

UNIVERSITI TEKNOLOGI MARA

**THE CHARACTERIZATION OF
GLASS FIBRE REINFORCED
UNSATURATED POLYESTER
FILLED WITH P84 POLYIMIDE /
MULTI-WALL CARBON
NANOTUBES (MWCNT) HYBRID
COMPOSITES**

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Thesis submitted in fulfillment
of the requirements for the degree of
Doctor of Philosophy

Faculty of Applied Sciences

May 2017

CONFIRMATION BY PANEL OF EXAMINERS

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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 works, 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 Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

This study was carried out with an aim to improve the strength and thermal stability of the glass fibre reinforced unsaturated polyester composites by incorporating the P84 Polyimide powder and Multi-wall Carbon Nanotubes (MWCNT) as filler. Research methodology for this study was divided into four main stages. First stage is the preliminary study on the effect of the masterbatch technique on the basic properties of unsaturated polyester. Masterbatch technique is the mixing of powder P84 Polyimide with liquid MEKP prior to be incorporated into the polyester resin, where a mixture that contain both filler and curing agent was produced. This mixture was prepared in bulk, stored in a closed container and only taken out when needed. The results showed that the masterbatch technique does not affect the gel time but does increased the T_g . The second stage was the preparation of the matrix-filled system as a function of different preparation techniques where two matrix systems were studied. First was the unsaturated polyester filled with masterbatch P84 Polyimide system and the second was the unsaturated polyester filled with P84 Polyimide system. The difference between the systems was the preparation technique. The first system was prepared by incorporating both filler and curing agent (masterbatch P84 Polyimide) simultaneously into the polyester resin. The second system was prepared by incorporating filler and curing agent in separate steps. The incorporation of P84 Polyimide into the unsaturated polyester through the masterbatch technique resulted in the increment in tensile strength with the increased amount of filler loading. Third stage was the treatment of glass fibre with 3-Aminopropylethxysilane. The treatment was considered successful in attaching the silanol species on the surface of glass fibre where the molecular vibration of amino organofunctional group; C-N and N-H, was detected in FTIR spectrum. The fourth stage was the fabrication of glass fibre reinforced unsaturated polyester filled with P84 Polyimide/MWCNT hybrid composite and the composites were analysed based on the physical, mechanical, and thermal properties and also the morphological observation of the fractured samples. In a nutshell, the addition of P84 Polyimide at lower loading into the unsaturated polyester matrix system improved the strength of the composite. However, at higher filler loading, the strength dropped and worsens with the increasing number of glass fibre laminates. On the other hand, the incorporation of MWCNT caused the reclining in strength due to the incomplete broken down of coiled MWCNT. Nevertheless, the hybridization of MWCNT with P84 Polyimide able to raise back the strength. Thus, most of the mechanical properties showed by the hybrid composites were in between the unfilled composites and single filler composites. Through the morphological observation, the difference in texture and failure modes between single filler and hybrid filler composites were observed.

TABLE OF CONTENTS

	Page
CONFIRMATION BY PANEL OF EXAMINERS	ii
AUTHOR'S DECLARATION	iii
ABSTRACT	iv
ACKNOWLEDGEMENT	v
TABLE OF CONTENTS	vi
LIST OF TABLES	x
LIST OF FIGURES	xii
LIST OF ABBREVIATIONS	xx
CHAPTER ONE: INTRODUCTION	
1.1 Background	1
1.2 Problem Statement	3
1.3 Significance of the Study	4
1.4 Scope and Limitation of the Study	6
1.5 Novelty of the Study	7
1.6 Objectives of the Study	8
CHAPTER TWO: LITERATURE REVIEW	
2.1 Introduction	9
2.2 The Modification of Unsaturated Polyester	9
2.2.1 Chemically Modified Unsaturated Polyester Resin	10
2.2.2 Physically Modified Unsaturated Polyester Resin	11
2.3 The Using of Fibre Reinforced Thermosetting Polymer as the Rehabilitation Material for Steel Pipelines	13
2.4 The Synergistic Effect of Hybrid Composites	15
2.5 Excellent Properties of P84 Polyimide	20
2.6 Outstanding Properties of Carbon Nanotubes as Nanofillers	24