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A Review Paper on Use of E-Waste in Concrete

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Abstract - *Concrete is a composite material of aggregates, water, and cement. In recent years, government and industry have been placing a strong emphasis on high strength and high-performance concrete. In the present scenario the availability of raw material is big questioned. Therefore other alternatives to these materials are need to find out. Also, e-waste is the problem with which every country is dealing right now. Because there is no method for the disposal of e-waste and with the growth in the consumption of electronic goods this problem is getting bigger and bigger. The most effective way of the disposal of e-waste is through landfills and this method requires large land mass which is very difficult to find in these days. So this is a decent idea of utilizing e-waste as fixing in cement by halfway substitution of the total. The possible use of e-waste in concrete by the different researchers is present in this paper. Their research shows possibilities of e-waste being used as a substitute of aggregate, use of e-waste decrease the use of natural aggregate.*

Key Words: **E-Waste in Concrete, Flyash, Printed Circuit Boards, Compressive strength, Tensile strength, and Flexural strength**.

1. INTRODUCTION

E-Waste is one of the fast-growing waste in the world. E-waste is the waste generated from the discarded electronic devices it is an emerging issue causing serious environmental problems as it is very difficult to efficiently dispose of the e-waste without causing any harm to the environment. As per Rajya Sabha analysis, India is one of the topmost countries to produce e-waste yearly. Storage of waste is a major problem in India. Out of the total e-waste generation 80 to 85% discarded in landfill which can involve or release certain toxic gases into the air, may affect directly or indirectly environment and only 12.5% was recycled. So to keep away from contamination and secure condition there is a need to use the waste. In the present study, the recycled Plastics were used to prepare the aggregates thereby providing a sustainable option to deal with the e-waste.

1. S. R. Shamili, et al. (July 2017)

They did an overview of electronic waste as aggregates in concrete. They found out that Nowadays, electronic products have become an integral part of daily life which provides more comfort, security, and ease of exchange of information. These electronic waste (E-Waste) materials have serious human health concerns and require extreme care in its disposal to avoid any adverse impacts. Disposal or dumping of these E-Wastes also causes major issues because it is highly complex to handle and often contains highly toxic chemicals such as lead, cadmium, mercury, beryllium, brominated flame retardants (BFRs), polyvinyl chloride (PVC), and phosphorus compounds. Hence, E-Waste can be incorporated in concrete to make a sustainable environment. This research paper strongly suggests that e-waste has a vivid application as aggregates in concrete.

2. P.Krishna Prasanna, et. al. (June 2017)

A trial consider was led to legitimize utilization of electronic waste in concrete as incomplete substitution of fine total just as coarse total in concrete with a percentage replacement from 0% to 20% i.e. (5%, 10%, 15%, and 20%) and Conventional specimens were also prepared for M30 grade Concrete without using E-waste aggregates. By conducting tests for both the specimens the hardened properties of concrete are studied by him. He has found that the use of E-waste aggregates results in the formation of concrete which has a lesser weight than that of conventional concrete. His study ensures that reusing of E-waste as coarse aggregate substitutes in concrete gives a good approach to reduce the cost of materials and solve solid waste problems posed by E-waste. He found the effective ways to reutilize the hard plastic waste particles as coarse aggregate. He has concluded that the compressive strength of concrete is found to be optimum when coarse aggregate is replaced by 15% with E-Waste beyond it the compressive strength is decreasing. The compressive quality will slowly diminish when fly cinder is included by 10% likewise with various extents supplanting of E-waste with Coarse total.

3. Sunil Ashirwar, et al. (October 2016)

They conducted an experimental study on Concrete by using E-Waste as Partial Replacement for Coarse Aggregate. E-waste causes various health hazards and various adverse effects on the environment. Their research paper focused on the application of e-waste as a replacement for coarse aggregates. The principal point of this examination is to research the change in mechanical properties of cement with the expansion of Electronic waste in cement. It is discovered that the utilization of Electronic waste totals results in the arrangement of lightweight concrete. In this exploration

article Coarse total is somewhat supplanted by E-squander from 0% to 30%. Then in this blend, 10%, 20% and 30% of fly fiery debris are likewise included by halfway substitution of concrete. It is accordingly recommended that users of this Electronic waste in solid will lessen the prerequisite for traditional course and fine totals along these lines bringing about the preservation of common assets.

