

Experimental Study On Partial Replacement of Coarse Aggregates In Concrete With E-Waste, Rubber Tyre And Coconut Shells

Dakshesh Sadanand Gurav¹, Siddhesh Annarao Hebale², Vishal Balasaheb Kharat³, Nikhil Yuvraj Khairnar⁴

Department of Civil Engineering, Viva Institute Technology University, Virar

Abstract— *The problem of Electronic and Industrial waste is increasing day by day in developing countries such as India. Rise of silicon valleys has caused increment in production, usage and discarding of huge amounts of electronic equipment. The transportation industry is producing rubber tyres as a waste product on daily basis, while the agricultural industry is producing lots of amounts of coconut shells on a daily basis.*

As the disposal of above mentioned 3 products is tedious it requires a modern sustainable solution for this problem. This project focuses on facing this problem for civil engineering point of view. In recent years attempts have been made to use Electronic waste, Coconut shells and Rubber tyres to replace coarse aggregates in concrete. This project primarily focuses on use of a mixture of above 3 materials together to replace the coarse aggregates in the concrete.

Upon receiving satisfactory results on testing sample cubes the results can be extrapolated to be used on large scale projects. This will ensure minimization of currently existing amounts of wastes and will also reduce the cost required for disposal of these waste materials by conventional methods

Keywords— *coconut shells, concrete, e-waste, partial replacement, rubber tyre.*

I. INTRODUCTION

Research concerning the use of various waste materials to augment the properties of concrete has been going on for recent years. Non recycling Waste materials are posing serious pollution problems to the human and the environment. So, new effective waste management options need to be considered. Efforts have been made in the concrete industry to use components of wastes as a partial replacement of the coarse or fine aggregates. In the recent decades, the efforts have been made to use electronic waste, coconut shell waste and rubber tyre waste from various sources in concrete for the replacement of cement, fine and coarse aggregate. The use of these materials in concrete comes from the environmental constraints in the safe disposal of these products.

Use of such waste materials not only helps in getting them utilized in cement concrete and other construction materials but also it helps in reducing the cost of cement and concrete manufacturing, but also has numerous indirect benefits such as reduction in landfill cost, saving in energy, and protecting the environment from possible pollution effects. Salient properties of each of the waste material used in this project are explained in initial chapter while the observations and results of 7 day strength tests are shown in further chapters.

II. LITERATURE REVIEW

In order to gather the primary information required for complete knowledge of the proposed project we collected various research papers about similar topic in internet. The information understood by us is explained in brief below. These research papers consist of previous projects undertaken by various people for use of waste materials as a partial replacement of coarse aggregates in concrete.

- 2.1 “An experimental study on partial replacement for coarse aggregate by E waste in concrete” “Saranya K Muthuswamy, R, Sathiyaraj, ASudharsan”(International Journal of Innovative Science, Engineering and Technology, Vol.4 Issue 3) March 2017

E waste is used to replace 20 mm size coarse aggregates. M25 mix was used. E waste was replaced with coarse aggregate by percentages 0%, 32%, 34%, 36%, 38%. The tests conducted were sieve analysis, specific gravity and, bulk density, Water absorption and pH test. Mix ratio used was 1:1.6:2.5 while the water cement ratio used was 0.45. Compressive strength tests were conducted on 7, 14 and 28 days. Split tensile strength test was conducted on cylindrical specimen. It was found that at optimum percentage of 34% replacement compressive strength of cubes casted was found to be more than conventional concrete cubes

2.2 “Partial replacement of coarse aggregate with coconut shell in the concrete” “Shrikant M. Harle” (Source- Journal of research in engineering and applied science)

Tests performed on cement were fineness tests, consistency test, IST and FST test and Compressive Strength tests. Test performed on fine aggregate was Sieve analysis. Tests performed on coarse aggregate were Fineness modulus, Bulk modulus etc. Coconut shells were dried for 5 days in sunlight and then cleaned by sandpaper. Then the outer shell was broken in up to 20mm size by hammering it with a 30 kg hammer. Water cement ratio used was 0.5 and Mix design ratio used was 1:1.5:3. The results showed that the coconut shells can be used to replace coarse aggregates by up to 10% without considerable loss in compressive strength in concrete.

2.3 “Effect of partial replacement of coarse aggregate in concrete by treated and untreated rubber tyre waste aggregate” “ShahidRasol Tarry”(- International journal of advanced science and research)

Rubber tyres were cut to 25 mm maximum size aggregates. The water cement ratio used was 0.45 while the mix ratio used was 1:1.5:3. The rubber tyre surface was treated by sodium hydroxide solution for cleaning the surface. It was observed that upon the use of rubber tyre as aggregate the flexibility of the concrete mix increases along with the compressive strength while the flexural strength decreases.

III. MATERIALS AND METHODOLOGY

3.1 Material Properties

3.1.1 Cement:

In the experimental work cement used is Ordinary Portland cement. Various properties were evaluated such as fineness of cement, setting time, soundness test.

