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Investigation On The Performance Of Concrete With Partial Replacement Of Coarse Aggregate Using Electronic Waste

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Absract: Concrete is the most important engineering material and the addition or replacement of some of the materials that may be more feasible to change the philosophy of the concrete. This paper reports the study of concrete using partial replacement of Coarse aggregate by E waste. In this project work, M30 grade of concrete was taken for concrete mix design. The properties and characteristics of materials for cement, fine aggregate, coarse aggregate and other supplementary materials was studied for concrete mix design with reference to Indian standard codes as per specification. The compressive strength, split tensile strength and flexural test of concrete was studied for various replacements of Coarse aggregate that are 0%, 10%,15% and 20%, At 15% partial replacement of Coarse aggregate with E waste, the concrete gains higher compressive strength at 7 and 28 days. As the Integral part of this project, the maximum optimum content of the E-Waste substituted concrete is occurred at 15% partial replacement of Coarse aggregate respectively.

I.INTRODUCTION

1.1 GENERAL:

Concrete is a composite material composed of fine and coarse aggregate bonded together with a fluid cement (cement paste) that hardens (cures) over time. When aggregate is mixed with dry Portland cement and water, the mixture forms a fluid slurry that is easily poured and moulded into shape. Standard ready-mix concrete is the most common form of concrete. It is prepared for delivery at a concrete plant instead of mixed on the construction site, which guarantees the quality of the concrete.

1.1.1 Waste in Concrete:

In the last decades, due to the modern lifestyle, the progresses in industry and technology had led to an important increase in the amount and type of wastes. The problem of waste accumulation every year is all over the world. These industrial and agricultural wastes are by-products, slag, rice husk ash, fly ash, cement dust, brick dust, sludge, glass, tires, etc. The wastes represent a major problem for the environment because the air pollution (the dust and very fine particles which spread in the atmosphere) and leaching toxic chemicals (arsenic, beryllium, boron, cadmium, cobalt, lead, manganese, mercury, molybdenum, selenium, strontium, thallium, hydrocarbon compounds, etc.) when are dumped in landfills, quarries, rivers or oceans. The capitalization of waste is difficult because of their variety, as well as their unknown properties over time. Lately, the environmental sustainability became an important problem from the point of view of natural resources and that of wastes. The construction and the building materials sectors are involved in both processes: building industry is the largest user of natural materials and in addition a large amount of wastes results from the demolition of constructions.

The building material industry is a domain of interest for using the wastes and researchers have tried to produce new construction materials incorporating wastes.

Concrete is obtained from natural aggregates, cement and water, compounds which make it a cheap material and easy to produce anywhere. Usually, ordinary concrete contains about 12% cement, 8% water and 80% aggregates by mass. Aggregates and water are from natural resources, only cement must be produced in fabrics, processes which are polluted the environment (for producing 1 m^3 of concrete a quantity of 480 kg of CO_2 is liberated in the atmosphere). For reducing the aggregate and cement consumption, the replacing materials obtained from wastes were studied.

1.1.2. Different types of Waste used in Concrete:

The 5 R's: Refuse, Reduce, Reuse, Repurpose, Recycle.

1. Liquid or Solid Household Waste. This can be called 'municipal waste' or 'black bag waste' and is the type of general household rubbish we all have. ...
2. Hazardous Waste. ...
3. Medical/Clinical Waste. ...
4. Electrical Waste (E-Waste) ...
5. Recyclable Waste. ...
6. Construction & Demolition Debris. ...
7. Green Waste.

1.2 E-WASTE IN CONCRETE:

Concrete is the first choice for the construction many countries today. This has increased the fast vanishing of natural resources. On the other hand, new electrical and electronic products have become an integral part of daily lives providing us with more comfort, security, easy, and faster acquisition. Due to technological growth, there is a high rate of obsolescence in the electronic equipment which leads to one of the fastest growing waste streams in the world. Although principally Favourable from a life cycle environment impact perspective, recycling of plastic from waste electrical and electronic equipment (WEEE) is not uncontested because of the potential dissipation of hazardous substance into new products. This study attempts to give a contribution to the effective use of domestic wastes (plastic in electronic waste) in concrete in order to prevent the environmental strains caused by them, also to limit the consumption of high number of natural resources.

