International Journal of Management, IT & Engineering
Vol.9 Issue 4, April 2019,
ISSN: 2249-0558 Impact Factor: 7.119
Journal Homepage: http://www.ijmra.us, Email: editorijmie@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gate as well as in Cabell's Directories of Publishing Opportunities, U.S.A

Ecological Pollutents as Aggregate in Concrete

Sauhardra Ojha, Prince Poddar*
Department of Civil Engineering, IET, Dr. Rammanohar Lohia Avadh University Ayodhya, U.P,- 224001, India

***Corresponding Author:**

Abstract:

The innovative technologies lead to upgrade of E- Equipment's like Smart phones, laptop, Gadgets, etc. The increase in E-waste (Electrical / Electronic) is also inevitable and hence increase in pollution and health hazard cannot be denied. Due to inappropriate management of E-waste, India will generate approximately 4.8 million tons of Electrical waste by 2020. The Utilization of Waste materials in construction industry as by-products is a sustainable solution to E waste management. Use of such waste materials as coarse and fine aggregate makes their reutilization in cement-concrete, RCC and other construction materials, which is more economical as conventional concrete. In this article the effect of E-waste as coarse aggregate on the mechanical properties of M 20 mix concrete has been studied. It has been found that the addition of E-waste causes the concrete to form light weight concrete and also enhance various properties. In this research article 10%, 15% and of E- waste is partially replaced by Coarse aggregate.

Keyword: waste utilization concrete, E-waste,

1. Introduction

In recent years, whole world is facing enormous problem due to scarcity of natural resources and waste management. Construction industry is facing the issues of scarcity as natural resources are getting depleted day by day. Concrete is considered as one of the prime important construction material that has to withstand various environmental conditions. Several researchers in recent days have utilised waste materials like electronic waste or e-waste to improve the quality and properties of concrete. E-waste are generally categorised as the electrical and electronics devices that have been discarded. The discarded and end-of-life electronics products ranging from computers, equipment used in Information and Communication Technology (ICT), home appliances, audio and video products and allof their peripherals are popularly known as Electronic waste (E-waste). There is, however, no standardor generally accepted definition of e-waste in the world. E-waste is not hazardous if it is stocked in safe storage or recycled. The e-wastecan, however, be considered hazardous if recycled by primitive methods. E-waste contains several substances such as heavy metals, plastics, glass etc., which can be potentially toxic and hazardous to the environment and human health, if not handled in an environmentally sound manner (Kale et al 2013). E-waste recycling in the non-formal sector by primitive methods can damage the environment. The ill effects of e-waste could be on soil through leaching of hazardous contents from landfills; in water due to contamination of rivers, wells and other water sources; in air dueto emission of gases and burning of e-waste. The recycling process,if not carried out properly, cancause damage to human being through inhalation of gases during recycling (Arora, A et al.2013), contact of the skin of the workers with hazardous substances and contact during acid treatment used in recovery process. The hazardous and toxic substances found in e-waste include lead (Pb) and cadmium (Cd) in printed circuitboards (PCBs). Lead is primarily found in allelectronic products/ assembly, cathode ray tubes (CRT) etc. Cadmium is found in monitor/ CRTs while there may be mercury in switches and flat screen monitors. Mercury is also found in CFL, relays and some other specific products. Besides the cadmiumin computer batteries, cadmium is also used for plating metal enclosures/ metal parts in sub-assemblies (Ghosh .B et al.2015).Polychlorinated biphenyls are found in capacitors and transformers and as brominates flame retardant onprinted circuit boards, plastic casings, cable and polyvinyl chloride (PVC) cable sheathing for insulation and PBD/PBDE in plastic parts of electronics. No exclusive study has so far been made to know the effect of the e-waste in the environment. (Zhitong Yao et al. 2018).

Material used

Details of various material used for this work has been given here in a well-defined manner in order to understand the properties and need of these materials.

2.1-FineAggregate

Fine aggregates are small size filler materials in construction,they are the particles that pass through 4.75 mm IS sieve and retain on 0.075 mm sieve.Sand, surkhi, stone screenings, burnt clays,cinders, flyash and also stone dust etc. are used as fine aggregate in concrete. The surface area of fine aggregates is higher and the voids between the coarse aggregate are filled up by fine aggregate.[7]

Stone dust as fine aggregate is used during mix design the properties of the material is given below.

