

**THE BEHAVIOUR OF NORMAL CONCRETE CONTAINING POFA AS PARTIAL FINE  
AGGREGATE REPLACEMENT**

**MAIZATIL AKMA BINTI YAACOB**

**Thesis submitted in partial fulfillment of the requirements for award of the degree of Bachelor of  
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## **TABLE OF CONTENTS**

	<b>Page</b>
<b>SUPERVISOR'S DECLARATION</b>	ii
<b>STUDENTS'S DECLARATION</b>	iii
<b>ACKNOWLEDGEMENTS</b>	iv
<b>ABSTRACT</b>	v
<b>ABSTRAK</b>	vi
<b>TABLE OF CONTENTS</b>	vii
<b>LIST OF TABLES</b>	xi
<b>LIST OF FIGURES</b>	xii
<b>LIST OF SYMBOLS</b>	xiv
<b>LIST OF ABBREVIATION</b>	xv

## **CHAPTER 1 INTRODUCTION**

1.1	Background of Study	1
1.2	Problem Statement	2
1.3	Objective	3
1.4	Scope of Study	3

1.5	Significance of Study	3
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## **CHAPTER 2            LITERATURE REVIEW**

2.1	Introduction	4
2.2	Normal Concrete	5
2.3	Ingredient for Normal Concrete	5
	2.3.1 Sand	6
	2.3.2 Coarse Aggregate	6
	2.3.3 Cement	7
	2.3.4 Water	10
2.4	Modified Concrete	10
2.5	Palm Oil Fuel Ash (POFA)	11
	2.5.1 Origin of POFA	11
	2.5.2 Characteristics of POFA	14
	2.5.3 Use of POFA in Concrete	15
2.6	PROPERTIES OF CONCRETE	16
	2.6.1 Compressive Strength	16
	2.6.2 Moisture Absorption	17

## **CHAPTER 3            METHODOLOGY**

3.1	Introduction	18
3.2	Flowchart of Research	19
3.3	Flowchart of Experience Work	20

3.4	Preparation of Material	21
	3.4.1 Cement	21
	3.4.2 Aggregates	21
	3.4.3 Water	23
	3.4.4 Palm Oil Fuel Ash	23
3.5	Design Mix of Normal Concrete	25
3.6	Preparation of Specimen	26
3.7	Testing Method	26
	3.7.1 Slump Test	26
	3.7.2 Compressive Strength Test	29
	3.7.3 Moisture Absorption Test	31

## **CHAPTER 4            RESULTS AND DISCUSSION**

4.1	Introduction	32
4.2	Effect of POFA Content on Concrete Workability	32
4.3	Effect of POFA Content on Compressive Strength	33
4.4	Effect of POFA Content on Water Absorption	36

## **CHAPTER 5            CONCLUSION AND RECOMMENDATION FOR FUTURE STUDY**

5.1	Introduction	37
5.2	Effect of POFA Content On Workability Concrete	37

5.3	Effect of POFA Content On Compressive Strength Of Concrete	37
5.4	Recommendations	38
	<b>REFERENCES</b>	<b>39</b>

## **LIST OF TABLES**

<b>Table No.</b>	<b>Title</b>	<b>Page</b>
Table 2.1	Main Constituents in a typical Portland Cement	8
Table 2.2	Types of Portland cement	9
Table 2.3	Physical Properties of Palm Oil Fuel Ash (POFA)	14
Table 2.4	Chemical Composition of Palm Oil Fuel Ash (POFA)	15
Table 3.1	Quantities of the materials per cubic metre	25
Table 3.2	Number of concrete specimen	26

## **LIST OF FIGURES**

<b>Figure No.</b>	<b>Title</b>	<b>Page</b>
Figure 2.1	The Original Palm Oil Fuel Ash (POFA)	13
Figure 2.2	The Ground Palm Oil Fuel Ash (GPA)	13
Figure 3.1	Flowchart of research	19
Figure 3.2	Flowchart of experimental work	20
Figure 3.3:	Coarse aggregate	22
Figure 3.4	Fine aggregate	22
Figure 3.5	Water	23
Figure 3.6	The production of Palm Oil Fuel Ash (POFA)	24
Figure 3.7	Mechanical shaker for sieve analysis	25
Figure 3.8	Palm oil fuel ash after sieve	25
Figure 3.9	Apparatus used in slump test	27
Figure 3.10	Types of slump (BS 1881 Part 102 : 1983)	28
Figure 3.11	The slump test procedure	28
Figure 3.12	Compressive strength test	30
Figure 3.13	The concrete after compressive strength test	30
Figure 4.1	Effect of POFA content on workability of concrete	32
Figure 4.2	Compressive strength results for 6 different percentage of	34

