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Experimental Study on Partial Replacement of Cement & Aggregate with Waste Material in Self Compacting Concrete

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Abstract
Electronic waste is major threats to the human health and environment. The disposal of Electronic waste in nature affects humans and animals. The construction industry will reduce natural disorders by the utilization of E-waste. The current study is focused on the attributes of strength and durability. M30 grade concrete mixes, electronic waste (0%, 4%, 8%, 10%,12%) is replaced by coarse aggregate and fly ash is replaced by cement in same % The study evaluated on compressive strength, split tensile strength and flexural strength,. The findings reveal that when the amount of electronic trash and fly ash in concrete mixes increases, the mechanical characteristics of the concrete steadily improve. With more E-waste and fly ash in the concrete, the proportion of saturated water absorption decreases. The average loss of compressive strength will grow as the amount of electronic waste in the acid test increases. Electronic garbage has been discovered to be utilized as an alternative to coarse aggregate in the building sector.

Keywords: Electronic waste, sand, coarse aggregate, fly ash, compressive strength, split tensile strength, flexural strength

Introduction

High Strength Self-Compacting Concrete (HSSCC) using mineral admixes, such as, is the major focus of this study. Fly Ash (FA), and electronic waste(E-waste). Mineral and chemical admixtures may be used to enhance workability and decrease segregation, while lowering the water cement ratio can boost strength. High Strength Self Compacting Concrete is examined for its fresh concrete qualities, mechanical properties, and long-term durability.

Thermal power stations generate electricity by burning coal, which produces fly ash, a byproduct. When the ash rises, the electrostatic precipitator collects the extremely tiny particles. Pond ash refers to the ash that collects at the bottom of a body of water. Coal ash includes both fly ash and pond ash. In general, there are two main categories of fly ash: class C and class F. Many methods have been implemented recently to reduce flue emission before fly ash may be discharged into the sky as it did in the past. Among the many uses for fly ash include lessening the occurrence of cracks, improving permeability, reducing bleeding and hydration heat, and lowering the water/cement ratio for comparable slumps. As an alternative to Portland Cement, an inorganic pozzolanic substance called GGBS has evolved (PC). It's a

green building material that helps keep pollutants to a minimum while also promoting long-term development.

Review of Literature

R R Bhopi et al (2022) was examine Bakelite is a industrial waste produce in manufacturing process like in Auto Industries etc. Nowadays the waste increases rapidly because of these modern living and thus creates a waste management problem. It is necessary to overcome such waste related problem in a meaningful manner. The purpose of this study is to find whether the Bakelite gives us that much Compressive strength as compared to conventional M25 grade concrete by replacing fine aggregate with Bakelite waste. So, this research examines the utilization of waste Bakelite in concrete with varying percentage like 0%,17%,20%30%,40%,50%,60% and 70%. Different percentages of Bakelite are added and tests like the slump cone test, compaction factor test were conducted to investigate the fresh properties like workability and compression test were performed to find out the 7, 14 and 28 days compressive strength. It is found that the replacement of fine aggregate with Bakelite can be done up to 20% without compromising the compressive strength of the M25 grade concrete.

R. Johnson Daniel et al (2021) Was study an experimental study on the utilization of waste material extracted from the Ceramic manufacturing plants and reused in concrete by replacing natural fine aggregate. Due to this ceramic waste, the natural fine aggregate extraction may be reduced, and the nominal cost of the river sand is high; compared to all the other alternate fine aggregate materials. Pulverized and granulated waste powder ceramic tiles are varies from 0%, 5%, 10%, 15%, and 20% replacement material for fine aggregate. The mix designs were prepared by replacing fine aggregate with different percentages of 0% to 20% pottery (crushed tiles) with M30 grade of concrete. Experimental investigations were conducted on fresh concrete for workability. In hardened concrete with various tests conducted like a Compression test, Young's modulus, and Flexural strength on concrete beam with different percentages of waste crushed ceramic tiles at different stages of curing time at 7 28 days.

