Investigation of Thermal Behavior for Natural Fibres Reinforced Epoxy using Thermogravimetric and Differential Scanning Calometric Analysis

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Abstract. This paper presented the research works on the investigation of the thermal behavior of the natural fibres; i.e. pineapple leaf fibre, kenaf fibre and mengkuang fibres reinforced epoxy. The thermogravimetric analysis and differential scanning calorimetric analysis were used to measure the thermal behavior of the treated and untreated pineapple, kenaf and mengkuang fibres reinforced epoxy. The samples for both analysis were subjected to maximum temperature 600°C at the heating rate of 10°C/min. The results showed that the treated fibres show higher maximum peak temperature as compared to the untreated fibres. Additionally, the glass transition temperature showed a lower value for all treated fibre. It can be concluded that investigation of thermal properties of these natural fibres could improve the utilization of natural fibre composites in various applications i.e. sports applications.

Introduction

Natural fibre reinforced epoxy is a relatively new material in the sports and recreation application as compared to the other synthetic materials. However, the usage of natural fibre composites are relatively high in automotive and construction applications [1]. Due to the increasing interest in green technology, the usage of natural fibres in polymer composites in the application of sports and recreation gaining its popularity [2, 3]. Various studies have been conducted on many natural fibres such as hemp, jute, sisal, kenaf and pineapple leaf fibre (PALF) [4-6]. As for natural fibres, differences in chemical composition make it essential to determine their thermal properties [7, 8]. One of the methods employed in studying the thermal properties of polymeric materials is thermogravimetric analysis (TGA). Additionally, differential scanning calorimetric (DSC) analysis is important in determining the melting point and glass transition of a polymer composite.

Many researchers presented their works on the degradation of natural fibres with TGA. The thermal stability of various materials i.e. natural fibres has been identified by their degradation temperature [7, 9, 10]. Besides that, DSC is also one of the necessary analysis to determine the chemical properties of the materials. According to Vilaplana et al. [11], glass transition somehow shows the transition between the glassy and the elastic state of a polymer. PALF and kenaf fibre have been widely discussed by many researchers [12-14]. However, least studies have been conducted on mengkuang fibre (*Pandanus Tectorius*) [15]. 12 different varieties of pineapple leaf fibre used in a study by Neto et al. [6] showed mechanical properties is inversely proportional to the diameter of the fibre bundle and lignin content. Yousif et al. [16] have studied the flexural properties of untreated and alkali treated kenaf fibre which results in improvement for the treated kenaf fibre.

In this work, the objective is to investigate the thermal properties of PALF, kenaf fibre, and mengkuang fibre reinforced epoxy under TGA and DSC analysis. A thorough study of the thermal properties of the untreated PALF, kenaf fibre, and mengkuang fibre reinforced epoxy are presented. Results of thermal properties of the PALF, kenaf and mengkuang composites were addressed. Finally, the study concluded in the last section.