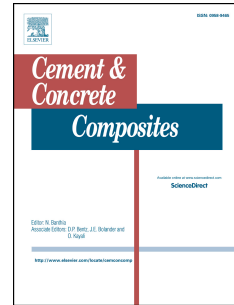


Accepted Manuscript

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PII: S0958-9465(17)30432-8

DOI: [10.1016/j.cemconcomp.2017.10.009](https://doi.org/10.1016/j.cemconcomp.2017.10.009)

Reference: CECO 2925

To appear in: *Cement and Concrete Composites*

Received Date: 7 May 2017

Revised Date: 11 October 2017

Accepted Date: 23 October 2017

Please cite this article as: G. Skripkiūnas, S. Vasarevičius, V. Danila, Immobilization of copper indium selenide solar module waste in concrete constructions, *Cement and Concrete Composites* (2017), doi: 10.1016/j.cemconcomp.2017.10.009.

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Immobilization of copper indium selenide solar module waste in concrete constructions

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Abstract. The aim of this study was to investigate the properties of concrete containing various quantities of copper indium selenide (CIS) solar module waste by replacing a certain part (up to 40%) of sand. The obtained results have shown that an increase in the content of solar module waste resulted in an increase of the density of fresh and hardened concrete. The compressive strength of the specimens compared to the control specimens has been higher, when sand aggregate was replaced by CIS solar module waste particles from 5 to 20%. Also, in all cases a decrease in the water absorption and porosity of concrete specimens containing immobilized waste compared to those with no waste has been observed. The leaching behaviour of the concrete containing immobilized waste was also studied. The results showed that the concrete with sand aggregate replacement by waste particles between 5 to 10% has the best leaching properties. That replacement can be used for CIS solar module waste recycling in concrete production.

Keywords: concrete, CIS solar module waste, compressive strength, porosity, leaching, immobilization

1. Introduction

Photovoltaic (PV) modules are an attractive and non-polluting technology for producing electricity [1]. Currently, growing concerns about the impact of gas causing greenhouse effect can be observed, and therefore more energy must be produced from renewable energy sources [2]. Solar energy is one of potential renewable energy sources for producing electricity. In recent years, a rapid growth in manufacturing and installing solar modules have been noticed [3]. The popularity of solar modules continues to grow as, at

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