Sr. no	Description of test	Results
1	Fineness of grinding (Residue on I.S. sieve no.9)	1%
2	Normal Consistency (%) water consistency	31%
3	Setting time Initial setting time (min) Final setting time (min)	85 min 290 min
4	Compressive strength (average of three cubes)	26.35 N/mm ²

3.1.2 Coarse Aggregate:

Sieve analysis of coarse aggregate:

The aggregates brought to an air dry condition at room temperature. The required quantity of the sample was taken (2000g). The sieves were placed in the order of size, with larger sieve on the top, in mechanical sieve shaker. Sieving was done for 10 minutes. The material retained on each sieve after shaking, represents the fraction of the aggregate coarser than the sieve considered and finer than the sieve above. The weight of aggregate in each sieve was measured and converted to a total sample. Fineness modulus was determined as the ratio of summation of cumulative percentage weight retained (F) to 100.

Physical and mechanical properties of coarse aggregates

SR NO	PROPERTIES	RESULTS
1	Specific gravity	2.67
2	Bulk density	1624
3	Fineness modulus	5.6
4	Water absorption	0.64

3.1.3 Fine Aggregates:

Physical and mechanical properties of fine aggregates

SR NO	PROPERTIES	RESULTS
1	Specific gravity	2.64
2	Bulk density	1656
3	Fineness modulus	3.37
4	Water absorption	1.0

3.1.4 Physical tests on wastes:

Sr. no.	Waste type	Fineness modulus
1	E waste	3.08
2	Rubber tyre waste	4.2
3	Coconut shells	5.5

3.2 Methodology

- Literature review

- Collection of materials
- Testing of materials
- Mix design
- Casting of specimen
- Testing of specimen
- Results and observations
- Determination of optimum percentage of replacement for coarse aggregates

Until now we have performed the tests on all the materials which will be used in this project. Based on these results we will be using the following specifications to design the mix.

Grade of concrete	Mix ratio	Water-cement ratio	Size of aggregates to be replaced
M25	1:1.5:3	0.5	20 mm

Henceforward we will be casting the specimen cubes by replacing the coarse aggregates in concrete with waste materials by 10%, 20% and 30% first individually and then as a mixture. The casted cubes will be subjected to various to strength tests the results of which will determine the feasibility of the use of waste material mixture as a coarse aggregate replacement on larger scale.

- Test for Fresh state properties-
- Slump value test

The concrete slump test measures the consistency of fresh concrete before it sets. It is performed to check the workability of freshly made concrete, and therefore the ease with which concrete flows. It can also be used as an indicator of an improperly mixed batch

3.3 Tests for hardened state properties-

- Compressive strength test

Compressive strength test, mechanical test measuring the maximum amount of compressive load a material can bear before fracturing. The test piece, usually in the form of a cube, prism, or cylinder, is compressed between the platens of a compression-testing machine by a gradually applied load.

IV. OBSERVATIONS AND RESULTS

- Slump values for fresh concrete mixes were observed to be as below from slump cone test

Replacement Percentage	Slump Value (mm)
0%	150
10%	100
20%	70
30%	40

- Compressive strength test results after 7 days strength test are as below

Replacement Percentage	7 days compressive strength (KN)	Average compressive strength (KN)
------------------------	----------------------------------	-----------------------------------

	Cube1	Cube2	Cube3	
0%	490	510	500	500
10%	540	550	540	543
20%	490	490	510	496
30%	370	350	360	360

V. CONCLUSION

7 days compressive strength test shows that replacement of coarse aggregates by mixture of electronic waste, rubber tyres and coconut shells by upto 10% gives compressive strength more than normal concrete while upto 20% replacement gives compressive strength approximately equal to that of normal concrete. Replacement more than 20% shows reduction in strength and thus not recommended.

VI. ACKNOWLEDGEMENTS

- Mr. Suraj S. Madhavi, Quality Manager, Ameya RMC Plant

REFERENCES

- [1] "An experimental study on partial replacement for coarse aggregate by E waste in concrete" "Saranya K Muthuswamy, R,Sathiyaraj,ASudharsan"(International Journal of Innovative Science, Engineering an Technology,Vol.4 Issue 3)March 2017
- [2] "-Replacement of coarse aggregate with e waste" "-Harish J Kulkarni, ArunKumar,Harshraj S"(4th international conference on emerging trends in engineering, technology, science and management)
- [3] "Recycle of e waste in concrete" "Shobana R."(- SSRG international journal of civil engineering(ICEHS))May 2017
- [4] "Partial replacement of coarse aggregate with coconut shell in the concrete" "Shrikant M. Harle" (Source- Journal of research in engineering and applied science)
- [5] "A review on partial replacement of coarse aggregate with coconut shells in concrete" "ShrikantHarle" (Journal of recent activities in Architectural science)
- [6] "Effect of partial replacement of coarse aggregate in concrete by treated and untreated rubber tyre waste aggregate" "ShahidRasol Tarry"(- International journal of advanced science and research)
- [7] "Waste Tyres as a partial replacement of coarse aggregate" "Ashok S, Kapil Dev. K, Senthil Kumar"(First International conference on nextgen technologies)