# EXPERIMENTAL INVESTIGATION ON USING E-WASTE, LUFFA FIBRE AND FLY ASH ON CONCRETE

**K.PERUMAL[1], S.SUDHARSAN[2], G.SHRIRAM[3], R.SANTHOSH SIVAN[4]**

*[1] ASSISTANT PROFFESSER, CIVIL ENGINEERING, K.RAMAKRISHNAN COLLEGE OF TECHNOLOGY, SAMAYAPURAM, TRICHY – 621 112, TAMILNADU, INDIA.*
*[2] STUDENT, CIVIL ENGINEERING, K.RAMAKRISHNAN COLLEGE OF TECHNOLOGY, SAMAYAPURAM, TRICHY – 621 112, TAMILNADU, INDIA.*
*[3] STUDENT, CIVIL ENGINEERING, K.RAMAKRISHNAN COLLEGE OF TECHNOLOGY, SAMAYAPURAM, TRICHY – 621 112, TAMILNADU, INDIA.*
*[4]STUDENT, CIVIL ENGINEERING, K.RAMAKRISHNAN COLLEGE OF TECHNOLOGY, SAMAYAPURAM, TRICHY – 621 112, TAMILNADU, INDIA.*

---

**Abstract -** *Concrete is an irreplaceable composition in civil engineering field. Since from the beginning of the construction it has been used. As the time passes, the raw material used in this concrete becoming very insufficient. So in order to develop a sustainable construction method, using of e-waste, fly ash and luffa fibre as a partial replacement could provide a better sustainable construction method in the concrete. E-waste is world third largest disposal of non-bio degradable waste. Luffa fibre is a high tensile natural fibre. So using this materials as a replacement in concrete could provide a better performance like conventional concrete at the same time. The present study involves the use of E-waste and luffa fibre in concrete which helps in better strength. Experiments are conducted in these investigations involve compressive strength, Flexural strength and Split tensile strength of the concrete of M20 grades in its 7th, 14th and 28th day. This deal with the comparison of conventional concrete with the concrete adding E-waste and luffa fibre. The aim of this project is to make construction economical and reduce the self-weight in concrete. In this project the addition of E-waste and fly ash in three different percentages (5.00%, 7.50% , 10.0% and 12.50%) for the concrete Grade M20. Luffa fibre is added as natural admixture not exceeding 2%. After the addition is done the strength of concrete is investigated. For this investigation IS 10262:2009 code book is referred for the calculation of mix design.*

***Key Words***: E-waste, luffa fibre, flexure strength, compressive strength, tensile strength

## 1. INTRODUCTION

Concrete is that the second most essential material consumed after water. For several years, efforts are made to use industrial by-products like ash, silica fume, ground granulated furnace slag, etc. as admixtures in concrete constructions. The extraction of natural resources for construction materials creates environmental problems, and thus, attention is being focused on the environment and safeguarding of natural resources and recycling of waste materials. Concrete is most usually used construction material because of its smart compressive, Tensile and flexure strength and strength. Relying upon the character of labor the cement, fine combination, coarse combination and water area unit mixed in specific proportions to produce plain concrete. Plain concrete desires appropriate atmosphere by providing wetness for a minimum amount of twenty eight days for good association and to know desired strength. Addition of E-waste can cut back the self-weight and build economical. Addition of luffa fibre can increase the strength and cut back the cracks at intervals the concrete. Electronic waste or e-waste describes abbreviated as electrical or electronic devices. Properly administered, it ought to greatly cut back the escape of nephrotoxic materials into the setting and mitigate against the exhaustion of natural resources. The fruit section of L. aegyptiaca might even be allowed to mature and used as a shower or room sponge when being processed to urge obviate everything except the network of vascular tissue fibers. If the loofah is allowed to utterly ripen then dried on the tracheophyte, the flesh disappears going away solely the fibrous skeleton and seeds, which can be simply agitated out. Marketed as luffa or loofah, the sponge is utilized as a body scrub. Fibre bolstered composite is one such material, that has revolutionized the construct of high strength. Most of the natural composite materials grows from the forest and agriculture. Luffa-cylindrica domestically referred to as as "sponge-gourd" is one such natural resources whose potential as fiber reinforcement in chemical compound composite has not been explored until date for tribological applications.

