FIBER REINFORCED CONCRETE USING EMPTY FRUIT BUNCH (EFB) WASTE

NURNADIANABILA BINTI ABD. HALIM

B. ENG (HONS) CIVIL ENGINEERING

UNIVERSITIY MALAYSIA PAHANG

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NURNADIANABILA BINTI ABD. HALIM

Thesis submitted in fulfillment of the requirements
for the award of the degree
of Bachelor in Civil Engineering (Hons)

Faculty of Civil Engineering and Earth Resources
Universiti Malaysia Pahang

JANUARY 2017

SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in term of scope and quality for the award of the degree of B.Eng.(Hons.) Civil Engineering.

Signature	:	
Name of Supervisor	:	DR. CHIN SIEW CHOO
Position	:	SUPERVISOR
Date	:	

STUDENT'S DECLARATION

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged. The thesis has not been accepted for any degree and is not concurently submitted for award of other degree.

Signature :

Name : NURNADIANABILA BINTI ABD. HALIM

ID Number : AA13025

Date :

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LIST OF SYMBOLS

$f'_{c'}$	Specified strength

LIST OF ABREVIATION

EFB	Empty fruit bunch waste
FRC	Fiber reinforced concrete
MSW	Municipal solid waste
OPEFB	Oil palm empty fruit bunch
PKC	Palm kernel cake
SFRC	Steel fiber reinforced concrete
UMP	Universiti Malaysia Pahang
GFRC	Glass fiber reinforced concrete
SFRC	Synthetic fiber reinforced concrete

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ABSTRACT

Malaysia produced about half of the world palm oil production (10.8 million tonnes), thus making Malaysia as the world’s largest producer and exporter of palm oil during this period (Abdullah & Sulaiman, 2013). The empty fruit bunch (EFB) is produced after the fresh fruit bunch is processed to produce oil palm mill. Due to the abundance of empty fruit bunch waste that was produced, it also generates waste management problem. EFB waste can be processed into fiber and can be used for other purposes. In this study, the EFB fibers are used as an additive in the concrete to control cracking due to plastic and drying shrinkage (Vajje & Krishna, 2013). Other than that, the usage of natural fibers are able to increase the concrete strength and reduce the plastic and drying shrinkage that can induce structural cracks. The main objectives of this study are to identify the optimum percentage of empty fruit bunch (EFB) fiber and to study the mechanical properties of empty fruit bunch (EFB) fiber in the reinforced concrete. This paper presents the compressive strength test, flexural strength test and splitting tensile strength test to study the mechanical properties of the concrete. In this experimental study, grade 25 MPa of concrete is used with a mix proportion of 1:1.5:3. The EFB fiber with percentages 0.25%, 0.50%, 0.75% and 1.00% was added into the concrete mixtures. The result shows that, the optimum percentage of EFB fiber 0.25% was identified as the most suitable percentage to be added into the concrete mixture. The findings from this experimental study shows that the optimum percentage of EFB fiber able to increase the early strength up to 10% of the concrete compared to the normal concrete. On the other hand, the strength increased for the flexural strength result of EFB fiber concrete up to 10% compared to the control mix. However, the splitting tensile strength for the EFB fiber lower 6% compared to the control mix. But with the addition of 0.25% EFB fiber able to resist the crack compared to the control mix.

ABSTRAK

Malaysia menghasilkan kira-kira separuh daripada pengeluaran minyak sawit dunia (10.8 juta tan metrik), sekali gus menjadikan Malaysia sebagai pengeluar dan pengeksport minyak sawit terbesar di dunia dalam tempoh ini (Abdullah & Sulaiman, 2013). Tandan kosong (EFB) dihasilkan selepas tandan buah segar diproses untuk menghasilkan minyak kelapa sawit. Oleh kerana sisa tandan buah kosong yang dihasilkan terlalu banyak, ia juga menneybabkan masalah pengurusan sisa buangan. sisa EFB boleh diproses menjadi serat dan boleh digunakan untuk tujuan lain. Dalam kajian ini, gentian EFB digunakan sebagai bahan tambahan dalam konkrit untuk mengawal keretakan disebabkan oleh plastik dan pengecutan kering (Vajje & Krishna, 2013). Selain daripada itu, penggunaan gentian asli dapat meningkatkan kekuatan konkrit dan mengurangkan pengecutan plastik dan pengeringan yang boleh menyebabkan keretakan struktur. Objektif utama kajian ini adalah untuk mengenalpasti peratusan optimum buah kosong sekumpulan (EFB) serat dan untuk mengkaji sifat-sifat mekanikal kosong serat tandan buah (EFB) dalam konkrit bertetulang. Kertas kerja ini membentangkan ujian kekuatan mampatan, lenturan ujian kekuatan tegangan dan membelah tegangan ujian kekuatan untuk mengkaji sifat mekanikal konkrit. Dalam kajian eksperimen ini, gred 25 MPa konkrit digunakan dengan sebahagian campuran 1: 1,5: 3. Serat EFB dengan peratusan 0.25%, 0.50%, 0.75% dan 1.00% telah ditambah ke dalam campuran konkrit. Hasilnya menunjukkan bahawa, peratusan optimum gentian EFB 0.25% telah dikenal pasti sebagai peratusan yang paling sesuai untuk ditambah ke dalam campuran konkrit. Penemuan daripada kajian eksperimen ini menunjukkan bahawa peratusan optimum gentian EFB mampu meningkatkan kekuatan awal sehingga 10% daripada konkrit berbanding konkrit biasa. Sebaliknya, kekuatan meningkat untuk keputusan kekuatan lenturan konkrit EFB serat sehingga 10% berbanding konkrit biasa. Walau bagaimanapun, kekuatan tegangan membelah untuk serat EFB yang lebih rendah 6% berbanding konkrit biasa. Tetapi dengan tambahan 0.25% gentian EFB dapat menahan retak berbanding konkrit biasa.

