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ORIGINAL ARTICLE

Load-bearing characteristics of a hybird Si_3N_4-epoxy composite

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Abstract

In this study, the epoxy composites were made using Si_3N_4 nanoparticle obtained from red matta rice husk ash and aluminised glass/pineapple hybrid fibre. The primary objective of this study was to develop lightweight structural composites for domestic infrastructure applications using biomass wastes. The epoxy composites were made using Si_3N_4 nanoparticle of 0.5 to 4 vol% and hybridised fibre of 40 vol% by hand lay-up method. The mechanical, fatigue and low-velocity impact characteristics of the composites were evaluated as per ASTM standards. The results showed that, among the composites that had been produced, composites with 2 vol% Si_3N_4 nanoparticle had the highest tensile, impact, flexural and hardness, measuring 168 MPa, 202 MPa, 6.2 J and 93 shore-D. Also, at 50% of UTS, the composite with the addition of 2 vol% Si_3N_4 nanoparticle had a better fatigue life count of about 36273. Similarly, the improved low-velocity impact strength of composite having 1 vol% of Si_3N_4 nanoparticle has maximum energy absorption of 11.4 J. Moreover, with the insertion of stacked fibre and Si_3N_4 nanoparticle, the epoxy composites have low combustion rate showing better flame-retardant behaviour. The results show that composites have been successfully produced for potential applications such as domestic infrastructure products like lightweight man-hole cover, hand rails, gratings, interior decoration panels, doors and windows.

Keywords Composites · Fibre · Nanoparticle · Mechanical · Fatigue · Flammability

1 Introduction

Composite material is made usually from two phases, i.e. reinforcement and matrix. Reinforcement works as load-bearing member and the matrix work as stress transfer among reinforcement elements. Due to their extensive application in the aerospace, automotive, construction and sporting industries, fibres are firmly regarded as reinforcement element in composite materials where they bear the majority of the loading [1–3]. Due to their durability and affordable pricing, glass fibres (GF) are one of the most popular reinforcement materials [4–6]. Nowadays, lignocellulosic fibres have been used as a reinforcement material to produce a polymeric composite and are receiving a lot of attention in the place of glass or other synthetic fibres [7–10]. Meanwhile, it is economical, commonly available and a recurrent crop with very high potential mechanical properties such as lightweight, high tensile strength, high thermal stability, flame-retardant property and prominent stiffness. Among the lignocellulosic fibres, pineapple is the promising fibre to be used as a reinforcement material due its easy availability. In order to create the faux celling board composite,

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