POTENTIAL OF OLEOCHEMICALS WASTE TO SERVE AS PARTIAL SAND REPLACEMENT IN CONCRETE

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STUDENT'S DECLARATION

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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ABSTRAK

Pengeluaran sisa oleokimia (*sludge*) dari minyak kelapa sawit melalui proses kimia semakin meningkat sejak kebelakngan ini. Pelupusan *sludge* telah membawa kepada masalah alam sekitar yang serius. Pada masa yang sama, peningkatan industri pembinaan telah membawa kepada peningkatan dalam aktiviti perlombogan pasir dan telah menimbulkan kesan buruk terhadap alam sekitar memandangkan ia mencetekkan sungai. Dalam usaha untuk memperbanyak kegunaan *sludge* dan untuk mengurangkan aktiviti perlombongan pasir, penyelidikan ini dijalankan dengan menggantikan separa pasir di dalam konkrit dengan *sludge*. Kajian ini dilakukan untuk menilai kekuatan dan kadar penyerapan air dalam campuran konkrit, dimana pasir diganti dengan 0%, 5% dan 10% *sludge* dari berat pasir. *Sludge* yang diterima daripada kilang akan dikeringkan menggunakan oven pada suhu 100°C dan tidak lebih daripada 24 jam. Kemudian, *sludge* yang kering akan dikisar dan diayak sebelum dibancuh. Semua campuran telah diacu dalam bentuk kiub dan prisma dan kemudian dikenakan pengawetan udara dan pengawetan air sehingga tarikh ujian. Hasil daripada kajian mendapati bahawa gabungan kandungan *sludge* akan mempengaruhi kekuatan dan kadar penyerapan konkrit. Sampel yang dihasilkan menggunakan 5% dan 10% *sludge* sebagai pengganti separa pasir tidak mencapai kekuatan optimum berbanding dengan konkrit kawalan kerana sampel konkrit terlalu rapuh dan mudah percah disebabkan *sludge* tersebut mengandungi polimer, manakala kadar penyerapan tidak dapat direkodkan kerana terdapat kesan terhakis pada permukaan sample apabila sampel direndam di dalam air.

ABSTRACT

The production of oleochemicals waste (sludge) from palm oil through chemical process is increasing over past few years. Disposal of sludge has brought towards serious environmental problem. At the same time, the growing of construction industry has lead towards the increasing in sand mining activities which pose adverse impact towards the environment as it lowers the stream bottom of the river. In an effort to use the sludge in large volume and to reduce sand mining activities, this research is carried out for its possible in making concrete containing sludge as partial sand replacement. The experimental investigation is performed to evaluate the strength and water absorption of concrete mixtures, in which sand is replaced with 0%, 5% and 10% of sludge by weight of sand. The sludge is oven dried at 100°C for not more than 24 hours after collected from the factory and then the dried sludge are grinded and sieved before mixing. All the mixes were cast in form of cubes and prisms and then subjected to air curing and water curing until the testing date. From the results, it is observed that the combination of sludge content would affect the strength and rate of absorption of the concrete. Samples produced using 5% and 10% sludge as partial sand replacement has not achieved optimum strength compared to control concrete due to the concrete sample are fragile and easily broken since there are presence of polymers in the sludge, while the rate of absorption cannot be recorded as there is corrosive effect on the surface of the sample when the sample is submerged in the water.

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INTRODUCTION

1.1 Background of study

Green technology aims to conserve nature, remedy the negative impact, encouraging the use of renewable resources as well as preserving energy and natural resources while providing a healthy environment (Bhardwaj & Neelam, 2015). In this era globalization, development industry in Malaysia is growing quickly cause an increasing utilization of sand in concrete production to meet the continuous demand of the construction industry. The growing construction industry has lead towards increase of sand mining activities which causing adverse effects to the environment (Mehta & Monteiro, 2013). The way to reduce the continuous sand mining activity of natural sand is by doing the sand replacement in concrete production. One of the successful sand replacements was done by replaced with 20% of sand with sludge from waste water treatment plant in concrete (Vazhviniyan et al., 2016). Based on the investigation, reported that compressive and flexural strength increased with the addition of sludge.

