USE OF E-WASTE IN CONSTRUCTION INDUSTRY

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Abstract - *There are many studies evaluating industrial by-products in cement as binder and aggregate in concrete industry. In the recent decades, the efforts have been made to use industry by-products such as fly ash, silica fume, ground granulated blast furnace slag, glass cullet, etc., in civil construction. The potential application of industry by –products in concrete is as partial aggregate replacement or as partial cement replacement or as addition as fiber material, depending on their chemical composition and grain size. In this study, the effect of use of such waste product on resultant properties of concrete mix is studied. This waste product is used as replacement of coarse aggregate and addition as fiber.*

Key Words: *Compressive Strength, Flexural Strength, Split Tensile Strength, Concrete, Electronic Waste, Cube, Beam, Cylinder, Concrete Bricks, Paver Blocks, Workability*.

1. INTRODUCTION

Waste generation and management is becoming a global challenge resulting into increased environmental concern. Waste management and recycle into a sustainable construction materials as proved to be an alternative for waste disposal helping out in the area of environmental pollution and economic. In recent years various type of waste has been used/reused in the development of sustainable construction materials. This study reviews various attempts that have been made to use e waste from different plants in construction industry. The mechanical and physical properties of the products, the environmental effect of the products and possible recommendations for future research was presented in the review.

1.1 Concrete Specimens

We have a casted a M20 grade of concrete specimen like as, concrete cube a size of 150 x 150 x 150 mm, concrete brick having a size of 150 x 200 x 300 mm, concrete paver blocks having size of 200 x 200 x 60 mm, concrete beam having size of 100 x 100 x 500 mm, and concrete cylinder having diameter size is 150 mm and depth having 300 mm. this specimen is casted for getting test on them like as compressive test, flexural strength test and split tensile strength test. After conducting those tests on concrete specimens we getting a result on e-waste concrete specimen and we compare this test result standard test results.

1.2 Advantages and Disadvantages of using E-Waste

- **Advantages**
  - It can save natural resources.
  - It can minimize pollution.
  - It can lower landfill space.
  - It can create employment.
  - It can prevent long-term damage.

- **Disadvantages**
  - When the E-waste is dismantled then it creates smell like burning of waste and it harmful to the human as well as animal lives.
  - The initial cost of dismantling the E-waste is more in initial time.

2. Experimental Works

- **Materials**
  - **Aggregate (Coarse And Fine Aggregate)**
    Aggregate used in present study, were tested for their specific gravity and other properties and result have been tabulated.
  - **Cement**
    Pozzolona Portland cement of 43 grade- grade was used as it satisfied the requirements of IS: 269-1969 results have been tabulated.
  - **E-Waste**
    E-Waste can be used in size of 10 mm coarse aggregate and fine powder like as cement clinkers. As a replacer or as a fiber in concrete.

- **Casting and curing**

  Usually m20 concrete is used for most constructional works, hence in this project m20 concrete is taken and E-Waste is used as replacement of aggregate and as addition of fiber. Aggregate such as 0%, 5%, 10%, and 15%, was added in percentage, in order to replace the same amount of aggregate and fiber such as 0%, 0.5%, 1%, 2%, and 3% was added in amount of cement taken.

Various test conducted in lab:

Table.1 Properties of Cement

Specific Gravity	3.15
Initial Setting Time	35min
Final Setting Time	329min

Table.2 Physical Properties of Aggregate

Type of aggregate	Coarse
Specific Gravity	2.96
Water Absorption	0.406%
Surface Moisture	Nil
Aggregate Impact Value	5.87%
Aggregate crushing Value	6.23%
Los Angeles Abrasion Value	19.1%

- **Casting and curing of specimens**

Fig -1: Curing of Concrete Specimen

Fig -2: Curing of Concrete Specimen

- **Result analysis**
  - **Compressive Strength results**
    - **Concrete Cube**

      Thirty cubic specimens of size 150 mm × 150 mm × 150 mm were casted for conducting compressive strength test.

