

THE EFFECT OF ELEVATED TEMPERATURE
ON PROPERTIES OF MORTAR CONTAINING
CRUSHED COCKLE SHELL AND PALM OIL
FUEL ASH AS MIXING INGREDIENT

MOHAMAD FIRDAUS BIN MOHAMAD AZHAR

B. ENG (HONS.) CIVIL ENGINEERING
UNIVERSITI MALAYSIA PAHANG

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Thesis submitted in fulfillment of the requirements for the award of the degree of
B. Eng (Hons.) Civil Engineering

Faculty of Civil Engineering and Earth Resources
UNIVERSITI MALAYSIA PAHANG

JUNE 2016

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I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Bachelor of Civil Engineering.

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LIST OF ABBREVIATIONS

OPC	Ordinary Portland Cement
HCl	Hydrochloric Acid
ASTM	American Society for Testing and Materials
BS	British Standard
POFA	Palm Oil Fuel Ash

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ABSTRACT

The issues on increasing utilization of waste materials from industry such as palm oil fuel ash and cockle shell during concrete production to meet the continuous demand of the construction industry has led towards efforts of using any waste material as partial replacement in this composite material. Nowadays, sand has become the most widely consumed natural resources on the planet after fresh water. By using POFA and cockle shell effectively, it can reduce the bad environmental effect, and it can also solve the landfill problem for the disposal of waste and sand mining activities. This thesis is to study the effect of elevated temperature on properties of mortar containing crushed cockle shell and palm oil fuel ash as mixing ingredient. The mortar subjected to the experiment consist of 20% of the crushed cockle shell and 20% of palm oil fuel ash that has been sieved as a partial sand replacement and cement sand replacement. The size of the mortar used is 50x50x50 mm (length x width x height). The specimens were water cured for 7, 14 and 28 days. The specimens were subjected to compressive strength test, acid resistance test and elevated temperature test. The results show that plain cement mortar (C) exhibits better resistance towards acid attacks. Besides, for elevated temperature test, the mix with 20% of cockle shell (CCS) exhibit longest percentage of mass loss compared to the other mix. Also, the mix with the 20% of cockle shell (CCS) shows the highest value of compressive strength rather than the other mix.

ABSTRAK

Isu-isu kepada peningkatan penggunaan bahan-bahan buangan daripada industri seperti abu terbang kelapa sawit (POFA) dan kulit kerang dalam pengeluaran konkrit untuk memenuhi permintaan yang berterusan daripada industri pembinaan telah membawa kepada usaha untuk menggunakan apa-apa bahan buangan sebagai pengganti separa dalam bahan komposit ini. Pada masa kini, pasir telah menjadi sumber asli yang digunakan secara meluas di planet ini selepas air tawar. Dengan menggunakan POFA dan kulit kerang dengan berkesan, ia boleh mengurangkan kesan alam sekitar yang buruk, dan juga boleh menyelesaikan masalah tapak pelupusan bagi aktiviti pelupusan perlombongan sisa dan pasir. Kajian ini adalah untuk mengkaji kesan kenaikan suhu pada sifat mortar yang mengandungi kulit kerang dan POFA sebagai campuran bahan. Mortar yang tertakluk kepada eksperimen terdiri daripada 20% kulit kerang yang dihancurkan dan 20% POFA yang telah disaring sebagai pengganti pasir dan pasir simen. Saiz mortar yang akan digunakan adalah 50x50x50 mm (panjang x lebar x tinggi). Spesimen akan tertakluk kepada satu jenis kaedah pengawetan, iaitu pengawetan air selama 7, 14 dan 28 tempoh hari. Spesimen itu akan menjadi ujian untuk ujian kekuatan mampatan, ujian rintangan asid dan ujian suhu tinggi. Keputusan menunjukkan bahawa simen mortar biasa (C) mempamerkan rintangan yang lebih baik ke arah serangan asid. Selain itu, untuk ujian suhu tinggi, campuran dengan 20% daripada kulit kerang (CCS) mempamerkan peratusan paling tinggi kehilangan jisim berbanding campuran yang lain. Juga, campuran dengan 20% daripada kulit kerang (CCS) menunjukkan nilai yang paling tinggi kekuatan mampatan daripada campuran lain.

