UNIVERSITI TEKNOLOGI MARA

CHARACTERIZATION AND FLEXURAL PROPERTIES OF NANOCLAY-MODIFIED FIBER REINFORCED POLYMER COMPOSITES

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Thesis submitted in fulfillment
of the requirements for the degree of
Master of Science

Faculty of Mechanical Engineering

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CONFIRMATION BY PANEL OF EXAMINERS

I certify that a Panel of Examiners has met on 9th April 2015 to conduct the final examination of Widia Wahyuni Binti Amir on his Master of Science thesis entitled "Characterization and Flexural Properties of Nanoclay-Modified Fiber Reinforced Polymer Composites" in accordance with Universiti Teknologi MARA Act 1976 (Akta 173). The Panel of Examiners recommends that the student be awarded the relevant degree. The Panel of Examiners was as follows:

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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.

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ABSTRACT

Fiber reinforced polymer (FRP) composites are high performance materials which are widely used in various applications, such as aircraft and high-end automobile structures. In theory, stiffer and tougher matrices provide better support to the fiber, hence enhancing the properties of the FRP composites. The aim of this study is to improve the properties of FRP composite by incorporating nanoclay as filler in the epoxy resin. The nanoclay particle was dispersed in epoxy resin using a three roll mill machine. This thesis comprises of two main parts which are the characterization of the nanomodified-epoxy polymer and investigation of mechanical properties of the nanoclay-FRP composites with an emphasis on flexural and interlaminar shear strength (ILSS) behavior. In the first part, an experimental investigation was conducted in order to identify the degree of dispersion of nanoclay in the resin system. The quality of the nanocomposites of the nanoclay in the epoxy was evaluated using x-ray diffraction (XRD), transmission electron microscopy (TEM) and atomic force microscopy (AFM) analysis. In addition, the thermal and mechanical properties of the nanoclay-modified epoxy compared to the neat epoxy system were also investigated using thermal gravimetric analysis (TGA) and flexural tests. In the second part, the mechanical properties of nanoclay-filled FRP composites were studied. The FRP composite laminates were fabricated using vacuum bagging techniques. The specimens were tested for flexural and short beam shear tests, respectively. The 5 wt% nanoclay content in the carbon fiber reinforced polymer composites (CFRP) composites gave a tremendous enhancement in flexural modulus, flexural strength and ILSS of 40%, 48% and 51%, respectively, when compared to the neat CFRP system. For glass fiber reinforced polymer composites (GFRP) composites, 5 wt% nanoclay content also gave a significantly improvement on flexural modulus, flexural strength and ILSS of about 37%, 80% and 63%, respectively, when compared to the neat GFRP system. Lastly, hybrid $[G_4C_4]_s$ composites with 5 wt% nanoclay also gave the highest flexural modulus, flexural strength and ILSS with 32%, 53% and 39%, respectively when compared to the pure hybrid system.

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