International Journal of Scientific Research & Engineering Trends
Volume 6, Issue 5, Sept-Oct-2020, ISSN (Online): 2395-566X

Literature Review on E-Waste Compounds and its Impact of using in Landfillings and Concrete Structures

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***Abstract*- Widespread use of digital devices, including mobile phones, tablets, computers, smart watches has made electronic waste a new environmental problem. Discarded gadgets result in massive piles of e-waste, which contaminates soil and groundwater in the world. Electronic waste or e-waste is one of the emerging problems in developed and developing countries worldwide. It comprises of a multitude of components with valuable materials, some containing toxic substances, that can have an adverse impact on human health and the environment. Previous studies show that India has generated 0.4 million tons of e-waste in 2010 which may increase to 0.9 to 1 million tons by 2019–2020. Coupled with lack of appropriate infrastructural facilities and procedures for its disposal and recycling have posed significant importance for e-waste management in India. In general, e-waste is generated through recycling of e-waste and also from dumping of these wastes from other countries. More of these wastes are ending up in dumping yards, recycling canters and e waste mixing in landfill and in concrete structures posing a new challenge to the environment, soil strata, underground water table and policy makers as well. In general electronic gadgets are meant to make our lives happier and simpler, but the toxicity it contains, their disposal and recycling becomes a health and nature nightmare. Most of the users are unaware of the potential negative impact of rapidly increasing use of computers, monitors, and televisions. This review article provides a concise overview of how the e-waste affects the environment and human health by the techniques currently using as landfills and in concrete structures as management of e waste.**

***Keywords*- Biological Leaching, Chemical Leaching, Emission Spectrometry, Environmental Hazard, E-Waste, Occupational Hazard, POES, Toxic.**

I. INTRODUCTION

Over many years our society is using plenty of Electronic items and till now and onwards, humans will become null without electronic appliances & mainly at this Corona schedule many of the human beings are still alive due to this findings. For example:- Mobile, Chips, Television, Radio etc. So as the usage increases the hurl away of the same items when gets useless also increasing parallelly and this unwanted material is known as **E-Waste** and India is producing 2 tonnes per annum. The material which is used for making electronic appliances are microscopic, nanoscopic, toxic, and non-biodegradable. Many of them are recycled in some recycling plants and if e-waste cannot be recycled then it need to be destroyed. Incineration is a method used for destroying e-waste, but it will affect the living beings and pollute environment when toxic substance is heated at high temperature. So nowadays e-waste is using as land fillings mainly on marshy lands, using as a mixing material with bitumen road or earthern roads and also using in concrete structures. How do most of us dispose of a mobile phone or a television set? Usually, by selling it to a scrap dealer. But as per the E-Waste Management Rules, which were notified in October 2016, manufacturers of electric and electronic equipments must facilitate their collection and return it to authorised dismantlers or recyclers. However, even one and a half years after the law was passed, there is little evidence that it is being implemented. India is one of the biggest producers of e-waste in the world. The Global E-waste Monitor 2017, published by the United Nations University, states that India generates about 2 million tonnes of e-waste annually and ranks fifth among e-waste producing countries, after the US, China, Japan and Germany. So to minimize the quantity of E-waste, it is using nowadays as Landfillings and also in mixing with some of substructures and super structures.

II. LITERATURE REVIEW

Ashok Kumar Das - E- Waste Management in India curent Scenario (2017). In the paper author examines the sorces and problems related with E-Waste and how to manage them.He says, As long as electronic products continue to contain an assortment of toxic chemicals and

are designed without recycling aspect, they would pose a threat to environment and public health at their end-of-life. He says, Many of these substances are toxic and carcinogenic -The materials are complex and have been found to be difficult to recycle in an environmentally sustainable manner causing health hazard -The impacts is found to be worse in developing countries like India where people engaged in recycling E-Waste are mostly in the unorganised sector, living in close proximity to dumps or landfills of untreated E-Waste and working without any protection or safe guards. He concludes that, the quantum of wastes generated over the past several years have posed an ever increasing threat to environment and public health. CPCB have identified over 88 critically polluted industrial zones .As far as e-waste is concerned, it has emerged as one of the fastest growing waste streams worldwide today .As long as electronic products continue to contain an assortment of toxic chemicals and are designed without recycling aspect, they would pose a threat to environment and public health at their end-of-life. Repeated awareness programme through print and electronic media is the need of the hour.