## 2. EXPERIMENTAL DESCRIPTION

### 2.1 Waste collection:

E- Waste was collected from TES-AMM recyclers, Kanchipuram.

### 2.2 Method of grinding:

Plastic waste of packed water and cold drinks bottle and so the e waste were grinded into the scrap grinder machine into tiny size particles passing through four.75 millimetre sieve.

Figure one shows the scrap grinding machine, the raw waste and thus the grinded waste. The grinded e-waste was any processed in friction roller machine throughout that the particles were crushed due to mutual touching and rubbing action. The machine was style with power window motor that rotates the friction disk. The particles cornered in between the disk brakes and develop irregular surface that in turn offer a lot of space to bind with cement. The e-waste contents are calculated as weight per cent of coarse mixture among the management combine. The fineness modulus of coarse mixture with varied e-waste contents was between one.86 and 2.78. The e-waste particles are typically thought of as partial coarse mixture substitute retentive combine quantitative relation as a result of a similar. The divided particle size is assumed to be between 600 micrometre – 2.36mm.

## 2.3 Mortar mixes

Cement mortar cubes, cylinder and prism of M20 proportions and modified with various E-waste contents as listed in Table 1. The fine aggregate used is the standard sand specified by IS 650-1966 (revised). The waste was mixed as a replacement of fine sand confirming to grade 1. Fly ash is added as a filler material along with partial replacement of cement. Luffa fibre is added as a natural admixture. So it is added as per the proportion within 2% specified by IS 10262:2009(revised).

**Table -1:** Mix ratio

| Mix specification | Control mix 1 | Control mix 2 | Control mix 3 | Control mix 4 |
|---|---|---|---|---|
| Proportion of E-waste | 5% | 7.5% | 10.00% | 12.50% |
| Proportion of fly ash | 5% | 7.5% | 10.00% | 12.50% |

## 2.4 Material property

### 2.4.1 E- WASTE

E-waste sources within the sort of loosely discarded, surplus, obsolete, broken, electrical or electronic devices from commercial informal recyclers are collected, crushed and ground to the particle size.

**Fig 1**: crushed E-waste particle

E-waste particle

- •Specific gravity :1.01
- •Absorption (%) : <0.2
- •Impact value : <2%
- •Color : Green and grey
- •Shape : Angular
- •Crushing value : <2%

### 2.4.2 FLYASH

Fly ash consists of the non-combustible mineral portion of coal. Particles are glassy, spherical ‘ball bearings’ finer than cement particles. Sizes of particle are 0.1μm-150 μm. it's a pozzolonic material which reacts with free lime within the presence of water, converted into calcium silicate hydrate (C-S-H) which is that the strongest and sturdy portion of the paste in concrete.

**Fig -2**: Dry fly ash

- Specific gravity : 3.15
- Initial setting time : 145 minutes
- Final setting time : 190 minutes
- Fineness : 95%

### 2.4.3 AGGREGATE

The fractions from twenty millimeter to four.75 millimeter are used as coarse mixture. The Coarse Aggregates from crushed volcanic rock, orthodox to IS: 383 are used. The Flakiness Index and Elongation Index were maintained well below 15 August 1945. Those fractions from four.75 millimeter to a hundred and fifty metric linear unit are termed as fine mixture. The stream sand and crushed sand is used along as fine mixture orthodox to the needs of IS: 383. The stream sand is washed and screened, to eliminate hurtful materials and over size particles.fig.-3, four & five fine mixture, coarse mixture and grit

**Table -2**: Properties

| Property | Fine aggregate | Coarse aggregate |
|---|---|---|
| Fineness (%) | 3.35 | 7.54 |
| Specific gravity | 2.38 | 2.76 |
| Water absorption (%) | 1.20 | 1.83 |

### 2.4.4 CEMENT

The most common cement used is an Ordinary Portland Cement (OPC). The Ordinary Portland Cement of 53 grade (Ramco OPC) conforming to IS: 8112-1989 is used. Many tests were conducted on Cement; some of them are specific gravity, consistency tests, setting time tests, compressive strengths, etc.