E- waste seems to have a more pronounced effect on the flexural strength than the split tensile strength. The use of E-waste in concrete is possible to improve its mechanical properties and can be one of the economical ways for their disposal in environment friendly manner.

II.SCOPE AND OBJECTIVES

2.1 AIM and Objectives:

1. To determine the properties of basic concrete making materials such as cement, fine aggregate, coarse aggregate, E waste and water.
2. To compare the properties with E waste with coarse aggregate and to check the suitability of adopting in concrete.
3. To determine the mechanical properties of e waste concrete and to compare with controlled concrete.
4. To determine the composition and formation of crystals in E-Waste concrete

2.2 Scope:

1. Effectively reduce the demand upon the natural resources.
2. Reduce the cost and production of coarse aggregate.
3. Reduce the environmental pollution by landfills and deposits of e waste.
4. Waste utilization and recycling can prove to be beneficial to society by reducing the green house gases to atmosphere.

III. MIX DESIGN

The mix design is done as per IS code 10262 – 2002 and the design is done for M30 grade concrete.

3.1 MIX PROPORTIONS:

Table 3.1 Mix Design Ratio

WATER	CEMENT	FINE AGGREGATE	COARSE AGGREGATE
186	413 kg	567 kg	1237 kg
0.45	1	1.37	3

Table 3.2 Quantity of materials required for Compression Test (per cube)

Sl No	Replacement Of Coarse Aggregate	Weight Of Cement	Weightof Sand	Weight Of Fresh Coarse Aggregate	Weight Of Recycled Coarse Aggregate	Quantity Of Water
	%	kg	Kg	kg	kg	liters
1	0	1.66	2.27	4.98	-	0.82
2	10	1.66	2.27	4.48	0.49	0.82
3	15	1.66	2.27	4.23	0.74	0.82
4	20	1.66	2.27	3.98	0.99	0.82
	TOTAL	**6.64**	**9.08**	**17.67**	**2.22**	**3.28**

Table 3.3 Quantity of materials required for Compression Test (6 cubes)

Slno	Replacement Of Coarse Aggregate	Weight Of Cement	Weight Of Sand	Weight Of Fresh Coarse Aggregate	Weight Of Recycled Coarse Aggregate	Quantity Of Water
	%	kg	Kg	kg	kg	liters
1	0	9.96	13.62	29.88	-	4.92
2	10	9.96	13.62	26.88	2.94	4.92
3	15	9.96	13.62	25.38	4.44	4.92
4	20	9.96	13.62	23.88	5.94	4.92
	TOTAL	**39.84**	**64.48**	**106.02**	**13.32**	**19.68**

Table 3.4 Quantity of materials required for Flexural Test (per beam)

S. No	% Of Coarse Aggregate Replaced	Weight Of Cement	Weight Of Sand	Weight Of Fresh Coarse Aggregate	Weight Of Recycled Coarse Aggregate	Quantity Of Water
	%	kg	kg	Kg	kg	liters
1.	0	2.44	3.34	7.32	-	1.2
2.	10	2.44	3.34	6.58	0.73	1.2
3.	15	2.44	3.34	6.22	1.08	1.2
4.	20	2.44	3.34	5.85	1.46	1.2
	TOTAL	**9.76**	**13.36**	**22.97**	**3.27**	**4.8**

Table 3.5 Quantity of materials required for Flexural Test (3 beam)