Sunil Ahirwar, Pratiksha Malviya , Vikash Patidar, Vikash Kumar Singh - An Experimental Study on Concrete by using EWaste as Partial Replacement for Course Aggregate (2016). The main aim of this study is to investigate the change in mechanical properties of concrete with the addition of Electronic waste in concrete. It is found that the use of Electronic waste aggregates results in the formation of light weight concrete. In this research article Coarse aggregate is partially replaced by E- waste from 0% to 30% .Then in these mix 10%, 20% and 30% of fly ash is also added by partial replacement of cement. It is thereby suggested that utilization of this Electronic waste in concrete will reduce the requirement for conventional coarse and fine aggregates thereby resulting in conservation of natural resources.

An experimental study has been done on concrete using electronic waste as coarse aggregate and also with fly ash as replacement of cement and observed that workability of the concrete increases when percentage of the electronic waste increases. When fly ash content added to electronic waste concrete, it has been observed that workability increased. Workability of flyash with electronic waste concrete is even more than conventional and electronic waste concrete. Compressive strength of electronic waste concrete decreases with increase in the percentage of e-waste. It has been observed that when we replace cement by fly ash in concrete along with electronic waste as a coarse aggregate compressive strength increases. Cement replacement of 30% by fly ash along with electronic waste gives best result. Study concluded that Electronic waste can replace coarse aggregate upto 10% or 20%. Study also concluded that electronic waste can replace coarse aggregate upto 30% in concrete when 30% fly ash is replaced by cement.

Pathariya Saraswati , Rana Jaykrushna , Shah Palas , Mehta Jay , Patel Ankit - Application of E -Waste Foundry Sand for Evolution of Low-Cost Concrete (2013). This paper demonstrates the use of waste foundry sand as a partial replacement by fine aggregate in concrete. An experimental investigation is carried out on a concrete containing waste foundry sand in the range of 0%, 20%, 40%, and 60% by weight for M-25 grade concrete(PPC). Material was produced, tested and compared with conventional concrete in terms of workability and strength.

These tests were carried out on standard cube of 150*150*150* mm for 7, 14 and 28 days to determine the mechanical properties of concrete. Through experimental result we conclude that the compressive strength increases with increase in partial replacement of waste foundry sand and split tensile strength decreases with increases in percentage of waste foundry sand. The aim of this research is to know the behavior and mechanical properties of concrete after addition of industrial waste in different proportion by tests like compressive strength and split tensile. In this study, maximum compressive strength is obtained at 60% replacement of fine aggregate by e-waste foundry sand. The result of percentage cost change reduces up to 3.5 for 60% replacement of waste foundry sand. This shows that the concrete produced is economical.

Salman Siddique1, Sikandar Shakil, Mohd. Shadab Siddiqui -Scope of utilisation of e-waste in Concrete (2015). literature shown that there is a strongly possibility of E-waste being used as substitute/ replacement of aggregate. Its use in concrete becomes more significant and important in view of the fact that sources of natural aggregates are getting depleted gradually, and it is of prime importance that substitute of aggregates be explored. This paper presents an overview of the published literature on the use of E-waste in concrete. Effect of E-waste on the properties of concrete such as compressive strength, split tensile strength and durability are presented. The review of different published literature results that E-waste has potential to be utilised as lower aggregate replacement in concrete.

The strength development pattern of E-waste concrete is similar to that of conventional concrete but there is decrease in strength at all the curing ages. The utilisation of mineral admixtures can be used to increase compressive strength. From the published research work it is concluded that:- E-waste is the potential 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 the environment surroundings. 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 aggregate replacement in concrete affects the rheological properties of fresh concrete, mechanical and durability properties of hardened mass are needed.

Amit Atmaram Naik -A study of e-waste management (2016). The paper points that, because of absence of an advanced & efficient e-waste management system in India, some procedures for workers involved in disposal of e-waste have to be there. It is difficult to successfully deal with e-waste management globally until a universally accepted of e-waste's definition is structure and accepted. In India technological and Industrial challenges are exists. Lax environmental regulations and slow economic development permits and promotes easy flow of hazardous wastes

Mahesh C. Vats, Santosh K. Singh -Status of E-Waste in India - A Review (2014). This paper states The ESI(Environmental Sustainable Index) rank was 101in 2005 and 66th in environmental governance, need further improvement by creating e-waste treatment infrastructure by PPPs(People, Private Partnership model in the country via Foreign Direct Investment(FDI) because European countries have technology and India has cheap manpower can collectively make the e-waste treatment viable and economical.

