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STUDY OF COMPRESSIVE STRENGTH OF CONCRETE BY USING E-WASTE

Name of Auther: Pawan Kumar Pankaj ,
Designation: Student
Name of Department: Dept of civil Engineering ,
Name of organization: Lingayas Vidyapeeth, Faridabad
Guide Name: Dr. Divyashree (HOD Civil)

Abstract:

E-Waste material is causing hazardous effect of the environment and human health. So, it is necessary to use it in those areas which can minimize its dangerous effect and can bring some positive result. Endeavors are made to use such type of waste material into concrete as a coarse aggregate or fine aggregate. This research paper is presenting an investigation on study of compressive strength of concrete by using E-waste as a part of coarse aggregate. Conventional Mix M-25 is designed as per the new guidelines of IS10262:2009. The E- waste is broken into specific size and shape. Total 90 specimens were casted with and without using E-waste (1%, 1.5% & 2%) along with fly-ash and Poly Carboxylic Ether (Plasticizer). Compressive strength test was conducted on both type of specimen after 7 days, 14 days and 28 days of curing. The utilization of E-waste in the concrete is quite effective and compressive strength is increasing upto 2% replacement. This ensure that the use of E-waste in the concrete results in to benefits, mainly the better waste management of such non-recyclable waste material, making the project economical and increasing the compressive strength of concrete.

I. INTRODUCTION

Electronic waste, popularly known as E-waste, can be defined as electronic and electrical equipment products (including the connecting power plug, batteries, motherboards, printed circuit board) which have become obsolete due to change in fashion, style and status and nearing the end of life. Rapid technology change, low cost has resulted in a fast growing surplus of electronic waste around the globe, several tones of E-waste need to be disposed per year. Traditional landfills or stockpiles method is not an environment friendly solution and disposal process is also very difficult to meet EPA (Environmental Protection Agency) regulation – "How to reuse the non- disposal E- waste become an important research topic". E- Plastic waste is one of the fastest growing waste streams in the world. In developing countries, it ranges 0.01% to 1% of the total municipal solid waste generation. Maharashtra ranks first followed by Tamil Nadu, Andhra Pradesh, Uttar Pradesh, West Bengal, Delhi, Karnataka, Gujarat and Madhya Pradesh & Punjab in the list of E-waste generating state in India. Among top ten cities Generating E-waste Mumbai ranks first followed by Delhi, Bangalore, Chennai, Kolkata, Ahmedabad, Hyderabad, Pune, Surat and Nagpur.

II. ADVERSE HEALTH & ENVIRONMENT IMPACTS OFE-WASTE

Electrical & Electronic equipment are made up of the several components many which contain toxic substance like lead, chromium, mercury, beryllium ,cadmium, acids & plastic etc .These toxic substance can have highly adverse impacts on human health and environment, if not handled properly.

III. DISPOSAL OFE-WASTE

Improper burning of printed circuit board (PCBs) and switches may lead to release of mercury, cadmium & beryllium, which are highly toxic to human health. Land filling of E-waste is one of the Most widely used method of disposal is prone to hazard because of leachate which often contains heavy water resources, even state of the art landfills which are sealed to the long term are not fully safe. Older landfills sites and uncontrolled dumps, however, pose a much greater danger of releasing hazardous emission. Mercury, Cadmium, and lead are among the most toxic leachates. Mercury, for example will leach certain electronic devices such as circuit breakers. Lead has been found to leach from broken lead containing glass of cathode ray tubes from TV and Monitors.

IV. OBJECTIVEOFTHE STUDY

- To analyze the effect on compressive strength of concrete by replacing coarse aggregate with E-waste.
- To minimize the effect of E-waste on environment and human health.

V. METHODOLOGY

Mix were design after conducting the various tests on material like specific gravity, fineness, consistency, and initial setting time for cement. Sieve analysis.Mixproportionwas1:1.96:3.7.

Two type of specimen were prepared first one is conventional concrete and other one was concrete with various proportions of E-waste along with incorporation of fly ash and admixture. Compressive strength test was conducted on specimens prepared using E-waste and the results were compared with the conventional mix.

VI. EXPERIMENTALINVESTIGATIONS

Materials Used:

- Cement– PPCasperIS1489:1991
- Fine aggregate – NaturalsandasperIS383-1970
- Coarse aggregate– Crushed20mmmaximumsize –as per IS 383-1970
- E-waste material (PCBs and motherboards)
- Fly-ash
- Plasticizer-PCE (Poly-carboxylic ether)

Tests on Material:

Tests are conducted on cement, fine aggregate and coarse aggregate which are shown in following tables.

