UNIVERSITI TEKNOLOGI MARA

THE PHYSICO-MECHANICAL AND THERMAL PROPERTIES OF COATED KENAF FIBRES IN EPOXY MATRIX COMPOSITE

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Thesis submitted in fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Science)

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Postgraduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Natural fibre is a sustainable material however, its drawbacks limit its usage. Thus, this research draws from the existing fibre treatments that are meticulous and high energy consumption by utilizing a simple and practical coating treatment. This study was carried out by direct coating the combed raw Kenaf fibres into 1:4, 1:5 and 1:6 coating solutions viscosities prior dried, pulverised and fabricated into the composite system. Each coated Kenaf fibre composite is varied by 10, 20, 30, 40 and 50 wt% fibre loadings; then analysed for its properties. The physical test consists of density, water absorption and hardness whereas; mechanical test includes tensile, flexural, compression and impact tests. The thermal and chemical characterisations are Thermogravimetric (TGA), Differential Scanning Calorimetry (DSC) and Fourier Transform Infrared (FTIR) respectively. The properties of both fibres and composites for coated samples were compared to the properties of pristine epoxy, untreated as well as NaOH/ Sil treated samples. In theory, fibres properties are highly influenced by the coating solutions viscosity which improves its surface interaction and stiffness once fabricated in the composite system. The optimum coating viscosity able to minimise the surface gap problem, by strongly adhere to the delicate surfaces of fibres and; concurrently penetrates also lock the fibres cell wall to creates a consistent deformation. The result showed that the 1:6 coating solution was the optimum viscosity as it highly penetrated the fibres system and form an individual coating formation as unachieved by other coating solutions viscosities. The high coating domination improved the fibres dispersion, density (72.7 %), shapes consistency, thermal stability (4.2 %) and mechanical stiffness (367 %). The improved fibres properties were proportional to the total improvement of composites density, voids content, specific water absorption as well as hardness properties. These also led to enhancement in composites stiffness in tensile (28.1 %), flexural (39.2 %), compression (46.1 %) and impact (227.8 %) properties. Since a well-stress distribution was observed at all samples fractured surfaces that contributed by the high mechanical interlocking and improved surface interaction. The 1:6 coated samples results were higher than treated NaOH/ Sil; followed by the coated 1:5, 1:4 and untreated samples. The coated 1:4 and 1:5 samples unable to perform well due to the low coating penetration as well as high coating deterioration that affect its overall properties. In general, the coating treatment might be a practical method for the industry as if offers a simple process that produces high strength of the treated materials. The treatment also might be a solution to revolutionise the other natural-based materials to venture in more robust applications for a sustainable future.

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