# Influence of E-Waste as Partial Replacement for Cement Material

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***Abstract- This paper is attempted to provide the investigation of properties and influence of e-waste on concrete. The utilization of the waste generated from the electronic devices adds sustainability for the environment. This study generates a path to find the efficient methods to reutilize the electronic waste in place of the conventional building materials. This paper reports the behaviour of the concrete with E-waste as a partial replacement of fine aggregate due to its compatibility. The percentage of E-waste replacement is 10%, 20%, 30%, 40% and 50% of the fine aggregate. We used the printed circuit boards [ PCBs] as E waste consist of approximately 26% metal, made up mainly of copper, lead, aluminum, iron and tin, as well as other heavy metals such as cadmium and nickel***

***Indexed Terms- PCBs, Compressive strength, Flexural Strength, E waste.***

## I. INTRODUCTION

Advances in the field of science and technology brought about industrial revolution in the 18th Century which marked a new era in human civilization. In the 20th Century, the information and communication revolution has brought enormous changes in the way we organize our lives, our economies, industries and institutions. These spectacular developments in modern times have undoubtedly enhanced the quality of our lives. At the same time, these have led to manifold problems including the problem of massive amount of hazardous waste and other wastes generated from electric products. These hazardous and other wastes pose a great threat to the human health and environment. The issue of proper management of wastes, therefore, is critical to the protection of livelihood, health and environment. It constitutes a serious challenge to the modern societies and requires coordinated efforts to address it for achieving sustainable development.

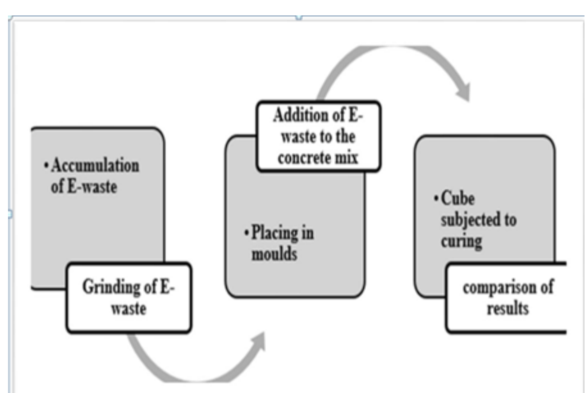
## II. AIM OF THE PAPER

- To identify that e-waste can be disposed by using them as construction material.
- Replacement of e-waste as cement powder
- To determine the compressive and flexural strength of concrete containing e-waste cement.

## III. METHODOLOGY

The step by step procedure for testing the concrete cube is as follow

1. Accumulation of E waste
2. Grading of E waste
3. Placing in molds
4. Addition of E waste to the concrete mix
5. Cube subjected to the curing
6. Compression of results



## IV. PREPARATIONS OF TEST SPECIMENS

The concrete of various specimens were prepared for different mixes with added cement and E– waste. After that water was added and the mixing was continued until the consistent mix was obtained and the concrete was placed in the moulds. For compressive strength and durability test, 54Nos. cubes of size 150 × 150 × 150 mm were casted. For flexural strength test 54 Nos. beams of size 100 × 100 × 500 mm were casted and after final setting of spaceman {for 24 hours}.

All specimens free from mould and placed into water tank for curing for period 7, 14, 28 days.

## V. PHOTOGRAPHS

Image1: - Casting of Beam

Image-2: - Casting of Cubes

- Compressive Strength [IS 516:1959 Method of test for strength of concrete]

It is one of the most vital properties of concrete and influences many other desirable hardened concrete. The compression type is a laboratory test to determine the characteristics strength of concrete. The compressive strength is determined as

Compressive Strength = P/A.

The compressive strength of the control mix, A1, A2, A3, A4, A5 concretes are given in Figure 2. A1, A2, A3, A4, A5 represents the mixing of E-waste in different Percentage for the replacement of cement in a concrete. The compressive strength result presented in the Figure 2 is for 7, 14 and 28 days. The testing of cubes in UTM is presented that the 28th day strength of control mix concrete is 27.35 N/mm2. It reduces gradually when cement is replaced by E-waste crush powder. As the percentage of replacement of cement by E-waste increases, the compressive strength decreases progressively after 10% mix of E-waste.


