International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 06 | June - 2023 SJIF Rating: 8.176 ISSN: 2582-3930

AN EXPERIMENTAL INVESTIGATION ON EFFECT OF CONCRETE INCORPORATING EGG SHELL POWDER AS CEMENT ALONG WITH E-WASTE AS COARSE AGGREGATE REPLACEMENT

ARAVEETI JAGADEESWAR REDDY[1], SHAIK ABDUL KAREEM M.TECH [2]

[1]PG Student, Dept. of Civil (structural engineering and Construction Management), Golden Valley Integrated Campus, Madanapalli, Chittoor, Andhra Pradesh, India.

[2]Assistant professor, Dept. of civil engineering, Golden Valley Integrated Campus, Madanapalli, Chittoor, Andhra Pradesh

ABSTRACT

The imagination of a world without concrete is impossible. It is a soul of infrastructures. Concrete is necessary to gain strength in structures. Conventional concrete, which is the mixture of cement, fine aggregate, coarse aggregate and water, needs curing to achieve strength. Concrete is a counterfeit material in which the totals both fine and coarse are reinforced together by the bond when blended with water. The solid has turned out to be so prominent and essential in view of its natural, concrete acquired an upheaval uses of cement. Concrete has boundless open doors for creative applications, plan and development methods. Its extraordinary adaptability and relative economy in filling extensive variety of necessities has made it is exceptionally focused building material.

This project focuses on concrete, keeping importance to this, an attempt has been made to develop strength in concrete incorporating recycling waste. As part of the project cement partially replaced with egg shall powder and e- waste as coarse aggregate Comparative studies were carried out for compressive strength, tensile strength and flexural test for conventional and material concrete mixture introducing new recycling materials

I. INTRODUCTION

In India, the manufacturing of Portland cement was commenced around the year 1912. The beginning was not very promising and growth of cement industry was very slow. At the time of independence in 1947, the installed capacity of cement plants in India was approximately 4.5 million tons and actual production around 3.2 million tons per year. The large construction activity undertaken during the various 5 years plans mainly during the necessitated the growth of cement industry. However, the five year plans envisaged for Multi-purpose projects and also for rapid industrial growth remained stinted due to the complete control exercised by the Government over the cement industry. As the infra-structure sector was developing during 1980s prompted the various industrial organizations were interested for setup new cement plants in the country. The full liberalization on cement industry in 1988 further provided rapid expansion for the growth.

Concrete is the most commonly used construction material; its usage by the communities across the globe is second only to water. Customarily, concrete is produced by using the Ordinary Portland Cement (OPC) as the binder. The usage of OPC is on the increase to meet infrastructure developments. The world-wide demand for OPC would increase further in the future. It is well-known that cement production depletes significant amount of natural resources and releases large volumes of carbon-dioxide. Cement production is also highly energy-intensive, after steel and aluminium. On the other hand, coal burning power generation plants produce huge quantities of egg shell powder e-wasteand some of the materials which are byproducts. In order to address the issues mentioned above, it is essential that other forms of binders must be developed to make concrete.

OBJECTIVES

The most important objectives of this study are 50% with 10% fixed proportion along with as cement replacement of 0, 2, 4 6, 8% respectively of M20 & M30 grade of concrete

1) To study the relative strength development with age of concrete with control concrete.

2) To study the comparative strength development with age of (Nano silica) concrete, with control concrete along with coarse aggregate replacement with E-WASTE.

4) Use of industrialized waste in a positive way.

5) To conduct compression test on E-WASTE with ordinary concrete on standard IS specimen size

6) To protect the environment by utilizing waste properly

8) Increment in strength with very less cost of materials

EXPERIMENTAL PROGRAM

This investigation focuses on the following pattern of work

- partial replacement of cement and E-WASTE as coarse aggregate replacement.
- In the present experimental investigation, the cement is partially replaced by 0, 2, 4 6, 8% respectively of M20 & M30 grade of concrete
- Curing was done at the ages of 7,28 and 56 days were tested i.e. compression, split tensile strength and flexural strength along with durability test.

