EFFECT OF WATER ABSORPTION ON TENSILE PROPERTIES OF PINEAPPLE LEAF FIBRE REINFORCED POLYMER COMPOSITES

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DECLARATION

I, the undersigned, hereby declare that this report is my own independent work except as specified in the references and acknowledgements. I have not committed plagiarism in the accomplishment of this work, nor have I falsified and/or invented the data in my work. I am aware of the University regulations on Plagiarism. I accept the academic penalties that may be imposed for any violation.

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ABSTRACT

In recent years, natural plant fibres have been in the limelight for its feasibility as the reinforcement for composites. In the pursuit of sustainable development whereby achieving the present needs without compromising the future, there is a paradigm shift of interest from synthetic fibres to natural fibres. Natural fibres are deemed to be the potential replacement for the synthetic fibres for its favourable mechanical properties, biodegradable, and low cost features. Pineapple leaf fibre is one of the potential selections as the reinforcement in composites for vast industrial applications. Nevertheless, natural fibres are subjected to doubts due to its tendency of absorbing moisture which may compromise its mechanical feasibility. In this paper, the effect of water absorption by the PALF reinforced polyester composite is studied. The specimens are fabricated using hand layup method and the tensile tests are carried out according to the standard of ASTM D3039. Specimens were immersed in tap water in the course of three weeks. It is revealed that the diffusion coefficient of water uptake increases as the fibre loading increases. The tensile strength and tensile modulus of the specimens show a significant drop as the immersion period increases. On the contrary, tensile modulus of 10% fibre loading specimens shows an increment trend of surpassing the pure polyester composite in each respective immersion period. Fibre volume fraction of 10% seems to be optimum ratio of producing the highest tensile properties of PALF reinforced polyester composite. In an overview, the tensile properties of immersed specimens are lower compared to standard specimens of no immersion. Hence, water absorption is a bane to the tensile properties of PALF reinforced polyester composite.

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DEDICATION

This thesis is dedicated to my parents on bestowing me the greatest love in the world.

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LIST OF ABBREVIATIONS

PALF	Pineapple Leaf Fibre
MMC	Metal Matrix Composite
CMC	Ceramic Matrix Composite
PMC	Polymer Matrix Composite
FRP	Fibre Reinforced Polymer
ASTM	American Society for Testing and Material
MEKP	Methyl Ethyl Ketone Peroxide
PVA	Polyvinyl Alcohol

NOMENCLATURE

Symbol	*Definition*
A	Area [m^2]
D	Diffusion coefficient [mm^2s^{-1}]
V_f	Volume of fibre [m^3]
V_c	Volume of whole composite [m^3]
l	Length [m]
d	Diameter [m]
$M_{\%}$	Moisture content in percentage [%]
M_t	Weight of specimen during t time [kg]
M_o	Initial weight [kg]
M_{∞}	Maximum water content [%]
P	Pressure [Pa]
h	Thickness of specimen [m]
σ	Stress [Nm^{-2}]
ε	Strain
δ	Total elongation [m]

CHAPTER 1

INTRODUCTION

1.1. Background

Composites are a combination of two or more different materials in which each of them retain their characteristic. This combination will produce different distinctive superior qualities where mere individual material cannot obtain. In the 1500s B.C., the idea of composition is already being used by Mesopotamian and Egyptians whereby combination of straw and mud is used to construct strong buildings. (Todd Johnson, 2006). In the early stages, natural fibres are broadly used which are plant fibre, animal fibre, and mineral fibre. Natural plant fibres can be further categorized into different parts such as leaf, bast, fruit, and seed. Commonly used plant fibres are flax, cotton, henequen, ramie, kapok, hemp and jute. (Susheel Kalia et. al,2009). It is used commercially in many industries such as textile industry. Generally, animal fibre contains mainly protein and silk and furs are commonly used. Mineral fibre such as asbestos are considered natural because it is formed naturally by six silicate minerals. These three types of fibres are pivotal in breakthrough of production of different superior materials. The insertion of natural fibres in composite material allows the enhancement of the strength and stiffness of the material. Around the beginning of 19th century, natural fibres are widely used with the emergence of polymer. Therefore, natural fibres are known as the reinforcement agents for polymer matrices.

However, in times to come, there was a shift of interest from natural fibre to synthetic fibre. Synthetic fibres are man-made from chemical means where it provides superior properties than natural fibre. It is proven to be stronger in physical properties than the natural fibres. Therefore, synthetic fibres are slowly superseding natural fibre in this globalization era. Nevertheless, it soon received criticism and disdain because it is hazardous to the environment for its production and recycling processes. In the wake of pursuing civilization, environment is usually being subjugated to whatever means necessary by human. It has come to a consensus that human should start to embrace