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Pultruded Kenaf Fibre Reinforced Composites: Effect of Different Kenaf Fibre Yarn Tex

Mohd Hafiz Zamri[a], HazizanMdAkil[a,b]*, ZainalAriffinMohdIshak[a,b],

[a]*School of Materials and Mineral Resources Engineering, Engineering Campus, UniversitiSains Malaysia, 14300 NibongTebal, Penang, Malaysia*

[b]*Cluster of Polymer Composite (CPC), Science and Engineering Research Centre (SERC), Engineering Campus, UniversitiSains Malaysia, 14300 Nibongtebal, Penang, Malaysia*

Abstract

Manufacturing high performance composites from natural fibres is one of an ambitious goal currently being pursued by researchers across the globe. The ecological benefits of this material among many others are environmentally friendly and do not cause health problems. In terms of sustainability, the natural fibre is an appropriate alternative candidate to replace the synthetic and other types of reinforcement since it is a renewable resource. In order for natural fibre reinforced composite to become competitive, it has to accommodate the processing avenues of which has long being associated with its synthetic counterpart. Among those proven technology in manufacturing advanced engineering component is pultrusion. In this paper, an attempt has been made to produce pultrudedkenaf fibre reinforced unsaturated polyester composites via pultrusion. The properties of the pultrudedkenaf fibre reinforced composites with different kenaf yarn sizes are reported and compared. Pultruded composites made with smaller tex number i.e. tex 1400 shows better compression properties of as compared to larger tex number. Smaller tex number help to produce better wetting on fibre during production of composites, consequently help to increase its properties. Pultruded composites made with smaller tex number i.e. tex 1400 shows better compression properties of as compared to larger tex number. Smaller tex number help to produce better wetting on fibre during production of composites, consequently help to increase its properties.

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* Corresponding author. Tel.: +0-000-000-0000 ; fax: +0-000-000-0000

E-mail address: hazizan@usm.my

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1. Introduction

By the increasing of worldwide social awareness about environmental impact, sustainability, and renewable energy sources, the polymer natural fibre composites recently have attracted the attention of researchers due to the fact that they are recyclable and biodegradable. The increasing environmental awareness and new rules and regulations are asking the industries to seek more ecologically friendly materials for their products. Nowadays natural fibres composites are replacing the synthetic and conventional fibre composites because of their easy availability, high specific strength, and low cost. Many studies have been made on the potential of the natural fibres as reinforcements for composites and in several cases the results have shown that the natural fibre composites own good advantages compared to synthetic fibre such as availability in large amounts, renewable, biodegradable, low cost, low density, less equipment abrasion and less skin and respiratory irritation[1-6]. Recent studies have investigated the development of biodegradable composite materials using natural fibres such as kenaf[7-9], flax[10, 11], bamboo[12], pineapple[13], sisal[14] and jute[15] as a reinforcement for biodegradable polymer composites. Concerning the matrix, the choice of unsaturated polyester is only based on economic interest. It incorporates very cheap resin, is easily available, has good mechanical properties, and has been used in many applications, such as transport, maritime, and sport [16].

Natural fibre reinforced composites can be produced by almost all production techniques including hand lay-up, press molding, resin transfer molding and many more. Nevertheless, the most proven technology in manufacturing advanced engineering component is pultrusion process. The strongest growth of any composites industry sector is found in pultrusionprocess which involve the manufacturing of continuous lengths of reinforced composites material with constant cross sections. It offers high content of reinforcing fibre materials i.e. almost 70% of fibre and also orderly layout of the fibre. Therefore the pultruded product strength is very high, oriented and programmable. It also improves the composite properties by forcing the fibre materials to lie under tension as the resin cures and are therefore the matrix and the fibre will tightly bonded to each other[17]. Pultruded composites are usually manufactured using thermosetting resin systems. Unsaturated polyester resins (USP) are widely used as a matrix because of relatively low price than other resins, ease of handling and possess a good balance of mechanical, electrical and chemical properties[18].

The combination of unsaturated polyester resin and kenaf fibres as reinforcement in composites will cater the demand for environmentally friendly materials. Since there are new interests in the development of natural fibre using the pultrusion process, many studies were found in this particular area recently [19-21]. In this study, preparation of pultrudedkenaf fibre reinforced composite (PKFRC) has been described. In addition, the compression and flexural properties of pultrudedkenaf fibre reinforced composites were studied as a function of different tex number of kenaf yarn fibre and volume fraction (v/v %) of kenaf fibre in the PKFRC samples.

2. Material and Methods

Kenaffibre yarns were supplied by JUTEKO Bangladesh, Pvt. Ltd. Bangladesh, in three different tex (sizes) which were tex 1400, tex 2200 and tex 3300. The tex number of the yarn refers to different diameter size of yarn used for pultrusion process. Tex is defined as a unit of measurement for the linear mass density of fibres and as the mass in grams per 1000 metres. Unsaturated polyester resin (Crystic P9901) was purchased from the Revertex Company, Malaysia. Other mixtures for resin such as benzoyl peroxide (BPO) as initiator, calcium carbonate ($CaCO^3$) as filler and the release agent powder were supplied by Revertex Company as well.

2.1 Preparation of Pultruded Composites

PultrudedKenaf Fibre Reinforced Composites (PKRFC) samples were prepared using a thermoset pultrusion machine at the School of Materials and Mineral Resources Engineering, UniversitiSains Malaysia, Penang, Malaysia. Kenaf fibre yarn, in roving form, were placed on bookcase-type shelves and equipped with a roving guide to lead the strands into the resin bath. The exact number of kenaf yarn fibres needed for the process was determined

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