II. LITERATURE REVIEW

AlirzaNajiGivi et.al. examined the size impact of nanosilica particles. They supplanted bond with nanosilica of size 15nm and 80nm with 0-5, 1, 1.5 and 2% b.w.c. An expansion in the compressive quality was seen with 1.5% b.w.c indicating most extreme compressive quality. An examination between molecule measure demonstrated that for 80nm particles the most extreme quality was more than for 15nm particles, additionally an extensive change in flexural and split rigidity of Nano SiO2 mixed cement was watched.

Sadrmotazi et.al., in another paper, have studied the effect of PP fiber along with nano SiO2 particles. The nanosilica was replaced up to 7% which improved the compressive strength of cement mortar by 6.49%. PP fiber amounts beyond 0.3% reduces the compressive strength but beyond 0.3% dose of PP fiber increases the flexural strength, showing the effectiveness of nano SiO2 particles. Also up to 0.5% PP fibers in mortar water absorption decreases which indicates pore refinement.

Ali Nazari et.al. considered the consolidated impact of Nano SiO2 particles and GGBFS on properties of cement. They utilized nanosilica with 3% b.w.c. substitution and 45% b.w.c. GGBFS, which demonstrates enhanced split elasticity. A change in the pore structure of SCC with silica particles was watched. Aside from this hello have examined the impact of ZnO2 nano particles on SCC concrete with steady w/c proportion of 0.4. The outcomes demonstrated that by expanding the substance of super plasticizer flexural quality declines. Upto 4% b.w.c. of ZnO2 content an expansion in the flexural quality of SCC was recorded. In another analysis a similar writer examined impact of Al2O3 nano particles on the properties of cement. The outcomes demonstrated that bond could be traded up to 2% for enhancing mechanical properties of cement, yet Al2O3 nano particles diminished rate water ingestion of cement. XRD investigation of the example demonstrated that there is more quick development of hydrated item.

III. MATERIALS AND METHODOLOGY

Materials:

- Cement
- Fine aggregate (sand)
- Coarse aggregate
- Water
- Egg shell powder
- E-WASTE

In the present study from the above mix design we have choosen the following cases for casting

M 20 Grade

Mix	Egg Shell Powder% of cement	e-waste		Cement (Kg/m^3)	Fine aggregate (Kg/m^3)	Coarse aggregate (Kg/m^3)	Water (lit/m^3)
CC	0%	0%	0	360	584	1223.8	180.42
		10%	122.38	360	584	1101.42	180.42
		20%	244.76	360	584	979.04	180.42
		30%	367.14	360	584	856.66	180.42
		40%	489.52	360	584	734.28	180.42
		50%	611.9	360	584	611.90	180.42
Mix-1	4%	0%	0	360	584	1223.8	180.42
		10%	122.38	360	584	1101.42	180.42
		20%	244.76	360	584	979.04	180.42
		30%	367.14	360	584	856.66	180.42
		40%	489.52	360	584	734.28	180.42
		50%	611.9	360	584	611.90	180.42
Mix-2	8%	0%	0	360	584	1223.8	180.42
		10%	122.38	360	584	1101.42	180.42
		20%	244.76	360	584	979.04	180.42
		30%	367.14	360	584	856.66	180.42
		40%	489.52	360	584	734.28	180.42
		50%	611.9	360	584	611.90	180.42