Materials and method

We used cement, sand, fly ash, electronic waste and aggregate and in method we used all method for fresh concrete as well as harden concrete.

The tests methods presented here are devised specifically for self - compacting concrete. Existing rheological test procedure have not considered here, though the relationship between the results of these tests and the rheological characteristics of the concrete is likely to figure highly in future work, including standardization work.

Result and analysis

In this chapter simply and objectively reports what we found, without speculating on why we found these results. The discussion interprets the meaning of the results, puts them in context, and explains why they matter.

Test Result on Fresh concrete

Slump flow and t50

About 6 liter of concrete is needed to perform the test, sampled normally. Moisten the base plate and inside of slump cone, place base plate on level stable ground and the slump cone centrally on the base plate and hold down firmly. Fill the cone with the scoop. Do not tamp, simply strike off the concrete level with the top of the cone with the trowel. Remove any surplus concrete from around the base of the cone. Raise the cone vertically and allow the concrete to flow out freely. Simultaneously, start the stopwatch and record the time taken for the concrete to reach the 500mm spread circle. (This is the T50 time). Measure the final diameter of the concrete in two perpendicular directions. Calculate the average of the two measured diameters.

Figure 4.1 shown the result of slump flow test and value shown in table 4.1 firstly value of slump flow increased Up to 12% replacement of cement and aggregate after that value of slump flow decreased.

Table 1 Shown The result of slump flow in mm

% Replacement	Slump flow in mm	T50 slump flow (seconds)
0	675	5.25
4	685	4.75
8	690	3.90
12	695	3.12
16	680	4.65

Test on Harden Concrete

Hardened concrete gains strength with time and testing these hardened concrete for quality check is important for structures. Different types of tests are available to check different properties of hardened concrete which are discussed.

Compressive Strength Test

Compressive strength of concrete is defined as the load, which causes the failure of a standard specimen. The test of compressive strength should be made on 150mm size cubes. Place the cube in the compression-testing machine. The green button is pressed to start the electric motor. When the load is applied gradually, the piston is lifted up along with the lower plate and thus the specimen application of the load should be 300 KN per minute and can be controlled by load rate control knob. Ultimate load is noted for each specimen. The release valve is operated and the piston is allowed to go down. The values are tabulated and calculations are done. Total 45 number cubes were tested in this job to find out the compressive strength of concrete M30 Grade. The compressive strength of cubes checked at 7 day, 14 days & 28 days of curing.

the replacement were done by 0%,4%,8%,12% and 16% cement replacement level by E-Plastic Waste, fly ash and super plasticizer is supplemental to the mixes. The results of compressive strength of E-waste and fly ash concrete result shown in Table 4.3.

Table 2 Result of Compressive Strength Test 7 day, 14 days & 28 days

% Replacement	7days Compressive strength N/mm^2 or MPa	14days Compressive strength N/mm^2 or MPa	28days Compressive strength N/mm^2 or MPa
0	25.30	35.05	38.95
4	25.90	35.90	39.90
8	26.25	36.35	40.40
12	27.65	38.25	42.55
16	24.40	33.80	37.55