Table.3 Compressive Strength Of Concrete Cube

Sr.no.	% of added	Weight (kg)	Curing period (days)	Strength (KN)	Compressive strength (N/mm^2)	Mean of Comp. Strength (N/mm^2)
1	0%	8.680	7	392.2	17.43	19.59
		8.840	7	454	20.18	
		8.800	7	476.2	21.16	
		8.620	28	696.2	30.94	28.65
		8.900	28	956.2	29.16	
		8.660	28	581.6	25.85	
2	0.5%	8.620	7	393.2	17.48	20.32
		8.560	7	455.4	20.24	
		8.660	7	523.0	23.24	
		8.700	28	620.2	27.56	29.22
		8.720	28	664.0	29.51	
		8.760	28	688.4	30.59	
3	1%	8.800	7	417.6	18.56	20.79
		8.820	7	460.6	20.47	
		8.680	7	525.4	23.35	
		8.600	28	660.0	29.33	30.40
		8.700	28	710.0	31.56	
		8.720	28	682.2	30.32	
4	2%	8.760	7	416.4	18.51	19.18
		8.560	7	427.0	18.98	
		8.620	7	451.4	20.06	
		8.200	28	605.2	26.90	25.73
		8.300	28	548.6	24.38	
		8.770	28	583.2	25.92	
5	3%	8.420	7	318.6	14.16	16.62
		8.580	7	363.4	16.15	
		8.560	7	439.8	19.55	
		8.500	28	529.0	23.51	25.12
		8.520	28	583.0	25.91	
		8.600	28	584.0	25.95	

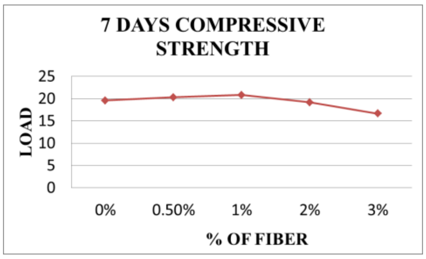

Fig -3: 7 days compressive strength of concrete cube

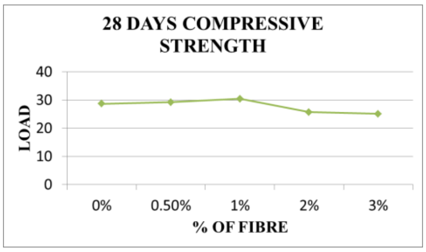

Fig -4: 28days compressive strength of concrete cube

Table.4 Compressive Strength of Concrete Bricks

Sr.no.	% of added	Weight (kg)	Curing period (days)	Strength (KN)	Compressive strength (N/mm^2)	Mean of Comp. Strength (N/mm^2)
1	0%	5.340	7	2020	50.500	50.24
		5.460	7	2005	50.125	
		5.460	7	2004	50.100	
		5.480	28	2006	50.150	50.16
		5.500	28	2005	50.125	
		5.520	28	2008	50.200	
2	5%	5.500	7	2007	50.175	50.15
		5.420	7	2006	50.150	
		5.300	7	2005	50.125	
		5.280	28	2006	50.150	50.15
		5.320	28	2005	50.125	
		5.300	28	2007	50.175	
3	10%	5.320	7	2005	50.125	50.11
		5.300	7	2004	50.100	
		5.400	7	2004	50.100	
		5.260	28	2006	50.150	50.38
		5.280	28	2004	50.100	
		5.340	28	2005	50.125	
4	15%	5.160	7	2005	50.125	50.1
		5.200	7	2003	50.075	
		5.100	7	2004	50.100	
		5.080	28	2005	50.125	50.14
		5.100	28	2006	50.175	
		5.160	28	2005	50.125	