M 30 grade

Mix	e-waste		Cement (Kg/m^3)	Fine aggregate (Kg/m^3)	Coarse aggregate (Kg/m^3)	Water (lit/m^3)
CC	0%	0	394	732	1139	197
	10%	113.9	394	732	1025.1	197
	20%	227.8	394	732	911.2	197
	30%	341.7	394	732	797.3	197
	40%	455.6	394	732	683.4	197
	50%	569.5	394	732	569.5	197
Mix-1	0%	0	394	732	1139	197
	10%	122.38	394	732	1025.1	197
	20%	244.76	394	732	911.2	197
	30%	367.14	394	732	797.3	197
	40%	489.52	394	732	683.4	197
	50%	611.9	394	732	569.5	197
Mix-2	0%	0	394	732	1139	197
	10%	122.38	394	732	1025.1	197
	20%	244.76	394	732	911.2	197
	30%	367.14	394	732	797.3	197
	40%	489.52	394	732	683.4	197
	50%	611.9	394	732	569.5	197

VI EXPERIMENTAL INVESTIGATION

The following are the strength tests which was conducted in the project:

- Compressive strength test
- Split tensile strength test
- Flexural strength test

V RESULTS

Fresh properties concrete

M 20 Grade

Mix	Egg Shell Powder% of cement	e-waste	Slump (mm)
CC	0%	0%	65
		10%	80
		20%	98
		30%	115
		40%	131
		50%	120
Mix-1	4%	0%	70
		10%	84
		20%	102
		30%	119
		40%	142
		50%	124
Mix-2	8%	0%	72
		10%	86
		20%	100
		30%	109
		40%	114
		50%	100

M 30 Grade

Mix	Egg Shell Powder% of cement	E WASTE	Slump (mm)
CC	0%	0%	68
		10%	75
		20%	85
		30%	94
		40%	124
		50%	112
Mix-1	4%	0%	72
		10%	84
		20%	105
		30%	112
		40%	128
		50%	105
Mix-2	8%	0%	74
		10%	86
		20%	98
		30%	108
		40%	115
		50%	103

Compressive strength M20 Grade of Concrete

Mix	Egg Shell Powder% of cement	E- waste Replacement	Compressive strength N/mm²			
			7 Days	14 Days	28Days	56 Days
CC	0%	0%	10.78	18.65	28.64	32.14
		10%	12.64	20.21	30.12	33.21
		20%	14.84	22.12	34.12	39.81
		30%	16.89	24.35	36.19	40.21
		40%	18.91	26.87	39.21	42.18
		50%	17.12	25.12	35.34	39.84
Mix-1	4%	0%	11.24	19.02	29.50	33.21
		10%	13.05	21.32	32.02	35.98
		20%	15.08	23.01	35.02	40.02
		30%	17.02	25.21	37.25	45.28
		40%	19.12	27.50	40.21	43.64
		50%	18.13	26.21	36.35	41.20
Mix-2	8%	0%	12.05	21.02	30.12	34.56
		10%	14.85	22.36	33.02	34.98
		20%	15.82	23.45	35.02	39.02
		30%	18.32	26.12	36.90	40.28
		40%	20.12	28.23	40.21	42.64
		50%	19.13	25.24	35.35	41.20