Properties	Value
Specific Gravity	2.64
Water absorption (%)	7.3
Density in loosest state (g/cc)	1.58
Density in densest state (g/cc)	1.75

2.2-CoarseAggregate

Coarse aggregates are larger size filler materials in construction works and coarse aggregates are the particles that retain on 4.75 mm sieve [8], some of the good example for coarse aggregate can be given as brickchips (brokenbricks), stonechips (brokenstones), gravels,pebbles,clinkers,cindersetc.Dolomite aggregates, crushed gravel or stone, natural disintegration of rock are the major sources of coarse aggregate. The surface area of coarse aggregate is less than fine aggregates and also coarse aggregate acts as inert filler material for concrete while they are mainly used in concrete, railway track ballast, etc.

Coarse aggregate for concrete, except as noted above and for other than lightweight concrete shallconform to IS 383. This shall consist of natural or crushed stone and gravel and shall be clean and freefrom elongated, flaky or laminated pieces adhering coatings, clay lumps, coal residue, clinkers slag,alkali, mica, organic matter or other deleterious matter.

2.3 Electrical/ElectronicWaste (E waste)

We have selected the range of electrical waste of size in between 4.75mm to 20mm for this project as it can be seen in figure1

Fig.1. E waste as coarse Aggregate

2.4 Cement

Cement is a binder substance used for construction that sets, hardens, and adheres to other materials tobind them together. Cement is seldom used alone but rather to bind sand and gravel (aggregate) together. Cement mixed with fine aggregate produces mortar for masonry, or with sand and gravel, produces concrete. Concrete is the most widely used material in existenceand is behind only water astheplanet's most-consumed resource.PPC cement is used in this project as it is used for moderate strength works and perfect for M20 grade concrete.

The properties of PPC Cement is given below in Table 2

Table 2 : Physical Properties of PPCCement

Characteristics	**Testvalue (PPC Cement)**
Normal consistency %	31.5
Specific gravity	3.1
Fineness %	5
3dayscompressiveStrength, MPa	16
7dayscompressiveStrength, MPa	22
28dayscompressiveStrength ,MPa	34

3. Methodology

The cubes were prepared by replacingCoarseAggregate by 10%,and 15% by e-waste inconcrete. The size of e-waste taken in the range of 4.75-20mm. Cement used was PPC and grade used was M20. Standard size of cube casted should be of the size 15x15x15 in cm. Compression testing machine was used for calculating the difference in compressive strength of the cube casted with having e-waste as coarse aggregate and with standard coarse aggregate. Total Numberof cubescasted for testing was 27. Compressive test will be conducted on the7th day,14th day and 28th day with the replacement containing 10%, and 15% having 3 cubes of similar Percentage. Average compressive strength was calculated by the compressive strength calculated on the 3 cube samples of same e-waste concentration.

4. Results and Discussion

Table 3 Strength Comparisons of Various Cubes (Average Strength)

	0%e-waste	10%e-waste	15%e-waste
Day7	15 N/mm^2	15.63 N/mm^2	13.96 N/mm^2
Day14	22 N/mm^2	21.27 N/mm^2	18.4 N/mm^2
Day28	23 N/mm^2	24 N/mm^2	22.3 N/mm^2