Peeranart Kiddee, Ravi Naidu , Ming H. Wong - Electronic waste management approaches: An overview (2013). Both laboratory simulation studies and landfill leachates from disposal sites demonstrate the release of toxic substances from e-wastes with the concentration varying significantly between field and laboratory based studies

Bala Subramanian, Dr. Gopala Krishna., G. Saraswathy. -Review of Literature on Electronic Waste Materials Used in Concrete (2018). Research is being carried out on the utilization of E-Waste products in concrete. The use of E-Waste products in concrete not only makes it economical, but also helps in reducing disposal problems. Total replacement of concrete is not possible due to no material plays the role of concrete in terms of strength, durability and workability. So we have to partial replace all the material to achieve desire properties of concrete. This paper includes survey of E-Waste material used in the concrete. From this survey we can understand the effect of EWaste materials on the properties of concrete. Waste from Electric and Electronic Equipments (WEEEs) is currently considered to be one of the fastest growing waste streams in the world, with an estimated growth rate going from 3% up to 5% per year. Solid waste management is one of the major environment concerns in the world. With the scarcity of space for land filling and due to its ever increasing cost, waste utilization has become an attractive alternative to disposal. Research is being carried out on the utilization of E-Waste products in concrete. The use of E-Waste products in concrete not only makes it economical, but also helps in reducing disposal problems. Total replacement of concrete is not possible due to no material plays the role of concrete in terms of strength, durability and workability. So we have to partial replace all the material to achieve desire properties of concrete. This paper includes survey of E-Waste material used in the concrete. From this survey we can understand the effect of E-Waste materials on the properties of concrete.

Md. Sharfuddin Baba, N Surya Teja, M Siri , B Sai Kumar, M Vishnu Vardhan5, G. Lalitha -Review Paper on E-Waste in Concrete as A Replacement of Fine and Coarse Aggregate. Civil or Construction Engineering is one of the oldest forms of engineering, and methods followed as were old for a certain time, but when the world was in deep environmental crises, civil engineering came up with many new solutions. Utilization of solid waste and other environmental-unfriendly materials to environmental-friendly materials. But nowadays e-waste is turning out to be a major problem. Like plastic and PCB's which are part of e-waste, is a big threat to the environment when left without treating them. It is creating a great threat to the environment, landfills, and groundwater is b coming toxic day by day. to solve this landfill problem and prevent groundwater from becoming toxic, e-waste was considered as a source of construction. E-waste as replacement either coarse, fine or both aggregate gave amazing results. On further let's see how long will this E-waste concrete sustains and its performances against workability and strength tests in the below papers.

Lakshmi et al. - usage of Ewaste materials for replacing the coarse aggregate (2010). Lakshmi along with her team, was studying the usage of Ewaste materials for replacing the coarse aggregate. The experiment was done by choosing percentage replacement ranging from 0%, 4%, 8%, 12%, 16%, 20%, 25% in Concrete Grade M20. The Compressive, the Tensile & Flexural Strength with and without replacing the aggregate with E-waste in Concrete. After the casting, the blocks showed a good gain in strength. The Ultrasonic Pulse tests on mechanical Properties were also executed. At last they concluded that till 20% replacement of E-Waste was good and increasing the E-waste replacement detiorated the performance. Hence, E-Waste can also be disposed in form of construction materials.

Kuldeep Rajput, Abhishek Gupta, Arushi -Re-cycle of e-waste in concrete by partial replacement of coarse aggregate (2019).In this paper authors replaced coarse aggregate with e-waste . It is found that the use of Electronic waste aggregates results in the formation of light weight concrete. In this research article Coarse aggregate is partially replaced by E- waste from 0% to 30% .Then in these mix 10%, 20% and 30% of fly ash is

also added by partial replacement of cement. It is thereby suggested that utilization of this Electronic waste in concrete will reduce the requirement for conventional coarse and fine aggregates thereby resulting in conservation of natural resources. Even in max proportion of E-waste workability is high which is good for working with concrete. By adding E-waste compressive strength is changed and compressive strength of concrete increases with increase in amount of E-waste but at a certain limit after that it decreases. Graph shows the actual amount of E-waste is 12% at which compressive strength is maximum.

S.Sabarai Mani, I.Seeni Mohamed, P.Nataraj Prabu & M.Rajkumar- experimental study on bituminous pavement by using e-waste and fly- ash (2017). The objective of our study is to experiment the study of e-waste and fly ash in bituminous road concrete and it deals with the development of modified bitumen from e-waste and fly ash as mineral filler with an aim to find an innovative technology for its effective use to produce bituminous mix used for road construction and to minimize these wastes in environment. As it increases the stability and it reduces the cost effective options as it reduces the usage of bitumen. Bitumen is partially replaced by e-waste and fly ash is used as mineral filler. It deals with the innovation of a modified mix. . And this method is cost effective and it is a method to utilize the waste produced in large amount. The bituminous concrete mixed have been found 10 to 15% of e-waste was found to be optimal. The use of e-waste in road construction will serve two purposes It will reduce the cost It will contributes towards efficient waste management. Fly as a mineral filler will increase the stability of the bituminous road.