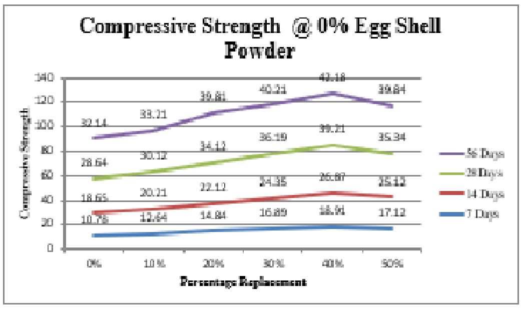


Fig.: Compressive Strength @ M20 0% Egg Shell Powder

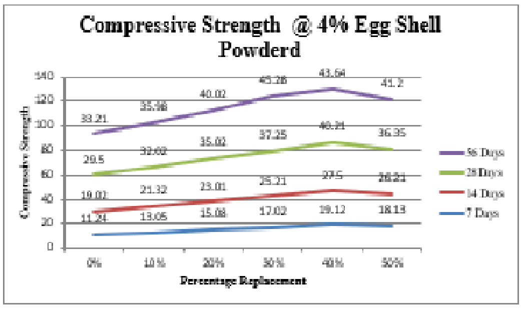


Fig.: Compressive Strength @ M20 4% Egg Shell Powder

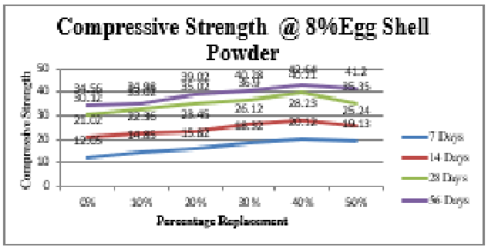


Fig.: Compressive Strength @ M20 4% Egg Shell Powder

Compressive strength M30 Grade of Concrete

Mix	Egg Shell Powder% of cement	E- waste Replacement	Compressive strength N/mm²			
			7 Days	14 Days	28Days	56 Days
CC	0%	0%	11.28	20.65	37.64	39.12
		10%	14.02	23.65	40.02	40.12
		20%	15.02	25.12	42.35	39.81
		30%	18.12	28.94	45.12	40.21
		40%	20.12	30.12	48.01	42.18
		50%	19.85	29.86	43.02	39.84
Mix-1	4%	0%	12.82	21.78	38.98	40.01
		10%	15.24	24.75	41.28	42.20
		20%	17.06	26.49	43.24	44.08
		30%	19.85	27.96	46.74	48.28
		40%	22.24	31.28	50.02	52.18
		50%	20.15	30.01	48.02	49.84
Mix-2	8%	0%	13.02	22.08	39.81	41.01
		10%	16.24	25.05	42.12	43.02
		20%	17.96	27.09	43.04	45.18
		30%	20.85	28.96	45.74	46.28
		40%	21.24	34.28	49.02	50.19
		50%	19.15	29.01	47.02	48.24

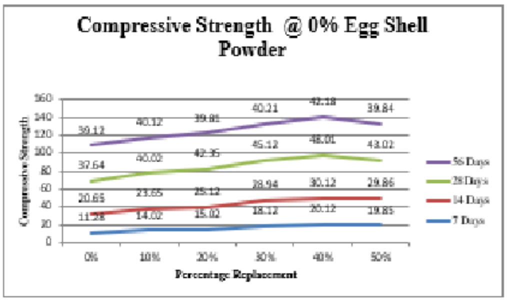
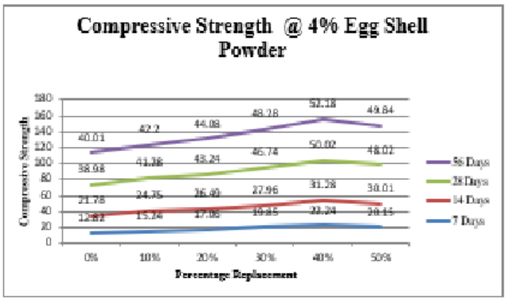
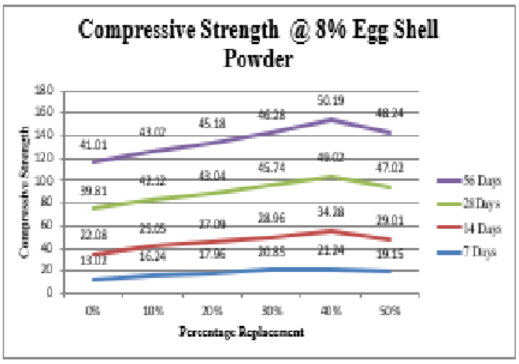


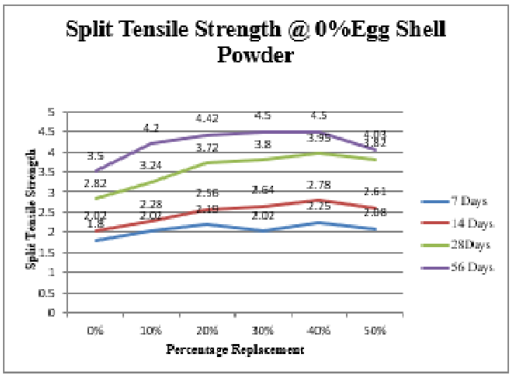
Fig.: Compressive Strength @ M30 0% Egg Shell Powder