S. No	% Of Coarse Aggregate Replaced	Weight Of Cement	Weight Of Sand	Weight Of Fresh Coarse Aggregate	Weight Of Recycled Coarse Aggregate	Quantity Of Water
	%	kg	kg	Kg	kg	liters
1.	0	7.32	10.02	21.96	-	3.6
2.	10	7.32	10.02	19.74	2.19	3.6
3.	15	7.32	10.02	18.66	3.24	3.6
4.	20	7.32	10.02	17.55	4.38	3.6
	TOTAL	**29.28**	**40.08**	**77.91**	**9.81**	**14.4**

Table 3.6 Quantity of materials required for Split Tensile Test (per cylinder)

S. No	% Of Coarse Aggregate Replaced	Weight Of Cement	Weight Of Sand	Weight Of Fresh Coarse Aggregate	Weight Of Recycled Coarse Aggregate	Quantity Of Water
	%	kg	kg	Kg	kg	liters
1.	0	2.3	3.2	6.9	--	1.15
2.	10	2.3	3.2	6.2	0.6	1.15
3.	15	2.3	3.2	5.9	1.03	1.15
4.	20	2.3	3.2	5.5	1.22	1.15
	TOTAL	**9.2**	**12.8**	**24.5**	**2.85**	**4.6**

Table 3.7 Quantity of materials required for Split Tensile Test (3 cylinder)

S. No	% Of Coarse Aggregate Replaced	Weight Of Cement	Weight Of Sand	Weight Of Fresh Coarse Aggregate	Weight Of Recycled Coarse Aggregate	Quantity Of Water
	%	kg	kg	Kg	kg	liters
1.	0	6.9	9.6	20.7	--	3.45
2.	10	6.9	9.6	18.6	1.8	3.45
3.	15	6.9	9.6	17.7	3.09	3.45
4.	20	6.9	9.6	16.5	3.66	3.45
	TOTAL	**27.6**	**38.4**	**73.5**	**8.55**	**13.8**

IV.TESTS ON HARDENED CONCRETE

4.1 Compressive Strength Test

Table 4.1 Compressive Strength of M-30 Grade Concrete on 7 days test

S. NO	% OF COARSE AGGREGATE REPLACED (%)	DATE OF CASTING	DATE OF TESTING	ULTIMATE LOAD "P" (KN)	COMPRESSIVE STRENGTH "fc= P/A" (MPa)
1.	0	17-02-25	24-03-25	460	20.5
2.	10	17-02-25	24-03-25	480	21.3
3.	15	17-02-25	24-03-25	490	21.7
4.	20	17-02-25	24-03-25	440	19.5

Table 4.2 Compressive Strength of M-30 Grade Concrete on 14 days test

S. NO	% OF COARSE AGGREGATE REPLACED(%)	DATE OF CASTING	DATE OF TESTING	ULTIMATE LOAD "P"(KN)	COMPRESSIVE STRENGTH "fc= P/A"(MPa)
1.	0	18-02-25	04-03-25	670	29.9
2.	10	18-02-25	04-03-25	690	30.8
3.	15	18-02-25	04-03-25	720	32
4.	20	18-02-25	04-03-25	635	28.2

Table 4.3 Compressive Strength of M-30 Grade Concrete on 28 days test

S. NO	% OF COARSE AGGREGATE REPLACED	DATE OF CASTING	DATE OF TESTING	ULTIMATE LOAD "P"(KN)	COMPRESSIVE STRENGTH "fc= P/A"(MPa)
1.	0	14-02-25	13-03-25	710	31.5
2.	10	14-02-25	13-03-25	730	32.4
3.	15	14-02-25	13-03-25	760	33.7
4.	20	14-02-25	13-03-25	755	33.5

4.2 Split Tensile strength test

Table: 4.3 Split Tensile Strength of M-30 Grade Concrete on 7 days test

S. NO	% OF COARSE AGGREGATE REPLACED(%)	DATE OF CASTING	DATE OF TESTING	SPLIT TENSILE STRENGTH F=2P/πDL(MPa)
1.	0	17-02-25	24-03-25	4.1
2.	10	17-02-25	24-03-25	4.2
3.	15	17-02-25	24-03-25	4.1
4.	20	17-02-25	24-03-25	3.7