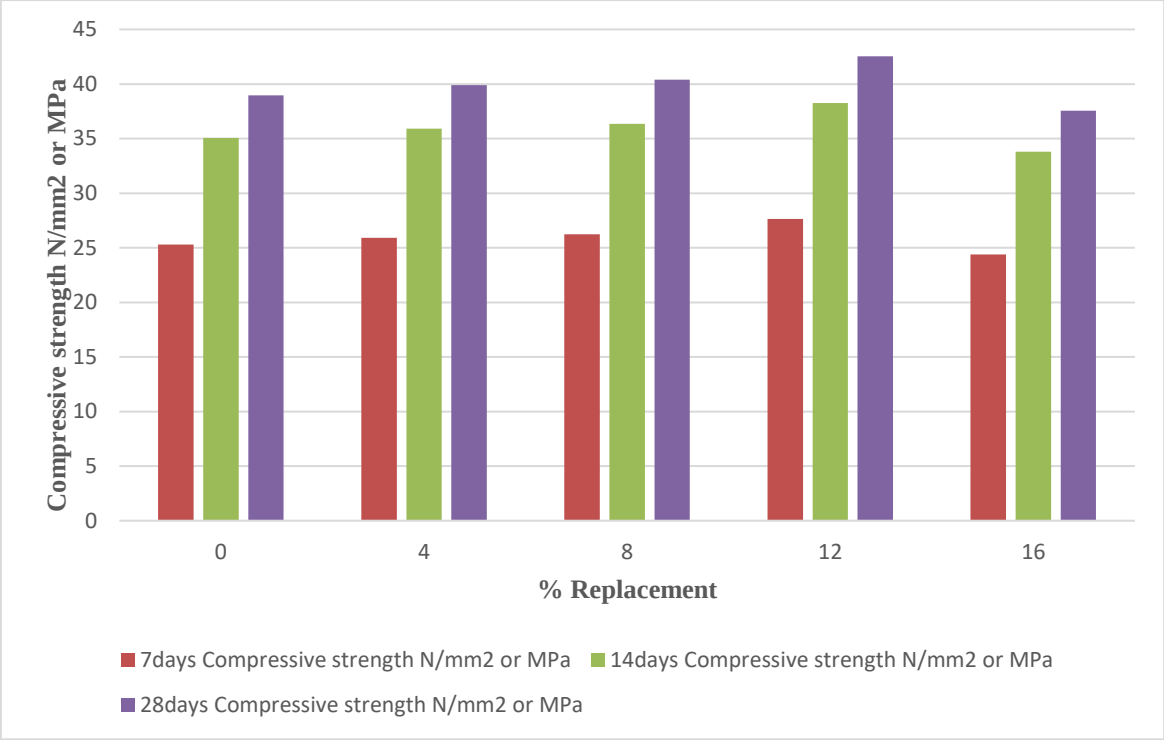

Figure 1 Shown Compressive Strength Test 7 day, 14 days & 28 days

Figure 1 clearly shown the experimental result when we replace cement and aggregate with fly ash and E- waste initially compressive strength increased up to 12% replacement. After 12% replacement strength of concrete decrees. Hence we can say 12% replacement give good compressive strength in this study.

Tensile strength Test

A concrete cylinder, size of diameter 150mm and 300mm height is subjected to the action of the compressive force along two opposite edges, by applying the force in this manner. The cylinder is subjected to compression near the loaded region and the length of the cylinder is subjected to uniform tensile stress. Note the type of failure, appearance of fracture and fracture load. Total 45 number cubes were Casted in this experiment to find out the tensile strength of concrete M30 Grade. The tensile strength of cylinder checked at 7 days, 14 days & 28 days of curing. E -waste and fly ash concrete with replacement 0%,4%,8%,12% and 16% of aggregate and cement .

Table 3 Tensile strength test result

% Replacement	7 days Tensile strength N/mm^2 or MPa	14 days Tensile strength N/mm^2 or MPa	28 days Tensile strength N/mm^2 or MPa
0	2.78	3.15	3.49
4	2.84	3.45	3.84
8	2.98	3.90	4.10
12	3.15	4.05	4.65
16	2.70	3.10	3.45

