

Manufacturing of sintered lightweight aggregate using high-carbon fly ash and its effect on the mechanical properties and microstructure of concrete

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Abstract

Fly ash is the largest source of industrial solid waste in China. Fly ash with its high content of unburned carbon has to be discarded in landfills and cause environmental problem. To reduce the environmental impacts, lightweight aggregate (LWA) was manufactured utilizing high-carbon fly ash (HCFA) (loss on ignition, LOI = ~16.3%). Trial tests were conducted on high-carbon fly ash lightweight aggregate (HCFA-LWA) in a laboratory electric furnace and in a manufacturer's batch furnace. A new temperature profile was proposed for the HCFA-LWA sintering process in which carbon served as a partial fuel substitute during the burning period, which can decrease the sintering period in the sintering stage of the LWA and save energy. Then, the mechanical properties and microstructure of lightweight concrete made with the HCFA-LWA were studied. The microscopic investigation of the interfacial transition zone showed that the cement paste infiltrated into the rough surface of the HCFA-LWA and improved the mechanical interlocking between the cement paste and the HCFA-LWA. Test results showed that the HCFA-LWA concrete developed 91% of the 28 d compressive strength within 7 d. The modulus of elasticity and tensile strength were also comparable to similar grades of LWA concretes. Therefore, HCFA-LWA can be used for structural applications. The utilization of HCFA-LWA in concrete would solve the waste disposal problems that are associated with fly ash and help reduce pollution to the environment.

Original language	English
Pages (from-to)	753-762
Number of pages	10
Journal	Journal of Cleaner Production
Volume	112
State	Published - Jan 20 2016

Lo, T. Y., Cui, H., Memon, S. A., & Noguchi, T. (2016). *Manufacturing of sintered lightweight aggregate using high-carbon fly ash and its effect on the mechanical properties and microstructure of concrete*. *Journal of Cleaner Production*, 112, 753-762. DOI: 10.1016/j.jclepro.2015.07.001