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ORIGINAL PAPER

The Effect of Eggshell Fillers on the Physical, Mechanical, and Morphological Properties of Date palm Fibre Reinforced Bio-epoxy Composites

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Abstract

Natural fibres have remained increasingly applied as reinforcement filler in polymer matrix for fabrication of composites for a long time. Environmentally friendly and sustainable fibres offer the possibility of a feasible substitute and alternative materials to synthetic fibres for a diverse range of products from composite materials. In this research, a new bio-composite has been produced by using date palm fibre (DP) and eggshell (ES) wastes into bio matrix. The current work focuses on how ES particles affect the physical, mechanical, and morphological aspects of DP/bio-epoxy composites. Bio-composites was manufactured by using a fibre loading of 40 wt% DP and filler concentrations of 5, 10, 15, and 20 wt% ES by closed mold hot press. A DP/bio-epoxy composite without ES filler was also prepared as control. Characterization of bio-composites was carried out as per ASTM standard. The obtained results indicate that ES can be used as a filler in bio-epoxy with this novel material composition. Mechanical properties results show that 15 wt% by weight of the ES particles filler loading displays good tensile and flexural properties with better impact strength at 5 wt%. The incorporation of ES above 15 wt% in DP/bio-epoxy composite is not remarkable, so 15 wt% filler matrix replacement is recommended. Furthermore, scanning electron microscopy (SEM) reveals fracture in matrix, implying that the bio-epoxy polymer structures are altered by the fillers. We concluded from findings that ES particles can utilize as potential source of green raw material for strengthening in polymer composites and ultimately help to establish its potential in structural applications.

Keywords Bio-epoxy · Eggshell · Date palm fibre · Fillers · Bio-composites

Introduction

A substantial effort has been made recently on the discovery, research, and application of bio-composites due to the high cost of products made from petroleum as well as environmental risks [1, 2]. Because polymers could be expensive, it is now customary to add less expensive filler to basic composite materials to minimize their overall cost while, in certain situations, increasing their qualities. Bio-composite are regarded as acceptable materials for a number of applications in the current environment due to their unique properties [3, 4]. A bio-composite has at least one

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