Table: 4.4 Split Tensile Strength of M-30 Grade Concrete on 14days test

S. NO	% OF COARSE AGGREGATE REPLACED(%)	DATE OF CASTING	DATE OF TESTING	SPLIT TENSILE STRENGTH F=2P/πDL(MPa)
1.	0	18-02-25	04-03-25	4.3
2.	10	18-02-25	04-03-25	4.7
3.	15	18-02-25	04-03-25	4.7
4.	20	18-02-25	04-03-25	4.1

Table: 4.5 Split Tensile Strength of M-30 Grade Concrete on 28 days test

S. NO	% OF COARSE AGGREGATE REPLACED(%)	DATE OF CASTING	DATE OF TESTING	SPLIT TENSILE STRENGTH F=2P/πDL(MPa)
1.	0	14-02-25	13-03-25	4.6
2.	10	14-02-25	13-03-25	4.9
3.	15	14-02-25	13-03-25	5.1
4.	20	14-02-25	13-03-25	4.7

4.3 FLEXURAL STRENGTH OF CONCRETE BEAM:

Table: 4.6 Flexural Strength of M-30 Grade Concrete on 7 days test

S. NO	% OF COARSE AGGREGATE REPLACED	DATE OF CASTING	DATE OF TESTING	FLEXURAL STRENGTH "fc= PL/BD^2"(MPa)
1.	0	17-02-25	24-03-25	5.1
2.	10	17-02-25	24-03-25	5.5
3.	15	17-02-25	24-03-25	5.4
4.	20	17-02-25	24-03-25	5

Table: 4.7 Flexural Strength of M-30 Grade Concrete on 14 days test

S. NO	% OF COARSE AGGREGATE REPLACED	DATE OF CASTING	DATE OF TESTING	FLEXURAL STRENGTH "fc= PL/BD^2"(MPa)
1.	0	18-02-25	04-03-25	6.2
2.	10	18-02-25	04-03-25	6.4
3.	15	18-02-25	04-03-25	6.7
4.	20	18-02-25	04-03-25	6.1

