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# Strength and abrasion resistance of palm oil clinker pervious concrete under different curing method

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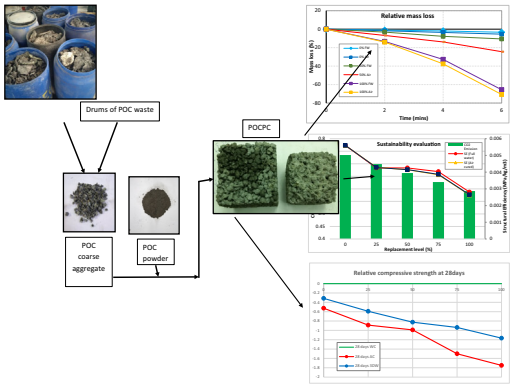
## HIGHLIGHTS

- Natural aggregate was replaced with POC aggregate in the production pervious concrete.
- Physical properties of the POC aggregate had substantial effect on the concrete properties.
- Curing method had a marginal effect on the concrete properties.
- POC aggregate is an alternative concreting material suitable for sustainable construction.

## GRAPHICAL ABSTRACT

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## ABSTRACT

This paper investigates the abrasion resistance and strength properties of pervious concrete (PC) containing palm oil clinker (POC) coarse aggregate under different curing method. Materials used include OPC Type I, 10 mm nominal size POC coarse aggregate and granite. The palm oil clinker pervious concrete (POCPC) mixes were developed with a fixed water-cement ratio of 0.3 and was studied at various replacement levels of natural aggregate with POC aggregate (0%, 25%, 50%, 75% to 100%). Selected curing methods for the POCPC samples were full water curing, air curing and 3 days water curing respectively. Based on results, compressive strength and abrasion resistance of the POCPC reduced, resulting from the incorporation of POC into the mix irrespective of the curing method. Given the selected curing method, POCPC cured in full water had superior performance in terms of compressive strength. However, the POCPC cured in air and 3 days water curing recorded about 5% loss of its compressive strength with respect to full water curing due to uncontrolled temperature and humidity condition. Abrasion resistance of the concrete was improved when full water curing was adopted with about 5% loss due to curing method. Thus, it becomes evident that curing had marginal effect on the properties of the concrete rather it is dependent mainly on the properties of the aggregate. Furthermore, incorporating POC as an alternative concreting material can help to sustain the construction industry based on the sustainability efficiency evaluation conducted.



## 1. Introduction

Globally, utilization of waste materials in construction industry is gaining fast attention. Using waste by-products and/or solid

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waste materials from different industries in concrete will not only reduce the problems relating to depletion of natural aggregates but further enhance its environmental and economic benefits. In the construction industry, these waste materials are commonly used as lightweight aggregates and/or powder materials to replace concrete constituents [1].

Despite the amount of agro-waste available in Malaysia, the construction industry is yet to fully exploit the possibility of incorporating these wastes into construction practice. Palm oil clinker (POC), a waste obtained from palm oil processing plants, was used in this study in the production of pervious concrete (PC). POC is generally porous, irregularly shaped with good lightweight characteristics and it is obtained in large chunks (Fig. 1a-b) during incineration process of oil palm shell and the fiber. Recent studies [2–7] have indicated that it can serve as an ideal alternative aggregate when crushed and sieved into suitable sizes as seen in Fig. 1c.

PC is a type of concrete with interconnected voids network taking a significant volume of the concrete mixture, usually 15–35%. This property allows easy infiltration and percolation of water through its pores, which makes it an environmentally friendly concrete material [8]. The compressive strength of PC is mainly dependent on its porosity [9]. Thus, the presence of high void in PC usually results in a reduced compressive strength often in the range of 5.6–21.0 MPa after 28 days of curing [10,11].

