THE EFFECT OF PALM OIL CLINKER POWDER AND COCKLESHELL POWDER AS CEMENT REPLACEMENT TO CONCRETE DURABILITY PROPERTIES

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SUPERVISOR'S DECLARATION

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

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ABSTRAK

Konsep bangunan mesra alam mendapat perhatian yang lebih hari ini. Bahan-bahan yang standard konkrit yang digunakan tidak sama sekali mesra alam. Oleh itu, banyak bahan-bahan daripada sumber semula jadi boleh menjadi alternatif kepada merealisasikan konsep bangunan hijau. Hasilnya, ramai penyelidik telah menumpukan perhatian mereka ke arah mengenal pasti eko-mesra penggantian yang akan digunakan di dalam konkrit. Kajian ini dijalankan untuk mengkaji kecekapan dua jenis bahan-bahan buangan yang klinker kelapa sawit (POC) dan kerang shell (CS) sebagai pengganti separa simen dalam aspek ketahanan. Penggantian simen adalah pada tahap yang berbeza (10% dan 20%). Enam perkadaran campuran telah dibuat dengan peratusan yang berbeza POC dan CSP. Spesimen telah sembuh dengan merendam dalam air selama 7 dan 28 hari. Ujian yang dijalankan ialah ujian rintangan asid dan ujian penyerapan air. The POC dan CSP telah dikisar untuk mencapai saiz zarah kecil untuk dimuatkan dengan campuran konkrit sebagai pengganti simen. Hasil eksperimen menunjukkan bahawa POC memberi kesan negatif kepada konkrit dalam kedua-dua ujian manakala CSP itu membuktikan ia adalah rintangan kepada asid. oleh itu ia telah membuat kesimpulan bahawa penggunaan kedua-dua POCP dan CSP untuk menghasilkan lebih bersih dan yg berhenti berusaha konkrit tidak kedap, kedua-dua mekanikal dan alam sekitar kerana ia akan mengurangkan pelepasan CO2.

ABSTRACT

The concepts of eco-friendly building are getting more attention today. The standard materials of concrete that used are not totally environmentally friendly. Thus, many materials from natural sources can be an alternative to the realization of the green building concept. As a result, many researchers have devoted their attention towards identifying eco-friendlier substitutions to be used in concrete. This study was conducted to investigate the efficiency of two different types of waste materials which are palm oil clinker (POC) and cockle shell (CS) as partial replacement of cement on durability aspects. The replacement of cement was at different levels (10% and 20%). Six mix proportions were made with different percentage of POC and CSP. The specimens were cured by immersing in water for 7 and 28 days. The tests that were conducted were acid resistance test and water absorption test. The POC and CSP were ground to achieve a small particle size to fit with the concrete mix as cement replacement. The experiment result showed that the POC had a negative impact to the concrete in both tests while the CSP proved it is resistance to acid. It was therefore concluded that the use of both POCP and CSP to produce cleaner and quitter pervious concrete, both mechanically and environmentally since it will reduce the emission of CO_2.

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LIST OF ABBREVIATIONS

POCP	Palm oil clinker powder
CSP	Cockle shell Powder
PCC	Portland composite cement
X-RD	X-Ray Diffraction
X-RF	X-ray fluorescence
$CaCO_3$	Calcium carbonate
SiO_2	Silicon dioxide
H_2S	Hydrogen Sulfide
CO_2	Carbon dioxide
CaO	Calcium oxide
Fe_2O_3	Ferric oxide
MgO	Magnesium oxide
K_2O	Potassium oxide
P_2O_5	Phosphorus pentoxide
TiO_2	Titanium dioxide
Al_2O_3	Aluminium oxide
SO_3	Sulfur trioxide
LOI	Loss of ignition
CPC	Composite Portland cement
OPC	Ordinary Portland Cement
Na_2O	Sodium oxide
SrO	Strontium oxide

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

The current trend in concrete engineering is shifting towards the sustainability aspect due to the depletion of natural concrete-making materials as well as the environmental impact arising from the utilization of these materials. Moreover, Concrete industry presents a challenge to the global environment as it consumes significantly large quantities of natural resources in addition to generating toxic gases, such as CO_2. Minimizing the industrial waste and reduction of natural resource consumption are the foremost focus achieving cleaner production. Cleaner production comprises the processes, which enhance the quality of production through promoting eco-efficiency and utilizing less raw materials. Therefore, man has developed concrete to increase the ability, hardness and durability to create more economical, environmentally friendly concrete, construction of skyscrapers and huge structures.

