UNIVERSITI TEKNOLOGI MARA

PHYSICAL AND MECHANICAL PROPERTIES OF MAGNETIC IRON FILLED RUBBER COMPOSITES

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ABSTRACT

The implementation of base isolators as seismic isolators or laminated rubber bearings is useful for high rise buildings and bridge constructions, especially in seismic prone areas. Generally, a base isolator is made up of alternate layers of steel and rubber. The idea of adopting magnetoreological elastomers (MREs) in base isolator systems was introduced in the past few years in order to improve the efficiency of base isolator systems. As planned, this research's aim is to study the performance of MRE composites due to effect of carbon black loading. The compounding process of MRE development was done using two roll mills and a conventional vulcanization system. The cure assessment of MRE composites was determined by Rheometer 100. The determination of MRE composites performance in this study includes the mechanical test, thermal test and magnetic test. The mechanical test through tensile test, hardness test and rebound test. Then, the morphological characterization was observed using a Scanning Electron Microscopy (SEM). The magnetic properties of MRE composites were evaluated by a Vibrating Sample Magnetometer (VSM). The thermal test involves determination of thermal behaviour of MRE composites using a Thermogravimetric Analyser (TGA), thus the degradation points of MRE composites were examined. Results show that the incorporation of carbon black loading reduces the cure time of MRE composites. The tensile test shows that as carbon black loading increases, the tensile strength also increases until an optimum value before it reduces back. The elongation would increase with carbon black loading. However, if the carbon black loading is increased more than optimum amount, the elongation decreases. The SEM results reveal that the morphology observation of MRE composites strongly proves and enhances the results of tensile strength and magnetization test. The magnetization values of MREs decreases with increasing carbon black loading. Furthermore, the saturation magnetization of MRE composites through VSM starts to occur when magnetization value reaches 0.7 Tesla. The thermal stability of MRE composites increases with increasing carbon black loading. Also, the MRE composites are highly decomposed at temperature in the range of 375°C to 400°C through the degradation process of TGA analysis.

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CHAPTER ONE
INTRODUCTION

1.1 RESEARCH BACKGROUND

The implementation of base isolators has increased in the civil engineering structures, especially in high rise buildings and bridge constructions. A base isolator serves the dual purposes of providing for thermal movement as well as protecting the bridge from dynamic loads by increasing the fundamental period and the seismic energy dissipation by hysteretic damping (Chaudhary et al., 2001). The use of an isolator is not just to reduce the earthquake and dynamic effect, but also to mitigate the effect of environmental hazards such as strong winds. Base isolators are now an accepted practice and have been implemented broadly in earthquake-prone countries around the world, especially the high seismic-prone areas such as China, Japan, Taiwan, Italy, New Zealand and United State of America.

Earthquakes would give major impacts to the nature and also human lives. Major destructions of nature are due to ground shaking and ground displacement. When a major earthquake hits, the ground moves and shakes vigorously, causes structures to receive the vibrations as well. The inertial forces would initiate the internal forces in structures to be generated. Thus, the horizontal shear forces would relocate and deteriorate the structural strength. The existing vertical loads induced in the structures making the structures to have several damages or even collapse. The collapse of a structure may take place if the structure has insufficient capacity to meet the seismic demand.

Normally, structures are designed to support vertical loads and lateral loads. Structures constructed without consideration of seismic hazards are in general more vulnerable to ground shaking during a major seismic event. A gigantic and powerful earthquake triggered a tsunami that struck swathes of Japan's northeast coast on 11th March 2011 with a magnitude of 8.9 Ritcher scale (BBC News, 2011) as shown in Plate 1.1.

Before the tsunami that hit Acheh in Indonesia 2004, Malaysians are not very concern about this natural disaster. This is due to the fact that earthquake event in