PARTIAL REPLACEMENT OF AGGREGATES WITH E-WASTE AND FLYASH AGGREGATES IN CONCRETE

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ABSTRACT

The rapid rising of technology, up-gradation of more technical innovations, and therefore the industry has ***one*** *of the fastest-growing waste streams with in the world. Electronic-wastes likes Refrigerator, Computers and Printers, Washing machines, Televisions, Mobiles, iPod, etc.increases day by day. The use of E-waste in the mix with concrete is feasible to enhance its mechanism and it's maybe one of the economical ways to their disposal in an environment-friendly manner. Most of the highest ten cities generating E-Waste i.e. 01-Mumbai,02-Delhi,03- Bengaluru,04-Chennai,05-Kolkata,06-Ahmedabad, 07-Hyderabad,08-Pune, 09-Surat & 10- Nagpur. Most electronics waste in India from the public, government, and private (.Industrial) sectors – 70percentage, the single household - 15 percentage, others contributed by manufacturers. For health effects of these toxins on human include birth defects on birth and harm to the liver, brain, kidney, heart, liver, and skeletal system.it may affect human body's reproductive system and nervous Electronic have the highly toxic element, including, Lead, Mercury, Cadmium, barium and fire retardants like Bromine. Its effects also soil, water, and food. I used very lightweight material for lightweight concrete*

Keywords: *Fly ash aggregate, OPC 53 grade, coarse aggregates, fine aggregate, strength properties of concrete, and e-waste.*

1. Introduction

Electronic waste in this modern era, gives rise to serious geo environmental issues. Approximately 2,700 tons of electronic waste is generated annually, as per BMC officials. As per the survey, most of the E wastes are generated by offices and institutions. There is always better to reduce and reuse solid wastes for the environment. The focus of the research is to make concrete lightweight and also to reuse waste plastics as well as fly ash aggregates. Nowadays people get addicted to electronic devices more. Every step of life we increase the electronics devices regularly. Everything like mobile, tv, washing machine, trimmer (grooming item), etc. Now we have to maintain our lifestyle with the help of electronics. Day by day the electronics are breathing of our life. According to WEEE directive total ten catagories of E wastes are generated i.e. Large household appliances, Small household appliances, Consumer equipment, Lighting Equipment, IT and Telecommunication equipment, Electrical and electronic tools, Toys, leisure and sports equipment, Medical devices, Automatic dispenser, and Monitoring and control instruments. The electronics are continuously upgrading or modifiyng for us. Due to this some industries are recycling it or reusing this to avoid land disposal problems and also to overcome leaching issues some industries started green electronics. But as most of the electronics parts are of single-use only, so the problem of generation and disposal of E wastes not solved completely. Research is going on preparation of concrete without conventional concrete and use waste materials. In this research, E waste is used in various proportions with replacement of aggregates in the view to reduce the cost of recycle and disposal of E wastes. This also reduce environmental pollution caused due to leaching of heavy metal ions from E wastes. According to research as natural resources are depleting, and we cannot think of an alternate material in place of concrete, we have to make concrete green and with sustainable materials. Flyash aggregates, an alternate method of fly ash use, can be proven to be best for increasing the workability of concrete. Also, Flyash aggregates make the concrete light weight.

Composition of E-waste:

Glass, Wood, Ferrous & Non-ferrous Metals Plastics, etc.

Non-ferrous metal - 13%

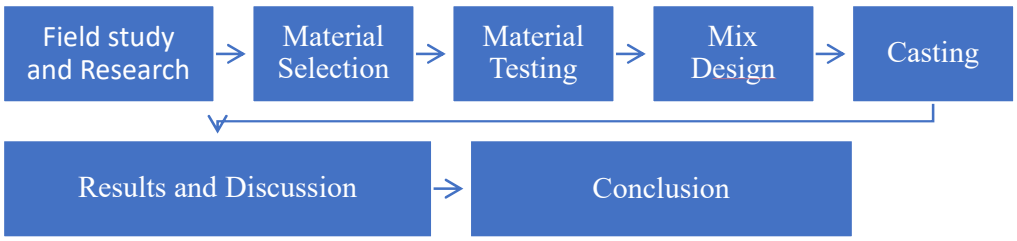
Plastics - 21%

Iron & Steel - 50%

Arsenic, Lead, Mercury, etc.