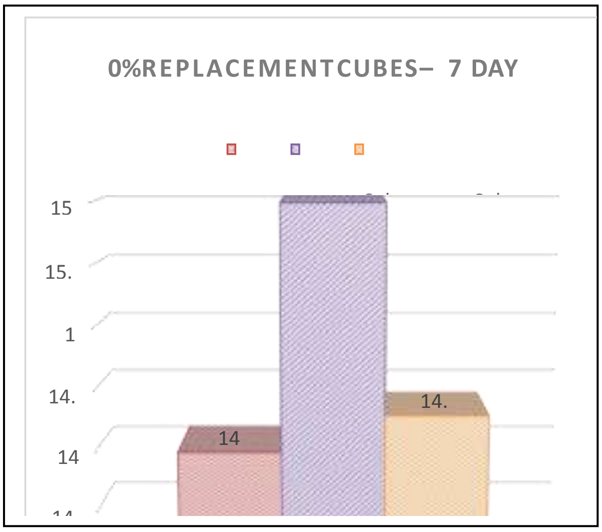


Fig.2. Conventional cubes strength at 7 days

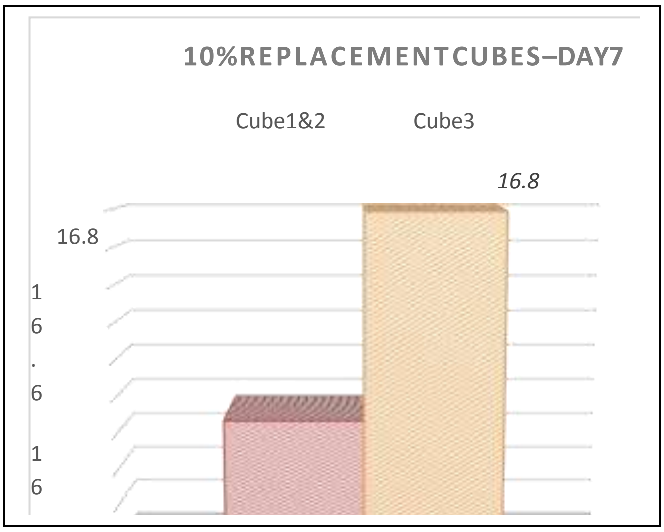
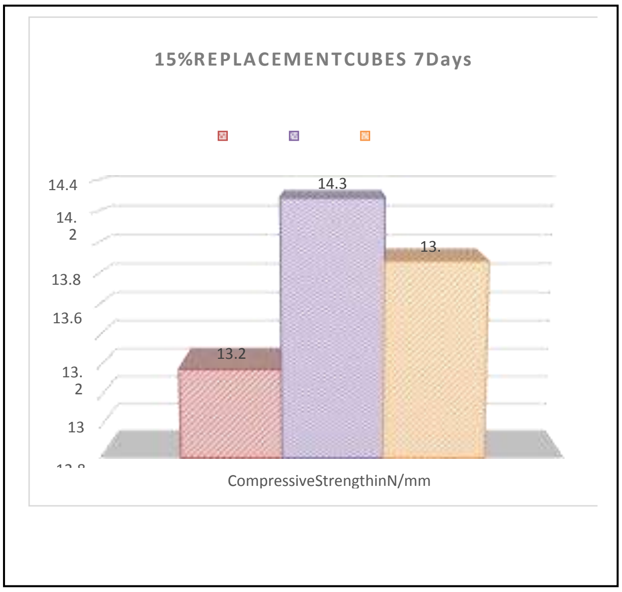