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

Malaysian is one of the world's largest palm oil exporter and palm oil production by 44% and 39% respectively. Malaysia produced about half of the world palm oil production (10.8 million tons), thus making Malaysia as the world's largest producer and exporter of palm old ring this period (Abdullah & Sulaiman, 2013). In Malaysia, palm industry has grown rapidly. Many areas were opened up for oil palm plantation since 1920, during that time 400 hectares were planted and it expands up to 54000 hectares in 1960, the statistic is increased up to 5 million hectares in 2011. The oil palm growths is related to the world's demand for oils and fats and directly make palm oil become the largest production and the first player in the oils and fats trade. This makes palm oil plantation need to be harvested more and more to ensure fulfill the world demand. Oil palm is the most important product from Malaysia that has helped to change the scenario of its agriculture and economy (Abdullah & Sulaiman, 2013). Malaysia produced 17.9 million tons of palm oil as well as 2.1 million tons of palm kernel in 2009, at the same time, quite a lot of waste biomass was generated, including 2.3 million tons of PKC (palm kernel cake), 30 million tons of EFB (empty fruit bunch) and waste fruit fiber and etc.

Due to increases of palm oil cultivation, there is an abundance of raw materials available on the palm consisting of around 90% of biomass wastes and only around 10% of the oil.

About 90 million tons of oil palm fruit production were recorded in 1998; however, 43-45% of this was mill residues in the form of EFB, shell, and fiber (Abdullah & Sulaiman,2013).

According to the Waste Management World (2012), waste, including POME, from the region's 1000 plus Palm Oil plantations is a significant issue for plantation owners, local communities and the region in general and contributes significantly to total emissions. This statement also is supported by Zafar (2015), from the palm oil waste, almost 70% of the volume from the processing of fresh fruit bunch is removed as waste as empty fruit bunch (EFB), fibers and shells.

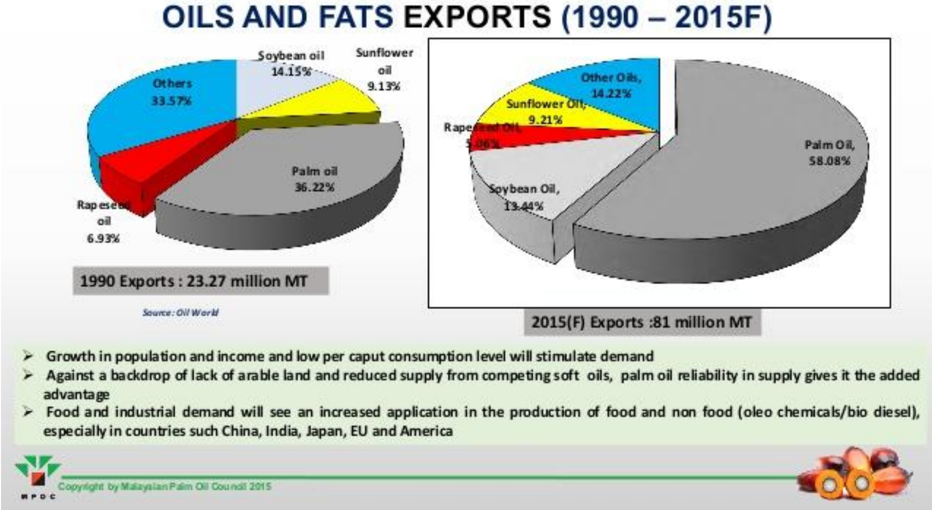

Figure 1.1: The statistical of oil and fats export (1990-2015F)

Source: MPOC

Figure 1.1 shows the palm oil is the highest exporter with 36.22% and 58.08% since 1990 and 2015.

Concrete is known as a composite material of sand, aggregates, cement and with the perfect amount of water. Concrete has its own characteristic that makes it is becoming popular in the construction industry in the world beside the steel and timber, concrete has high compressive strength, but lower in tensile strength. For conventional concrete also has its own specialty like good in thermal conductivity and sound insulation properties, good fire rating, non – combustible and ease of handling. Besides that, concrete also has been invented by several researchers to produce concrete by using the waste material. Likes empty fruit bunch (EFB) fiber have been used in previous researchers into the concrete mixture to produce the concrete to improve certain aspects of concrete.

In this research, the empty fruit bunch (EFB) fiber used in concrete mixed as an additive. By using this empty fruit bunch (EFB) fiber into the concrete mixture will become a renewable of empty fruit bunch (EFB) fiber usage into the valuable and useful product where it can help to control the pollution and environmental sustainability.

Figure 1.2: Empty fruit bunch (EFB)

1.2 PROBLEM STATEMENT

In Malaysia, with an annual growth of 5.9%, areas under oil palm increased from 641,791 hectares in 1975 to 5.0 million hectares in 2011. By 2012, oil palm plantations occupied 15.4% 0r 5.08 million of Malaysia's land mass (Adnan & Kum,2015). Empty fruit bunch (EFB) is produced after the fresh fruit bunch is a process to produced oil mill, the EFB will be sent back to the field for disposal and may be to be used for mulching. Due to the abundance of empty fruit bunch waste that was produced by the palm oil cultivation, it also generates to the other problem that related to waste management. According to Lim, (2010), replacement of fossil fuel for industrial use and consequently address the issue of waste management since the density of EFB

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