S. Andavan (1), Ramesh Bhaskar, Ch.Indra Reddy - Partial replacement of coarse aggrigate by Using electronic waste The management and utilization of E plastic waste is apace growing because it may be a valuable resource of IT industries and its very risky substances and with low utilization rate. The employment of e-plastic waste materials may be partial answer to environment and ecological issues. The use of e-plastic waste can reduce the combination price and it will reduce the low land price. The e plastic waste consists of discarded plastic waste from the previous computers, television's, refrigerators, radios, these plast ic squares, measure non-biodegradable elements of E plastic waste as a partial replacement of the coarse or fine aggregate. An experimental study is formed The e plastic waste consists of discarded plastic waste form the previous computers on the employment of E-waste particles as fine and coarse aggregates in concrete percentage replacement starting from the zero is concern. on the strength criteria of M20 Concrete. Compressive strength, durability and Flexural Strength Concrete with and while not E- waste plastic as aggregates was observed that exists an honest strength. The practicableness of utilizing E-waste plastic particles as partial replacement of coarse aggregate has been given. Within the gift study, compressive strength was investigated for optimum cement content and 10 e-plastic content combined and yielded stability and really smart in compressive strength of fifty- three grade cement. Concrete is a combination of cement and water. The values which was obtained was slightly changes or decreased on compressive strength, tensile strength and flexural strength.so that E-wastage was eco-friendly with the concrete and no cracks was coming on the cubes, cylinders and prisms.

Manikandan.P, Senthamilkumar.S -Behavior of E Waste Plastics in concrete (2015). Generation of waste materials is creating the most ecological problems for the environment. Especially the electronic waste materials are the harmful and toxic waste materials compare to other solid waste. To rectify those environmental problems by reuse of E waste in some other methods. If using this e waste materials in construction wise the cost of cement, concrete manufacturing and cost of construction materials will reduce. It will reduce the value of landfill cost, saving energy and it will protect the environment from the solid waste pollutions and its effects indirectly. E waste consist a waste of TV, Refrigerator, radio, AC, broken laptops and some electronic wastage. An experimental study utilization of e waste materials or particles additionally in concrete with a percentage of 0% to 20% at the strength criteria M25 grade of concrete. Following that the chemical properties like chloride and sulphate testing also be conduct for this study. Finally this study gives the environmental aspects for the E wastes and basic mechanical properties and chemical behavior of conventional and e waste concrete for M25 grade. The chemical behavior and mechanical properties of E waste concrete is to be done at the curing period of 7 days, 28 days and 105 days.

Prof. Arnav Chowdhury, Prof. Jitendra Patel - E-Waste Management and its Consequences: A Literature Review 2017. Central issue of the present study is electronic-waste (e-waste) that is rising as a brand new environmental challenge for twenty first century. The rapid climb of the electronic and IT trade, gift client culture, increasing rates of consumption of electronic product have lead to fateful environmental consequences. E-waste, while recycling, is also risky due to toxicity of a number of the substances which contains several cancer-causing agents. The implications and toxicity is thanks to discharge of lead, mercury, cadmium, metallic element and alternative virulent substances. Developed countries export this waste within the type of donation to developing countries. China and some Asian nations, where environmental standards are low, are the most important recipients of e-waste which, in most cases, is processed illicitly. The environmental burden of e-waste is born by people that sleep in developing countries.

Despite varied laws and directives in developed countries, the e-waste management is uncontrollable. The current study focuses on the effect of usage, marketing and use of the electronic waste on the natural setting. The paper aims to define and analyze the main areas of research on electrical and electronic waste, while offering a broader analysis of the relevant literature in order to summarize the information available and to create common knowledge. Based on this few key points were observed. Firstly, many countries don't have any standardized method to estimate e-waste generation. Further, there is a need to implement and frame polices for proper e-waste management in developing countries so as to solve environmental issues related to informal recycling practice. There is a need for developing a legal framework for the management of this waste fraction is one of the challenges for the policy makers in developing countries. Awareness programs should be generated and training should be provided in handling ewaste.