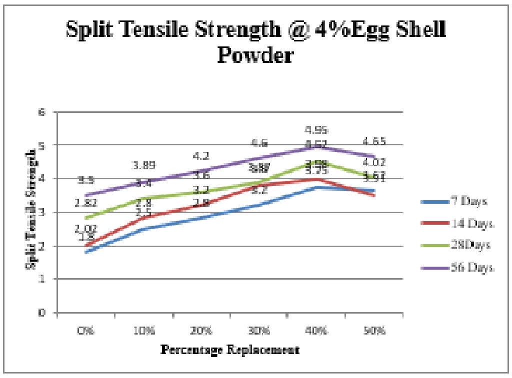


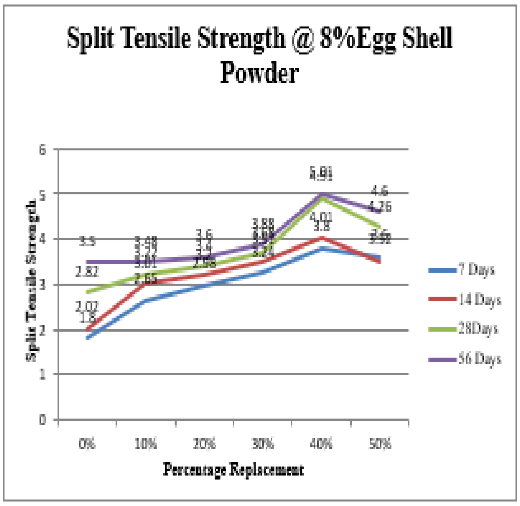


Split Tensile Strength M20 Grade of Concrete

Mix	Egg Shell Powder% of cement	E- waste Replacement	Split Tensile Strength N/mm²			
			7 Days	14 Days	28Days	56 Days
CC	0%	0%	1.8	2.02	2.82	3.5
		10%	2.02	2.28	3.24	4.2
		20%	2.19	2.56	3.72	4.42
		30%	2.02	2.64	3.8	4.5
		40%	2.25	2.78	3.95	4.5
		50%	2.08	2.61	3.82	4.03
Mix-1	4%	0%	1.8	2.02	2.82	3.5
		10%	2.5	2.8	3.4	3.89
		20%	2.8	3.2	3.6	4.2
		30%	3.2	3.8	3.87	4.6
		40%	3.75	3.98	4.52	4.95
		50%	3.62	3.51	4.02	4.65
Mix-2	8%	0%	1.8	2.02	2.82	3.5
		10%	2.65	3.01	3.22	3.48
		20%	2.98	3.2	3.4	3.6
		30%	3.24	3.51	3.68	3.88
		40%	3.8	4.01	4.91	5.01
		50%	3.60	3.52	4.26	4.6







Split Tensile Strength M30 Grade of Concrete

Mix	Egg Shell Powder% of cement	E- waste Replacement	Split Tensile Strength N/mm^2			
			7 Days	14 Days	28Days	56 Days
CC	0%	0%	2.2	3.18	3.7	4.2
		10%	2.62	3.28	3.96	4.45
		20%	2.89	3.77	4.01	4.65
		30%	3.15	3.98	4.5	4.8
		40%	3.25	4.12	4.68	5.01
		50%	3.10	3.82	4.42	4.82
Mix-1	4%	0%	2.2	3.18	3.7	4.2
		10%	2.7	3.32	4.01	4.8
		20%	2.92	3.92	4.23	5.21
		30%	3.18	4.02	4.68	5.6
		40%	3.35	4.32	4.92	5.99
		50%	3.21	3.52	3.98	5.81
Mix-2	8%	0%	2.2	3.18	3.7	4.2
		10%	2.92	3.82	4.32	5.02
		20%	3.28	3.98	4.62	5.36
		30%	3.64	4.03	4.94	5.49
		40%	3.92	4.28	5.01	5.67
		50%	3.68	4.01	4.581	4.91