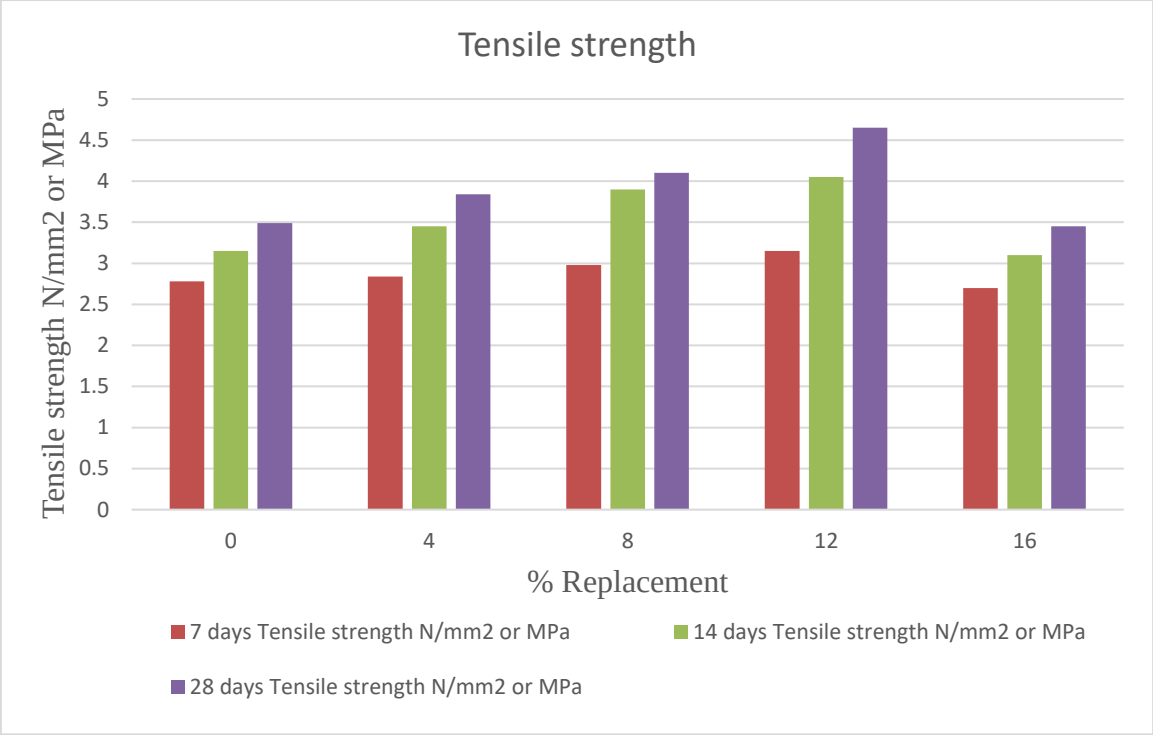

Figure 2 Shown Tensile Strength Test 7 day, 14 days & 28 days

Figure 2 clearly shown the experimental result of tensile strength of concrete. When we replace cement and aggregate with fly ash and E- waste initially Tensile strength increased up to 12% replacement. After 12% replacement strength of concrete decrees. Hence we can say 12% replacement give good Tensile strength in this study.

Flexural strength

Flexural strength or modulus of rupture carried out on the beams of size (100mm×100mm×500mm), by considering the material to be homogeneous. The beam should be tested on a span of 400 mm for 100mm specimen by applying two equal loads placed at third points. To get these loads, a central point load is applied on a beam supported on steel rollers placed at third point. The rate of loading shall be 1.8 KN/minute for 100 mm specimens the load should be increased until the beam failed. Note the type of failure, appearance of fracture and fracture load. The flexural strength of beam checked at 7 days, 14

days & 28 days of curing. E -waste and fly ash concrete with replacement 0%,4%,8%,12% and 16% of aggregate and cement . Result shown in table 4

Table 4 Flexural strength test result

% Replacement	7 days Flexural strength N/mm^2 or MPa	14 days Flexural strength N/mm^2 or MPa	28 days Flexural strength N/mm^2 or MPa
0	5.72	6.27	10.14
4	6.12	7.34	11.04
8	8.41	9.40	11.24
12	8.82	10.10	12.21
16	8.40	10.00	12.20

