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An Experimental Investigation on Partial Replacement of Fine Aggregate by E-waste and Quarry Sand in Cement Concrete

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Abstract

The construction industry is an important industry at both the global level and national level. Concrete when set and cured, resembles stone in weight, hardness, brittleness and strength. In developing the alternatives to the concrete a new replacement to fine aggregate has been made and is named as partial replacement(5%, 10%, 15%, 20%) of fine aggregate, here e-waste(waste from electronics)and quarry dust is replaced .e waste is unwanted and obsolete from electrical materials, quarry dust is also waste from quarry. This has good compressive strength and impact strength when compared to normal concrete. Time and cost are the two major elements in project management, apart from quality and scope.

This experimental study deals with the study of utilization of e-waste(waste from electronics) and quarry dust in place of fine aggregate replacement partially(5%, 10%, 15%, 20%).

Keywords: *E-Waste, Quarry Sand, Cement Concrete, Fine Aggregate*

INTRODUCTION

Concrete is most commonly used construction material in the world of construction industry due to it has ability to mould in a shape. We also know that concrete being the mixture of cement,

sand, gravel and water. Concrete becomes stronger when it is set and cured and it has strength similar to the stone. Concrete is being used in every modern constructions. Based on strength the concrete is divided as M10,M15, M20, M25, M30 and M40. The compressive strength of the concrete at 28days expressed in N/mm^2. Here concrete is made of cement, gravel, water and there is partially replacement sand by E-waste and Quarry dust. The sand is replaced by 5%, 10%, 15% and 20% of E-waste and Quarry dust. M25 grade concrete is being prepared and compressive strength of the concrete is noted down.

As this Generation is totally blown away by Electronic devices so there is a lot of waste being produced which latter is crushed and used as a fine aggregate in making concrete. We are always making use of Quartz dust as a partial replacement of fine aggregate. After the concrete is made using Quartz dust and E-waste as fine aggregate it is then used to make cubes, cylinders, beams and then its strength is found out.

MATERIAL USED

In this project the materials used are Cement, E-Waste and Quartz sand. The materials are arranged from the nearest store, where different materials of Fine Aggregate are collected and stored.

a. Cement

Cement is often supplied as a powder, which can act as blinder material when it is combined with water, Sets harder and adheres to other material. The 53 grade cement type is used.

b. Sand

Sand is the other important material in the field of construction and used for the preparation of concrete mixture. Sand is collected from nearby source and sieved through 4.75mm.

c. Replacement of Fine Aggregate

E-waste:

As it is the 21st century and there is a huge development of technology in the field of electronics day-to-day life, its waste also increased. So to overcome this, engineers are in need of new arena to fine best system for e-waste management. One such system is “Construction Materials.”

Quarry dust:

As Quarry dust is an natural fine aggregate which is obtained by crushing of rocks into 4.75mm size particles. It gives maximum strength to normal concrete.

d. Coarse Aggregate

It mined from the rocks or from the bed of river, each particle is of different size and property based on the location. It ranges from 10mm to 20mm

TEST RESULTS AND DISCUSSION

The tests were done on the three different concrete moulds such as cube, cylinder and beams. The casted specimens were allowed to test at the duration of 3,7 and 28 days. The adopted mix grade is M25.

a. Compressive strength test

Compressive strength is the internal resisting force of an material to break under compression. This test is carried out on concrete 3 E-waste cubes and 3 quarry dust cubes in compressive testing machine (CTM). The cube is placed in between the two supporting forces. The size of the cube specimen is 150mm×150mm×150 mm. The obtained rest results are as in table 1& table 1.1

Table 1 Compressive strength test Values for E-waste

Compressive strength (N/mm^2)				
MIX	**% of E-waste**	**3rd day**	**7th day**	**28th day**
Concrete	0	18.21	23.56	34.7
Replaced fine aggregate material E-waste	5	17.16	23.12	33.5
	10	17.9	24.3	34.2
	15	17.6	23.8	33.9
	20	16.1	21.4	30.16