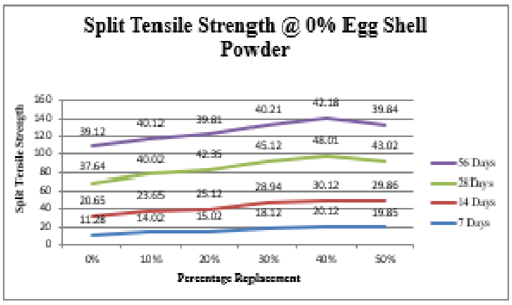


Fig.: Split Tensile Strength @ M30 0% Egg Shell Powder

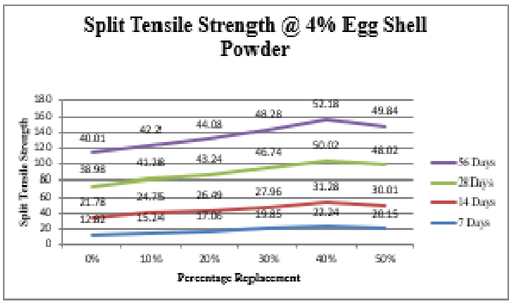


Fig.: Split Tensile Strength @ M30 4% Egg Shell Powder

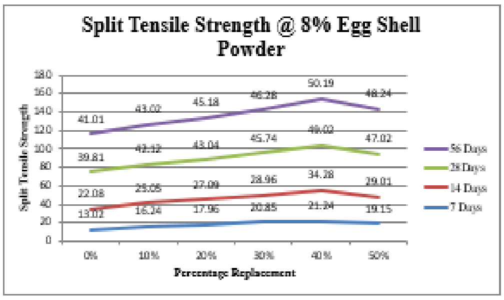


Fig.: Split Tensile Strength @ M30 8% Egg Shell Powder

Flexural StrengthM20 Grade of Concrete

Mix	Egg Shell Powder% of cement	E- waste Replacement	Flexural Strength N/mm^2			
			7 Days	14 Days	28Days	56 Days
CC	0%	0%	2.2	2.45	2.98	3.52
		10%	2.42	2.96	3.01	3.92
		20%	2.65	3.01	3.45	4.05
		30%	2.88	3.65	3.86	4.56
		40%	3.12	3.98	4.02	4.98
		50%	3.01	3.45	3.98	4.45
Mix-1	4%	0%	2.2	2.45	2.98	3.52
		10%	2.38	2.9	3.28	4.2
		20%	2.45	3.25	3.68	4.68
		30%	2.92	3.68	3.92	4.99
		40%	3.25	3.98	4.25	5.25
		50%	3.01	3.52	4.01	4.98
Mix-2	8%	0%	2.2	2.45	2.98	3.52
		10%	2.8	3.2	3.9	4.2
		20%	2.98	3.42	4.02	5.02
		30%	3.01	3.54	4.8	5.42
		40%	3.28	3.98	4.92	5.68
		50%	3.01	3.52	4.82	5.52

