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Engineering properties of lightweight aggregate concrete containing limestone powder and high volume fly ash

Payam Shafigh^{a*}, Mohammad A. Nomeli^b, U. Johnson Alengaram^c, Hilmi Bin Mahmud^c, Mohd Zamin Jumaat^c

^aDepartment of Building Surveying, Faculty of Built Environment, University of Malaya, 50603 Kuala Lumpur, Malaysia

^bDepartment of Mechanical Engineering, University of Maryland, College Park MD 20742, USA

^cDepartment of Civil Engineering, Faculty of Engineering, University of Malaya, 50603 Kuala Lumpur, Malaysia

*Corresponding author: Email: pshafigh@um.edu.my; pshafigh@gmail.com, Tel: +60172437383, Fax: +60379675318

Abstract:

Concrete industry is one of the major sources of consuming high volume of natural resources. On the other hand, cement industry is a significant point source of carbon dioxide emissions due to the decomposition of raw material and burning fuel during the manufacturing process. As the demand for concrete is growing, one of the effective way to minimize the negative environmental impact of the industry is the use of waste and by-product materials as cement and aggregate replacement in concrete.

In the current study, possibility of making structural lightweight aggregate concrete using large amounts of waste material was investigated. The waste materials comprised oil palm shell, which was used as coarse aggregate, and a high volume (50% and 70%) of type F fly ash, as cement replacement by mass. The mechanical properties, such as compressive strength in different curing conditions, splitting tensile and flexural strengths, as well as density, ultrasonic pulse velocity, water absorption, and drying shrinkage up to one year were investigated. All oil palm shell concretes containing high volume fly ash are found to have adequate strength for formwork removal. Oil palm shell concretes containing high volume fly ash had 46% to 60% lower cement content compared to previous studies with a similar compressive strength. Although, using high volume fly ash in oil palm shell concrete significantly reduced short-term mechanical properties, however, the use of limestone powder significantly improved the compressive strength at early and later ages. Test results also showed that there is no significant difference between the drying shrinkage of oil palm shell concrete containing 50% fly ash and the control oil palm shell concrete.

Keywords: Lightweight aggregate concrete; limestone powder; fly ash; mechanical properties; drying shrinkage

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