ELSEVIER Scopus doi

Journal of Vibration Engineering

ISSN:1004-4523

Registered

- SCOPUS
- GOOGLE SCHOLAR
- DIGITAL OBJECT IDENTIFIER (DOI)
- IMPACT FACTOR 6.1

"COSTANALYSISBETWEENELECTRONICWASTECONCRETEANDCONVENSIONAL COCNRETE"

SHWETABH UPADHYAY

*M.Tech.Scholar,**MadhyanchalProfessionalUniversity**,(Schoolofengineering)Bhopal, M.P., India.*

Prof.VinayKumarSinghChandrakar

DepartmentofCivilEngineering,SchoolofengineeringBhopal

ABSTRACT

Electronic garbage is a growing concern that poses major environmental and human health risks. whose disposal is evolving into a difficult issue. The reuse of E-waste material in the concrete industryisthoughttobethemostpracticalapplicationforaddressingthedisposalofvastamounts of E-waste material. The cost of typical coarse and fine aggregate has increased, forcing civil engineers to look for suitable substitutes. One such substitute for both coarse aggregate and fine aggregate is e-waste. Due to the lack of coarse aggregate needed to prepare concrete, an attempt wasmadetopartiallysubstituteE-wastewithcoarse.M30grademixwasusedfortheproject.The proportion of coarse aggregate replaced by E-waste in the range of 0%, 3%, 6%, 9%,12%, 15% and 18%. Electronic waste can also help to partially reduce the problem of rising construction material cost in this study save the material cost 2.35% 1m^{3}as compare to control mix.

Keywords:-E-waste,MixDesign,Costanalysis,conventionalconcrete,E–wasteconcrete.

INTRODUCTION

Electronic garbage, sometimes known as e-waste, refers to outdated electrical or electronic equipment. E-waste includes used electronics that are intended for recycling through material recovery, refurbishment, reuse, resale, or disposal. E-waste processing done informally in developing nations can have a negative impact on human health and pollute the environment.

Lead, cadmium, beryllium, and brominated flame retardants are just a few of the potentially hazardouscompoundsfoundinelectronictrashcomponentslikeCPUs.Thehealthofworkersand the communities they live in may be significantly at risk during the recycling and disposal of e-waste.

When an electronic product is discarded after reaching the end of its useful life, it produces "e-waste" or electronic garbage. E-waste is produced in enormous quantities as a result of the quick advancement of technology and our consumer-driven culture.

E-wasteisa

Table1Yearlyelectronicwastegenerated

Year	2016	2017	2018	2019	2020	2021	2022
E-waste Generated	18.2Mt	23.6Mt	30.6Mt	35.3Mt	42.8Mt	57.4Mt	59.4Mt

OBJECTIVEOFTHESTUDY:

- Toreducetheamountofconstructioncostbyusingcertainelectronicwaste product

LITERATUREREVIEW

MonaBrahmacharimayumetal(2019)beingexaminedConcreteisacommonlyusedcomposite materialinthebuildingindustrymadeoffineaggregate,coarseaggregate,cement,andwaterwith or without additives. However, as the creation of concrete requires a lot of energy, efforts have been undertaken to find substitutes for its traditional constituents. With an estimated growth rate rangingfrom 3%to 5%annually,electronicwaste (or"E-wastes")is oneof thefastestincreasing categories of waste in the world. Old computers, TVs, refrigerators, and other electrical devices that have reached the end of their useful lives are considered e-waste. E-waste's impact on the environmentandecologymaybesomewhatmitigatedbyusingitinconcrete.Additionally,itwill assist in the disposal of E-waste and lower landfill costs.

Suchithra et al (2015) I studied Electronic garbage is a growing concern that poses major environmentalandhumanhealthrisks.whosedisposalisevolvingintoadifficultissue.Thereuse of E-waste material in the concrete industry is thought to be the most practical application for addressing thedisposal ofvast amountsofE-wastematerial.Thecost oftypical coarseaggregate hasincreased,whichhascompelledcivilengineerstolookforappropriatesubstitutes.Onesuch substitute for coarse aggregate is e-waste. Due to the lack of coarse aggregate needed to prepare concrete, an attempt was made to partially substitute E-waste with coarse aggregate. The M20 grade mix was used for the project. A replacement of 0%, 5%, 10%, or more of the coarse aggregate with E-waste