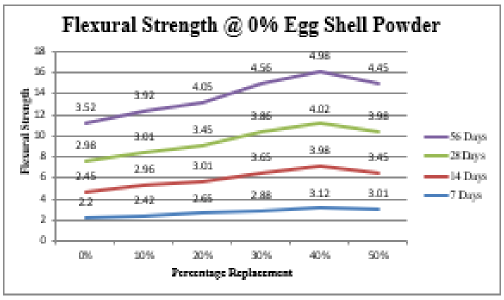


Fig. Flexural Strength@ M20 0% Egg Shell Powder

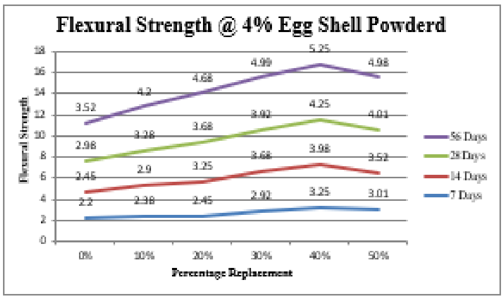


Fig.: Flexural Strength@ M20 4% Egg Shell Powder

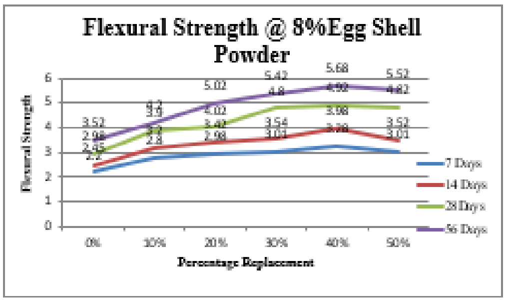


Fig.: Flexural Strength@ M20 4% Egg Shell Powder

Flexural StrengthM30 Grade of Concrete

Mix	Egg Shell Powder% of cement	E- waste Replacement	Flexural Strength N/mm²			
			7 Days	14 Days	28Days	56 Days
CC	0%	0%	3.02	3.85	4.09	4.8
		10%	3.19	4.11	4.35	5.32
		20%	3.26	4.54	4.56	5.87
		30%	3.46	4.86	4.98	6.48
		40%	3.58	4.98	5.01	6.68
		50%	3.20	4.5	4.88	6.42
Mix-1	4%	0%	3.02	3.85	4.09	4.8
		10%	3.29	4.28	4.45	5.45
		20%	3.36	4.62	4.8	5.95
		30%	3.52	4.98	5.12	6.69
		40%	3.68	5.12	5.38	6.98
		50%	3.49	5.05	5.21	6.52
Mix-2	8%	0%	3.02	3.85	4.09	4.8
		10%	3.57	4.02	4.69	5.06
		20%	3.68	4.2	4.89	5.82
		30%	3.98	4.5	5.12	6.2
		40%	4.12	5.25	5.8	6.9
		50%	3.98	4.9	5.35	6.5

