

**UNIVERSITI TEKNOLOGI MARA**

**EFFECT OF EGG SHELL POWDER  
(ESP) ON CURE CHARACTERISTIC,  
PHYSICAL AND MECHANICAL  
PROPERTIES OF ACRYLONITRILE  
RUBBER (NBR) COMPOSITES**

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the degree of

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## **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 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 Undergraduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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## ABSTRACT

Calcium Carbonate ( $\text{CaCO}_3$ ) is an inorganic powder that is usually used in paints, plastics and rubber industry as a filler.  $\text{CaCO}_3$  is used as a filler in some applications and studies have shown that egg shell contains about 95 % calcium carbonate. The objectives of this study are to study the characterization of treated Egg Shell (tES) and untreated Egg Shell (uES) powder in micron size by using Fourier-Transform Infrared Spectroscopy (FTIR). To determine the effect on cure characteristic of treated Egg Shell (tES) and untreated Egg Shell (uES) powder in NBR composites. To evaluate the physical and mechanical properties of treated Egg Shell (tES) and untreated Egg Shell (uES) powder in NBR composites.

$\text{CaCO}_3$  is derived from egg shell and undergoes pre-treatment which is alkali treatment. The egg shell undergoes specific process to make it as powder and being treated with 6 % concentration of Sodium Hydroxide (NaOH) to improve the Nitrile Rubber (NBR) composites performance. The treated egg shell (tES) is weighed based on the formulation compounding and divided into 5 phr, 10 phr, 15 phr and 20 phr of filler loading. Then, it was compounded with NBR and other ingredients. Besides, optimum loading of filler is determined. Hence, untreated egg shell (uES) and tES at optimum loading were compared the results. In addition of egg shell with different filler loading in the NBR composites, the cure characteristic, physical and mechanical properties of the composites are determined. For cure characteristic, tES was higher than uES which are 14 min and 12 min respectively. Meanwhile, for physical characteristic which is hardness, the higher result has been 52.25 which is tES due to the presence of NaOH coated in Egg shell powder (ESP). Besides, for crosslink density, tES had  $6 \times 10^{-4}$  while uES got  $4 \times 10^{-4}$ . In the result of mechanical properties, tensile strength 2.51 MPa which is on tES was higher than uES. Then, for Young's Modulus of tES also higher than uES, which is 4.94 MPa and 4.77 MPa respectively. Meanwhile, for elongation at break, tES got lower percentage than uES, which is 143.97 % and 190.97 %.

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