4. Balasubramanian et al (July 2016)

They carried out an investigation to evaluate the compressive strength, flexure strength and split tensile strength when coarse aggregate is partially replaced with e-waste. Concrete mixtures were made by replacing the coarse aggregate with e-waste by 5%, 10%, 15%, 20%, 25%, and 30% and then comparing the results with standard concrete mixture in their research they have found out that the compressive strength, flexure strength and split tensile strength have increased when coarse aggregate is replaced with e-waste by 15% and after that the strength starts reducing. They have found out that the concrete became more lightweight and it can bear the seismic loads more effectively as compared to conventional concrete.

5. Ashwini Manjunath B T et al. (June 2016)

They have analysed the utilization of E-waste plastic particles as coarse aggregate in concrete with a percentage replacement ranging from 0%, 10%, 20% and 30% on the strength criteria of M20 concrete with w/c ratio of 0.5. By comparing the obtained results with conventional concrete at 28 days the compressive strength, split tensile strength and flexural strength of concrete is reduced by 52.98%. This proves that the strength of concrete gets reduced when coarse aggregate was replaced by E-waste plastic particles. Thus they have concluded that the introduction of plastic in concrete becomes fails in strength aspect. But plastic can be used to replace some of the aggregates in a concrete mixture to reduce the unit weight of the concrete. This is useful to produce lightweight concrete such as concrete panels used in facades.

6. Aditya Gavhane et. al. (February 2016)

An experimental study was conducted to justify the use of e-waste in concrete as partial replacement of fine aggregate as well as coarse aggregate. They carry out an experiment on two different mixes one with 10% replacement of fine aggregate against e-waste and another with conventional concrete of M-30 grade. After experimental observation, they found e-waste can be used as replacement up to 10%. For 10% replacement, there is very less strength variation after 7, 14, and 28 days. They also stated, e-waste containing concrete is more workable than conventional concrete, it saves the cost of admixtures. The density of e-waste containing concrete is less thus can be used for producing lightweight concrete structures. E-waste concrete exhibits better resistance to sulphate attack. After trials, they reasoned that e-plastic can be disintegrated by utilizing it as development material which can, at last, diminish ecological contamination just as landfill load.

7. T. Subramani et al. (May 2015)

They have studied on partial replacement of plastic waste as a coarse aggregate. The replacement was made of three different ratios i.e, 5%, 10%, and 15%. The 7 days, 14 days and 28 days of Compressive strength test, Split tensile strength test and Flexural strength test was conducted. The Compressive strength and Split tensile strength of concrete containing plastic aggregate are retained more or less in comparison with controlled concrete specimens. Anyway quality discernibly diminished when the plastic substance was over 20%. It has been inferred that 20% of plastic waste total can be joined as coarse total substitution in cement with no long haul negative impacts and with worthy quality advancement properties.

8. Vivek S. Damal et al. (April 2015)

An experimental study is made on the utilization of E-waste particles as fine aggregates in concrete with a percentage replacement ranging from 0 % to 21.5% i.e. (7.5%, 15%, and 21.5%) on the strength criteria of M30 Concrete. By comparing above results with conventional concrete at 28 days the compressive strength of concrete it is observed that the compressive strength of concrete is reduced by 52.98% when the fine aggregate is replaced by 21.5% of E-waste. This proved that the compressive strength of concrete gets reduced when fine aggregate is replaced by E-waste. Compressive strength test is used to calculate the strength of concrete containing various E-waste contents at the age of 7, 14, 28 days respectively. Cube specimens are cast for finding the compressive strength of specimens on 7, 14, 28 days for each mix specification following the standard test procedures with the help of cube testing machine. It is observed that the compressive strength of concrete is found to be optimum when the fine aggregate is replaced by 7.5% with Electronic waste. Past it, the compressive strength of cement continues diminishing. The compressive strength of concrete will gradually decrease when fine aggregate is replaced beyond 15% with Electronic waste. From this study, we can use Electronic waste into the concrete by replacing the fine aggregate.