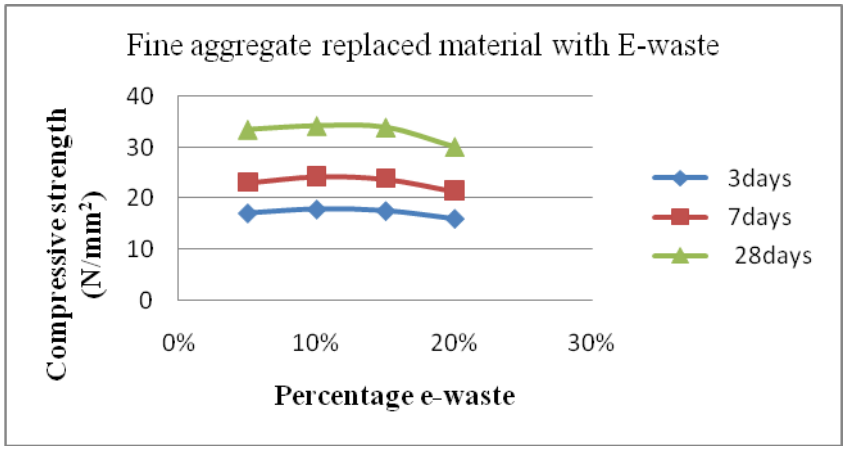


Fig 2 Compressive strength test for E-waste in graph represent station

Table 2 Compressive strength test Values for Quarry dust

Compressive strength (N/mm^2)				
MIX	**% of Quarry dust**	**3rd day**	**7th day**	**28th day**
concrete	0	16.58	21.41	31
Replaced fine aggregate material Quarry dust	5	15.87	20.32	30.4
	10	15.62	21.23	30.28
	15	15.47	21.3	29.36
	20	13.62	18.16	24.63

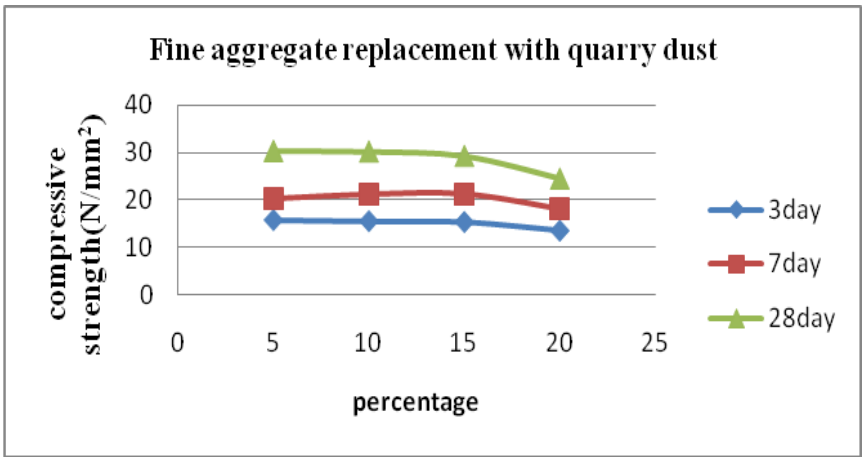


Fig 2 Compressive strength test of Quarry dust graph represent station

b. Split tensile strength

It is the test performed on 3 E-waste cylinders and 3 Quarry dust cylinders. It is used to find out resisting force of a material. We all know concrete is strong in compression and week in tension so alternatives is to be taken to overcome this problem. The cylinder must be placed horizontally as the line of contact should be throughout the length. The test results are as in table 2& 2.1

Table 3 Split tensile Strength test results concrete and E-waste

Split tensile strength (N/mm^2)				
MIX	**% of E-waste**	**3rd day**	**7th day**	**28th day**
concrete	0	2.61	3.82	3.94
Replaced fine aggregate material E-waste	5	3.13	3.47	3.9
	10	2.09	2.86	3.08
	15	3.16	3.52	4.01
	20	3.00	3.57	3.87