When e-waste is burning or warmed-up, a lot of toxins are released to the environment. When e-waste is thrown away in dumping ground, due to leaching from these, harmful toxic materials soaked into ground-water.

2. Methodology



Materials

The materials used for preparing sample concrete for test

- OPC 53 Grade
- Fine aggregate
- E-waste
- Fly ash aggregates
- Coarse Aggregate

PROPERTIES OF MATERIAL

Cement-

Ordinary Portland cement Birla 53 grade cement confirming (Indian Standard) IS 12269:1987 is taken for research work.The physical properties like water specific gravity, consistency, setting time,soundness, fineness and compressive strength is tested in material testing lab of Centurion University of Technology and Management. The results of the tests are tabulated as below.

Table 1 Properties of cement

Sl. No	Physical Properties	Test Result
1	Fineness by Sieving through IS 90 Micro Sieve	7.25
2	Standard consistency (using Vicat apparatus)	30%
3	Specific Gravity (using Pycnometer)	3.146 ≈ 3.15
4	Sound-ness (using Le- Chatelier apparatus)	5 mm
5	Setting Time	
	Initial-Setting Time	60min
	Final-Setting Time	320min
6	Compressive Strength (using CTM)	

	3 Days	27.4Mpa
	7 Days	32.8Mpa
	28 Days	44.65 Mpa

Fine Aggregate (Sand):

Locally available river sand is taken as fine aggregate confirming to Zone-II as per Indian Standard. Proporties like Fineness modulus, Specific Gravity, Water absorption, Bulk Density and silt content were tested. The results are in table 1.1.

Table 1.1 Properties of fine aggregates

Sl. No	Physical Properties	Test Result
1	Fineness modulus	2.48
2	Bulk Density(gm/cc)	1.52-1.60
3	Specific Gravity	2.81
4	Water absorption	0.80%
5	Silt content (Max. 5% allowable)	2.44%

Fly ash aggregates:

For test sample, fly ash aggregate is collected from IMFA, Cuttack, Odisha. Physical properties like bulk density, sizes, aggregate crushing strength, specific gravity, water absorption, fineness modulus, aggregate abrasion value, aggregate impact value were tested. The test results are in table 1.2.

Figure1.0 Fly ash aggregate

Table 1.2 Properties of fly ash aggregate

Sl. No	Physical Properties	Test Result
1	Bulk Density(kg/m3)	640-750
2	Sizes produced(mm)	10 – 4.7
3	Aggregate crushing strength (%)	16.32
4	Specific Gravity	2.38
5	Water absorption	0.16
6	Fineness modulus	6.42

7	Aggregate abrasion value (%)	31.24
8	Aggregate impact value (%)	16.02

Coarse Aggregate:

The natural coarse aggregate used for research work was collected from the nearest Crusher, Jatni, Khurdha. It was released from weeds, clay, and any other organic matters, and are non- porous. The water absorption capacity was less than 1% i.e. in the acceptable range. Test results of physical properties of natural coarse aggregates are in table 1.3.

Sl. No	Physical Properties	Test Result
1	Bulk Density(kg/m3)	1.5-1.67
2	Sizes produced(mm)	20
3	Aggregate crushing strength (%)	19.62
4	Specific Gravity	2.723
5	Water absorption	0.21
6	Fineness modulus	7.20mm
7	Aggregate abrasion value (%)	30
8	Aggregate impact value (%)	13.40%

Table 1.3 Properties of CA

Figure1.1 Coarse Aggregate

E-wastes:

It is collected from near electronic repair centers i.e. mobile repairing, computer repairing, etc. and was crushed by hand using metal cutting tools, hammer, and any others possible.