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

The issues of increasing usage of waste materials from industry such as palm oil fuel ash and cockle shell during concrete production to satisfy the continuous demand of the building industry has led towards efforts of using any waste material as partial replacement in this composite material. Today, sand has become the most widely consumed natural resources along the planet after fresh water. By using POFA and cockle shell, effectively, we can reduce the bad environmental effect, and we can also solve the landfill problem for the disposal of waste.

Cockle shell also knows as SBP. Vast volumes of Seashell-By-Products (SBP) are made annually (Chiemchaisri, 2007). Palm oil is one of the most important agro industries in Malaysia, Indonesia and Thailand. For example, Malaysia is considered as the largest exporter by around 47% of world exports of palm oil (Bamaga, 2013). Palm Oil Fuel Ash (POFA) is by-product obtained by burning of fibres, shells and empty fruit bunches as fuel in palm oil mill boiler.

1.2 PROBLEM STATEMENT

Cockle shell is a waste material, meanwhile POFA is a waste material from industry. Also, by using POFA and cockle shell we can scale down the environmental contamination. For cockle shell, using an eco-friendly solution to the problem of disposal of the cockle shell, by turning waste into a high value-added product like partial sand replacement is enabled since the price of the sand is increasing drastically this day. These wastes from industries can pollute the environment. Palm oil fuel ash (POFA) can be used as a partial replacement for cement in the concrete mix due to its pozzolanic content (Munir, 2015). Thus by using POFA as a partial cement replacement and cockle shell as a partial sand replacement, we can sweep over the issue of the environmental problem such as to bring down the utilization of landfill for this disposal waste

1.3 OBJECTIVES

The objectives of this study are as follows:

- 1) To investigate the durability of mortar containing crushed cockle shell and palm oil fuel ash as mixing ingredient when subjected to acid attack.
- 2) To investigate the effect of elevated temperature on mass loss of mortar containing crushed cockle shell and palm oil fuel ash as mixing ingredient.
- 3) To investigate the effect of elevated temperature on compressive strength of mortar containing crushed cockle shell and palm oil fuel ash as mixing ingredient.

1.4 SIGNIFICANCE OF RESEARCH

This study will provide knowledge on the effect of elevated temperature on properties of mortar containing crushed cockle shell and POFA when it is subjected to fire resistance and acid attack respectively. The information is expected to contribute towards better understanding of the properties of modified concrete containing POFA and cockle shell. This study is conducted to prevent the environmental issue that caused by waste disposal such as POFA and cockle shell. It is because POFA and cockle shell are a waste material. By using POFA and cockle shell in our mix design of mortar, we can fully reduce the environmental problems thus contribute towards a cleaner environment.

1.5 SCOPE OF RESEARCH

The scope of this research cover all the important information on the acid resistance and fire resistance test on the behavior of mortar containing crushed cockle shell and POFA. Best mix design with varying percentage of POFA and cockle shell were subjected to test for acid resistance test and fire resistance test. There are 3 types of mix that will be used in this experimental work that is plain cement brick, brick containing POFA and crushed cockle shell and brick containing crushed cockle shell.

The curing days for this mortar containing crushed cockle shell and POFA were 28 days. The type of curing use in this experiment is water curing. 3 mix design were subjected to acid resistance test. The physical changes and mass loss of the sample from 3 mix design will be observed and recorded for a specific period throughout this research. For the fire resistance test, the temperature is controlled by the designated standard, which is 100°C, 300°C, 500°C and 800°C. The specimen will use water-cooling condition after heat.