Construction and Building Materials 174 (2018) 713–729

Contents lists available at ScienceDirect

Construction and Building Materials

journal homepage: www.elsevier.com/locate/conbuildmat

Review

Mechanical properties evaluation of sisal fibre reinforced polymer composites: A review

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HIGHLIGHTS

- Sisal fibre obtained by decortication from sisal plants widely found in East Africa.
- It possess super engineering mechanical properties like jute and hemp fibres.
- Tensile strength, modulus and elongation at break are comparable to jute and flax.
- Adding in thermosets, thermoplastics and biopolymer improves mechanical strength.
- Sisal polymer composites impart revolution in structural and building industries.

ARTICLE INFO

Article history:
Received 15 February 2018
Received in revised form 13 April 2018
Accepted 17 April 2018

Keywords:
Natural fibres
Sisal fibre
Sisal fibre reinforced polymer composites
Mechanical properties
Chemical treatments
Hybrid composites

ABSTRACT

Recently, growing environmental impact associated with production, disposal and recycling of synthetic fibre based polymer composites triggers the development of ecofriendly composite for various applications such as automotive, marine, chemical, Infrastructure, sporting goods etc. Among many natural fibres like kenaf, jute, oil palm, cotton, flax, banana and hemp, sisal are gaining attention as they are abundantly available, cheaper, eco-friendly and possess remarkable and satisfactory mechanical properties to hemp, banana and jute. Sisal fibre will play a key role to fabricate a varied range of structural and non-structural industrial products with different polymer matrix. This review article deals the mechanical properties of sisal fibre and the several factors influencing the mechanical properties of its polymer composites, such as fibre loadings, fibre length, fibre architecture, chemical treatments and hybridization by incorporating different natural/synthetic fibre/fillers or additive, according to the application and strength requirements. Attempt also been made to investigate the effect of water absorption, chemical concentration, exposure time, filler weight% and individual fibre loading % in the hybrid configuration on the mechanical properties. Overall present review article was designed to explore, highlights and gathered the previous reported studies directing the mechanical properties of sisal fibre and its polymer composites to provide a perfect source of data and literature for doing future research to reveal it as construction and building materials like synthetic fibres.

Contents

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https://doi.org/10.1016/j.conbuildmat.2018.04.143
0950-0618/

Abbreviations and Description

FRC	Fibre reinforced polymer composites
SFC	Synthetic fibre reinforced composites
NFC	Natural fibre reinforced composites
T	Tensile
F	Flexural
I	Impact
TS	Tensile strength
TM	Tensile modulus
FS	Flexural strength
FM	Flexural modulus
IS	Impact strength
PE	Polyester
VE	Vinyl ester
B/E	Benzoxazine/Epoxy
HDPE	High density polyethylene
LDPE	low density polyethylene
HIPS	high impact polystyrene
PP	Polypropylene
PLA	poly-lactic acid
PHBV	Polyhydroxybutyrate-co hydroxyvalerate
PALF	Pineapple leaf fibre
APS	γ-aminopropyltrimethoxysilane
MPS	γ-methacryloxypropyltrimethoxysilane
GPS	γ-glycidoxypropyltrimethoxysilane
SEM	scanning electron microscope
HCl	Hydrochloric acid
$KMnO_4$	Potassium permangnate
NaOH	Sodium hydroxide
DCP	Dicumylperoxide
BP	Benzoyl Peroxide
MAPP	Maleic anhydride grafted PP
Al	Aluminium powder
$Mg(OH)_2$	Magnesium hydroxide
MCC-g-HPG-SA	Microcrystalline cellulose grafted hyper-branched polyglycerol grafted stearic acid
CNF	Cellulose nano fibers
HBT	1-hydroxy benzotriazole
MA	Maleic anhydride

1. Introduction

Fibre reinforced polymer composites (FRC) has been used widely in various applications due to their light weight and excellent strength/stiffness [1]. FRC is made up of two constituents, namely, fibre and matrix. Fibres could be synthetic or man-made and based on natural resources like plants. Synthetic fibre reinforced composites (SFC) have outstanding mechanical properties in comparison with the natural fibre reinforced composites (NFC). However, limitations of synthetic fibres due to their non-degradability involves disposal, recycling and environmental impact leads immense pollution to the surrounding environment which are the matters of concern for the government and researchers. Thus depending upon the application and strength requirements of the FRC the use of synthetic fibres has to be either reduced partially or fully with natural fibres. Natural fibres such as kenaf, sisal, banana, jute, flax, hemp, curaua and coconut sheath are considered as potential and attractive substitutes for the synthetic fibres [2,3], such as in automotive, constructional structures [4] and in many consumer profits formulation schemes. As natural fibres possess several advantages such as low density, biodegradability, abundant availability, non-abrasive and non-toxicity which