Sl. No	Physical Properties	Test Result
1	Fineness modulus	1.28
2	Water absorption	0.17
3	Specific Gravity	1.23

Table 1.4 Properties of E-waste

Figure 1.2 Cutting tool

Figure1.3 *E-waste*

Figure1.4(specific gravity testing)

Figure1.5(dry mixing)

Figure 2.0 After casting

Figure 2.1 concrete mix

Figure 2.2 Before dry mixing

Casting:

Cubes of size 150mm*150mm*150mm, cylinders of 150 mm diameter and 300 mm height, beams of 250mm7*5mm*75mm were casted to find the 3 days, 7 days and 28 days compressive strength, split tensile strength and flexural strength. This gives the mechanical strength properties of designed concrete.

3. Result & discussions

Compressive strength

Calculated the specimen of Compressive strength by dividing the maximum compressive load taken by the specimen by its cross-sectional area.In this experiment compressive strength is calculated taking cube specimen of 15CM*15CM*15CM and found the result for 0%, 5%, 7.5%, 12.5% replacement of aggregate with E-waste and similarly 0%,10%, 15%,20% replacement of coarse aggregate with Fly ash aggregate for 3days, 7days and 28days.The maximum strength of 56.94N/mm^2 is found at 12.5% E-waste and 20% replacement of fly ash aggregate in concrete.The minimum strength of 37.95 N/mm^2 is found at 5% e-waste and 10% replacement of fly ash aggregate in concrete. As shown in below

Table 3.0 compressive strength

S.NO	PROPORTION OF E-WASTE (%)	PROPORTION OF fly ash aggregates (%)	COMPRESSIVE STRENGTH (N/mm²)		
			3days	7days	28days
1	0	0	19.50	26.02	33.32
2	5	10	25.91	30.68	37.95
3	7.5	15	29.78	36.98	41.67
4	12.5	20	30.08	42.89	56.94

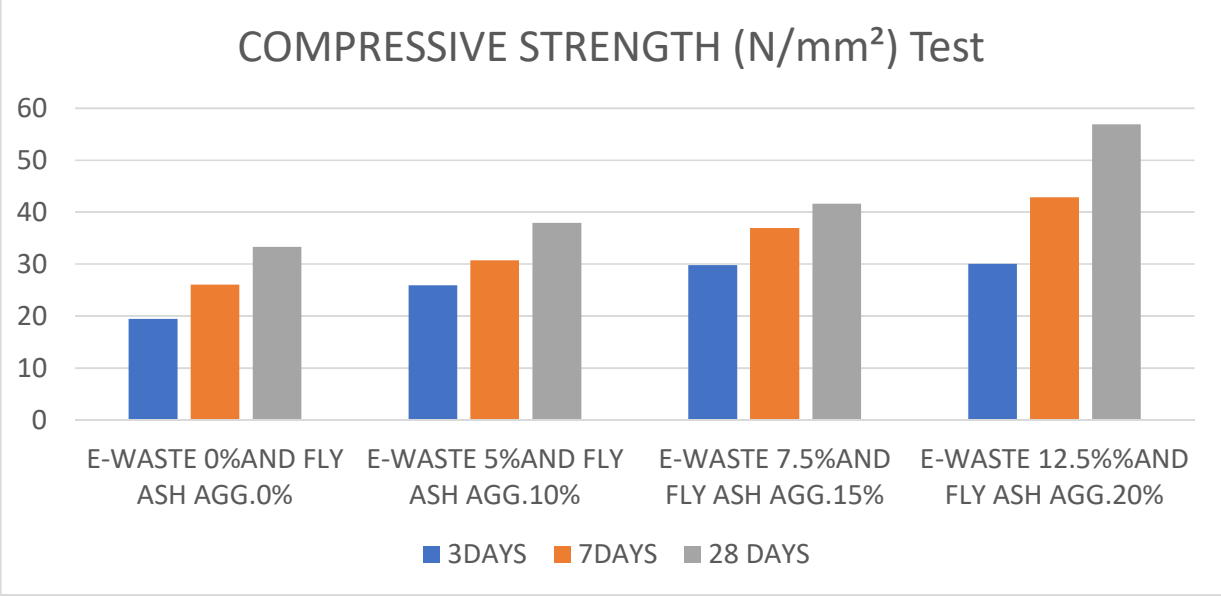


Figure 3.0 compressive strength chart

Split Tensile Strength (N/mm²)

