UNIVERSITI TEKNOLOGI MARA

THE MECHANICAL PERFORMANCE OF NATURAL RUBBER LATEX FILLED CARBON NANOTUBES (CNT) COATED KEVLAR FABRIC

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

Faculty of Applied Sciences

September 2016

ABSTRACT

Coated fabrics are widely used for technical textiles of late and there have been some interests in coating high strength fabrics with natural rubber (NR) latex. However, the addition of fillers in the form of carbon nanotube (CNT) and its relation with the mechanical properties of fabrics are not fully understood. The purpose of fillers addition is to get the desired properties of the NR latex as fillers have various functions that can modify the properties of latex. Therefore, the main objective of this study is to investigate the effects of nanofillers on the mechanical properties of high strength woven coated fabric. Kevlar fabrics were single-dipped coated with pre-vulcanized NR latex and CNT filled NR latex. The content of multi-walled (MW) CNT in liquid dispersion was varied at 1 phr, 3 phr and 5 phr. The neat, NR latex coated and CNT added NR latex coated samples were tested for puncture resistance, tensile strength and tearing strength. For the puncture resistance test, three different puncture probe shapes were used to test the fabrics which were in the form of conical, ogival and hemispherical shapes. The results suggest that the NR latex coated fabric have higher puncture resistance for about 5 to 25% in comparison with the neat fabric. The result also showed that the CNT filled influenced the properties of the coated fabric by increasing the tensile strength and tearing strength by about 8 to 21% in comparisons with the neat fabric.

ACKNOWLEDGEMENTS

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CHAPTER ONE

INTRODUCTION

1.1   BACKGROUND OF STUDY

Since the twenty first century, new millennium fibres are being created for various applications. These fibres are categorized into several classes such as high performance, high function, high Kansei and high-tech fibre (Hongu et. al, 2005). The uses of these advanced fibres are for the civil engineering, agricultural, medical and personal protective clothing applications. High performance fibres or sometimes called, super fibres are fibres with improved performance such as strength and heat resistance. These fibres have been improved to possess strength more than 20 g/den and modulus of more than 500 g/den (Hongu et. al, 2005). These properties are absolutely too high compared to other general-purpose fibres. Kevlar, Twaron and Technora are examples of fibres categorized as high performance fibres. Each of the fibres today has their own function in specific applications. For example, Kevlar fibre is used for bullet proof protection while carbon fibre is used for high performance composites.

Numerous researches are done to increase the quality and performance of the fibres. Some of the ways are by impregnating Kevlar fibre with shear thickening fluid (STF), thermoplastic film and polyamide (Rosen et. al, 2007) (Mayo et. al, 2009) (Varelidis et. al, 2000) while Twaron fabric is coated with NR latex (Ahmad et. al, 2007, 2012). Recently, many researches associated their works to NR latex for wide end-uses. The flexibility and durability of NR latex are the reasons why it is used rather than for cost reason. Previously, the performance of NR latex added with fillers has been investigated such as with carbon black, kaolins, and silica (Bellingen et. al, 2004) (Hancock, 2004) (Bertrand et. al, 2004). The purpose of these fillers addition is to get the desired properties of the NR latex as fillers have various functions towards properties of latex. As nanotechnology emerges, NR latex is also being added with nanomaterials such as nanoclay, carbon nanotube (CNT) and nanosilica (Ansarifar et. al, 2004).