

**ECO-FRIENDLY CARBONIZED MOLASSES POWDER AS FILLER IN  
NATURAL RUBBER VULCANIZATE**

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**Final Year Project Report Submitted in Partial Fulfillment of the  
Requirements for the Degree of Bachelor of Science (Hons.) of Polymer  
Technology in the Faculty of Applied Sciences  
Universiti Teknologi MARA**

**JULY 2019**

## 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.

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## **ABSTRACT**

### **ECO-FRIENDLY CARBONIZED MOLASSES POWDER AS FILLER IN NATURAL RUBBER VULCANIZATE**

Further researches have been carried out to utilize carbonized molasses as possible filler to replace carbon black in order to reduce environmental problems and provide substitution of synthetic filler with natural filler. Study of carbonized molasses had undergone carbonization process to produce natural filler that have comparable properties as carbon black. The research also focuses on minimization of the usage of carbon black as it has a high tendency to deplete and is dangerous for the environment and human health. Therefore, natural filler is introduced to replace or minimize the usage of carbon black in the rubber industry. Characterization of carbonized molasses is observed by using FTIR. It was found that carbonized molasses has quite the same properties as carbon black in which carbonized molasses contain similar functional groups as carbon black. It shows that carbonized molasses is suitable to be used with carbon black. This is because they have a good filler-rubber relationship and can form a good reinforcement effect on vulcanized natural rubber. The rubber compound has been reinforced with carbonized molasses and carbon black has been produced using a two-roll mill and vulcanized using a hot press at 170 °C. This study has been done to determine the effect of various amounts of carbonized molasses compared with carbon black on its behavior. On top of that, there are three types of tests that have been carried out. Firstly, mechanical tests such as tensile tests to determine tensile strength, elongation at break, and tensile modulus. Secondly, physical tests such as hardness and swelling tests. Thirdly, cure characteristics such as optimum cure time,  $t_{90}$  has been carried out. Based on the data results, it shows that the incorporation of carbonized molasses (50%) with carbon black (50%) has the highest mechanical properties in terms of tensile strength, tensile modulus, and elongation at break. Moreover, in terms of physical properties, it also has the highest hardness, Mooney viscosity, and swelling resistance. On top of that, in terms of cure characteristics, it also has a good cure characteristic. To sum up, carbonized molasses has a good reinforcement effect and can be used to replace carbon black up to 50% which means it can partially be used to replace carbon black.