Past studies have recognized the possible use of lightweight aggregates in pervious concrete. Most of them have indicated that as the amount of lightweight aggregate in the concrete mixture increased, the strength of the concrete decreased. However, study conducted on incorporation of recycled concrete aggregate (RCA) and recycled concrete block aggregate (RBA) as lightweight aggregate in PC showed improved compressive strength, except at full replacement (100%). Also, the surface abrasion resistance of the concrete improved when RCA was incorporated at all replacement levels while the surface abrasion resistance improvement was limited to 20% for the RBA replacement [12]. On the other hand, the use of recycled lightweight aggregate from waste autoclaved aerated concrete block showed that incorporation of the waste material resulted in low density and compressive strength. However, the mechanical and thermal properties of the concrete improved with the use of sand and fly ash which resulted in a reduced void

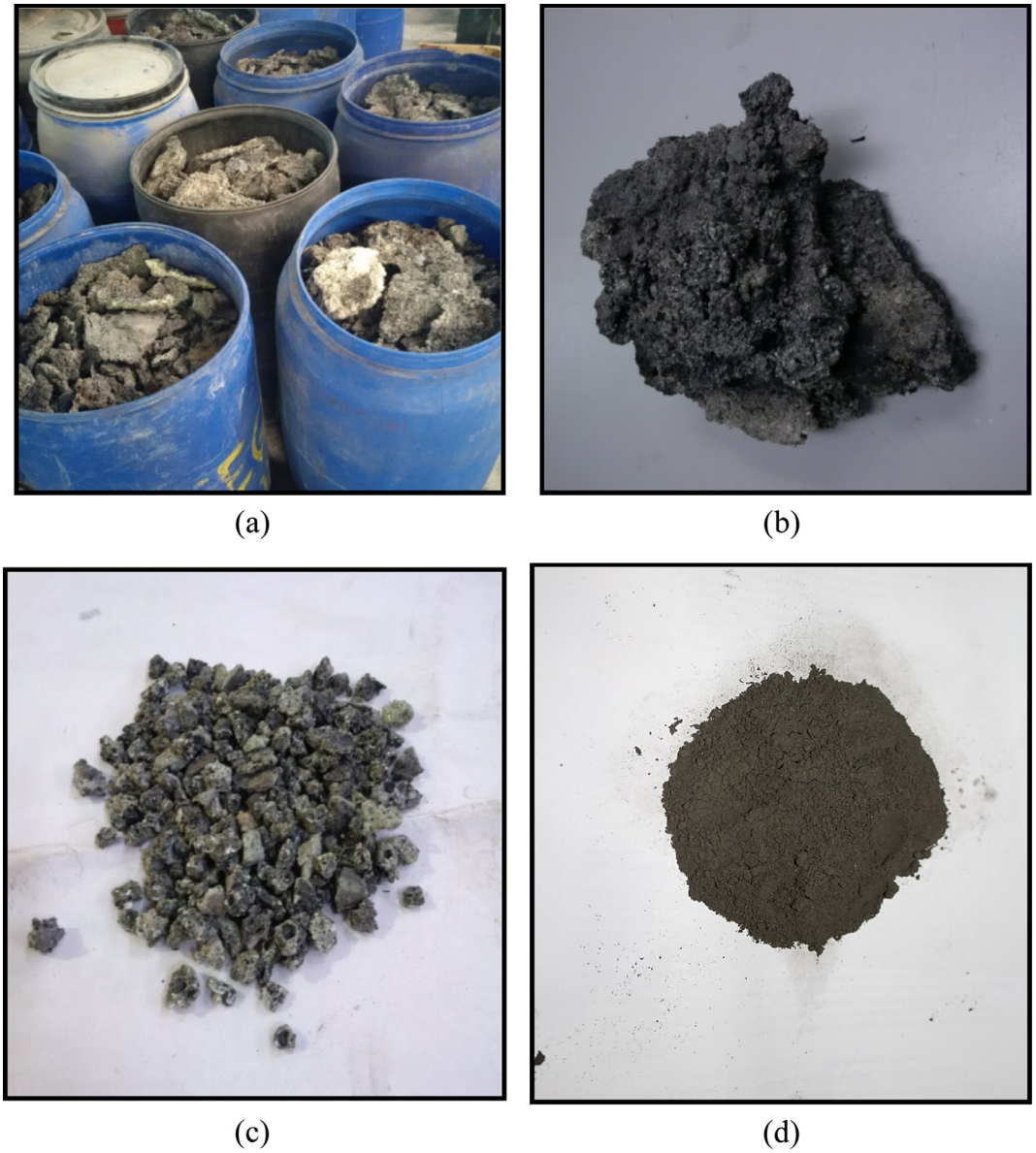


**Fig. 1.** (a) Drums of POC (b) Chunk of POC (c) POC coarse aggregate (d) POC powder.