Table: 4.8 Flexural Strength of M-30 Grade Concrete on 28 days test

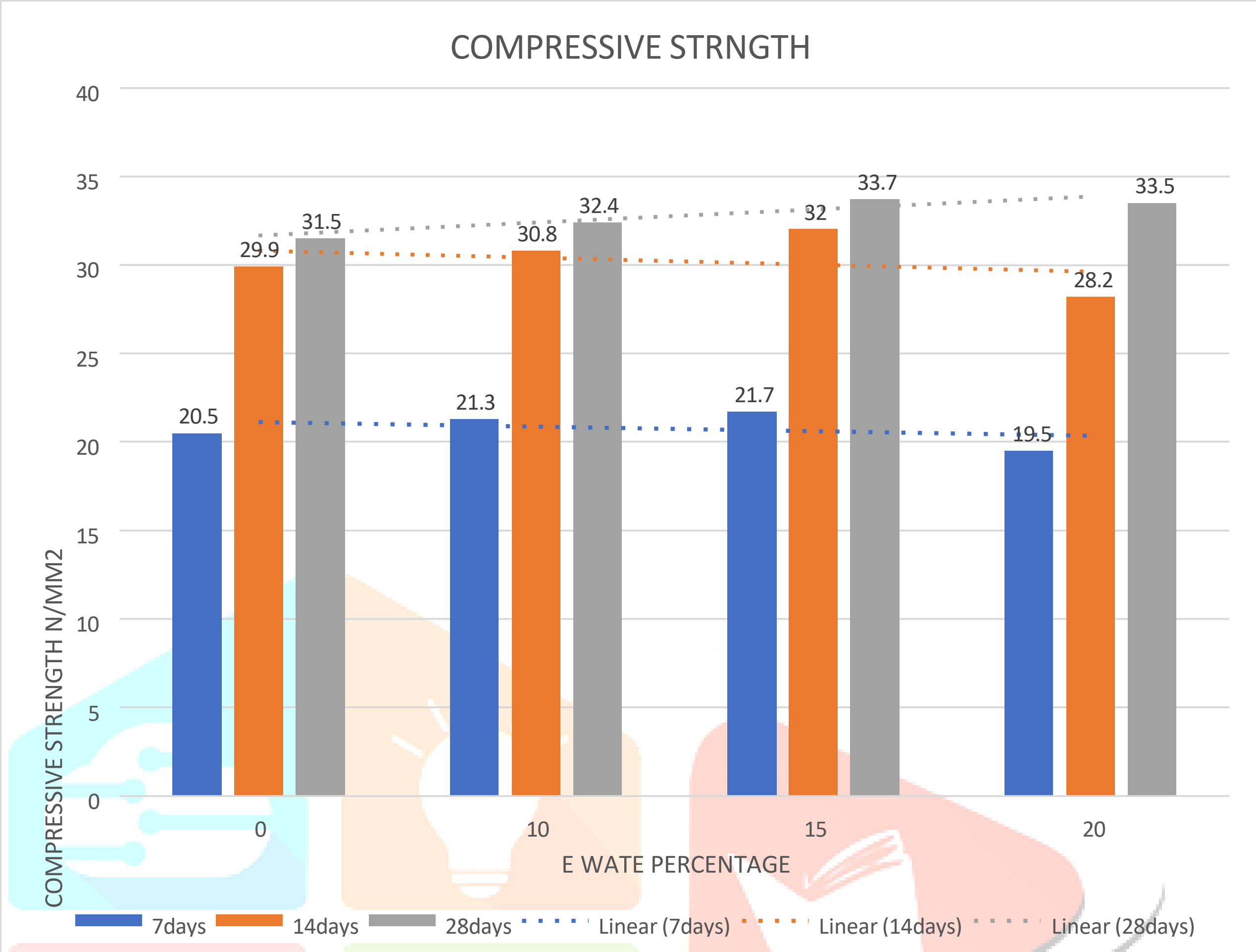
S. NO	% OF COARSE AGGREGATE REPLACED	DATE OF CASTING	DATE OF TESTING	FLEXURAL STRENGTH "fc= PL/BD^2"(MPa)
1.	0	14-02-25	13-03-25	7
2.	10	14-02-25	13-03-25	7.2
3.	15	14-02-25	13-03-25	7.4
4.	20	14-02-25	13-03-25	6.9

V.RESULTS AND DISCUSSIONS

In this chapter the results for test on materials, compressive strength of concrete cube, Flexural strength of concrete beam with fresh coarse aggregate and partially& fully replaced recycled coarse aggregate with bacterial solution were separately studied and compared.