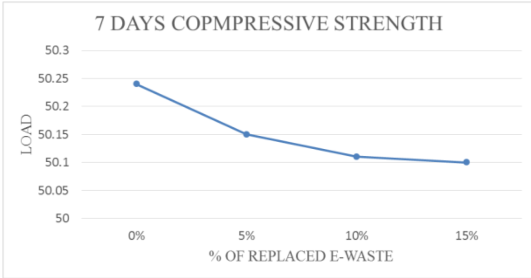

Fig -5: 7 days compressive strength of concrete bricks

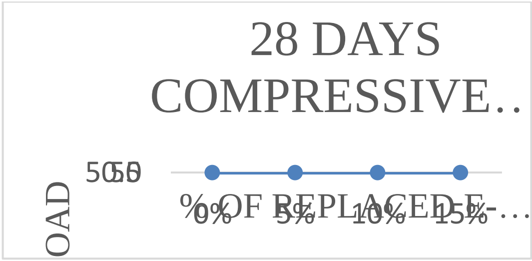

Fig -6: 28 days compressive strength of concrete cube

Table.5 Compressive Strength of Concrete Paver Blocks

Sr.no.	% of added	Weight (kg)	Curing period (days)	Strength (KN)	Compressive strength (N/mm^2)	Mean of Comp. Strength (N/mm^2)
1	0%	17.940	7	112.4	2.5	3.885
		19.100	7	117.6	2.61	
		19.100	7	119.6	2.66	
		18.760	28	113.60	2.52	2.5
		18.780	28	98.20	2.18	
		18.900	28	126.00	2.8	
2	5%	17.220	7	87.0	1.93	2.35
		18.100	7	124.0	2.76	
		17.920	7	106.6	2.37	
		17.980	28	96.20	2.14	2.47
		19.020	28	139.8	3.11	
		18.000	28	97.00	2.16	
3	10%	16.200	7	81.2	1.80	2.03
		16.700	7	95.4	2.12	
		16.500	7	97.0	2.16	
		16.540	28	70.0	1.56	1.65
		16.620	28	69.0	1.53	
		17.420	28	83.4	1.85	
4	15%	19.880	7	189.8	4.22	5.82
		20.200	7	284.0	6.31	
		20.220	7	312.0	6.93	
		21.700	28	251.2	5.58	5.97
		19.600	28	265.2	5.89	
		21.720	28	290.2	6.45	

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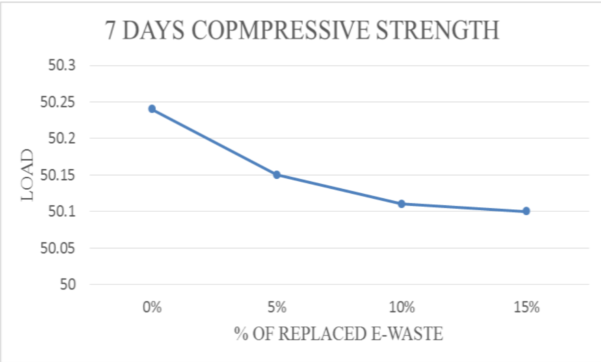

Fig -7: 7 days compressive strength of concrete paver blocks

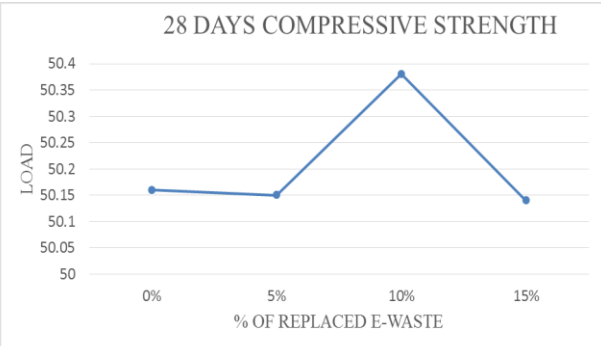

Fig -8: 28 days compressive strength of concrete paver blocks

- **Split Tensile Strength Test**

Splitting tensile strength is generally greater than the direct tensile strength and lower than the flexural strength (modulus of rupture). Splitting tensile strength is used in the design of structural light weight concrete members to evaluate the shear resistance provided by concrete and to determine the development length of the reinforcement.

Table.6 Split Tensile Strength of Concrete Cylinder

Sr.no.	% of added	Weight (kg)	Curing period(days)	Strength (KN)	Split tensile strength (N/mm^2)	Mean of Spilt tensile Strength (N/mm2)
1	0%	13.140	7	165	2.33	2.57
		13.020	7	204.8	2.90	
		12.960	7	173	2.48	
		13.440	28	310	4.39	3.78
		13.060	28	233	3.30	
		13.160	28	258	3.65	
2	0.5%	13.260	7	166.2	2.35	2.47
		13.060	7	179.6	2.54	
		12.860	7	178.2	2.52	
		13.160	28	331.6	4.69	4.26
		12.940	28	280.0	3.96	
		13.080	28	292.4	4.14	
3	1%	13.100	7	158.0	2.23	2.24
		13.120	7	144.0	2.04	
		13.040	7	173.4	2.45	
		13.060	28	251.2	3.55	3.65
		13.120	28	268.0	3.79	
		13.160	28	255.0	3.61	
4	2%	13.220	7	153.6	2.17	2.16
		13.120	7	151.2	2.14	
		13.220	7	154.4	2.18	
		12.980	28	254.2	3.60	3.61
		13.020	28	254.6	3.61	
		13.120	28	255.8	3.62	
5	3%	13.200	7	152.4	2.16	2.06
		13.120	7	148.2	2.10	
		13.120	7	136.2	1.93	
		13.120	28	293.4	4.15	4.16
		13.040	28	308.0	4.36	
		13.100	28	280.2	3.96	