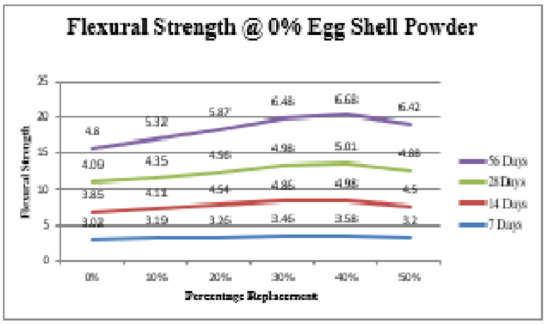


Fig.: Flexural Strength@ M30 0% Egg Shell Powder

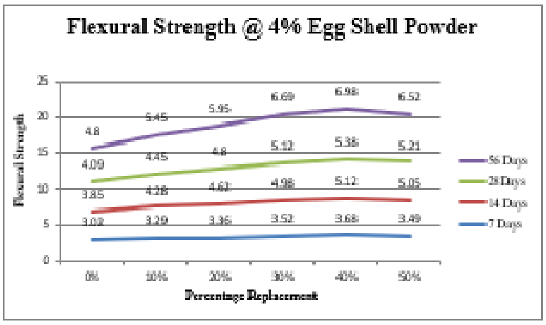


Fig.: Flexural Strength@ M30 4% Egg Shell Powder

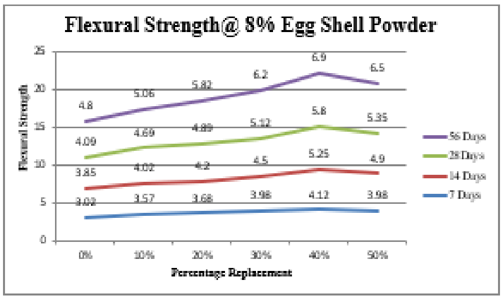


Fig.: Flexural Strength@ M30 8% Egg Shell Powder

VI. CONCLUSIONS

The aim of this investigation was the utilization of e waste collected from industries in concrete as coarse aggregate and the strength characteristics of tile waste as replacement of coarse aggregate in concrete by adding 4% and 8% Egg Shell Powder of weight of the cement. The agent Egg Shell Powder is added to improve the bonding between cement and e-waste in concrete to get increase in concrete strength. The following are the conclusions obtained

Replacement of coarse aggregate with e- waste has much effect on the workability of concrete.

1. Compressive strength of concrete mixes up to 40% replacement of e- waste is greater than conventional concrete mix.
2. For 7, 14, 28 and 56 days of curing, compressive strength of 40% replacement of e- waste is greater than conventional concrete.
3. Adding 4% Egg Shell Powder of weight of the cement by various percentage e-wastes as replacement of coarse aggregate

increases the compressive strength of it up to 40% compared to the normal concrete.

4. Split Tensile strength of concrete mixes up to 40% replacement of e- waste is greater than conventional concrete mix.
5. For 7, 14, 28 and 56 days of curing, Split Tensile strength of 40% replacement of e-waste is greater than conventional concrete.
6. Adding 4% Egg Shell Powder of weight of the cement by various percentage e-wastes as replacement of coarse aggregate increases the Split Tensile strength of it up to 40% compared to the normal concrete.
7. Flexural strength of concrete mixes up to 40% replacement of e- waste is greater than conventional concrete mix.
8. For 7, 14, 28 and 56 days of curing, Flexural strength of 40% replacement of e- waste is greater than conventional concrete.
9. Adding 4% Egg Shell Powder of weight of the cement by various percentage e-wastes as replacement of coarse aggregate increases the Flexural strength of it up to 40% compared to the normal concrete.
10. Optimum results upto E- waste 40% replacement of coarse aggregate along with 4% Egg Shell Powder recommendable.

FUTURE SCOPE

Further testing and experiment can be done on E-WASTE concrete, as it is highly recommended to indicate strength characteristics of this type of material for application in normal or low rise structural concrete. Some recommendations made for further studies:

1) Experiment can be done by varying water/cement ratio, to know the varying strength parameters while addition of sodium silicate, in order to get better grip on workability.

2) More investigations and research can be done on the strength characteristics of E-WASTE powder as cementitous material which is also a pozzolanic material.

3) Non-destructive testing like Rapid Chloride Penetration Test (RCPT) can be done to support its suitability for structural concrete.

4) Use of waste can sustain environment and eco-system the whole; therefore, there is an active research on E-WASTE.

REFERENCES

1. Eva Vejmelkova , Martin Keppert , PavlaRovnanikova , Michal Ondracˇek , ZbyneˇkKeršner ,Robert Cˇ erny. 2012,the study of high performance concrete Properties containing fine-ground ceramics as supplementary cementitious material, Cement & Concrete Composites, 34, 55–61 high-strength reinforced concrete in a chloride solution, Cement & Concrete Composites, 27, 117–124
2. Michel Mbessa, Jean Pe´ra. 2001, High-strength concrete durability of in ammonium sulfate solution, Cement and Concrete Research, 31, 1227–1231
3. Pacheco-Torgal F., Jalali S. 2010, Reusing wastes of ceramic in concrete, Construction and Building Materials, 24, 832–83
4. Sathiyanarayanan S., Panjali Natarajan, Saravanan K., Srinivasan S.,Venkatachari.2006
5. Corrosion monitoring of steel in concrete by using technique galvanostatic pulse, Cement & Concrete Composites, 28, 630–637