MATERIALSANDMETHODS

Thematerialsthosewereusedinourthesisworkareas follows:-

- Bindingmateriali.e. Cement
- Fineaggregate (Sand)
- Coarseaggregate
- Electronicwaste
- Potable water

MixDesignofM30GradeofconcreteIS10262-2019

Step-1TargetMeanStrength

F_{ck}= f_{ck}+ 1.65S

OR

F_{ck}=f_{ck}+X Where

F_{ck}=Targetmeancompressivestrengthat28Day f_{ck}

=Charestetic compressive strength at 28 day S=

Standard deviation

X=Factorbasedonthegradeof concrete

TargetMeanStrength

F_{ck}= f_{ck}+ 1.65S

Soheref$_{ck}$=30N/mm^2

S= 5

Thestandarddeviationvalue(SD)istakenfrom,Table2ofIS:10262-2019for**up-toM30grade F_{ck}= 30+1.65*5**

F_{ck}=38.5N/mm^2

Nowwehavecalculatedanotherformula

ValueofXtakenformIS10262-2019tableno1andpageno2 X=6.5

Then

F_{ck}=30+6.5

F_{ck}=36.5N/mm^2

Fordesignpurposealwaysconsiderhighervalueofboth Hence,

F_{ck}=38.5 N/mm^2

Step-2Selectionofwatercementratio

WatercementratiocanbeestablishedbyrelationshipfronthegrapeprovideIS10262-2019figure no 1 and page no 4

Nowconsiderwatercementratiois0.43

ButaccordingtoIS456-2000maximumwatercementratioisForM30gradeconcreteis0.45 But in our mix design we have calculated 0.43 hence ok.

Step-3Selectionofwatercontain

Theamountofwatercontentneededpercubicvolumeofconcretemustbeestimatedinthisphase. With the nominal maximum size of coarse aggregate being 20 mm, the following chart from IS 10262:2019 can be used to determine this water content. (angular coarse aggregate).

Okay,so as youcan see from thetable, IS 10262 specifies that 186kgofwaterareneeded for20 mm angular aggregate with a 50 mm Slump.

However, the workability requirement is 75 mm slump, and the method of putting concrete is by chute.

186Kgsofwaterarecurrentlybeingusedforonlya50mmslumpvalue,asthecoderecommends. As a result, we must make certain adjustments to account for the additional 25 mm of slump at a rate of 3%.

By the way, the formula provided by IS 10262:2019 in Clause No. 5.3 makes it simple to determine.

$$WC_{75}=186+(75–50)/25*(3/100)*186$$

$$WC_{75}=191.58Kg/m^3$$

Soconsiderofwater192Kg/m^{3}St

ep-4 calculation of cement

Quantityofcement=$\frac{WaterContain}{WaterCenetratio}$

Quantityofcement=$\frac{192}{0.43}$

Quantityofcement=447Kg/m^3

Step-5Courseandfineaggregatecalculation

Since 20 mm is the maximum nominal size, Table 5 of IS 10262:2019 states that the volume of coarseaggregateperunitvolumeoftotalaggregateforthevariouszonesoffineaggregateis0.62. The approximate values for this aggregate volume are given in Table 5 for a water-cement/water cementationsmaterialsratioof0.5,whichmaybesuitablyadjustedforotherratios.Accordingto IS 10262:2019 Clause 5.5.1, "the proportion of volume of coarse aggregates to that of total aggregates is increased at the rate of 0.01 for every decrease in water cement/cementations materialsratioby0.05anddecreasedattherateof0.01foreveryincreaseinwater-cementratio." Oncemore,inordertocollecttheamountofcoarseaggregate,wemustmakesomemodifications to our designed water-cement ratio. The overall decrease in this ratio is = (0.50-.043) = 0.07

Intheend,themodifiedvalueofcoarseaggregate=(0.01x0.07)/0.05=0.014willincreaseto=
0.62+0.014=0.634

Sowegetthevalue

$F_{ck=}$

30MpaW/Crati

o=0.43

Water contain = 192 kg

CementContain=447kg

C.A/Totalaggregate=0.634

F.A/Totalaggregate=(1–0.634)=0.366

Mix calculation

Mass/(Sp.GravityofCement*1000)=VolumeofCement Cement

volume = 447/(2.880 * 1000) = 0.155 m3

VolumeofWater=Mass/(Water'sSpecificGravity* 1000)

VolumeofWater=192/(1.000*1000)=**0.192m^3**

VolumeofAll-in-aggregate(Coarse+Fineaggregate)=(TotalConcreteVolume–AirContent– Volume of Cement – Volume of water)

VolumeofAll-in-aggregate=(1–0.01–0.155–0.192)=**0.643m^3**

Anyway,wecansaythat,theTotalVolumeofCoarseandFineAggregateisoffractionalof0.719 m^3 out of total 1m^3 Concrete Volume.

