FIRE RESISTANCE OF OIL PALM SHELL LIGHTWEIGHT AGGREGATE CONCRETE CONTAINING FLY ASH AS PARTIAL CEMENT REPLACEMENT

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I/We* hereby declare that I/We* have checked this thesis/project* and in my/our* opinion, this thesis/project* is adequate in terms of scope and quality for the award of the Bachelor Degree of Civil Engineering

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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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ABSTRACT

Oil palm shell (OPS) and fly ash are the waste products from Malaysia. They are disposed at the landfills in increasing quantity and this causes of environmental pollution. The steps taken to introduce these waste products disposed at the landfill. This thesis is present experimental study on the effect of elevated temperature on properties of oil palm shell (LWAC) containing fly ash as partial cement replacement. All the specimens were cured for 28 days. The temperature used is 100℃, 300℃, 500℃ and 800℃ for 1 hour. Two type of cooling system were used that is, air cooling and water cooling. This study shows that the compressive strength of concrete decrease as the temperature increase. The concrete losses more weight as temperature increase. Concrete containing fly ash as partial cement replacement weight and compressive strength increase compared to control specimen.

ABSTRAK

Tempurung kelapa sawit (OPS) dan abu terbang adalah produk buangan dari Malaysia. Sisa buangan ini dilupuskan di tapak pelupusan dalam jumlah yang meningkat dan menyebabkan pencemaran alam sekitar. Langkah yang diambil untuk memperkenalkan bahan buangan yang dilupuskan di tapak pelupusan. Tesis ini membentangkan satu kajian mengenai kesan suhu tinggi pada sifat tempurung kelapa sawit (LWAC) yang mengandungi abu terbang sebagai separa pengganti simen. Semua spesimen telah diawet selama 28 hari. Suhu yang digunakan adalah 100 ℃, 300 ℃, 500 ℃ dan 800 ℃ selama 1 jam. Dua jenis sistem pendinginan yang digunakan ialah penyejukan udara dan penyejukan air. Kajian ini menunjukkan bahawa kekuatan mampatan konkrit menurun apabila suhu meningkat. Kehilangan berat konkrit apabila suhu semakin meningkat. Konkrit yang mengandungi abu terbang sebagai separa pengganti simen adalah kehilangan berat berkurang dan kekuatan mampatan meningkat berbanding dengan spesimen kawalan.

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LIST OF SYMBOLS

%	Percentage
MPA	Megapascal
℃	Degree celcius
Kg/m^3	Kilogram per meter cube

LIST OF ABBREVIATIONS

ASTM	America Society for Testing and Material
BS	British Standard
BS EN	British Standard European Norm
OPS	Oil palm shell
FA	Fly ash
LWAC	Lightweight aggregate concrete
SSD	Saturated on Dry Surface
Al_20_3	Aluminium Oxide
Ca0	Calcium Hydroxide
LOI	Loss on Ignition
Fe_2O_3	Ferric Oxide
C1-	Chloride
SiO_2	Silicon Oxide

CHAPTER 1

INTRODUCTION

1.1 Introduction

Concrete is a broadly utilized construction material in common civil engineering all through the world for the following reasons. It has amazing protection from water, basic solid components can be shaped into an assortment of shapes and sizes and it is normally the least expensive and most promptly accessible material for the job (Mehta et al., 2006). Lightweight aggregate concrete is one type of lightweight concrete. Traditionally, light concrete structures generated by combining coarse lightweight aggregate (LWA) such as pumice, perlite, and clay expands into the mixture (Kramar., 2011). For LWC that was used for structural load bearing purposes, minimum design strengths is often prescribed for specific applications. Lightweight aggregate concrete (LWAC) is one of the choices in construction industry because of its advantage in terms of economic and also it is practical.

Oil palm shell is an agricultural solid waste lightweight aggregate and used to produce lightweight concrete, which has been recognized in Malaysia for more than two decades (Abdullah, 1984). According (Sahu et al., 2011) reported that the amount of oil palm shell increases every year because there are more than 270 palm oil mills operating in this country to generate the waste. The growing need for sustainable development has motivated researchers to focus their research on the use of waste or recycled materials in potential construction material (Zulkarnain et al., 2014).

1.2 Problem Statement

Oil palm shell is solid waste from palm oil industry. In Malaysia, more than 4.6 million tons of OPS was delivered every year as waste (Teo et al., 2006). This is because of a lot of OPS squander materials was accumulated and dumped, causing stockpiling issues inside the region of manufacturing plants. Vast amounts of these squanders are created each day. According to a recent study by the Centre for Science and Environment (CSE), and NGO working on environmental issues, fly ash disposal remains as a major problem as with only about 50-60% of the total fly ash generated by the power sector being utilized.

Fly ash is one of the major causes that is affecting health condition due to its small size particle which can get to human's respiratory system through inhalation and causing respiratory problems. Other than that, fly ash can harm the environment (Kurda et al. 2018). It is estimates that, about a billion ton of toxic ash lie dumped in ponds which is polluting the land, air and water. By 2021-22, the thermal power sector is estimated to produce 300 million ton of fly ash a year and with that, utilization of all the fly ash being generated is going to get tougher (Jain, 2014).

1.3 Objective

The objectives of this study are:

i. To determine the effect of elevated temperature on mass loss of oil palm shells lightweight aggregate concrete (LWAC) containing fly ash as partial cement replacement.
ii. To determine the effect of elevated temperature on discolouration of oil palm shell lightweight aggregate concrete (LWAC) containing fly ash as partial cement replacement.
iii. To investigation the effect of elevated temperature on residual compressive strength of oil palm shell lightweight aggregate concrete containing fly ash as partial cement replacement.

1.4 Scope of Research

The scope of research focuses on the fire resistance of oil palm shell lightweight aggregate concrete containing fly ash as partial cement replacement, which is 10%, 20%, 30%, and 40% as cement replacement. For the produced the product that were is cube and using the size 100mm x 100mm x 100mm. This study focuses on the production of concrete with different temperatures(100℃, 300℃, 500℃, and 800℃). Each temperature with various mixes difference percentage of fly ash as cement replacement.

Each mixes prepared in form of cube were heated until the temperature reached 100℃, 300℃, 500℃, and 800℃ respectively. The cooling methods used air cooling and water cooling. The effect of temperature on mass loss and residual compressive strength on concrete were measured.

1.5 Significance of Research

The research provide understanding about the fire resistance of oil palm shells (OPS) lightweight aggregate concrete (LWAC) containing fly ash (FA) as partial cement replacement. The oil palm shell and fly ash are renewable materials, it can reduced the pollution in Malaysia. The use of these waste materials can decrease the amount of waste material disposed at landfill. In addition, when using waste, it can further promote the use of waste such as oil palm shells and fly ash in the field of industry and create more sustainable environment.

1.6 Layout of Thesis

This research contains chapter one until the chapter five. Chapter one is about the introduction of fire resistance of oil palm shell (OPS) lightweight aggregate concrete (LWAC) containing fly ash (FA) as partial cement replacement, problem statement related with the oil palm shell and fly ash, objective of study about the elevated temperature, scope of study, significance of research and the layout of the thesis. In Chapter two is the elaboration of characteristic of lightweight aggregate concrete, and its application in industry of palm oil waste. It also includes the elaboration of the properties of concrete in elevated temperature, the advantages and also the disadvantages using the fly ash.

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