690 MPa for some heat-treatable alloys.

Table 1 Physical properties of aluminium

Property	Value
Atomic Number	13
Atomic Weight (g/mol)	26.98
Melting Point (°C)	660.2
Boiling Point (°C)	2480
Mean Specific Heat (0-100°C) (cal/g.°C)	0.219
Thermal Conductivity (0-100°C) (cal/cms. °C)	0.57
Co-Efficient of Linear Expansion (0-100°C) ($x10^{-6}$/°C)	23.5
Electrical Resistivity at 20°C (Ω.cm)	2.69
Density (g/cm^3)	2.6898
Modulus of Elasticity (GPa)	68.3
Poissons Ratio	0.34

3. Deflection test in UTM

Fig 1 Deflection of pure Al

3. Results and Discussion

DEFLECTION	LOAD ON PURE Al	LOAD ON CONCENTRIC Al	LOAD ON Al WITH ROD
0.1	6.26	8.08	6.46
0.5	6.8	11.52	8.34
1	7.52	13.36	10.82
1.5	8.08	14.62	12.86
2	8.58	15.48	14.48
2.5	9.12	16.26	16.38
AVG	**10.643**	**16.92**	**13.681**

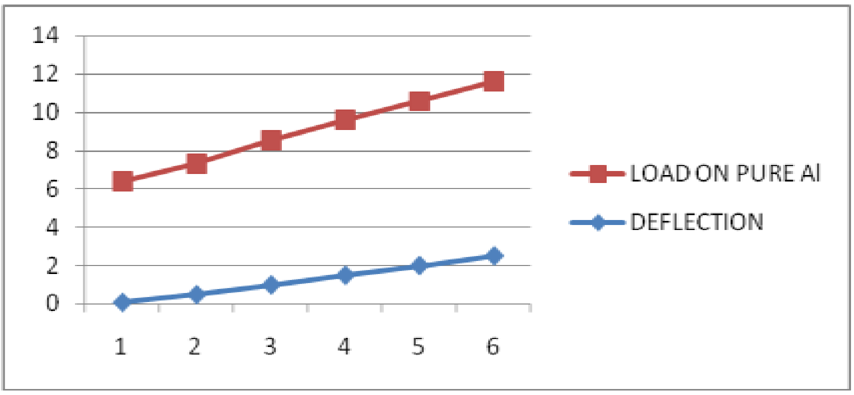

Figure 1 Load on pure aluminium

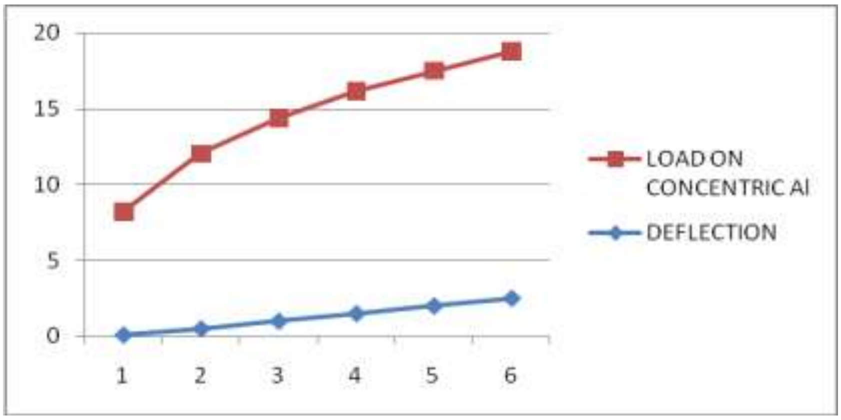

Figure 2 Load on concentric arrangement

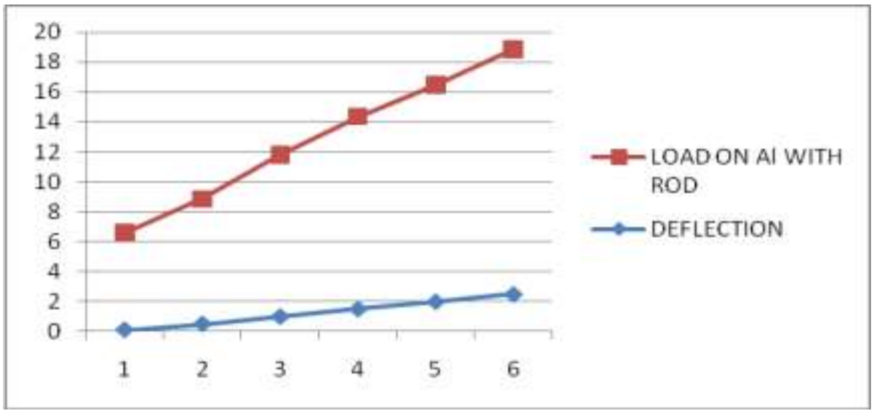

Figure 3 Load on steel matrix

- The material required for the concentric arrangement of aluminium with steel is half the percentage of material required for the arrangement of steel matrix.
- But the stiffness of the concentric arrangement of the aluminium is higher than the stiffness of the steel matrix arrangement.
- The strength of the material is higher in the concentric steel orientation.
- The concentric steel orientation has high young's modulus (doubled) than compared to the orientation with steel rod young's modulus.

Conclusion

From this project work, We analysed and calculated that the concentric steel orientation has high young's modulus(doubled) than compared to the orientation with steel rod young's modulus. So we concluded that the strength of the material is higher in the concentric steel orientation.