**Table -3**: Properties

| S.no | Physical properties of cement | Result | Requirement as per IS: 8112-1989 |
|---|---|---|---|
| 1 | Specific gravity | 3.10 | 3.10-3.15 |
| 2 | Standard consistency (%) | 28 | 30-35 |
| 3 | Initial setting time | 35 min | 30 minimum |
| 4 | Final setting time | 178 min | 600 maximum |

### 2.4.5 LUFFA FIBRE

Dried luffa fruit's fibrous system forms a natural 3D network which is able to reinforce matrices in composite materials, entertaining cracks on the complicated array of 3D interfaces between the fibers and thus the building material matrix. To avoid fiber deterioration, the cement paste was changed by incorporating pozzolanic materials. The fibers were automatically characterized by tensile testing of strips of the 3D fibre array and of single fibers extracted from the array.

## 3. TESTING

### 3.1 COMPRESSION STRENGTH TEST

Casted twelve cube specimen with individual proportion. Compressive strength is that the ability of fabric or structure to hold the masses on its surface with none crack or deflection. a fabric below compression tends to cut back the dimensions, whereas in tension, size elongates.

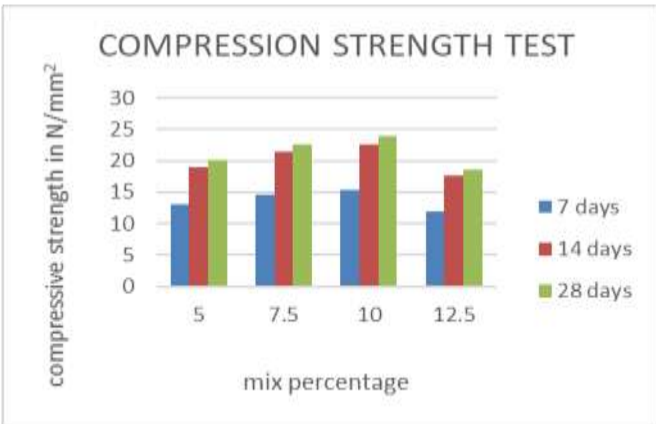


**Chart-1:-** compression strength test

### 3.2 TENSILE STRENGTH TEST

The results of cacophonic strength of concrete mixes measured at seven, fourteen and twenty eight days Figures shows the variation of splitting strength. Split strength at seven days as compared to controlled concrete of M20 grade. As split strength at fourteen days as compared to controlled concrete of M20 grade strength whereas split strength at twenty eight days when put next to controlled concrete of M20 grade strength severally. All cylinders show associate honest ductile behaviour. Cacophonic strength will increase with the age of hardening. Wherever the utmost gain is at M20 grade concrete other with luffa fibre attain higher split strength at associate age of twenty eight days hardening amount. These results review the potency of concrete as a strengthening material for concrete columns however as this paper solely presents tests on tiny concrete specimens like cubes and cylinders, more analysis should be done on strengthened columns of assorted cross sections.

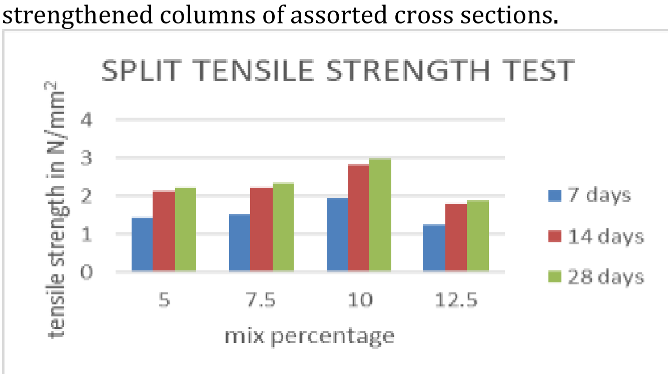


**Chart-2:-** tensilestrength test

### 3.3 FLEXURAL STRENGTH TEST

The beam specimens of size 150×10×700mm were tested to work out the flexural strength. It's clear from the Table seven and Figure three that there is increase inside the flexural strength with the addition of E-waste & luffa fibers. But most increase in strength was ascertained from e-waste & luffa fibers proportions seven.5% & 10.0% severally. There is additionally gradual increase in flexural strength of concrete.