Image3:- Compressive Strength test

- Flexural Strength [IS 516:1959 Method of test for strength of concrete]

The flexural behavior of the beams shows that structural properties similar to the load–deflection curve pattern. Before cracking, the linear slope of the load–deflection curve was steep occurred in all testing beams due to the stiffness reduction, the flexural cracks were observed from the change in slope of the load–deflection. Flexural strength can be described as the capacity of a beam Fb= (pl)/ (bd2) if supported length is greater than 13.3 mm

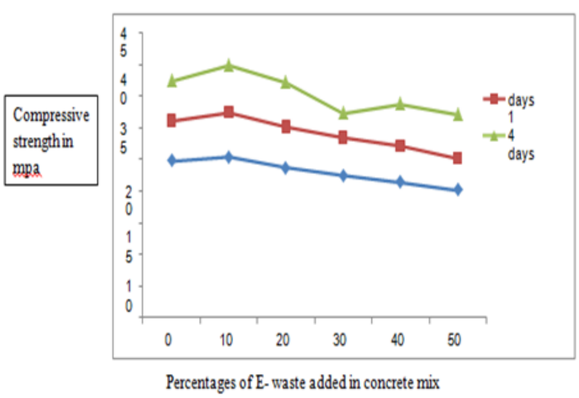
Where,
p = Maximum load applied (N),
I = Supported length of the specimen (mm)
b = Measured width of the specimen (mm)d= Measured depth of the specimen at the point of failure (mm)
Flexural strength is equal to 1/10 of cube test.

Image4: - Flexural Strength test

## VI. TEST RESULT

7.1 Compressive strength test results in N/MM$^2$

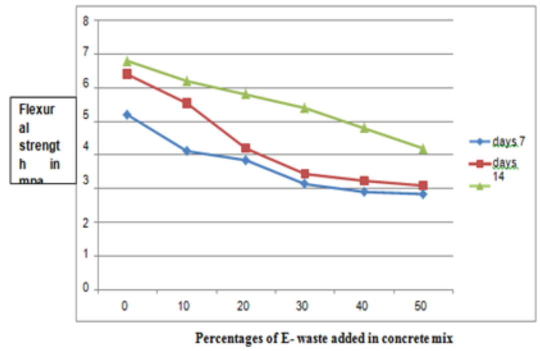
| Sr. No. | Mix Specification | Control mix | A1 | A2 | A3 | A4 | A5 |
|---|---|---|---|---|---|---|---|
| 1 | Proportion of E-waste | 0% | 10% | 20% | 30% | 40% | 50% |
| 2 | 7 Days | 20.23 | 21.5 | 19.10 | 18.25 | 17.9 | 15.68 |
| 3 | 14 Days | 24.10 | 25 | 24 | 23.4 | 21.24 | 19.28 |
| 4 | 28 Days | 27.35 | 28.71 | 27.15 | 25.61 | 23.42 | 22.52 |




Graph1: - Relation between Compressive Strength and % of E waste

7.2 Flexural Test

| Sr. No | Mix Specification | Control mix | B1 | B2 | B3 | B4 | B5 |
|---|---|---|---|---|---|---|---|
| 1 | Proportion of E-waste | 0% | 10% | 20% | 30% | 40% | 50% |
| 2 | 7 Days | 5.2 | 4.12 | 3.85 | 3.14 | 2.91 | 2.85 |
| 3 | 14 Days | 6.4 | 5.54 | 4.2 | 3.44 | 3.24 | 3.1 |
| 4 | 28 Days | 6.8 | 6.2 | 5.8 | 5.4 | 4.8 | 4.2 |




## DISCUSSION

- By observation of cube and beam molding after 24 hours. drying specimen change its color from gray to pink due to chemical reaction between cement and E-waste (Due to mineral contain)
- After placing specimen into water tank for curing after some days white floc is produce on water surface. Which is float on water
- After test result notice the compressive strength values of all waste plastics concrete mix tend to decrease below the values for the reference concrete mixtures with increasing the waste plastic ratio at all curing stages. This may attribute to the decrease in the adhesive strength between the materials. In addition, waste plastic is hydrophobic materials which may restrict the hydration of cement.

## CONCLUSION

According to the experimental results, we can conclude that:

Utilization of partial replacement of E–waste as a cement is the best alternative for the conventional concrete. The disposal of E–waste can be used as cement provides the reduction in burden on landfill disposing and environmental pollution. The E–waste concrete density is less as compared with the conventional concrete which reduces the cost of the concrete and produces the light weight concrete structure. The results shows that the good strength, greater durability and addition of E–waste exhibits increase in compressive strength up to 10% replacement. This is useful in applications requiring non-bearing lightweight concrete, such as concrete panels used in facades, P.C.C concrete Road. Also making building Material i.e. E-waste concrete paving block, Bricks etc.

For a given w/c, the use of E-waste powder in the mix lowers the density, flexural strength of concrete.

The effect of water –cement ratio of strength development is not prominent in the case of E-waste concrete. It is because of the fact that the E-waste powder reduce the bond strength of concrete. Therefore, the failure of concrete occurs due to failure of bond between the cement paste and E-waste powder. Introduction of E- waste plastic powder in concrete tends to make concrete ductile, hence increasing the ability of concrete to significantly deform before failure. This characteristic makes the concrete useful in situations where it will be subjected to harsh weather such as expansion and contraction, or freeze and thaw.

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