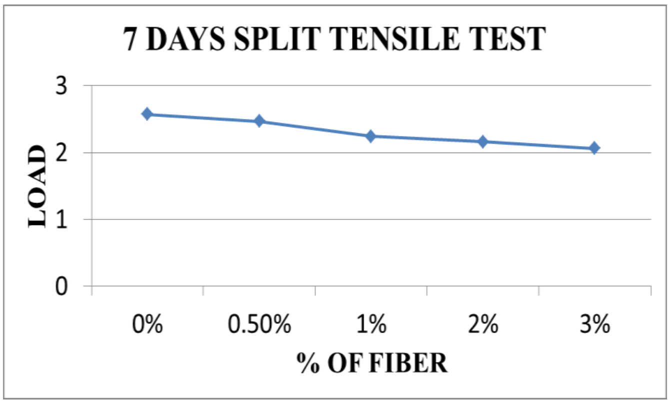

Fig -9: 7 Days Split Tensile Strength of Concrete Cylinder

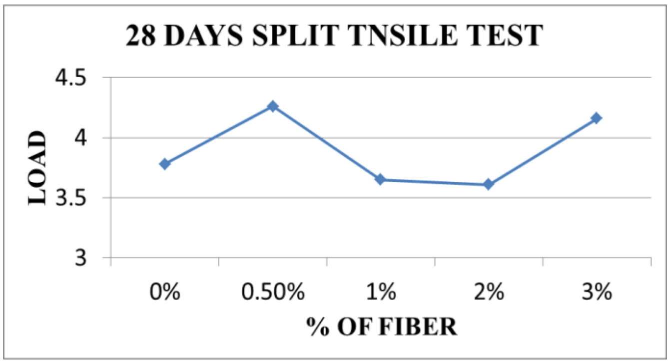

Fig -10: 28 Days Split Tensile Strength of Concrete Cylinder

- **Flexural Strength Test**

Flexural strength is one measure of the tensile strength of concrete. It is a measure of an unreinforced concrete beam to resist failure in bending. It is measured by loading 100 x 100 mm concrete beams with a span length of 500 mm.

Table.7 Flexural Strength of Concrete Beam

Sr.no.	% of added	Curing period(days)	Strength (KN)	Compressive strength(N/mm^2)	Mean of Comp. Strength (N/mm2)
1	0	28	31.070	0.777	0.697
		28	31.100	0.622	
		28	31.120	0.692	
2	0.5	28	31.290	0.782	0.781
		28	30.420	0.761	
		28	31.940	0.799	
3	1	28	33.390	0.835	0.820
		28	32.340	0.809	
		28	32.610	0.815	
4	2	28	31.110	0.778	0.80
		28	32.340	0.809	
		28	32.610	0.815	
5	3	28	32.540	0.814	0.80
		28	32.430	0.811	
		28	31.280	0.782	

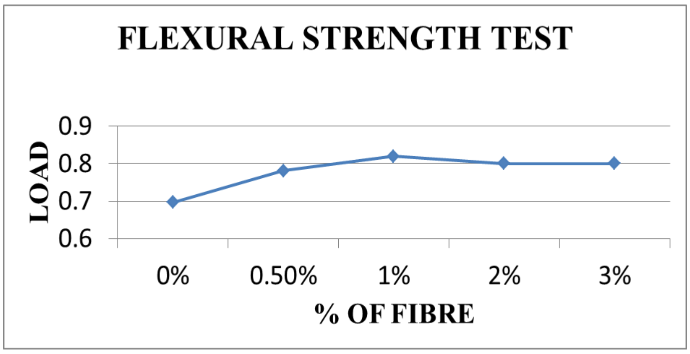

Fig. 11: Flexural Strength of Concrete Beam

3. CONCLUSIONS

The analysis concluded that the E-waste can be used in the cement concrete mix. This modified cement concrete mix is applicable in the construction of rigid pavements and construction of structure. The compressive strengths of modified cement concrete are as equal as plain cement concrete. The optimum modifier content of E-waste is found to be 1% of fiber addition in concrete specimens and at 10% replacement of aggregate in concrete for paver blocks and 15% aggregate replacement in concrete bricks. The cost of construction will reduce and also helps to avoid the general disposal technique of waste plastics namely land filling and incineration which have certain burden on ecology.

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BIOGRAPHIES

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