# PHYSICAL AND MECHANICAL PROPERTIES OF WOOD-WOOL CEMENT PANELS MANUFACTURED USING LESSER KNOWN TIMBER SPECIES FOR STURCTURAL APPLICATION

RESEARCH MANAGEMENT INSTITUTE (RMI)
UNIVERSITI TEKNOLOGI MARA
40450 SHAH ALAM, SELANGOR
MALAYSIA

BY :

ASSOC. PROF. DR ZAKIAH AHMAD
MOHD AZRIZAL FAUZI

April 2011

## Contents

## 4. Enhanced Research Title and Objectives

(if any)

Original Title as Proposed:

**INVESTIGATION ON THE PHYSICAL AND MECHANICAL PROPERTIES OF BIOCOMPOSITE CEMENT BLOCK MANUFACTURED USING LESSER KNOWN TIMBER SPECIES FOR STURCTURAL APPLICATION**

Improved/Enhanced Title:

**PHYSICAL AND MECHANICAL PROPERTIES OF WOOD-WOOL CEMENT PANELS MANUFACTURED USING LESSER KNOWN TIMBER SPECIES FOR STURCTURAL APPLICATION**

Original Objectives as Proposed:

a) To determine the bondability properties of selected timber species with cement.
b) To produce and manufacture the wood shaving -cement block (SWCB).
c) To determine the physical and mechanical properties of WSCB.
d) To determine the durability properties of WSCB against water.

Improved/Enhanced Objectives:

1. To determine the effect of wood-wool sizes on the physical and mechanical properties of woodwool cement panel namely flexural, compression and tensile strength.
2. To determine the durability properties of WWCP with different sizes of wood-wool against water ($H_2O$), acid solution (Calcium chloride, $CaCl_2$) and salt solution (Natrium hydroxide, NaOH).

# 5. Report

## 5.1 Proposed Executive Summary

Cement block has been used in the construction of low-cost housing due to its bigger surface area when compared to brick which required less cement mortar and longer man-hours during construction of housing units. Nowadays cement block weight has been an issue in the construction industry. As the building become higher and enormous, the block weight will become a significant factor in the design and hence as the determinant for the economical factor in the construction cost. In order to overcome this issue, lightweight block has been developed by introducing the use of fiber at higher percentage in order to reduce the amount of cement and sand. The addition of fibre in the production of cement block or cement bonded particle board still does not solve the problem of the high weight to strength ratio. This is due to the size of the fiber which has very high aspect ratio and the function of the fiber is just to increase the mechanical properties and improve the toughness. Therefore this study explores the potential of using wood shaving from less known species in the manufacturing of cement block by adding higher percentage of wood shreds in order to obtain light weight cement block.

## 5.2 Enhanced Executive Summary

This report presents the findings on the investigation of wood cement composite manufactured using woodwool from lesser known timber species; Kelampayan *(Neolamarckia cadamba)* with cement based matrix. A series of experiments were conducted to examine the effects of wood-wool sizes (1.5mm, 2.5mm and 3.5mm width) and thickness (25 mm, 50 mm and 75 mm) of the boards on the mechanical properties of woodwool cement panels (WWCP) (bending strength, compressive strength, internal bond strength (tensile strength) and modulus of elasticity), physical properties and durability (thickness swelling and moisture absorption capacity) due to immersion in water, acid and salt solution. The sizes of woodwool greatly affects the performance of the boards and become the dominant factor especially on the performance of the boards of different thicknesses.

The density and the mechancial proeprties of WWCP increases as the sizes of woodwool decreases. This implies that the strength correlates well with the density of the panels. There is significant interaction between wood-wool sizes and the thickness of panels on thickness swelling. The largest thickness swelling value was obtained from 25mm panels with 3.5mm wood-wool soaked in $CaCl_2$, and water for 24-h. The moisture absorption capacity also decreases as the woodwool sizes decrease. This might be due to low amount of voids with respect to the high density of the panel.

### 5.3 Introduction

A wood-cement particle composite is composed of wood materials, cement and water and this composite product is generally produced in two groups: Cement particleboard and cement wood-wool board. Cement particles board has high density and smooth surface, meanwhile wood-wool cement board is low in density and porous surface. Cement particles board has been used in the construction of low-cost housing due to its bigger surface area when compared to brick which required less cement mortar and man-hours during construction. However the weight of cement particles board has become an issue during construction and also imposed a significant factor in the design which resulted in the rise of the construction cost. Indeed, the addition of wood particles in the production of cement bonded particle board is to increase the mechanical properties and improve the toughness, but unfortunately this does not solve the problem of the high weight to strength ratio. Wood-wool cement composite board (WWCCB) composed of wood-wool and cement where the wood-wools were produced by shredding the log using special shredding machine. Since wood-wool is light and has high aspect ratio, the wood-wool cement composite outweighs the cement particles board.

Moreover, WWCB has outstanding potential as a housing and building component because it resists biological degradation and has excellent insulation capabilities against heat and noise. Studies has been made on the effects of various parameters, such as wood species, wood-cement ratio, type of accelerator, amount of water, soaking time and board density, on the