Thereso,the**WeightofCoarseAggregate**=(0.634x0.643x2.74x1000)

=**1117Kg.**

IntheSimilarway,the**WeightofFineAggregate**=(0.366x0.643x2.65x1000)

=**624Kg.**

Table2materialsusedin1m^3 ForM30gradeofconcrete

Inthistableshowallmaterialquantityperm^{3}cement,sand,aggregateand water.

Cement	Sand	Aggregate	Water
447	624	1117	192

But in our research we replaced aggregate 0%, 2%,4%,6%,8%,10% and 12% and sand replace0%,1%,2%,3%4%,5% and 6 % with e- waste.

Sonewmaterial'squantityper1m^{3}is

Table3weightofAggregateande-waste

Inthistableshownelectronicwastequantityandcoarseaggregatequantity.

%ofe-waste	Actual Weight of Aggregateinkgas per mix design	Weightofe-waste in kg	Weight of Aggregate in kgafterreplacingwithe-waste
0	1117	0	1117
2	1117	22.34	1094.66
4	1117	44.68	1072.32
6	1117	67.02	1049.98
8	1117	89.36	1027.64
10	1117	111.7	1005.3
12	1117	134.04	982.96

Table4weightofSandande-waste

Inthistableshownelectronicwastequantityandfineaggregatequantity.

%ofe-waste	ActualWeightof Sandinkgasper mix design	Weightofe-waste in kg	Weight of Sand in kg afterreplacingwithe-waste
0	624	0	624
1	624	6.24	617.76
2	624	12.48	611.52
3	624	18.72	605.28
4	624	24.96	599.04
5	624	31.20	592.80
6	624	37.44	586.56

RESULTSANDDISCUSSION

The Results (or Findings) section follows the Methods and precedes the Discussion section. The Discussion section follows the Results and precedes the Conclusions and Recommendations.

COST ESTIMATION

Cost Analysis

The cost is the main important factor in any research. The invented material should be cost effectiveso thatitcanbeeasily adoptedinmodernconstructionindustry. Forconstructionofany project60%ofthecostisincurredinthematerial.Ourmaterialinwhichwehaveusedelectronic waste as a partial replacement of course aggregate and fine aggregate by 0% to 12 %. and 0% to 6% In this way less aggregate will be used for every $m^3$of concrete and we can save the direct material cost. The details of the cost economics of the material is described briefly in following table.

MaterialRateinBhopal11-04-2023 Cement -

355 Per Bag

1bag=50kg

Sorateof1kgcement=355/50=7.1Rs

Sand-43cuft

1cuft=28.32kg

Sorateof1kgsand =43/28.32=1.52Rs

Aggregate–25cuft

Sorateof1kgaggregate =25/28.32=0.88Rs

A correct rate per unit of work or supply of work specifications such labor, materials, and equipmentisdeterminedusingrateanalysis.Itcanalsobedescribedastheanalyticalinvestigation that identifies the fundamental needs to define unit rates of work.

Table5MarketRateofAll Material

S. No.	Material	Rate(Rs./Kg)
1	Cement	7.1
2	FineAggregate	1.52

3	CoarseAggregate	0.88
4	ElectronicWaste	0.2

Costofcementperm^3=447*7.1=3173.7rs

Table6Costofcoarseaggregateandelectronicwaste

%ofe-waste (1)	Weightof e-wastein kg (2)	Weight of Aggregateinkg after replacing withe-waste(3)	Cost of electronic wasteinRs(4)	Costofcoarse aggregate in Rs (5)	Totalcost of coarse agg+ E waste= (4+5)
0	0	1117	0	982.96	982.96
2	22.34	1094.66	4.47	963.30	967.77
4	44.68	1072.32	8.936	943.36	952.296
6	67.02	1049.98	13.40	923.98	937.38
8	89.36	1027.64	17.87	904.32	922.19
10	111.7	1005.3	22.34	884.66	907
12	134.04	982.96	26.81	865	891.81