9. Salman Siddique, et al. (March 2015)

They made an experimental study to describe the strength development pattern of E-waste concrete is similar to that of conventional concrete but there is a decrease in strength at all the curing ages. The utilization of mineral admixtures can be used to increase compressive strength. They concluded that E-waste is the potentially viable material to be used as fine aggregate to produce durable concrete., Its use as fine aggregate in concrete will help in alleviating the potential problem of dwindling natural resources. Its use will also help

in protecting environmental surroundings. They also said that till date a very limited research work on E-waste as aggregate in concrete has been carried out. Therefore further investigations to study the ways in which E-waste as an aggregate replacement in concrete affects the rheological properties of fresh concrete, mechanical and durability properties of hardened mass are needed.

10. S.P.Kale et. al. (January 2015)

The preparing of electronic waste in creating nations causes genuine well being and contamination issues because of the way that electronic hardware contains some intense contaminants, for example, lead, cadmium, and beryllium and brominated fire retardants. A couple of potential reuses of recuperated non-metallic Printed Circuit Board have been looked into. Numerous past applications have utilized the recouped non-metallic materials as filler or for concrete and different encircling material. The main object of this project is to determine the compressive strength, tensile strength, flexural strength, and bond strength by using fresh concrete material (FCM), waste concrete material (WCM), and E-waste material. Different blends were set up for completing the exploration by shifting the extents of cement, sand, and totals. All mixes were designed for the characteristic strength of M25. The compressive strength, tensile strength, Flexural strength and bond strength of concrete was tested in a laboratory after 7 and 28 days. The specimens used for testing include cubes, cylinders, and beams. In this project comparison between fresh concrete materials, waste concrete material, and E-waste concrete material for compressive strength, tensile strength, flexural strength, and bond strength. The main aim of this study recommends the recycling of waste concrete as an aggregate and sand material in the production of new concrete.

11. Ankit Arora, et al. (August 2013)

They conducted a study on the various application and utilization of bottle plastic and e-waste. They firstly took E-waste from electrical and electronic equipment, that may be old or might have reached the end of life and plastic waste from plastic mineral and cold drink bottles were collected and grinded to the size of 2 mm using pulverizing machine. It is done to develop roughness and make grinded pieces shape irregular so that they can bond well with cement when mixed with it. A blend configuration was accomplished for M20grade of cement by IS technique. Customary Portland bond of 43 grade was selected. Pounded E-waste and plastic waste were supplanted by 0%, 2%, and4% of the fine totals. Compressive quality and flexural quality were tested and contrasted and control concrete. They discovered that there was an increase in compressive quality by 5% and decrease the cost of concrete production by 7% at an ideal level of crushed waste.

12. B.V. Bahoria el at. (April 2013)

They examined the possibility of using SGP as a replacement in fine aggregate for new concrete. Natural sand was in part supplanted (10%, 20%, 30%, 40% and half) with SGP. Compressive strength, Tensile strength (blocks and barrels) and Flexural strength as long as 180 days of age were contrasted and those of cement made with regular fine totals. Fineness modulus, explicit gravity, dampness content, water retention, mass thickness, %voids, % porosity (loose and compact) state for sand (S) and SDA were likewise contemplated. The test outcomes show that it is conceivable to produce concrete containing Sheet glass powder (SGP) with attributes like those of normal sand total cement given that the level of SGP as a fine total is constrained to 10-20%, individually. Waste glasses as a total in concrete, however, it appears that the solid with waste glasses dependably splits. Very limited work has been conducted for the use of ground glass as a concrete replacement. The raw materials, used for this study are natural coarse aggregate, fine aggregate, Sheet glass Powder and 53- grade Portland cement. They concluded that sheet glass powder (SGP) is suitable for use in the concrete making when replaced in fine aggregate for concrete in various sections as the tensile strength of cubes and cylinders of the solid for all blend increments than that of ordinary concrete.

