

**DEVELOPMENT OF COIR FIBER BASED
INSULATIVE COMPOSITE MATERIAL TO REDUCE
THERMAL HEAT IN BUILDINGS**

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DECLARATION

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DEDICATION

This dissertation is dedicated to my loving parents who always encouraged and motivated me during my ups and downs.

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ABSTRACT

Energy consumption is a critical factor in building design. Maintaining a comfortable indoor temperature consumes high energy than other necessities such as lighting and cooking. The building envelope is the main component of the building that transfers heat between indoor and outdoor environments. During the daytime, a proper ventilation system or an air conditioning system can control the heat in a building. Insulation layers are also used under the roofing sheets to control the heat transfer through the roof because a building's roof contributes to a significant heat gain in tropical countries.

Sustainable insulation materials have been more attractive in the last two decades due to biodegradability, low embodied energy, availability, and non-toxicity. Sustainable insulation materials are primarily fabricated using lignocellulose fiber (natural plant fibers). Then it is mandatory to add binder material to adhere to fibers and the material formulated as a composite material, and an air void should be introduced to the combination of fiber and binder to increase insulation properties. Now the whole material can be identified as a three-phase composite material. Thus, the volume fraction of each phase (fiber, binder, and air void) is the most critical factor which controls these composites' insulation properties.

The insulation properties of the material can be analysed using experimental, analytical, and numerical methods. Analytical and numerical methods are more attractive than experimental methods. However, there are limited number of studies on the effect of volume fraction with insulation properties in a three-phase composite. In this study, the effective thermal conductivity (K_{eff}) of the composite was analysed through the analytical and numerical models and validated through the experimental results. The results concluded that the experimental results agreed with the numerical and analytical results. Furthermore, a novel mathematical model has been proposed to find the K_{eff} of the three-phase composite using the analytical and numerical methods. The proposed model shows better agreement with the experimental result. Therefore, it can be used to develop this research area further.

Keywords: Building insulation, Composites, Coir fibers, Thermal conductivity

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LIST OF ABBREVIATIONS

GHG	Global Greenhouse Gas
IEA	International Energy Agency
AC	Air Condition
MFA	Microfibril Angle
TGA	Thermal Gravimetric Analysis
DTGA	Derivative Thermal Gravimetric Analysis
FWO	Flynn Wall Ozawa
FEM	Finite Element Method
EMA	Effective Medium Approximation
EMT	Effective Medium Theories
FTIR	Fourier Transform Infra-Red Spectroscopy
SEM	Scanning Electron Microscope
NR	Natural Rubber
GHP	Guarded Hot Plate
DSC	Differential Scanning Calorimetry
KAS	Kissinger Akahira Sunose