A.Rajesh, J.Louis Maria Leveil, R.Sasikumar, V.Karthikeyan - Partial replacement of coarse aggregate using E-waste (2020). Electronic waste (E-waste) is found to be better alternative material for replacing coarse aggregate. Using E-waste in concrete, compressive strength can be increased up to certain percentage of addition and also helps us for disposing E-waste safely. From the above plotted result values the following points are concluded, Greater compressive strength is achieved when E-waste is replaced by 15%. Workability of concrete is found to be same as addition of aggregate . Addition of E-waste in concrete reduces the self weight of conventional concrete and can be utilized for constructing light weight structures. May be at higher risk of conducting electricity, since E-waste particles contains permits electricity to pass through. E-waste is found to be a better replacement for coarse aggregate, thereby by saving earth's natural resource.

Prof Ankur Gupta, Abhinav Singh, Utkarsh Singh, Archna Singh, Chhavi Tomar -A Review Paper on Use of E-Waste in Concrete (2019)**.** 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 ewaste 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 ewaste in concrete by the different researchers is present in this paper. Their research shows possibilities of ewaste being used as a substitute of aggregate, use of ewaste decrease the use of natural aggregate

Vivek S. Damal et al. - An experimental study on the utilization of E-waste as fine aggregates in concrete (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.

Aditya Gavhane et. A. - An experimental study on the use of ewaste in concrete as partial replacement of fine aggregate as well as coarse aggregate (2016). An experimental study was conducted to justify the use of ewaste 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.

Shishir Kumar Sikder Amit- Utilization of E-waste in Concrete and its Environmental Impact - A Review This paper presents a summary on probable use of E-waste in concrete on the basis of different researchers and it

marches strong possibility of E-waste being used as additional of aggregate as well as environmental impact. The use of natural aggregates in concrete will be decreased if different types of by-product are used in concrete as a substitute material. And it is more important to renovate the waste material. It has been found that strength development pattern of E-waste concrete is analogous to that of conventional concrete. E-waste are the potential viable material can be used as fine aggregate to produce durable concrete as well as coarse aggregate. Every year millions of ton E-waste produce whole over the world. So, the use E-waste in concrete will benefit in alleviating the potential problem of worsening natural resources. The use of e-waste will also help in shielding the environment surroundings. The uses of E-waste have not been used extensively as alternative construction materials, so, it is needed to further study to use of E-waste material in concrete as well as others purposes.

S. Needhidasan et.al - behavior of partially replaced aggregate by the E-waste plastic concrete. The main objective of the study is to study the behavior of partially replaced aggregate by the E-waste plastic Concrete & the minimization of the impact of E-waste on the environment and the re-use of the same to place in required shape and to study the behavior of M40 concrete in presence of Super Plasticiser. The mix design ratio in the manufacturing of concrete was done as per the standards of IS 456:2000 and IS 10262:2009. OPC 53 grade Cement is used during the entire test. Coarse aggregates in the range of 10 to 20 mm were used in equal weight. The w/c ratio of the mix design was 0.28 and the slump cone value was 50 mm.

The relative density of cement, coarse aggregate, and fine aggregate are 3.14, 2.71, and 2.84 respectively and concrete was placed conventionally. The cubes were molded and tested for the compression strength test, Flexural strength test, and Split tensile strength test for 7, 14, and 28 days. The results showed that the properties of fresh and hardened concrete have been improved. Hence, it is concluded that the usage of E-Waste plastic as coarse aggregates partial replacement in concrete by volume 0%, 12%, 17%, and 22%. The utilization of plastic aggregate in concrete resulted in the reduction of the overall unit weight of concrete and the compressive strength of the concrete was gradually increased.

III. SUMMARY FROM LITERATURE REVIEW

- An E-waste is toxic and hazardous material and the heavy metals present are (Pb, Cd, Be, Sb, As, Cr, Cr (VI) and Hg) were determined by the International Electrotechnical Commission (IEC) methods IEC 62321-4:2013 by inductively coupled plasma optical emission spectrometry (Argon gas is electrically heated to a high temperature ie, >6000K), and by inductively coupled plasma mass spectrometry) (same).

Where
Pb – Lead Cd- Cadmium Be – Beryllium
As- Arsenic Cr – Chromium Hg – Mercury
Cr (VI) – Hexavalent chromium

- The usage of E-waste as replacement in concrete can affect the structure in future.
- The usage of E-waste in land fillings can pollute the ground water and also the soil fertility by leaches from the e-waste.
- The method of reduce, reuse and recycling need to be promoted and awareness program should be given to the peoples about the toxic material.

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