13. C. G. Moriconi et al. (November 2010)

They discussed on the basis of which the use of by-products and recyclable materials in concrete can be optimized. Fresh concrete behavior during placing was also discussed. Moreover, when using recycled materials appropriately, some important properties of the hardened concrete such as ductility and durability can be better engineered. They fractioned up Recycled-aggregate to 15 mm, although containing brickwork rubble up to 25 to 30%, turned out to be appropriate for assembling basic cement notwithstanding when utilized as an absolute substitution of the fine and coarse common total parts. The most imperative end was attracted seems, by all accounts, to be that the compressive quality of the reused total cement can be improved to equivalent or even surpass that of regular total cement by adding fly powder to the blend as a fine total substitution. Along these lines, a given quality class esteem, as required for a wide scope of regular uses, can become to through both characteristic total cement and reused total cement with fly fiery remains, by satisfactorily diminishing the water to bond proportion with the guide of a super plasticizer so as to keep up the usefulness.

14. R. Lakshmi (June 2010)

They studied on concrete containing e-plastic waste States that E-waste or waste electronic and electrical equipment is an emerging issue posing serious pollution problems to the human and the environment. New effective waste management options need to be considered especially on

recycling concepts. About 70% of the heavy metals (mercury and cadmium) in landfills come from electronic waste. An exertion has been made to detail an orderly investigation of compressive strength of cement with different extents of E-waste as coarse aggregate in concrete. From the compressive strength tests, it has been confirmed that no major changes found in the compressive strength of concrete with the presence of E- plastic as percentage replacement to coarse aggregate. However, when 20% of the coarse aggregate is replaced by E-plastic, the compressive strength was reduced by 23.6% compared the compressive strength was reduced by 23.6% compared to the control mix. In general strength gain of E-plastic concrete is satisfactory and it has been concluded that 12% of E-plastic particles can be incorporated as an aggregate replacement without any long term detrimental effects.

15. Zhigang Shen et al (June 2009)

This paper portrayed are taken the necessary steps on flexural modulus and Flexural strength of the composites can be effectively improved by filling non-metals reused from waste printed circuit sheets (PCBs) into polypropylene (PP), with the help of scanning electron microscopy (SEM), the influence of non-metals on fracture behavior of PP composites are investigated by in situ flexural test. Observation results show that the particles can effectively lead to mass micro cracks instead of the breaking crack. The process of crack initiation, propagation, and fiber breakage dissipate a great amount of energy. The result, the flexural properties of the composites can be reinforced significantly. After effects of the in situ SEM perception and examination to the dynamic flexural process supply viable test proof for the fortifying component of the non-metals/PP composites based on the vitality scattering hypothesis

16. Mou P, et. al. (June 2007)

They made an experimental study to describe several methods for convert recovered non-metals from waste PCBs. The PCB non-metallic material can be used in development materials, to make models, in composite sheets, and in down to earth items, for example, sewer meshes and little pontoons. Mechanical procedures, for example, pounding, processing, and division were utilized to squander PCBs. The PCB non-metallic material can be used in development materials, to make models, in composite sheets, and in handy items, for example, sewer meshes and little vessels. The flexural strength of the PCB non-metallic material composite boards is 30% greater than that of standard products. The examination demonstrates that PCB non-metals can be used in productive and earth well-disposed ways.

3. CONCLUSION

Use of e-waste in concrete is the most important building material for sustainable construction. The literature discussed in the present paper has given an overview of the advantages of e-waste concrete to increase strength and durability of concrete. The literature surveyed has also listed the strength gain at early ages by using accelerators with e-waste and fly ash in concrete at a different proportion. A detailed mix design procedure along with confirmation of results for designing e-waste concrete to achieve the required strength at 28 days is needed. It is must to shift contractors focus on economic and environmentally friendly concrete. The review of various literature effects that E-waste has the capability to be utilised as decrease combination replacement in concrete. The power improvement sample of E-waste concrete is similar to that of conventional concrete however there is a decrease in strength at all the curing ages. So it is concluded that E-waste is the potentially viable material can be used as fine aggregate to produce durable concrete. The use of fine aggregate in concrete will help in alleviating the potential problem of dwindling natural resources.

