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Electronic Wastes as Additives in Concrete

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Abstract

Objectives: To determine the compressive strength of concrete with e-wastes as additives after a curing period of 28 days. **Methods/Analysis:** Concrete was produced with 1%, 2% and 3% e-wastes utilizing the Printed Circuit Boards (PCB) made as chips using the Class A mixture with the control. The compressive strength was determined. **Findings:** Concrete passed the allowable compressive strength with the control sample, 1%, 2% and 3% e-wastes which yielded to an average value of 20.85 MPa, 21.75 Mpa, 24.75 MPa, and 23.18 MPa respectively. **Improvement:** Addition of electronic wastes improved the strength of concrete.

Keywords: Additives, Concrete, E-wastes, Electronic, Wastes

1. Introduction

The world today is advancing too fast with our environment changing progressively. Attention is being focused on recycling of waste materials and some mitigation measures to safeguard the natural resources. To alleviate the environmental impact of improper disposal of electronic waste, some organizations tried to come up with recycling methods. After the possibilities of reuse have been exhausted, the next move to be done is on the recycling process. Recycling of old raw materials that are retrieved are to be made of in producing new products that could be beneficial to the community or the environment.

Dependence on electronic gadgets and equipment at home and in the workplace caused additional impact to a new environmental challenge that involves electronic wastes. These are the wastes that come from the electronic products that are no longer serviceable. These include computers, cellular phones, refrigerators, televisions, cameras, and washing machines. These pieces of equipment contain hazardous materials such as lead, beryllium, mercury, cadmium, and chromium that pose both an occupational and environmental health threat. Although electronic equipment is considered safe during use, the potential for release of the toxic constituents increases during storage or disposal. Because of the growing number of discarded electronic devices resulting from rapid product obsolescence, this type of waste is an emerging concern among developing countries[1].

Electronic wastes are described as loosely discarded surplus and broken electronic devices. A huge ton of electronic waste needs to be disposed per year. These contain various types of substances and chemicals creating health problems and environment issues if not handled properly. Electronic waste is an emerging issue causing serious pollution problems to humans and the environment, such that mitigation measures need to be taken into consideration especially on recycling concepts.

This is the right time to come up with an alternative method for disposing electronic wastes by utilizing it as additives in concrete would somehow help our environment.

1.1 Objectives

a) To determine the strength of concrete after 28 days curing period using class A (1:2:4) mixture:
b) A mixture is the concrete sample without electronic wastes (control sample);

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Table 1. Materials for the Concrete

Mixtures	Cement (kgs.)	Sand (ft^3.)	Gravel (ft.^{3})	Electronic Wastes (kg.)	Water (Liters)
A (control)	10	0.50	1	-	5
B (1% electronic wastes)	10	0.50	1	0.44	5
C (2% electronic wastes)	10	0.50	1	0.88	5
D (3% electronic wastes)	10	0.50	1	1.32	5

Table 2. Compressive Strength of Concrete

Samples	Compressive Strength (MPa)			Average Compressive Strength (MPa)	Allowable Compressive Strength (MPa)	Remarks
	A	B	C			
A (control)	20.02	22.28	20.25	20.85	20.7	Passed
B (1% electronic wastes)	22.5	17.33	25.43	21.75	20.7	Passed
C (2% electronic wastes)	26.55	26.1	21.6	24.75	20.7	Passed
D (3% electronic wastes)	22.73	22.95	23.85	23.18	20.7	Passed

c) B mixture is the concrete sample with 1% electronic wastes;
d) C mixture is the concrete sample with 2% electronic wastes; and
e) D mixture is the concrete sample produced with 3% electronic wastes.

2. Methodology

2.1 Preparation of Materials

PCBs are the electronic wastes that were utilized in this study. The PCBs was collected from disposed computers, prepared and cleaned with clean water to eliminate chemicals or dirt and have it dried in an open space. These were cut into chips at an approximate size of 20mmx20mm. It was mixed with cement, sand (fine aggregate), gravel (coarse aggregates) and water based on the design mixture. Table 1 shows the composition of materials for the cement-bonded floor tiles.

2.2 Experimental Procedure

The electronic wastes were mixed with the cement, sand (fine aggregate), gravel (coarse aggregates) and water based on the design mixture. The concrete mix was poured in a molder. It was casted-out after 28 days curing period and was subjected to compression test using the Universal Testing Machine (UTM).

2.3 Experimental Design

Concrete samples with electronic wastes cut into chips at an approximate size of 20mmx20mm

Concrete with electronic wastes as additives:

A mixture of concrete without electronic wastes added (control);

B mixture of concrete with 1% electronic wastes;

C mixture of concrete with 2% electronic wastes;

D mixture of concrete with 3% electronic wastes.

The mixture that was utilized in the study was the Class A mixture (1:2:4). A mixture is the concrete sample considered as the control sample with no electronic wastes added. For B, C, and D concrete samples, 1%, 2% and 3% of electronic wastes using printed circuit boards cut into chips was utilized as additives.

3. Results and Discussion

Table 2 presents the results of the compressive strength of the samples cured for 28 days in MPa. It can be observed that the average compressive strength of the control and all other samples passed the minimum compressive strength of concrete that is 20.7 MPa.

4. Conclusions

The utilization of electronic wastes as additives to concrete is limited to 3% of the coarse aggregates. Beyond that percentage, it may or may not result to a passing strength, though the output will also depend on the quality of work.

5. References

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