UNIVERSITI TEKNOLOGI MARA

COAL ASH FOAMED BRICKS STABILISED WITH HYDRATED LIME-ACTIVATED GGBS (HL-GGBS)

MOHAMAD EZAD HAFEZ BIN MOHD PAHRORAJI

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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 result 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 Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

Name of Student	:	Mohamad Ezad Hafez Bin Mohd Pahroraji
Student I.D. No	:	2010989063
Programme	:	Doctor of Philosophy (Civil Engineering) - EC990
Faculty	:	Civil Engineering
Thesis Title	:	Coal Ash Foamed Brick Stabilised with Lime-Activated GGBS (HL-GGBS)
Signature of Student	:	.....
Date	:	June 2017

ABSTRACT

Coal-fired thermal power plant produces million tonnes of coal ash as an industrial by-product and is significant to be used as raw material for fabrication of bricks. Coal ash could potentially substitute the traditional materials i.e. clay and sand that were used to produce fired clay and cement sand bricks. Clay and sand were continuously extracted from depleting and dwindling non-renewable natural resources that could gradually degrade the environment in the long run. Meanwhile, lime and Portland cement are popular binding materials that could eventually damage and pollute the environment if continually used without control. Alternatively, ground granulated blastfurnace slag (GGBS), an industrial by-product could be used as substitution. However, GGBS requires activation in an alkaline environment for self-cementitious acceleration. For now, the reliable source of alkali is lime or Portland cement. Most researchers have used either fly ash or bottom ash as raw material and either lime or Portland cement as binder. There is also less evidence in effort to lightweight the bricks that were using industrial by-products as raw materials. Therefore, the combination of fly ash and bottom ash as raw material with hydrated lime-activated GGBS (HL-GGBS) as binder and the incorporation of foam need to be investigated. In the present study, coal ash was used as raw material, HL-GGBS system was used as binder and foam was used to reduce weight for the fabrication of coal ash foamed bricks. Portland cement-activated GGBS (PC-GGBS) system was established for comparison to HL-GGBS system. The amount of water was constant at 30% of total weight of dry materials. Pre-foam foaming method was applied. The ratio of foaming agent to water was 1:30. Steel moulds size of 215 mm x 102.5 mm x 65 mm were used and the bricks were dried for forty eight (48) hours before demould and wrapped with cling film for several layers prior to air curing. The determination of compressive strength, density, flexural strength, water absorption, salt attack resistance, thermal conductivity, sound transmission loss and sound absorption were carried out. Traditional fired clay bricks and cement sand bricks were procured and underwent similar testing for comparison. It was discovered that the use of HL-GGBS and PC-GGBS system as binder increase the strength of the bricks compared to the use of hydrated lime and Portland cement alone. However, the addition of foam has resulted in decrease of compressive and flexural strength, lower density, weak salt attack resistance, high water absorption, low value in sound transmission loss and thermal conductivity but provide insignificant effect to sound absorption.

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CHAPTER ONE
INTRODUCTION TO STUDY

1.1 INTRODUCTION

This chapter provides the explanation on background of study, elaboration of problem statement, establishment of research aim, determination of objectives of study, description on scope of study, clarification on significance of study and finally summary of thesis outline.

1.2 BACKGROUND OF STUDY

Malaysia is a developing country with rapid growth in population and industrial development. In order to ensure the uninterrupted economic growth and consistently ongoing development, a sustain supply of energy is crucial. This energy is generated by the electric power plants. Table 1.1 shows list of five (5) types of power plant currently operated in Malaysia. Malaysia once ago used to depend heavily on gas-fired power generation but later turned to adapt more on coal utilization as power plant fuel (Mohd Annas Mohd Nor, 2005). From the year 1999 to 2010, the coal-fired power generation shows significant growth from 8 % to 41 %. Coal-fired power plant utilizes coal to generate energy. Since the coal-fired power generation has shown significant growth, the amount of coal used has also increased significantly from year to year.

The process of coal combustion has indeed generated coal ashes in an enormous amount in the form of fly ash and bottom ash in which the ash will be sent for disposal to lagoons or ash pond if unutilized. It was recorded that in between 2000 until 2005, the coal utilization in thermal power plants has shown significant increased from four (4) to thirteen (13) million tonnes, thus produced an approximate amount of two (2) million tonnes of residue yearly in the form of coal ash in which has created disposal and environmental problem (Kolay and Singh, 2010). At the moment, towards reduction of the disposal cost and impact to the environmental problem, effort is being carried out by a few cement production companies to collect and use fly ash as part of the raw materials in the production of commercialize composite cement. On the other hand,