REFERENCES

1. S. R. Shamili, C. Natarajan, J. Karthikeyan; An Overview of Electronic Waste as Aggregate in Concrete; World Academy of Science, Engineering and Technology International Journal of Structural and Construction Engineering Vol:11, No:10, 2017 1444International
2. P.Krishna Prasanna, M.Kanta Rao, “Strength variation in concrete by using e-waste as coarse aggregate”, IJEAR Vol 4 (June 2014)
3. Sunil Ahirwar Pratiksha Malviya, Vikash Patidar Vikash Kumar Singh; An Experimental Study on Concrete by using E-Waste as Partial Replacement for Course Aggregate IJSTE - International Journal of Science Technology & Engineering | Volume 3 | Issue 04 | October 2016 ISSN(online): 2349-784X
4. Iftekar gull, M. Balasubramanian, K.S.anandh, K.vetrivel "An experimental investigation on the use of post-consumed e-plastic waste in concrete" Vol.2., Issue.2., 2014 C.
5. Ashwini Manjunath B.T, “Partial Replacement of EPlastic Waste as Coarse Aggregate in Concrete” Procedia Environmental Sciences 35 (2016), 731 739
6. Mr. Aditya Gavhane, Mr. Dinesh Sutar, Mr. Shubham Soni and Mr. Praveen Patil Utilisation of E - Plastic Waste in Concrete International Journal of Engineering Research & Technology (IJERT), Vol. 5 Issue 02, February-2016, 594- 601.
7. T.Subramani, V.K Pugal, “Experimental Study on Plastic Waste as a Coarse Aggregate for Structural Concrete” International Journal of Application or innovation in Engineering & Management(IJAIEM), Volume 4, Issue 5, May 2015, 144-152.
8. Vivek S.Damal, Saurabh S. Londhe, Ajinkya B Mane "Utilization of electronic Waste plastic in concrete"

International Journal of Engineering Research and applications volume 5 April 2015

9. Salman Siddique, Sikandar Shakil, Mohd. Shadab Siddiqui; SCOPE OF UTILISATION OF E-WASTE IN CONCRETE; International Journal of Advanced Research In Science and engineering http://www.ijarse.com IJARSE, Vol. No.4,Special Issue (01), March 2015 ISSN-2319-8354(E) 776
10. S.P.Kale and H.I.Pathan "Recycling of Demolished Concrete and E-waste" International Journal of Science and Research (IJSR) Volume 4 Issue 1, January 2015, 789-792.
11. Ankit Arora and Dr. Urmil V. Dave; UTILIZATION OF E-WASTE AND PLASTIC BOTTLE WASTE IN CONCRETE International Journal of Students Research in Technology & Management Vol 1 (04), August 2013, ISSN 2321-2543, pg398-406
12. B.V. Bahoria1, Dr. D.K. Parbat2, Dr.P.B.Naganaik3 Dr. U.P Waghe4 "Comprehensive literature review on the use of waste product in concrete" International journal of application or innovation in Engineering & management volume 2, Issue 4, April2013
13. G. Morikoni, "Recyclable material in concrete technology; sustainability and durability", International Journal of Environmental Science. Vol. 1 (Nov 2010).
14. R.lakshmi; concrete containing e-plastic waste;1 SRM University, Kattankulathur, Chennai, Tamilnadu, India studies on concrete containing e-plastic waste
15. Zhigang Shen, Yanhong Zheng, Zhigang Shen, Chujiang Cai, Shulin Ma, Yushan Xing " Influence of non-metals recycled from waste PCB on flexural properties and fracture behavior of polypropylene composites", materials and design 30 (2009) pp 958–963
16. Xiang Dong, Peng Mou "products made from non-metallic materials reclaimed from waste printed circuit boards", Tsinghua science & technology volume12, issue 3, June 2007, pp 276 – 283