The determination of the tensile strength of concrete is useful to determine the load at which the concrete member may crack. The cylinder of size 150mm dia & 300mm height is cast and cured. In this experiment the

strength of concrete with 0%,5%,7.5%,12.5% replacement of fine aggregate with e-waste and similarly 0%,10%, 15%,20% replacement of coarse aggregate with Fly ash aggregate for 3days, 7days and 28days.The maximum strength of 6.59N/mm^2 is found at 12.5% e-waste and 20% replacement of fly ash aggregate in concrete. The minimum strength of 5.56 N/mm2 is found at 5% e-waste and 10% replacement of fly ash aggregate in concrete as shown in below

Table 3.1 split tensile strength

S.NO	PROPORTION OF E-WASTE (%)	PROPORTION OF fly ash aggregates (%)	SPLIT TENSILE STRENGTH (N/MM²)		
			3days	7days	28days
1	0	0	2.56	3.04	3.88
2	5	10	2.73	3.53	4.57
3	7.5	15	2.98	3.91	5.07
4	12.5	20	3.19	4.27	5.49

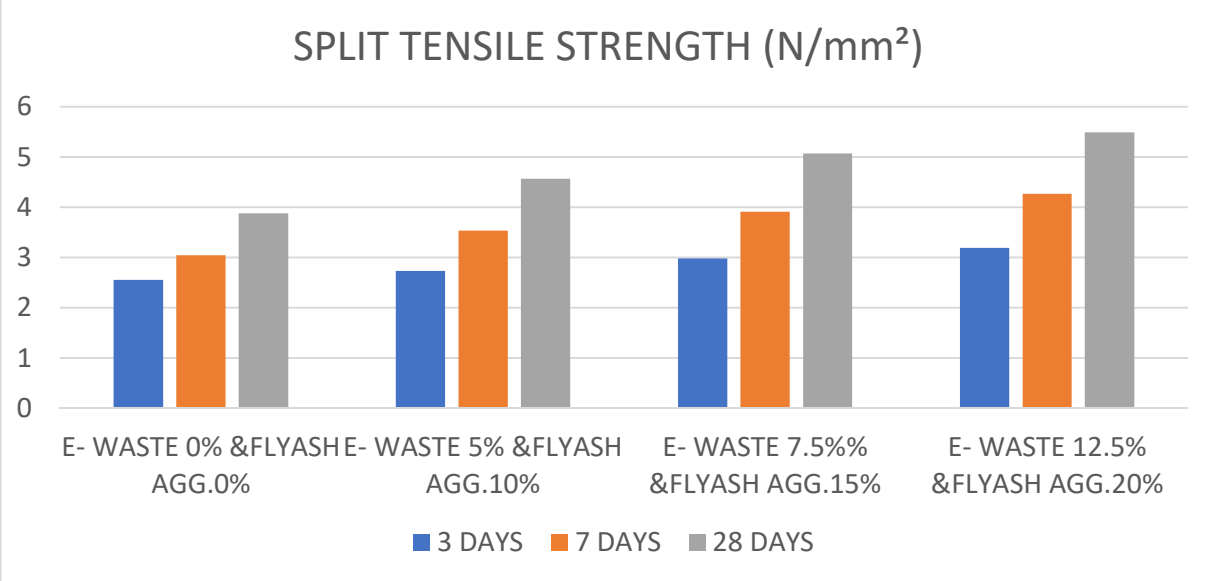


Figure 3.1 split tensile strength char

Flexural strength(N/mm²)

For test beams of 250×75×75 cubic mm size was adopted. The load was increased until the specimen failed and was applied without shock, and the maximum load applied which is on the meter to the prism during the test was recorded. IN this experiment found that the result for 0%,5%,7.5%,12.5% replacement of fine aggregate with e-waste and similarly 0%,10%, 15%,20% replacement of coarse aggregate with Fly ash

aggregate for 3days, 7days and 28days.The maximum strength of 5.49N/mm2 is found at 12.5% e-waste and 20% replacement of fly ash aggregate in concrete.The minimum strength of 4.57 N/mm^2 is found at 5% e-waste and 10% replacement of fly ash aggregate in concrete.