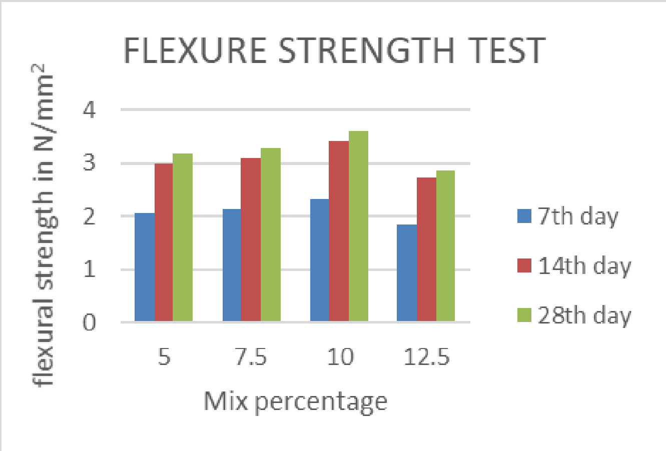


**Chart-3:-** Flexural strength test

## 4. CONCLUSIONS

As from above test result the conclusion was about the usage limit of E-waste as fine aggregate in concrete by following points:

- The usage of E-waste gave a considerable result comparing to conventional concrete but not up to its level. It gives equivalent result 10 % mix proportion.
- It is found that using of fly ash would have helped to attain its strength despite E-waste material
- Luffa fibre addition has to be done carefully with proper compaction. So it would arrest the crack effectively
- Although it hasn't provided a tremendous change in workability of concrete, it's suggested that using E-waste in an optimum level will really improve strength. Mix above 12.5% shows a decrease in its strength.
- In order to meet future crisis on construction further study has to be made.

## 5. RECOMENDADTION

It is recommended to pulverize the E-waste at proper fineness to get better granular texture and fineness. But using e-waste in concrete as a fine aggregate as has to be reviewed again by further studies. Luffa fibre provides a promising result which arrests the tensile crack effectively.

## REFERENCES

[1] Performance of Recycled E-waste as Aggregates in Green Concrete, A. Arun Kumar† and R. Senthamizh Selvan, School of Mechanical and Building Sciences, VIT University Chennai Campus, Chennai, India. †Corresponding author: A. Arun Kumar

[2] Response Surfaces for Fresh and Hardened Properties of Concrete with E-Waste (HIPS), K. Senthil Kumar and K. Baskar, Department of Civil Engineering, NIT, Tiruchirappalli, Tamil Nadu 620015, India. Received 17July 2014; Accepted 10September 2014; Published 25September 2014.

[3] Investigations on Durability Characteristics Of E-Plastic Waste Incorporated Concrete R. Lakshmi and S. Nagan KLN College of Information Technology, Sivagangai Dist, TamilNadu, India. Thaigarajar College of Engineering, Madurai, Tamiladu, India. Received: 20 January 2011, Accepted: 11 April 2011.

[4] Scope of Utilisation of E-Waste in Concrete, Salman Siddique, Sikandar Shakil, Mohd. Shadab Siddiqui, International Journal of Advance Research in Science and Engineering IJARSE, Vol. No.4, Special Issue (01), March 2015.

[5] An Experiment Investigation on Concrete by Using E-Waste as Fine Aggregate and Enhanced the Thermal Insulation and Ultrasonic Properties, A.A. Dhanraj, C. Selvamony, A. Joshuva; International Journal of Civil Engineering and Technology (IJCIET).