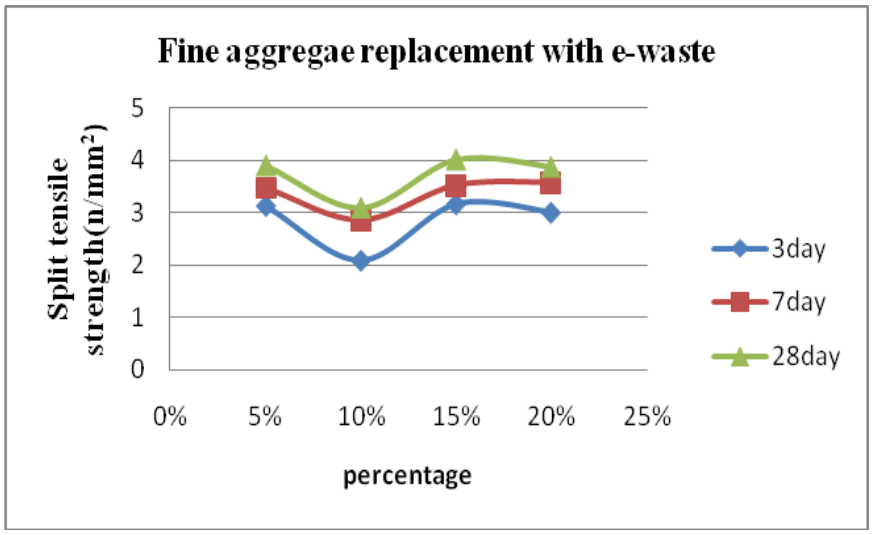


Fig3Split tensile Strength test results for e-waste graph represent station

Table 4 Split tensile Strength test results Quarry dust

Split tensile strength (N/mm^2)				
MIX	**% of quarry dust**	**3rd day**	**7th day**	**28th day**
Concrete	0	2.31	2.78	3.54
Replaced fine aggregate material Quarry dust	5	2.27	2.63	3.23
	10	2.28	2.55	3.14
	15	2.15	2.46	3.07
	20	2.18	2.34	3.09

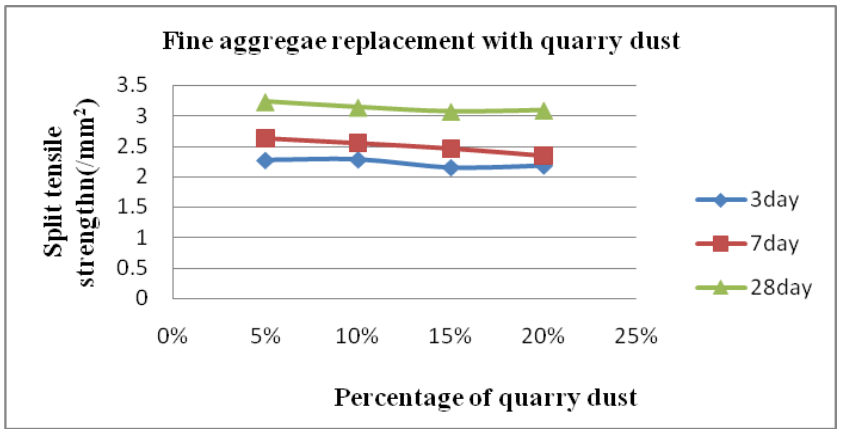
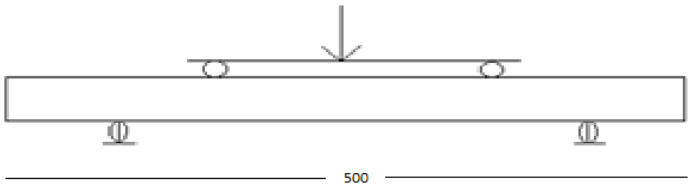


Fig 4Split tensile Strength test results Quarry dust graph represent station



Flexure beam diagram (dimensions in mm)

Table 5 Values of flexure beams test

Flexure Strength in (N/mm^2)				
MIX	**% of E-waste**	**3rd day**	**7th day**	**28th day**
Concrete	0	4.17	5.8	6.9
Replaced fine aggregate material E-waste	5	5.01	6.1	7.4
	10	5.14	6.36	7.9
	15	5.68	6.0	7.82
	20	5.54	6.17	8.01