Furthermore, Concrete is one of the most important elements in the development of civilization and to meet the needs of modern life. Additional materials are one of the strategies used to improve concrete performance. After many researches, many materials were discovered that can be partially replaced with cement to improve the performance of concrete, mechanical properties and durability properties. The rate of change in the properties is depend on the type and quantity of the material that supplemented.

Today, the additional alternative materials are widely used in concrete either in blended cements or added separately in the concrete mixture. The use of the additional alternative materials such as blast-furnace slag, a by-product from pig iron production, or fly ash from coal combustion, represents an appropriate solution to partially substitute Portland cement (PC). The use of such materials, where no additional clinkering process is involved, leads to a significant reduction in CO_2 emissions per ton of cementitious materials (grinding, mixing and transport of concrete use very little energy compared to the clinkering process) and is also a means to utilize by-products of industrial manufacturing processes. In additional, using these materials it will enhance the durability and mechanical properties of concrete in order to increase and achieve resistance to acid, resistance to sulphate and water absorption.

However, the usage of agricultural waste in form of ashes as one of the constituent materials in concrete has been done through the years, with the advances in cement and concrete technology the application of various materials has also been increased. Perhaps the latest addition to the ash family is palm oil clinker (POC), a waste material obtained on burning of palm oil husk and palm kernel shell as fuel in palm oil mill boilers that has been identified as Most of problems relating to concrete is associated to the development of durability, corrosion and cracks. Thus, a substantial solution that decreases the brittleness of concrete is required.

From environmental perspective, agricultural waste materials have been investigated by many researchers and have been shown to have better properties in concrete than the cement materials, whereas the latter also generates a high amount of CO_2, which is harmful for environment. Since POC is environmentally friendly and consumes less amount of energy than traditional materials during production. In Malaysia, a lot of tons of POC have been dumped into lagoons and landfills without exploiting the use of this material in other industries. In terms of cost saving, using POC as partial cement replacement will reduce the cost of cement production as well as transportation of the same from cement plants to the stores. Moreover, this will improve the environment by mitigating and reducing waste materials in landfills.

Another potential waste material that is available in abundance is waste seashells. Since its rich with calcium it will cover the lack of calcium in the POC which will partially replace with cement. There are many different types of waste seashell available, such as oyster shells, mussel shells, scallop shells, periwinkle shells and cockle shells. In some countries, large quantity of shellfish had produce in the world, about millions tons of waste seashells are disposed of in landfills annually. This amount of seashell waste primarily consists of oyster, clam, scallop, and mussel shells, most of which are landfilled with only a small fraction re-used for other purposes, such as fertilizers and handicrafts. The re-use is limited due to the restriction on the amount that can be used, the problem of soil solidification, and economic problems.

1.2 PROBLEM STATEMENT

POC is one of the materials resulting from the burning of waste materials such as palm kernel shell and palm oil husk. POC is usually disposed in landfills, which results in the increased amount of materials deposits every year and now has become a burden. With the increased in population, industrialization, and urbanization, the quantity and types of solid waste materials have also increased. non-biodegradable waste materials will remain in the environment for hundreds, perhaps thousands of years. Non-biodegradable waste materials are difficult to disposal and thus pose a significant threat to the environment. Hence, there is a steady increase in realizing the sustainability of concrete production using recycled waste materials as substitutes for conventional materials in concrete. For this purpose, several studies have been carried out to utilize wastes originating from different sources, most of these wastes are available in huge volume in certain countries, and hence, have the potential to be re-used in large-scale concrete production. The utilization of waste materials in concrete could moderate the problem of excessive consumption of conventional materials as well as reduce the amount of waste generated. In addition, there are problems with illegal dumping of waste seashells into public waters and reclaimed land. These waste seashells, if left untreated for a long period of time, can cause foul odours due to the decay of the remaining flesh in the shells or the microbial decomposition of salts into gases, such as H_2S, NH_3 and amines. These problems can negatively affect the quality of living for people near and result in environmental pollution issues.

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