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UTILIZATION OF PALM OIL BOILER ASH (POBA) AS A PARTIAL REPLACEMENT OF SAND IN FOAMED CONCRETE

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ABSTRACT

Industrial by-products derived from agricultural crops are observed as viable resources for the development of environmentally friendly and durable concrete. Undesirable waste generated from agricultural activities has distinct properties that make it suitable for proper application in concrete production. For additional cementitious materials, oil palm kernel shell (OPKS), coconut shell, fly ash, rice husk ash (RHA), and oil palm shell are some of the wastes that can be utilized because of their pozzolanic qualities, which enhance the mechanical properties of solid concrete. The goal of this study is to assess the potential of palm oil boiler ash (POBA) to be used in foamed concrete as a partial replacement material. It has been discovered that adding POBA to the foamed concrete matrix boosts the compressive strength of the concrete blends by filling the voids in the concrete with fine POBA particles, which function as a filler and improve the compressive strength of the concrete. The compressive strength and density values for 12% POBA as a sand replacement were found to be the highest of any percentage of POBA replacement. It has been demonstrated that adding POBA to the foamed cellular concrete structure matrix helps in pores formation, producing a lightweight product with a better compressive strength. The results of this study suggest that POBA can be employed as a supplementary cementing ingredient.

Keywords: *foamed concrete, palm oil boiler ash (POBA), sand replacement, compressive strength, water absorption*

1. INTRODUCTION

Waste from palm oil production has significantly impacted both society and the environment regarding its waste disposal. On the other hand, the cost of concrete materials is increasing due to resource scarcity and elevation of global demand for concrete. Instead of being discarded as trash, the use of palm oil boiler ash (POBA) in foamed concrete offers great potential to reduce the weight of concrete with adequate strength. Several studies had been conducted to find solutions to the problem of the rising amount of waste disposal and the shortage of natural sand (Castillo et al., 2020; Payá et al., 2017; Sankh et al.,2014; Tran & Ghosh, 2020). The objectives

of this study are to evaluate the feasibility of POBA as a partial sand replacement in foamed concrete and to determine the ideal POBA composition in the foamed concrete.

2. METHODOLOGY

Mixture sample	Mix proportion [kg·m^{-3}]				Foaming agent [l·m^{-3}]
	Cement	Fine aggregate	POBA	Water	
Control	538	538	-	323	301.55
4% POBA	538	517	21	323	301.55
8% POBA	538	495	43	323	301.55
12% POBA	538	473	65	323	301.55

Table 1 Detail of Mix Proportions Foamed Concrete Sample

The foamed concrete consists of original Portland cement, foaming agent, POBA, water, and fine aggregate. POBA used to replace the sand in this study was sieved through a 2 mm sieve, with different percentage mass replacement; 0%, 4%, 8% and 12%. Details of the mix proportions is shown in Table 1. The foamed concrete sample was cast and cured according to the desired mix proportion. Three tests were conducted to evaluate the foamed concrete with varying percentages of POBA which were water absorption test, density test and uniaxial compressive test in accordance with the standard practice.

3. FINDINGS

In comparison to other replacement levels, the foamed concrete with 12% POBA recorded the maximum density. The density data shows that longer curing days have resulted in increased foamed concrete density. Apart from that, the foamed concrete with the highest POBA content had the greatest water absorption. This result indicates that increasing POBA in the foamed concrete will increase the water absorption value. The strength of foamed concrete is significantly increased when POBA is used in place of sand, as demonstrated by the fact that 12% of POBA as sand replacement had the maximum compressive strength.

4. CONCLUSION

The present study on utilizing palm boiler ash (POBA) as sand replacement in foamed concrete shows a promising result in concrete manufacturing. The presence of POBA in foamed concrete significantly enhanced the pore amount in their matrix structure, resulting in the invention of lightweight concrete but with higher compressive strength. The result from this study indicated that the POBA was feasible to be utilized as the supplementary cementing material in the concrete mixture.

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