At present, Malaysia has become a major producer of basic oleochemicals using the large supplies of indigenous raw material such as palm oil, palm kernel oil and also coconut oil which has almost 70% of the total oleochemical productions capacities (Abbas et al., 2016). Oleochemicals industry is one of major industries that produce effluent and affecting the water quality in the environment due to large consumption of mixture of water and chemicals for processing crude palm oil (Takemoto & Ichise, 2016). Oleochemicals waste or sludge that been used in this study is derived from sustainable resources that are majorly oils and fats of vegetable and animal origin through chemical process which produced glycerine, fatty acids and methyl esters (Elias et al., 2018). Sludge is a by-product of oleochemicals manufacturers and it has prime

and critical environmental problem. Generally, oleochemicals waste requires more landfill area for dumping due to its large production, significantly affects the surrounding environment. Therefore, this study is conducted to investigate the use of oleochemicals waste as the partial sand replacement in concrete.

1.2 Problem statement

The growing construction industry has brought in the increasing of sand mining activities. It is reported that about nine billion tonnes of natural aggregates is annually consumes by concrete industry (Mehta & Monteiro, 2013). Sand mining activity where it was done by removing sand has cause environmental effects such as lowers the stream bottom, landslide and soil erosion (Bhardwaj & Neelam, 2015). It is not renewable sources and the source is decreased over the past few years. Simultaneously, oleochemicals wastes (sludge) also pose a significant environmental problem. Sludge is stored in landfills without any treatment. It is reported by Department of Environment, Malaysia that about 171.64 metric tonne of oleochemicals waste created in 2011. These sludge or disposal waste are disposed as landfill material without any reuse or recycling. Moreover, this sludge also is chemical wastes that contribute to the environmental pollution. Oleochemicals manufacturers has been facing difficulties in disposing this abundantly generated waste because more landfill site need to be provided and large cost need to be spend in order to place and manage this disposal waste. Hence, in order to overcome this problem, the invention of reuse oleochemicals waste as partial sand replacement in concrete is investigate, at the same time to build sustainable building.

1.3 Objectives

The aim of this research is to study the potential of oleochemicals waste to serve as partial sand replacement in concrete. The objectives of the study are:

i) To determine the effect of oleochemicals waste as partial sand replacement towards compressive strength and flexural strength at the age of 7 and 28 days.

ii) To determine the effect oleochemicals waste as partial sand replacement towards water absorption at the age of 28 days.

1.4 Scope of research

This study concentrated on investigation of compressive strength, flexural strength and water absorption of the concrete made by integrating oleochemicals waste as a partial sand replacement. The scopes of study are:

i) The testing is conducted in FKASA concrete lab at UMP Gambang.

ii) The oleochemicals waste is obtained from FPG Oleochemicals Sdn Bhd located at Gebeng Pahang.

iii) The oleochemicals waste is dried in an oven, grind and sieve before casting.

iv) The percentages of oleochemicals waste use as partial sand replacement are 0%, 5% and 10%.

v) The specimen is in the form of cube and prism which has size 100 x 100 mm x 100 mm and 100 x 100 x 500 mm respectively.

vi) There are three mixture of the concrete and the total sample is 45 which are 27 cubes and 18 prisms.

vii) The concrete design to be 25 N/mm2.

viii) Samples with 0% of sludge are cured using water curing, while samples with 5% and 10% of sludge are cured using air curing.

ix) The sample for compressive strength and flexural strength test are tested at the age of 7 days and 28 days, while the sample for water absorption test are tested at the age of 28 days.

1.5 Significance of research

The properties of concrete produced by utilizing oleochemicals waste as partial sand replacement are investigated in this study. The utilization of sludge from oleochemicals waste as partial sand replacement in concrete is able to reduce the amount of waste ending up at the landfill. The fundamental objective of disposal waste management is encouraging reuse of the wastes including diminishing environmental

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