Flexure Strength of Beam

Testing of beam in the field of construction is an important thing as it is one measure of the tensile strength. The beam was prepared in steel moulds of sizes 500mm length, 100mm wide and 100mm depth. A total of 3 e-waste beams and 3 quarry dust beams were casted and tested according to their duration. By the test we can conclude the strength of the particular material of the beam. The tested beam values with deflection are as in the following table 3 & 3.1

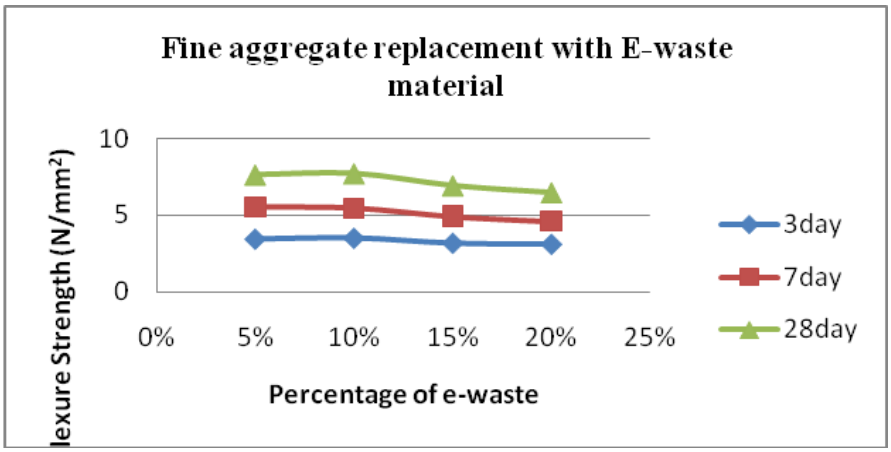


Fig 5Flexural beams results in graph

Table 6 Values of flexural beams

Flexural Strengthin (N/mm^2)				
MIX	**% ofquarry dust**	**3rd day**	**7th day**	**28th day**
Concrete	0	3.66	5.57	7.83
Replaced fine aggregate material Quarry dust	5	3.42	5..52	7.64
	10	3.48	5.46	7.72
	15	3.16	4.92	6.93
	20	3.09	4.61	6.47

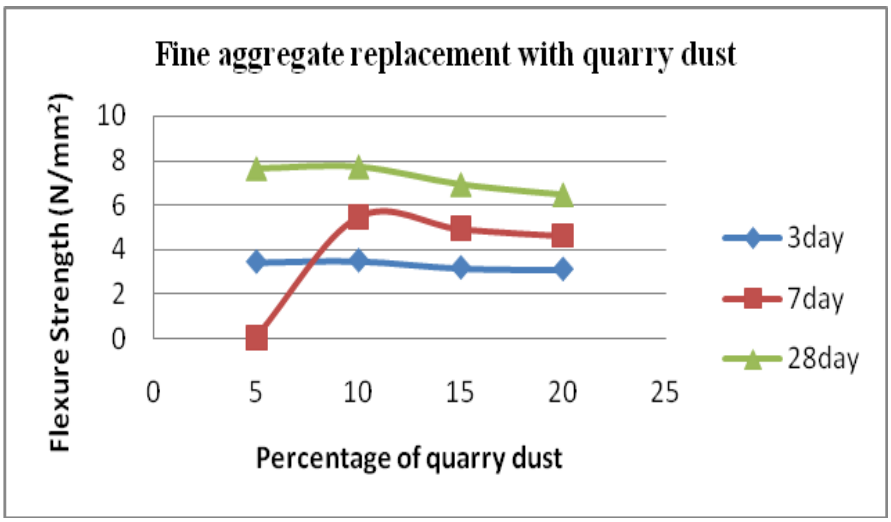


Fig 6 Values of flexure beams of Quarry dust graph represent station

CONCLUSION

Based on the above discussion following conclusion are drawn:

- The optimum replacement of fine aggregate by E-waste is possible up to 20%.
- Quarry dust replacement in fine aggregate can be done up to 15%.
- Based on the replacement of these above two materials, slightly we can reduce cost upto 10% to 20% in purchasing of concrete

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