Table7Costoffineaggregateandelectronic waste

%ofe-waste (1)	Weightof e-wastein kg (2)	Weight of Sand in kg after replacingwithe-waste (3)	Cost of electronic wasteinRs(4)	CostofFine aggregatein Rs (5)	Total cost offineagg+ E waste= (4+5)
0	0	624	0	948.48	948.48
1	6.24	617.76	1.25	939	940.25
2	12.48	611.52	2.5	929.5	932

3	18.72	605.28	3.7	920	923.7
4	24.96	599.04	5	910.54	915.54
5	31.20	592.80	6.24	901.05	907.29
6	37.44	586.56	7.5	891.57	899.07

Table8TotalcostofmaterialsinRsperm^3

Electronic waste %	Costofcement in RS	Costof coarse agg+electronic waste	Costoffineagg +electronic waste	Totalcost
0	3173.7	982.96	948.48	5105.14
3	3173.7	967.77	940.25	5081.72
6	3173.7	952.296	932	5057.996
9	3173.7	937.38	923.7	5034.78
12	3173.7	922.19	915.54	5011.43
15	3173.7	907	907.29	4987.99
18	3173.7	891.81	899.07	4964.58

Conclusion

Fromtheexperimentalexaminationthisexplorationworkcanbeconcludeas following:-

- Sincethedensityofconcreteisreducedwhene-wasteisutilizedinitsstead,thisEWCcan be used to make light-weight concrete.
- One of the finest methods for disposing of e-waste is to use the EWC in conjunction with ordinary concrete.
- Uptillapoint,usinge-wasteinconcretecansuccessfullyaddresstheissueofe-waste disposal.
- EWCcanalsohelptopartiallyreducetheproblemofrisingconstructionmaterialcost.To save the material cost 2.35% 1m^{3}as compare to control mix.

REFERENCES

[1] Mona BrahmacharimayumChitraShijagurumayum and Thokchom Suresh "E-Waste in Concrete-AReview"JournalofCivilEngineeringandEnvironmentalTechnology p-ISSN:2349-8404;e-ISSN:2349-879X;Volume6,Issue6;July-September,2019,pp.384-387 ©KrishiSanskritiPublicationshttp://www.krishisanskriti.org/Publication.html.

[2] Suchithra S1, Manoj Kumar2, Indu V.S "STUDY ON REPLACEMENT OF COARSE AGGREGATE BY E- WASTE IN CONCRETE" International Journal of Technical Research and Applicationse-ISSN:2320-8163, www.ijtra.comVolume3, Issue4(July-August2015),PP.266-270

[3] Tomas U. GanironJr "Effect of Thermoplastic as Fine Aggregate to Concrete Mixture" International Journal of Advanced Science and Technology, 2014.

[4] S.P.Kale, H.I.Pathan "Recycling of Demolished Concrete and E-waste" International Journal of Science and Research, 2013.

[5] Salman Siddique, SikandarShakil, ShdabSddiqui "Scope of Utilisation of E-waste in Concrete" International Journal of Advance Research in Science and Emerging Vol.No 4, Special Issue(01), March 2015.

[6] R.Lakshmi, S. Nagan, "Utilization of Waste E –plastic Particles in Cementitious Mixtures " Journal of Structural Engineering, Vol.38, No.1, April- May 2011,pp.26-35.

[7] R. Lakshmi, S. Nagan, "Investigation on Durability Characteristics of E-plastic Waste Incorporated Concrete" Asian Journal of Civil Engineering (Builing and Housing) Vol.12, No.6, April 2011.

[8] IftekarGull,Mr.M.Balasubramanian"ANewParadigmonExperimentalInvestigation of Concrete for E- plastic Waste Management" International Journal of Engineering Trend and Technology, Vol.10, No.4, April 2014.

BIOGRAPHIES

	**ShwetabhUpadhyayStudents** **MadhyanchalProfessionalUniversityBhopal**
	VinayKumarSinghChandrakar PROFESSOR DeptofCivil Engineering **MadhyanchalProfessionalUniversityBhopal**