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Technical Report

The effect of processing parameters on the mechanical properties of kenaf fibre plastic composite

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ABSTRACT

This paper investigates the effects that processing parameters, including temperature and speed, have on the mechanical properties of kenaf fibre plastic composite. Kenaf fibre was used to fabricate a composite material along with polypropylene (PP) as a binding material. The composite was manufactured using a newly developed compression moulding machine. Tensile and impact tests were performed on the PP/kenaf composite to characterise its mechanical properties. The tensile properties of PP/kenaf composite increased by 10% after the addition of unidirectional kenaf fibre (UKF). However, its impact properties simultaneously deteriorated. Dynamic mechanical analysis (DMA) was carried out to examine the material properties. Results show that the storage modulus (E') and loss modulus (E'') increase with the addition of UKF. However, its addition decreases the tan δ amplitude. The fracture surface of PP/kenaf composite was investigated by SEM. The newly invented compression moulding machine illustrates a new trend in processing parameters of long kenaf fibre plastic composite.

1. Introduction

In recent years attention has been focused on the development of technologies that utilise composite materials (such as agricultural residues and wood fibre), combined with synthetic materials, in the fabrication of new products [1]. Reinforcing plastic with natural fibre is already a well-establish approach to obtaining special composites with useful properties [2–5]. One of the celebrated constituents of natural fibre reinforced plastic composites in Malaysia is kenaf fibre. The research in kenaf plastic composite is growing tremendously along with the plastic industry's high demand for it for producing petroleum-based materials. Kenaf long fibre plastic composite could be used for a wide variety of applications if the properties were found to be comparable to existing synthesis composites. Since kenaf is always available in long fibre form, the mechanical properties found could be of use in many industrial applications such as insulators seals. In addition, kenaf fibre offers the advantages of being biodegradable, of low density, non-abrasive during processing, and environmentally safe [6].

There have been a few recent reports focused on the investigation of the properties of kenaf plastic composites under various conditions. For example, Ochi et al. investigated the effect of the cultivation environment and part of the plant used on tensile strength in kenaf/PLA composites [7]. Shibata et al. investigated the effects of the number of kenaf layers used, heating time and the kenaf weight fraction on the flexural modulus of laminate composites made of kenaf and PP fibres [8]. Liu et al. investigated the influences of processing methods and fibre length on kenaf fibre-reinforced soy based biocomposites [9]. The opportunity to design composites with specific mechanical properties makes these materials of great interest to designers and users who can reduce the production cost. At present, our compression moulding machine has excellent manufacturing capabilities, especially when using long natural fibres. Existing lab moulding techniques require suitable logic material consumption and high-energy use to transform the melted material into solid form. Therefore, the aim of this study is to develop and optimise a new method of compression for processing long kenaf fibre composite that will result in good mechanical properties.

2. Experimental procedures

2.1. Materials

In this study, we obtained UKF of the unidirectional kenaf fibre, kenaf variety name v36: melt flow index (MFI) 41 g/10 min (V36 and PP with MFI 41) variety from local Malaysian composite manufactures. At first, the kenaf fibre was combed in order to clean and untangle the strong bonding of individual fibres. It was reported that combed fibre has strong mechanical properties in comparison to uncombed fibre. Kenaf long fibres were chopped to 300 mm

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