5.2 COMPRESSION TEST:

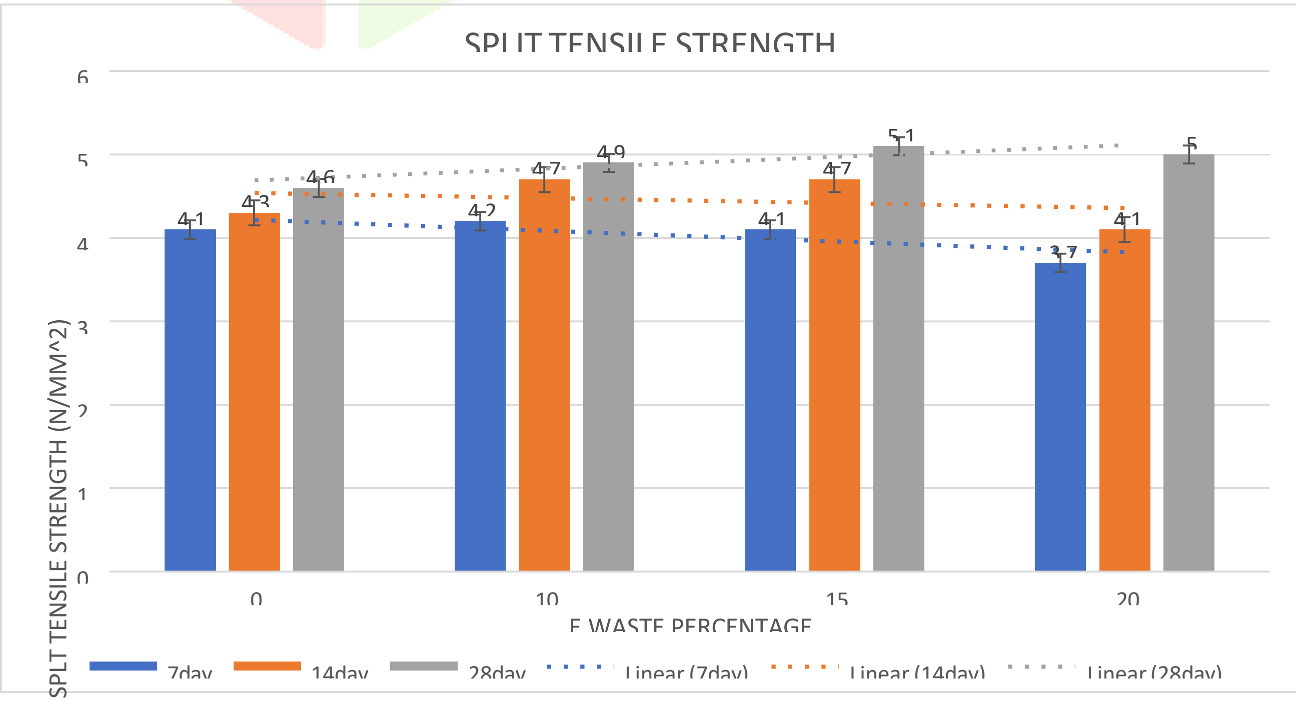
Compression test done on cubes by partial replacement of coarse aggregate with Ewaste in the ratios of 0%, 10%, 15%, 20% on 7th day, 14th day and 28th day.