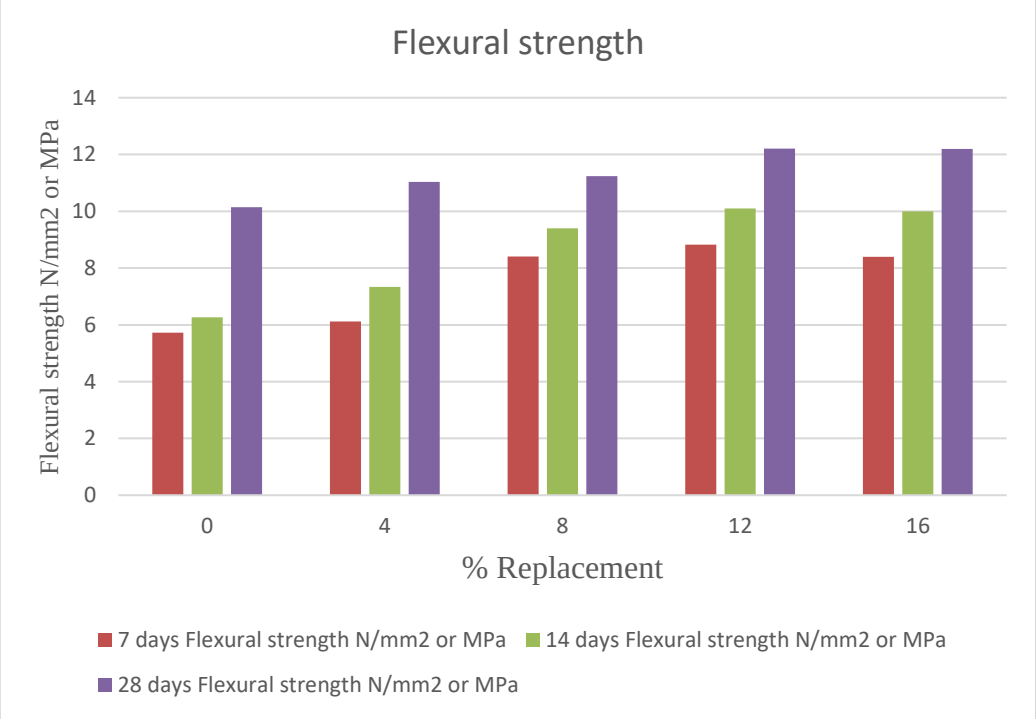

Figure 3 Shown Flexural Strength Test 7 day, 14 days & 28 days

Figure 3 clearly shown the experimental result of Flexural strength of concrete. When we replace cement and aggregate with fly ash and E- waste initially flexural strength increased up to 12% replacement. After 12% replacement strength of concrete decrees. But in flexural strength test after 12% replacement not changes in strength very much value of Flexural strength result similar 16% replacement as a 12%.

Conclusion

Test on both fresh and hardened self-compacting concrete using fly ash and electronic waste as a replacement for cement and aggregate. The following conclusion are drawn:

- ✓ E Waste as a partial replacement of coarse aggregate and fly ash is a cement gives good result in both fresh and hardens state. In low volume of replacement gives good strength and workability than high volume of replacement. Every year millions of ton waste produce whole over the world.

- ✓ E Waste and fly ash as a Partial substitute for coarse aggregate and cement possesses a great potential to be utilized as coarse aggregate and cement in self-Compacting concrete. Partial substitution of coarse aggregate and cement by E Waste effectively improves compressive strength of self-Compacting concrete up to substation level.
- ✓ Experimental investigations were conducted to determine the Characteristics and Strength of self-Compacting concrete by replacing of coarse aggregate with e-waste and cement with fly ash.
- ✓ To calculate workability of concrete we used slump flow and experimental result clearly show Slump flow increased Up to 12% replacement of cement and aggregate after that value of slump flow decreased.
- ✓ Based on the test results it was inferred, which percentage gave better results than the conventional concrete with respect to 7, 14 and 28-days Compressive strength, split tensile and flexural strength when replaced with e-wastes and fly ash with different replacement.
- ✓ Research works reported that the addition of E-waste and fly ash shows increase in compressive strength up to 12% replacement.
- ✓ Increase in split tensile strength has occurred even up to 12 % replacements. E-waste and fly ash seems to have a more pronounced effect on the split tensile strength.
- ✓ Research works reported that the addition of E-waste and fly ash shows increase in flexural strength up to 12% replacement.

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