UNIVERSITI TEKNOLOGI MARA

EFFECTS OF VARIOUS ENVIRONMENTS ON TENSILE PROPERTIES, FLEXURAL PROPERTIES AND FRACTURE TOUGHNESS OF KENAF FIBRE REINFORCED UNSATURATED POLYESTER (KFRP) COMPOSITES

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

Faculty of Mechanical Engineering

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CANDIDATE'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of University Teknologi MARA. It is original and is the result 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 other degree or qualification.

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ABSTRACT

Natural fibres have an outstanding potential as reinforcement in composites materials. This research deals with the preparation of kenaf fibre reinforced unsaturated polyester (KFRP) composites by compression moulding technique. The preparation and testing of composite specimens were carried out per ASTM standards. Tests were conducted on ESH 50kN servo hydraulic machine using built-in data acquisition system at displacement rate of 1.5 mm/min. At the first stage, this research aimed to determine the mechanical properties of KFRP composites at various fibre volume fractions with three types of target volume fraction i.e. 10%, 15% and 20%. Among three types of target volume, the fibre volume fraction of 20% was selected as the greatest fibre volume fraction based on the highest mechanical properties obtained and then was evaluated for the effects of various environments. At the second stage, the research has been carried on the tensile, flexural and fracture toughness testing of KFRP composites after exposing to various environments, i.e. distilled water, saline water, organic fuel (diesel), acidic water (sulphuric acid 33.5% *v/v*), high temperature and low temperature. Exposure to the low temperature were executed by exposing the specimen in ice at -10^{o}C and for high temperature, the specimen have been kept in a closed oven at 60^{o}C monitored by using a built-in thermocouple. Analysis of the results reveals that the lowest in tensile properties for the same duration of exposure was found after exposure into saline water (σ = 9.59 MPa, E = 4.15 GPa) and then in distilled water followed by acidic water, high temperature, organic fuel and low temperature (σ = 14.39 MPa, E = 6.26 GPa). The lowest flexural properties were found after exposure into saline water (σ_{fs} = 13.34 MPa, E_{fs} = 0.48 GPa) followed by distilled water, then in acidic water, organic fuel, high temperature and low temperature (σ_{fs} = 13.34 MPa, E_{fs} = 0.48 GPa) for the same duration of exposure. The lowest fracture toughness was found after exposure into high temperature (K_I = 100 MPa$\sqrt{mm}$) and then in low temperature followed by saline water, distilled water, acidic water and organic fuel (K_I = 138 MPa$\sqrt{mm}$) for the same duration of exposure. The fractographic analysis of the specimens was done to identify the damage mechanism of KFRP composites due to the environmental effects. The failure was dominated by brittle failure and fibre-matrix interface debonding.

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