Graph: 5.1 Compression test on cubes

5.2 SPLIT TENSILE STRENGTH:

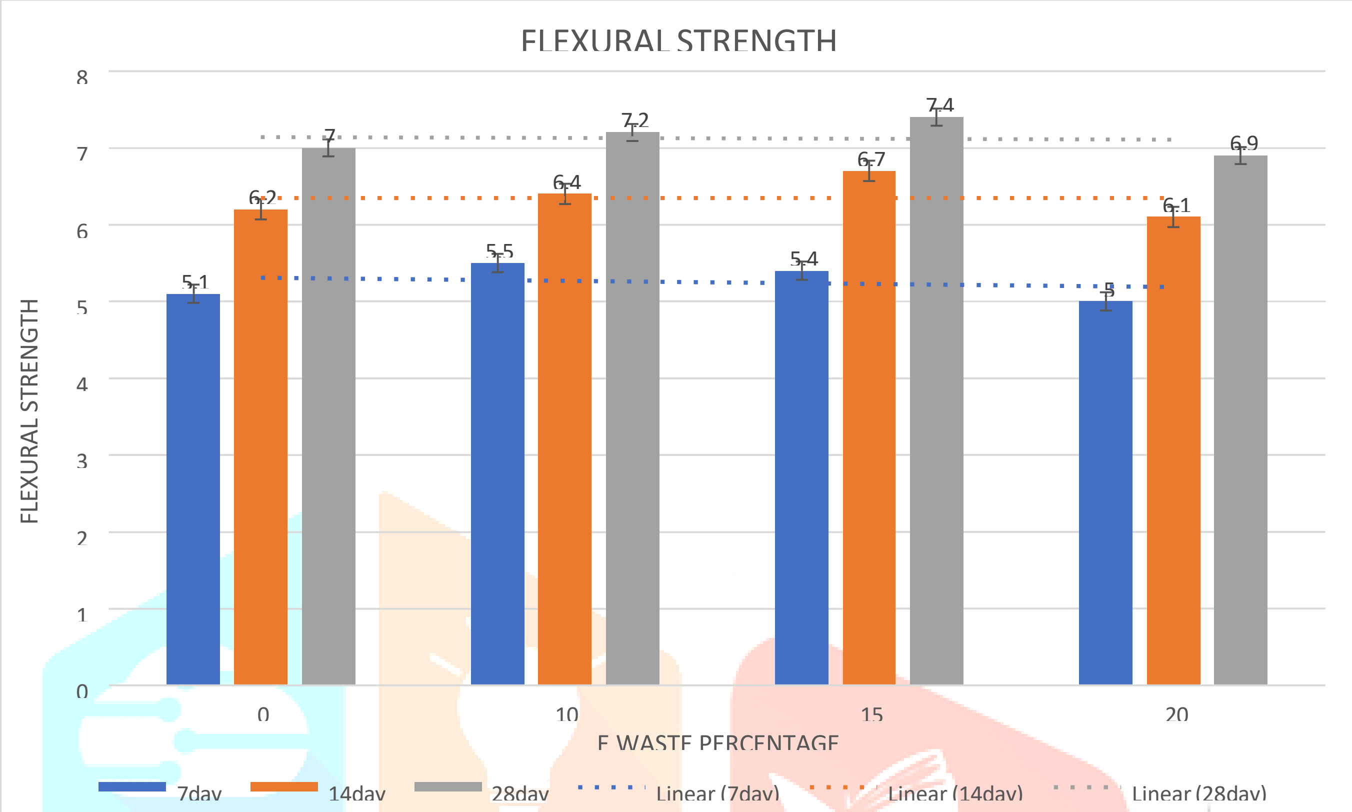
Split tensile strength done on cylinder by partial replacement of coarse aggregate with E waste inthe ratios of 0%, 10%, 15%, 20% on 7th day, 14th day and 28th day.



Graph: 5.2 Split Tensile test on cylinders

5.3 FLEXURAL STRENGTH TEST:

Flexural test done on prisms by partial replacement of coarse aggregate with E waste in the ratios of 0%, 10%, 15%, 20% on 7th day, 14th day and 28th day.



Graph:5.3 Flexural test on prisms

VI CONCLUSION

6.1 GENERAL

The Following Conclusions Are Given Below:

- E Waste as a partial replacement of Coarse aggregate in concrete 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 E-waste produce whole over the world. The use of e- waste will also help in shielding the environment surroundings by using the low quantity of E waste as a replacement of coarse aggregate can improve the strength up to a 15%replacement.
- E Waste as a Partial substitute for coarse aggregate possesses a great potential to be utilized as coarse aggregate in concrete. Partial substitution of coarse aggregate by E Waste effectively improves compressive strength of concrete up to substation level.
- Experimental investigations were conducted to determine the Characteristics and Strength of concrete by replacing of coarse aggregate with e-waste.
- Concrete specimens were casted and tested to determine the Compressive Strength, split tensile strength and flexural strength by error standard deviation method.

- 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.
- Research works reported that the addition of E-waste shows increase in compressive strength up to 15% replacement.
- Increase in split tensile strength has occurred even up to 15 % replacements. E- waste seems to have a more pronounced effect on the split tensile strength.
- Research works reported that the addition of E-waste shows increase in flexural strength up to 15% replacement.
- Disposal and land filling problems can be sorted out thereby proves beneficial to the society.

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