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Desert cotton and areca nut husk fibre reinforced hybridized bio-benzoxazine/epoxy bio-composites: Thermal, electrical and acoustic insulation applications

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ABSTRACT

Due to increasing environmental concerns, significant attention has been gained for seeking out alternative sources for deforestation and to reduce as much as possible for the utilization of petroleum-based chemicals. In the present work hybrid bio-composites have been developed using epoxy resins (DGEBA-isophoronediamine and DGEBA-phenalkamine) and hybridized blend of bio-based cardanol-diaminodiphenylmethane (C-ddm) benzoxazine and DGEBA-isophoronediamine (bio-benzoxazine: epoxy resin 50:50 wt%)reinforced with desert cotton (DC) and areca nut husk fibres (ANF) separately under appropriate experimental conditions, in order to utilize them for high performance thermal, electrical and acoustic insulation panel applications. Mechanical behaviour, thermal conductivity, thermal resistance, electrical surface resistivity, electrical volume resistivity, sound absorption coefficient and sound transmission loss were studied as per standard methods. Results obtained from different studies infer that hybrid blended cardanol benzoxazine composite panels reinforced with desert cotton sandwich areca nut husk fibre (DC-sw-ANHF) possess appreciable thermal resistivity and electrical volume resistivity and the corresponding values are 0.22141 M^2 k/w, and 1.888 $\times$ 10^{10} Ω, respectively. Data obtained from acoustic studies, indicate that all the fibre reinforced composites possess more than 0.7 value of sound absorption coefficient at 6400 Hz. The composite panel specimens developed using both desert cotton, and areca nut husk fibre reinforced with hybridized blend of bio-benzoxazine/epoxy resin can be used as insulation materials in the field of building construction.

1. Introduction

Bio-composite products have penetrated reasonable extent to commercial markets in the form of value-added products and have become popular in the field of building construction, automotive products, and outdoor industrial infrastructure applications [1]. At present the demand for natural fibres are gradually progressing and expected to grow significant extent. The use of natural fibre composites has increased substantially in the field of construction, viz., automotive, electrical and electronic sectors [2]. The performance and sustainability of wood and natural fibre composites become paramount in material choice. The development of methods, systems, and standards adopted for bio-composite materials possesses a distinct advantage over traditional materials. There is a significant research effort underway to develop bio-composite materials and to explore their use in civil engineering applications [3].The acoustic proof materials are used in the construction of walls and ceiling in the field of construction of buildings, lecture halls, auditoriums, theatres, automobiles, aerospace and other transport systems to alleviate problems associated with noise pollution [4–9].

Acoustic absorption panels made from natural fibres are less hazardous to human health and more environmentally friendly than those made of conventional synthetic fibres [10]. Hence, to satisfy environmental issues, synthetic materials need to be replaced with suitable natural fibres. Bio-fibrous waste have been widely used due to their inherent properties such as bio-degradability, renewability and their abundant availability, in addition to their light weight, carbon neutral

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