Fig.3.Cubes strength (10% E waste) at 7days



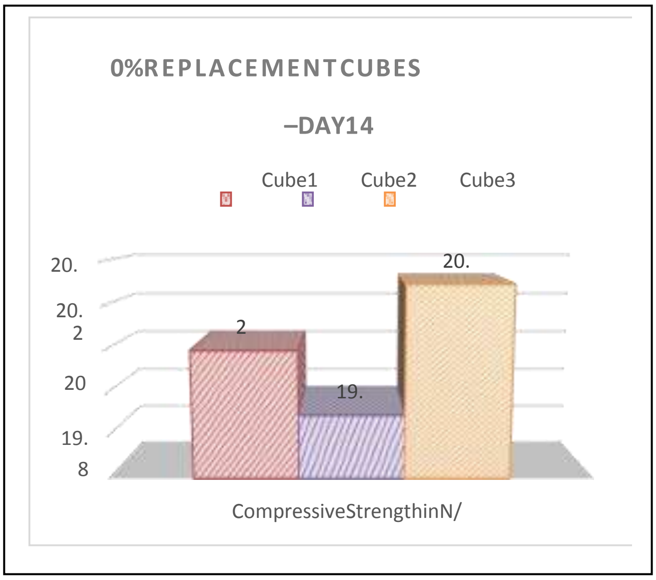


Fig.4. Cubes strength (15% E waste) at 7days

Fig. 5. Conventional cubes strength at 14 days

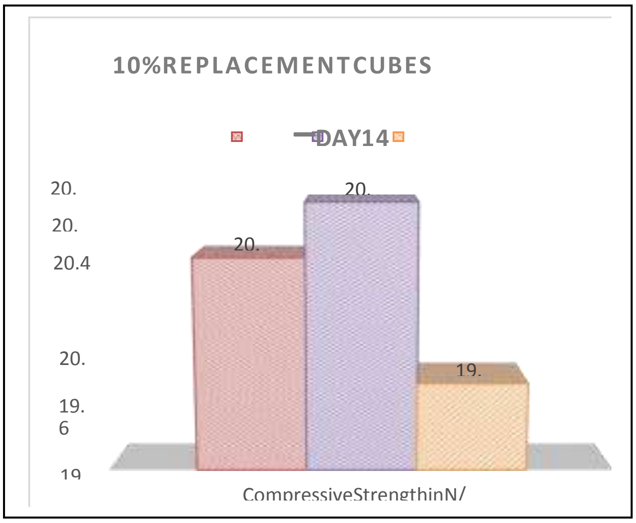


Fig. 6. Cubes strength (10% E waste) at 14 days

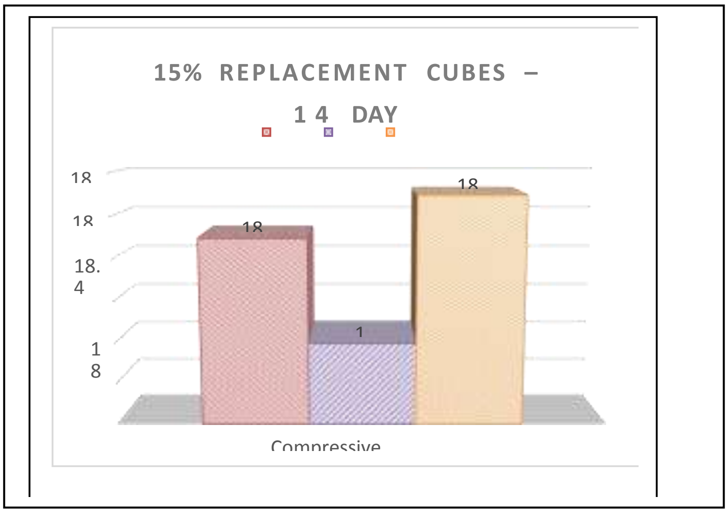


Fig .7. Cubes strength (15% E waste) at 14 days

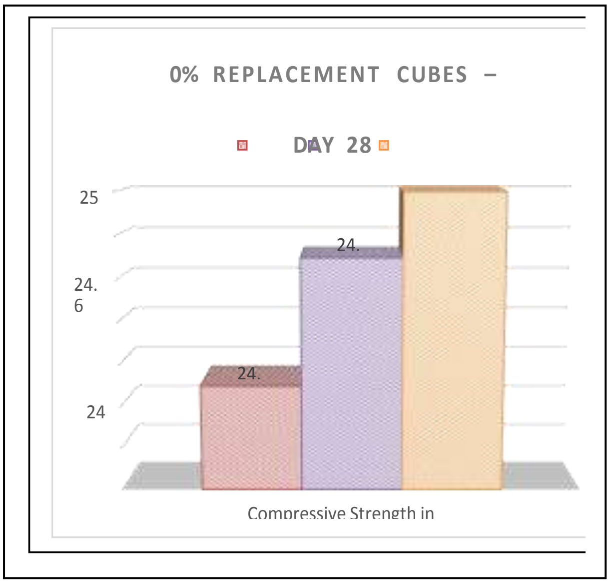


Fig.8.Conventional cubes strength at 28 days

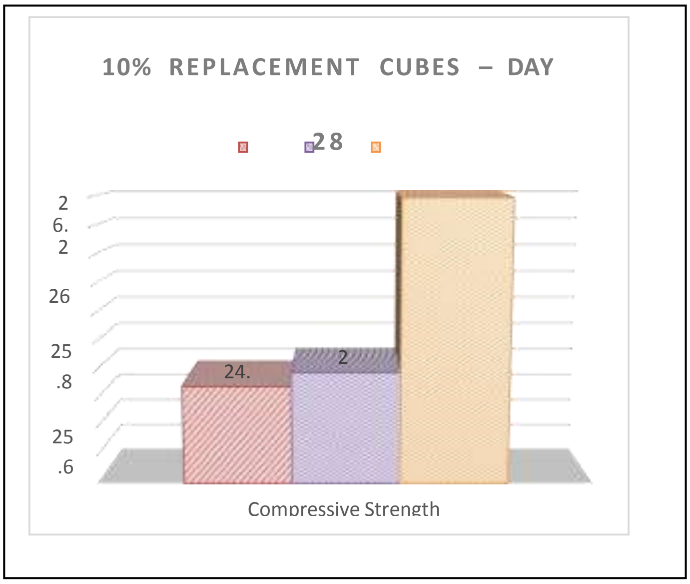


Fig.9.Cubes strength (10% E waste) at 28 days

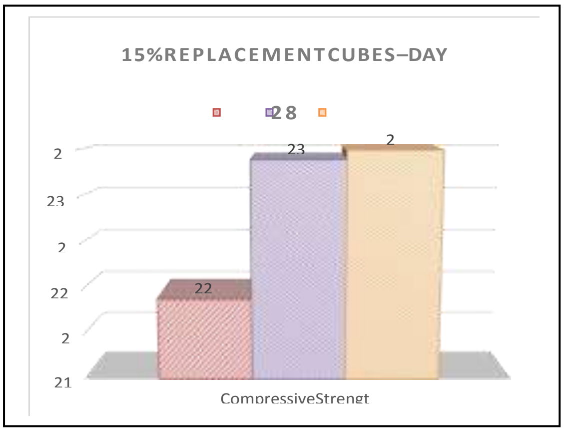


Fig.10 Cubes Strength (15 % E waste) at 28 days

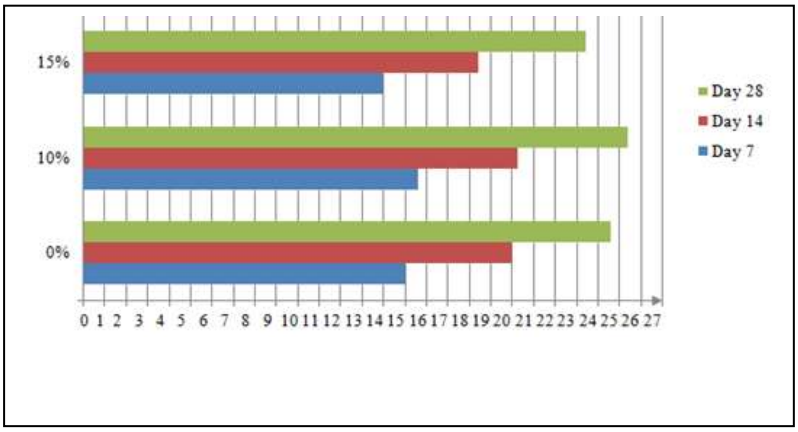


Fig.11.Combined data of all cube strength with % replacement and No of days

5. Summary and Conclusions:

Following points can be deduced from the experiment performed above, which can be summarized as following.

As the amount of electrical waste increases, strength increases from 0% to 10% butwhen the amount is further increased the decrease in strength can be noted for 15%.

Hence this experiment was successful in utilization of electrical waste in concrete for M20 grade.

The highest strength can be noted at10% electrical waste when mixed in coarse aggregate than theotherpercentages.

At day7, 10% electrical waste has shown 4.3 % increase in strength than the conventional cubes.

At day 14, 10% electrical waste has shown 3.1% increase in strength than the conventional cubes. At day 28, 10% electrical waste has shown 3% increase in strength than the conventional cubes.

