UNIVERSITI TEKNOLOGI MARA

PHYSICAL AND MECHANICAL PROPERTIES OF HYDROXYAPATITE/ SILICONE RUBBER COMPOSITES

NURUL NADIAH BINTI ARIS

Thesis submitted in fulfilment
of the requirements for the degree of
Master of Science
(Polymer Science and Technology)

Faculty of Applied Sciences

June 2023

ABSTRACT

Hydroxyapatite (HA) and Silicone rubber (SR) has been used in this research are two well-known materials in biomedical field. Hydroxyapatite as filler in the rubber composites are varied to various loading of 0 phr to 30 phr. Silicone rubber is the matrix and 2, 5-bis – (t-butylperoxy) 2, 5-dimethylhexane) (DBPMH) as organic curing agent. The materials have been compounded by two roll mills. The rubber compounds have been cured by hot press compression at 200 °C. Then, HA/SR composites has been characterized under cure characteristic, physical testing, mechanical testing, chemical testing and morphology. In cure characteristics, scorch time and cure time are approximately the same without significant difference. But 30 phr of HA shows the highest torque value of 31.55 dNm with more addition of HA. As referred to physical properties, 30 phr of HA shows the highest density and water absorption with 1.17 g/cm^3 and 7.8% respectively. Hardness value of 25 phr of HA is the highest value with 94 IRHD and reduced at 30 phr of HA with 88.2 IRHD. According to mechanical properties, tensile strength value and elongation at break decreased up to 30 phr of HA with 3.15 MPa and 333.25%. Tensile modulus of modulus 100, 300 and 500 are similar in value. In chemical characterization of FTIR, more addition of HA filler into rubber composites are detected by appearance of strong intensity of OH^- band with broad peak of 30 phr of HA at 3456.99 cm^{-1}, meanwhile formation of crosslinks can be found on strong intensity of C-C band at 1637.29 cm^{-1} in 30 phr of HA. Lastly, SEM microstructure surface of 30 phr of HA shows most formation of large pores, aggregates and dislocation of HA which the root of low physical and mechanical properties of HA/SR composites. Further research on HA/SR composites with organic coupling agent is essential to enhance crosslinks between hydroxyapatite and silicone rubber. Based on physical and mechanical performance, HA/SR composites may be potential as candidate for human bone tissues in biomedical application.

ACKNOWLEDGEMENT

Alhamdulillah, thank you Allah for the opportunity to further my studies up to this level degree. There are no words to describe all the challenges that I have been through in this long journey until this peak point of my life. Besides, I would like to express my sincere gratitude to my main supervisor, Ts Dr Norazura Ibrahim for all endless ideas, time, courage, support and guidance upon this research completion.

My appreciation also goes to all of the official supports from Mr Goo Yow Nam, general manager of Immortal Green Sdn Bhd for sponsoring materials, En Hasrul Nizam from Behn Meyer Malaysia Sdn Bhd and En Haffiz Mohd Jabar from Lembaga Getah Malaysia (LGM) for the assistance on material testing. The utmost gratitude to the Ministry of Higher Education Malaysia (MOHE) and Research Management Centre (RMC) of Universiti Teknologi MARA, Malaysia, for financial support through Grant No: 600-IRMI/DANA 5/3/ BESTARI (P) (086/2018).

My completion of this study could not have been accomplished without continuous love and support from my family, friends and colleagues. Especially to my mom for being my backbone and there is nothing I could do to repay all the sacrifices that she has been through for me along this journey.

TABLE OF CONTENTS