Table 3.2 flexural strength

S.NO	PROPORTION OF E-WASTE (%)	PROPORTION OF fly ash aggregates (%)	FLEXURAL STRENGTH (N/mm²)		
			3days	7days	28days
1	0	0	3.09	3.37	4.94
2	5	10	3.56	4.49	5.56
3	7.5	15	4.13	5.73	6.38
4	12.5	20	4.64	5.96	6.59

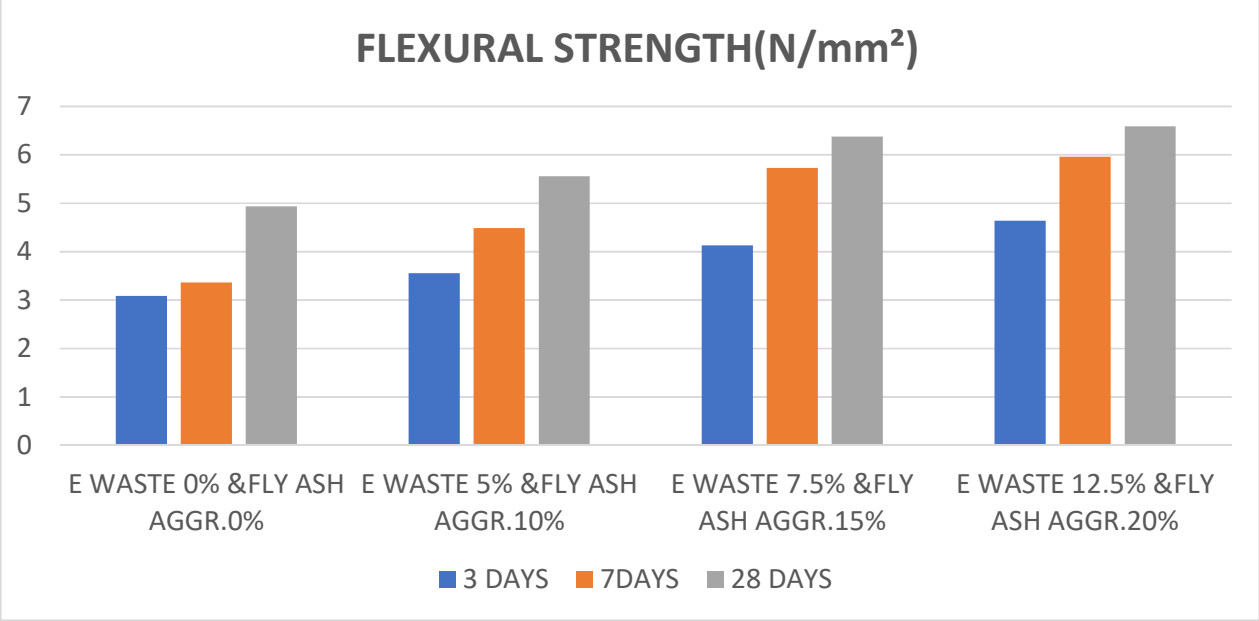


Figure 3.2 flexural strength chart

4. Conclusion

The compressive strength shows increase

of up to 12.5% replacement of E-waste. WHEN 12.5 % replacements the Developed in split tensile strength is almost insignificant where as gain in flexural tensile strength have occurred IT have a more pronounced effect on the flexurals strength than the split tensile strength. Utilization of E-waste in concrete is may be develop its mechanism and in environment friendly manner it can be one of the economical ways for their disposal .

Figure4.0 After testing cube

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