So, from the above we can finally conclude that we can use electrical waste in concrete to solve various environmental problems like pollution and also save human or living life from poisonous chemicals and this will also be accompanied by greater strength than the conventional concrete.

References

1. ZhitongYao., Tung-Chai Ling.,P.K.Sarker.,WeipingSu., JieLiuWeihong., WuJunhong Tang.,"Recycling difficultto-treat E-waste cathode-ray-tube glass as construction and building materials", 2018.
2. Alagusankareswari, K., Kumar, S. S., Vignesh, K. B., & Niyas, K. A. H. (2016). An experimental study on E-waste concrete. *Indian Journal of Science and Technology*, *9*(2).
3. Kale, S. P., & Pathan, H. I. (2013). Recycling of Demolished Concrete and E-waste. International Journal of, 260-268.
4. Ghosh .B, Ghosh.MK, Parhi. P, Mukherjee. PS , Mishra B.K (2015)"Waste Printed Circuit Boards recycling: an extensive assessment of current status" , Journal of Cleaner Production 94, pp. 5-19
5. Arora, A., & Dave, U. V. (2013). Utilization of e-waste and plastic bottle waste in concrete. *International Journal of Students Research in Technology & Management*, *1*(4), 398-406.

6. Raut, Sagar R., Roshani S. Dhapudkar, and Monali G. Mandaokar. "Experimental study on utilization of E-waste in cement concrete." *The International Journal of Engineering and Science (IJES)* 5.5 (2018): 82-86.
7. IS 456:2000 - Bureau of Indian Standards, Indian Standard Code of Practice for Plain and Reinforced Concrete.
8. IS 383:1970 Bureau of Indian Standards, Indian Standard specification for coarse and fine aggregate .
9. IS 1489:1991 Bureau of Indian Standards, Indian Standard Code of Portland Pozzolona cement.