Environmental Engineering and Management Journal xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
http://www.eemj.icpm.tuiasi.ro/; http://www.eemj.eu

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RECYCLING OF LIGHT-EMITTING DIODE WASTE QUARTZ SAND ACTING AS A POZZOLANIC MATERIAL FOR PORTLAND CEMENTT

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Abstract

LED waste quartz sand (LEDWS), which is a prominent byproduct of the LED manufacturing process, may contaminate the environment because it comprises specific heavy metals (e.g., As and Cu), which are hazardous ingredients to the environment when disposed of improperly. Therefore, this study investigated the use of light-emitting diode (LED) waste quartz sand to partially replace Portland Type I cement (OPC) to evaluate the feasibility of reusing it as a pozzolanic material. The SiO_2, Na_2O, and CaO contents in the LED waste quartz sand were 70.37, 16.52, and 9.19%, respectively. The results showed that the LED waste quartz sand met the Taiwan EPA regulatory thresholds. Microstructure analysis techniques, such as mercury intrusion porosimetry (MIP), X-ray diffraction (XRD) and scanning electron microscopy (SEM), were used to measure the LED waste quartz sand-blended cement paste (LEDBCP) samples. Compressive strength analysis of the pastes containing 10 wt.% LED waste quartz sand showed that the LED waste quartz sand not only acts as a pozzolanic material to increase the density of the microstructure but also improves the compressive strength of the pastes. LEDBCP with LED waste quartz sand exhibited higher intensity diffraction peaks corresponding to calcium silicate hydrate and lower intensity diffraction peaks corresponding to portlandite (CH) compared with ordinary Portland cement samples at an early age. The gel porosity and pore sizes of the LEDBCP increased with increases in the proportion of LED waste quartz sand. LEDBCP with 10–20 wt.% LED waste quartz sand provides a paste with good pozzolanic characteristics.

Keywords: light-emitting diode, microstructure, pozzolanic material, waste quartz sand

Received: July, 2019; Revised final: November, 2019; Accepted: December, 2019

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