

https://dspace.org/

Utilisation of electrical and electronic plastic waste as replacement for aggregate in concrete

Parsons, Lewis Alfred

2019

https://hdl.handle.net/10539/28947

Parsons, Lewis Alfred (2019) Utilisation of electrical and electronic plastic waste as replacement for aggregate in concrete, University of the Witwatersrand, Johannesburg, <http://hdl.handle.net/10539/28947>

Downloaded from a DSpace repository. https://dspace.org/

Abstract

Waste electrical and electronic plastic (WEEP) recycling is complex due to the presence of different hazardous additives, variety in plastic types and degraded polymers among others. This often results in vast quantities of WEEP being discarded of in landfills, incinerated or stored in warehouses, whereby it could have rather been used as an aggregate replacement material in concrete.

The main aim of this research was to produce structural concrete with a minimum compressive strength of 25MPa using different types of WEEP. The different types of WEEP used include: acrylonitrile-butadiene-styrene (ABS), polycarbonate acrylonitrile-butadiene-styrene (PC/ABS), high impact polystyrene (HIPS) and an equal blend of the aforementioned WEEP types. To address the concretes strength reduction found from WEEP substitution and to improve its durability, 10% condensed silica fume and 25% metakaolin replaced cement in concrete by mass respectively. Furthermore, a superplasticiser was used to maintain a set workability. In the experimental program WEEP was used at replacement percentages of 0%, 5%, 10%, 20% and 30% in the partial replacement of both fine and coarse natural aggregates in concrete to assess its behaviour for structural applications. By performing test of compressive and tensile strength, durability performance and scanning electron microscopy analysis it has been found that all WEEP types show a real possibility for use as aggregate in concrete.

Results showed that all mixes made without and with WEEP substitution for the natural aggregate attained the minimum compressive strength of 25MPa. When concrete with a WEEP replacement of 30% was compared to the control mix there was a large decrease in strength, but when concrete with a WEEP replacement of 5% was compared with the control mix the results showed almost equal strength for all WEEP types. There was a reduction in the oxygen permeability index and water sorptivity and an increase in chloride conductivity for concrete made with a WEEP replacement of 30% compared to the control mix. It was also found that all concrete mixes made using metakaolin or condensed silica fume as partial replacement for cement had a higher strength and improved durability compared to concrete mixes made using only cement as binder material. The use of WEEP in concrete could reduce the amount of WEEP disposed of and reduce the amount of natural aggregates mined. This in turn may produce an environmentally friendly concrete.