UNIVERSITI TEKNOLOGI MARA

THE PERFORMANCE OF LIGHTWEIGHT CONCRETE CONTAINING TREATED OIL PALM SHELL AGGREGATE UNDER DIFFERENT CURING CONDITIONS

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Thesis submitted in fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Design and Built Environment)

Collage of Built Environment

February 2023

ABSTRACT

Concrete made from oil palm shells, also referred to as OPS concrete has a great deal of potential for use in the construction industry. Despite having a lot of potential to be developed as one of the built structures, this material is not presently used commercially in the construction industry because of its unusual physical condition and properties compared to other aggregates. Therefore, it is important to treat this material before using it in concrete as well as to explore and understand the behaviour of OPS-treated concrete over a long period of time in order to gain more reliable conclusions about the use of OPS in built structures. This study discusses in detail the experimental study of the overall performance of lightweight concrete made of OPS treated by a synthetic polymer which is styrene acrylic emulsion (SAE). The SAE coats the OPS surface at different volume percentages as an overall replacement for natural coarse aggregate at different curing conditions. In order to increase the performance of OPS treated concrete, testing under various curing conditions is essential to determine the best performance for OPS treated concrete. Overall, the method of this study involved extensive testing in evaluating the physical performance of treated OPS. Multiple tests have also been conducted to evaluate the effectiveness of surface treatment on the engineering performance and durability of OPS treated concrete when exposed to three different curing methods over the period of 90 days: normal water (NW), alternative curing (AC), and open (EC). The results of the study show that all the physical properties of OPS improved significantly after surface treatment. The performance of the engineering properties and durability of OPS concrete are seen to increase as the physical properties of OPS are improved. The effect of treatment was also found to be beneficial in improving the durability performance of OPS concrete. The effect of different curing methods on OPS concrete, which has been observed, produces different results. Normal water curing (NW) of OPS concrete produces more encouraging test results than other curing methods. This result may be credited to the consistent development and good cement hydration products used in OPS concrete during curing. Microstructure analysis of treated OPS concrete found a narrower ITZ gap compared to untreated OPS concrete. This proves that OPS surface treatment and exposure to proper curing can simultaneously improve the overall performance of OPS concrete while increasing the usability of OPS concrete in light structural applications in construction.

ACKNOWLEDGEMENT

Firstly, I wish to thank God for giving me the opportunity to embark on my PhD and for completing this long and challenging journey successfully. My gratitude and thanks go to my supervisor Assoc Prof Dr Sallehan bin Ismail and Dr Azamuddin bin Husin for their supervisions, invaluable advices and motivations throughout this study. Without their continuous helps, guidances and encouragements, this thesis would not have completed.

My appreciation goes to all the staff members of the FSPU concrete laboratory, UiTM, Perak, especially Pn Maznida Mohamad Daud and En. Muhammad Azrul Md Aminur Rashid for their kind support and assistance throughout the experimental stage of this study.

Finally, this thesis is dedicated to the loving my dear father and mother for the vision and determination to educate me. Special thanks also to my beloved husband Wan Khairil Joehari, my lovely kids Wan Zara Arissa, Wan Nayli Amanda and Wan Naura Medina for their continuing prayers and moral support throughout the duration of my studies. This piece of victory is dedicated to all of you. Alhamdulillah.

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INTRODUCTION

1.1 Introduction

The population in Malaysia grew to 32.63 million in 2019 compared to 28.3 million in 2010 (DOSM, 2019). This situation creating more demand for building and infrastructure development. After 2020, Malaysia has now been driven towards rapid industrialization and determined to become a developed country by 2030. The rapid growth of the construction sector lead to the increasing of production and consumption in building materials, especially in concrete production sectors.

Concrete is the most widely consumed material among various types of construction materials due to the production more than 10 billion tons annually (Meyer, 2009). According to Mehta. & Monteiro, (2006) by year 2050, concrete demand is expected to increase to about 18 billion tons. It's been used for a long time as a primary material for constructing stable and reliable engineering structures. Concrete is used for the majority of building projects, including the foundation, the architectural structure, the dam, the dwellings, the towers, the highways, and the pavement. However, the concrete industry still faces a number of challenges in the current day.

First and foremost, the concrete industry has significant issues related to the consumption of natural raw materials, as concrete has been designated as a non-environmental-friendly material (Hamada et al., 2020) Concrete is responsible for rapid depletion of natural resources as a significant amount of its main constituent materials, especially aggregates, are drawn from nature. Approximately, 70–80% of the total volume of concrete is occupied by aggregates (Alexander & Mindess, 2005 ; Kumar et al., 2019). Malaysia has several distributed natural aggregate resources, with nearly every state carrying its own quarry and aggregate production. According to Murlidhar et al. (2016), the average consumption of aggregate reached approximately 80 million tonnes per year which is produced in Peninsular Malaysia. Overuse of aggregates causes depletion of these natural resources and the quarrying and mining activities could lead to environmental impact such as conversion of land use, soil erosion and contamination of environment.