UNIVERSITI TEKNOLOGI MARA

MECHANICAL PROPERTIES OF HYBRID GRAPHENE NANO PLATELET-NANOSILICA FILLED BASALT FIBRE REINFORCED POLYMER COMPOSITES

UMMU RAIHANAH BINTI HAJI HASHIM

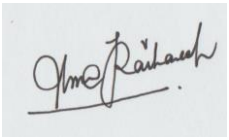
PhD

August 2020

AUTHOR'S DECLARATION

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 work, unless otherwise indicated or acknowledge 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.

Name of Student	:	Ummu Raihanah Binti Haji Hashim
Student ID No.	:	2015752509
Programme	:	Doctor of Philosophy (Mechanical Engineering) – EM950
Faculty	:	Mechanical Engineering
Thesis Tittle	:	Mechanical Properties of Hybrid Graphene Nano Platelet-Nanosilica Filled Basalt Fibre Reinforced Polymer Composites
Signature of Student	:	
Date	:	August 2020

ABSTRACT

The emergence of natural fibre composites (NFC) owing to their encouraging properties such as good mechanical properties, availability and environmental friendly has brought to the development of green composites in various applications. Basalt fibre (BF) is one of the promising reinforcing natural material as an alternative to glass fibre due to their comparable properties. It is primarily used in high-end application, which usually requires the use of autoclave in resin transfer moulding (RTM) with high temperature curing resin. The use of BF with fast-cured resin or out of autoclave process are still limited as this could affect the strength of Fibre Reinforced Polymer (FRP) composite. The use of nanofillers in polymer composites are very efficient to enhance the mechanical properties of the composites. The discovery of graphene has extensively brought the material world to a new level as this amazing carbon material could create superior composite properties. However, the challenge to use this material is mainly on its dispersion state and aggregation in epoxy due to its high surface area and strong Van der Waals forces between each graphene sheets. Other than functionalization, one of the effective way to improve the graphene's dispersion is by introduction of other nano or micro-scale filler. Hence, by adopting the good dispersive nanosilica and its advantages, this study was conducted to evaluate the thermo-mechanical properties of hybrid Graphene Nanoplatelet (GNP)-Nanosilica (NS) in epoxy composites by conducting the Thermogravimetric Analysis (TGA), Dynamic Mechanical Analysis (DMA), tensile, compression, and flexural tests. The solvent-exchange, sonication and high-shear milling methods were used to mix the GNP and NS in epoxy matrix. Then, the hybrid nanofiller modified epoxy polymers were impregnated into BF to evaluate the mechanical properties of the BFRP system under the tensile, compression, flexural, and drop-weight impact tests. In response to the synergistic effect of zero-dimensional NS and two-dimensional GNP, the thermal properties of hybrid nanofiller modified epoxy polymers were improved as the nanofiller loading increased, with the maximum degradation temperature of hybrid system increased by 0.6% for H0.1, 1% for H0.2 and 1.1% for H0.3 as compared to unmodified epoxy polymer. The glass transition temperature (T_g) of the hybrid nanofiller modified epoxy system were increased by 10.3%, 10.2% and 10% for H0.1, H0.2, and H0.3, respectively to compare with unmodified epoxy due to good nanofillers dispersion state in epoxy resin. The mechanical properties of hybrid nanofiller modified epoxy showed that the highest increment in modulus were observed in highest filler system which is H0.3 with 58% improvement in tensile, 36% in compression, and 43% in flexural, respectively, compared to unmodified epoxy. It was found that good dispersion system exhibited the highest strength where H0.2 showed the highest tensile strength of 101.45MPa, while H0.1 showed highest compressive and flexural strength of 298.24MPa and 195.65MPa, respectively. A significant improvement in mechanical properties of BFRP with hybrid nanofiller were also observed especially in BF-H0.2 with highest increment in modulus and strength to compare with neat BF. These findings also revealed that the incorporation of hybrid nanofiller contributed to the improvement in the mechanical properties of the composite, and BF have the potential to be used as a maintenance repair material for structural component as an alternative to the synthetic glass fibre.

ACKNOWLEDGEMENT

بِسْمِ ٱللَّهِ ٱلرَّحْمَٰنِ ٱلرَّحِيمِ

In the name of Allah, the Most Gracious and the Most Merciful, first and foremost, I would like to thank Allah for His never ending blessing and *rizq* towards me throughout my PhD journey.

A special thanks to my dedicated supervisor, Assoc. Prof. Dr. Aidah Jumahat for her full support, continuous guidance, sincere advices and beneficial critics throughout my studies to complete this PhD thesis.

My special appreciation goes to my other half, Azri Jaharudin, for being my pillar of strength with your motivation, advices, sacrifices and never ending contributions for me to achieve my dream. My gratitude also goes to my beloved parents, Haji Hashim Karim, Hajah Wan Hasnah Wan Abdul Kadir, and siblings for their never ending support, helps and prayers for my success. To my in-laws, Jaharudin A. Rahman, Rogayah Kia and all my family members, thank you for the encouragement and support for me to successfully completed what I have started before. Therefore, I dedicate this thesis to all of you.

I would also like to convey my gratitude to all the technicians and staffs in Faculty of Mechanical Engineering that were involved in assisting me throughout my laboratory work especially to Mr. Mohd Rahimi Abdul Rahman, Mr. Ahmad Nazeman Mohamed, Mr. Norazman Nordin, Mr. Mohd Alif Jalaluddin and Mr. Mohd Emy Azli Mohd Arnawi. Also special thanks to my lecturers, colleagues and friends especially to Dr. Napisah Sapiai, Prof. Ir. Dr. Jamaluddin Mahmud, Dr. Norazean Md Noh, Nurul Emi Nor Ain Mohammad and others for fruitful discussions and guidance throughout this PhD journey. Alhamdulillah and thank you Allah for this blessing.

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