#### POFA at 7 days

Figure 4.3	Compressive strength results for 6 different percentage of POFA at 14 days.	35
Figure 4.4	Compressive strength results for 6 different percentage of POFA at 28 days.	35
Figure 4.5	Compressive strength results for 6 different percentage of POFA on water absorption at 28 days.	36



## LIST OF SYMBOLS

%	Percent
MPa	Megapascal
Mm	Milimetre
$f_c$	Compressive strength in MPa (N/mm <sup>2</sup> )
$A_c$	Cross-sectional area of the specimen
N/mm <sup>2</sup>	Newton per milimetre square
Kg/m <sup>3</sup>	Kilogram per meter cube

## **LIST OF ABBREVIATION**

OPC	Ordinary Portland cement
ASTM	American Society for Testing and Material
BS	British Standard
DOE	Department of Environment
PC	Plain concrete
POFA	Palm Oil Fuel Ash
GPA	Ground Palm Oil Fuel Ash

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## **ABSTRACT**

Nowadays, demand for sand and gravel continues to increase in concrete production. Excessive sand mining has negative effect to environment setting and water quality of the river basin. At the same time, Malaysia as one of the largest palm oil producer generates abundant palm oil fuel ash, a by-product from palm oil mill which dumped as waste. Palm oil fuel ash (POFA), produced by burning palm oil shell and husk as fuel ash in a palm oil mill boiler to generate electricity for the palm oil extraction process. Utilization of POFA can reduce amount of waste ending at landfill that contribute to the environmental problem and reduce the cost of concrete. In this study, the effect of POFA content as partial fine aggregate replacement on fresh properties and compressive strength on normal concrete has been investigated. There were six types of mix have been used in this study. Concrete mixes containing 0%, 2%, 4%, 6%, 8% and 10% of POFA fine aggregate replacement level were cast before subjected to water curing for 7, 14 and 28 days. Workability test, compressive strength test and water absorption were conducted for the concrete. The findings show that inclusion of 6% POFA enhances the compressive strength performance of concrete.

## **ABSTRAK**

Pada masa kini permintaan untuk pasir dan batu terus meningkat dalam pengeluaran konkrit. Perlombongan pasir secara berlebihan akan membawa kepada kesan negatif kepada alam sekitar dan kualiti air sungai. Dalam masa yang sama, Malaysia merupakan pengeluar minyak kelapa sawit terbesar yang telah menjana banyak abu kelapa sawit satu product dari kilang kelapa sawit yang dibuang sia-sia. Abu kelapa sawit (POFA), dihasilkan daripada pembakaran tempurung dan sabut kelapa sawit yang dijadikan sebagai bahan bakar didalam kilang kelapa sawit untuk menjana elektrik bagi proses pengekstrakan minyak kelapa sawit. Penggunaan POFA boleh mengurangkan kawasan tempat pelupusan yang boleh menyumbangkan masalah kepada alam sekitar dan boleh mengurangkan harga konkrit. Kajian terhadap kesan penambahan POFA sebagai pengganti pasir telah dikaji didalam ujian sifat konkrit segar dan ujian kemampatan. Dalam kajian ini, terdapat enam jenis bancuhan dimana bancuhan tersebut mempunyai tahap peratusan POFA yang berbeza. Tahap peratusan POFA adalah 0%, 2%, 4%, 6%, 8% dan 10% dalam penggantian pasir untuk konkrit biasa. Ianya dibuat sebelum tertakluk kepada pengawetan air selama 7, 14 dan 28 hari. Ujian kebolehkeraan, kekuatan mampatan kiub dan ujian penyerapan air dilakukan ke atas kiub. Kemasukan POFA pada 6% sebagai pengganti pasir meningkatkan prestasi kekuatan mampatan konkrit.

## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 BACKGROUND OF STUDY**

Concrete is very important material and widely used in construction material since previous years until nowadays. Concrete is one of the oldest manufactured construction material used in construction of various structures around the world. Due to its high demand, the material used for concrete production depleting every year. Nowadays, demand for sand and gravel continues to increase in concrete production. Excessive sand mining will led to the degradation of riverine environment. An indiscriminate and illegal sand mining has negative effect to environment setting and water quality of the river basin. The negative impact of excessive sand mining was elaborated by Asyraf *et al.*,(2011). This issue has motivated researchers to investigate the potential of using waste materials as partial sand replacement material in concrete production. Success in integrating waste material as partial sand replacement in concrete would result in a more sustainable concrete product and cleaner environment.

Research towards the producing of new concrete materials can be divided into two factors presented by the two different industries in Malaysia that is by-product of palm oil industry and the rapid development of construction industry. The palm oil fuel ash (POFA) is generated from the burning of pressed fibre and shell at temperature of 800 – 1000 C to produce steam which is used in turbine for supplying the electrical energy to the whole mill for milling operation and domestic or estate use. *Elaeis guineensis* most famous by oil palm tree was first introduced to Malaysia as an ornamental plant in 1870. Since 1960, planted area had increase at rapid pace. It had increase for 4.3 million hectares in 2007. And it expand until 4.917 million hectares in 2011. Malaysia is now the second of largest producer of palm

oil after overtaken by Indonesia the first producer of palm oil in 2006. So, there are much of waste product produces every years that contribute to environment pollutant unless recycle it for other applications. According to (Abdul., 1997) it is estimated that million tons of its waste will be produced yearly and the Malaysian Government need to allocate more dump area for disposal in the form of land-fills. Innovation to the new products of freely waste material will convert this environmentally polluting by-product into beneficial material for the development of human civilization.

The incorporation of palm oil fuel ash(POFA) as a partial fine replacement is the better one because it give benefit to construction industry, palm oil industry and also for environment. The creation of new material is not expected to offer an extra incoming profit for palm oil industry and reducing ash ending at landfill but also able to contribute towards improvement of Malaysian construction technology.

## **1.2 PROBLEM STATEMENT**

The rapid development of construction industry in Malaysia contribute to a variety of experimental a new technology in order to enhance the strength and durability of the concrete. At the same time, to produces a cheap and high quality of concrete in order to reduce the cost of construction Nowadays, demand in construction industry for concrete materials leading to increasing the use of local natural fine aggregate exploited fom the environment. It is possible if the conventional raw materialsuch as river sand use in concrete mix will run out. Excessive sand mining will lead to the degradation of riverine environment. An indiscriminate and illegal sand mining has negative effect to environment setting and water quality of the river basin.

Generally, the wastage of palm oil in industry for every years is increase gradually. Palm oil fuel ash which is unsuitable to be used as the fertilizer was dumped as waste behind the mill or landfill. Being lighth, this ash is easy to be blown by the wind and spread to other place thus causing air pollution. The air pollution may cause respiratory illness for the workers of the mill. The disposal of palm oil fuel ash causes negative effect on the health and comfort of the community. The other environmental problem is due to ground water source pollution (Tay and Show, 1997). So, in order to find a solution how to solve the wastage it is use for the concrete. It also contribute the side income for the palm oil industry. At the same

time, to focus to save environment because the wastage will give impact to the environment. To recycle the waste natural material by produces new product by develop the new technology.

### **1.3 OBJECTIVE**

The objective of study are :

- I) To investigate the effect of sieved POFA as partial sand replacement on workability.
- II) To determine effect of sieved POFA content as partial sand replacement on compressive strength of concrete.
- III) To determine the effect of sieved POFA content as partial sand replacement on water absorption of concrete.

### **1.4 SCOPE OF STUDY**

The present research is an attempt to incorporate POFA as partial sand replacement in the production of normal concrete. Basically, the research is aimed to investigate the mechanical properites of concrete containing palm oil fuel ash as partial sand replacement. The quantity of POFA used is limited to 0%, 2%, 4%, 6%, 8% and 10%. All the specimens is subjected to air curing and water curing. Compressive strength test were conducted at the age of 7, 14 and 28 days. Water absorption test were conducted at 28days.

### **1.5 SIGNIFICANCE OF STUDY**

The outcome of study would provide information on the behaviour of normal concrete at different replacement level of POFA. At the same time, this study would encourage more studies to be conducted on the utilization of POFA in concrete production. This research also will help to reduce the use of river sand and minimizes the sand mining in Malaysia. Hence, it will lead to preservation and conservation of the environment.



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