Table–1 Test on Cement

Test	***Results***
Specific Gravity	*2.91*
Consistency	*33%*

Table– 2

Test on Fine Aggregate

Test	*Results*
Specific Gravity	*2.70*
Free Surface Moisture	*2.1%*
Gradation	*Zone2*

Table– 3

Test on Coarse Aggregate

Test	*Results*
Specific Gravity	*2.78*
Aggregate impact value	*31.33%*
Aggregate crushing value	*17.30%*

Total 10 composition of concrete mix were casted with different proportion of E-waste (1%, 1.5%, and 2%) and experimental investigation is carried out in the table shown below

Table–4 Mix Proportion

MIX		*PROPORTION*
		PPC+ FA+ CA
MIXX	*MIXX1*	*PPC+FA +CA +1%E- WASTE*
	MIXX2	*PPC+FA+CA+1.5%EWASTE*
	MIXX3	*PPC +FA +CA +2%E-WASTE*
MIXY	*MIXY1*	*PPC +FA +CA +1%E- WASTE+10%FLY ASH*
	MIXY2	*PPC +FA +CA +1.5%EWASTE +10%FLY ASH*
	MIXY3	*PPC +FA +CA +2%E- WASTE + 10%FLY ASH*
MIXZ	*MIXZ1*	*PPC +FA+CA +1%E-WASTE+10%FLY ASH+PCE*
	MIXZ2	*PPC+FA +CA +1.5%EWASTE +10%FLY ASH +PCE*
	MIXZ3	*PPC +FA +CA +2%E-WASTE+10%FLY ASH+PCE*

Abbreviations

PPC:-Portland Pozzolana Cement, FA: Fine Aggregate, CA: Coarse aggregate, PCE: Poly Carboxylic Ether

Test on Hardened Concrete

Compressive strength test

Compressive strength test was conducted to evaluate the strength development of concrete containing various E-Waste contents at the age of 7, 14 & 28 days

Table–5 Compressive Strength in N/mm^2

Mix Specification	*onventional Mix*	*X1*	*X2*	*X3*
Proportions of E-wastes	*0%*	*1%*	*1.5%*	*2%*
7 Days	*19.8*	*25.3*	*26.9*	*29.3*
14 Days	*27.5*	*28.8*	*29.1*	*38.3*
28 Days	*32.1*	*35.7*	*36.2*	*39.5*

Table – 6 Compressive Strength in N/mm^2

Mix Specification	*Conventional Mix*	*Y1*	*Y2*	*Y3*
E-waste+10%flyash	*0%*	*1%*	*1.5%*	*2%*
7 Days	*19.8*	*27.8*	*28.9*	*29.3*
14 Days	*27.5*	*33.0*	*34.0*	*35.2*
28 Days	*32.1*	*38.4*	*38.7*	*39.84*

Table–7 Compressive Strength in N/mm^2

Mix Specification	*Conventional Mix*	*Z1*	*Z2*	*Z3*
E-waste+10%flyash+PCE	*0%*	*1%*	*1.5%*	*2%*
7 Days	*19.8*	*28.5*	*31.2*	*31.7*
14 Days	*27.5*	*35.6*	*37.6*	*40.7*
28 Days	*32.1*	*40.01*	*42.50*	*44.31*

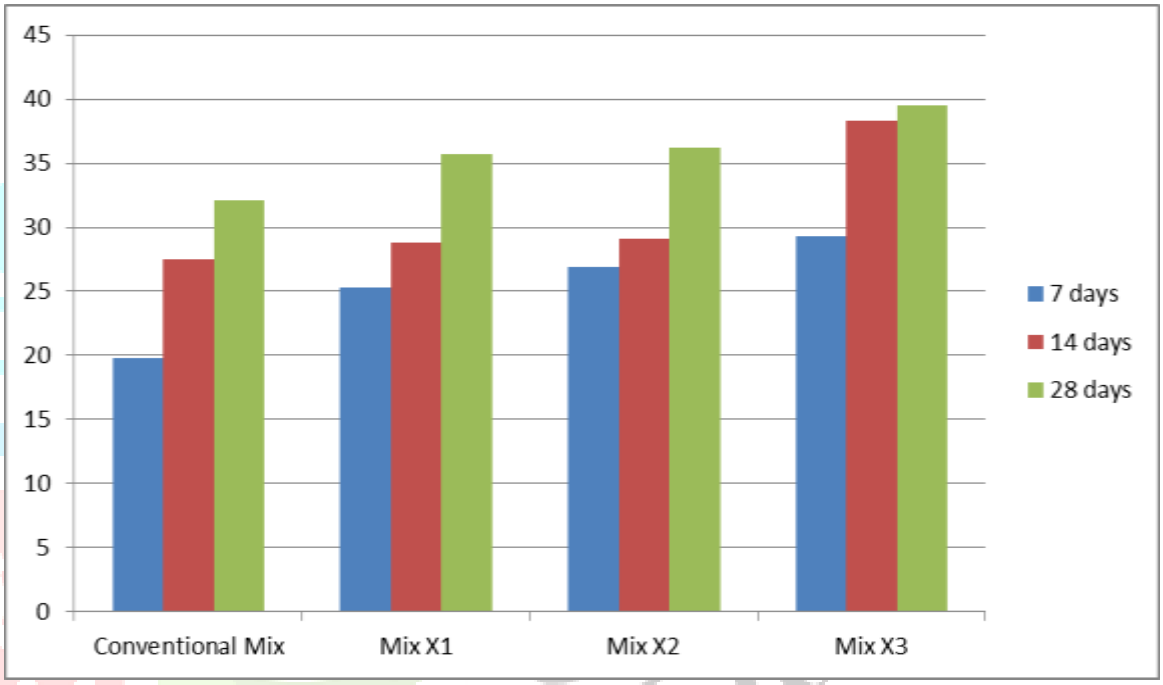

Chart1: Comparison between Conventional Mix and X series

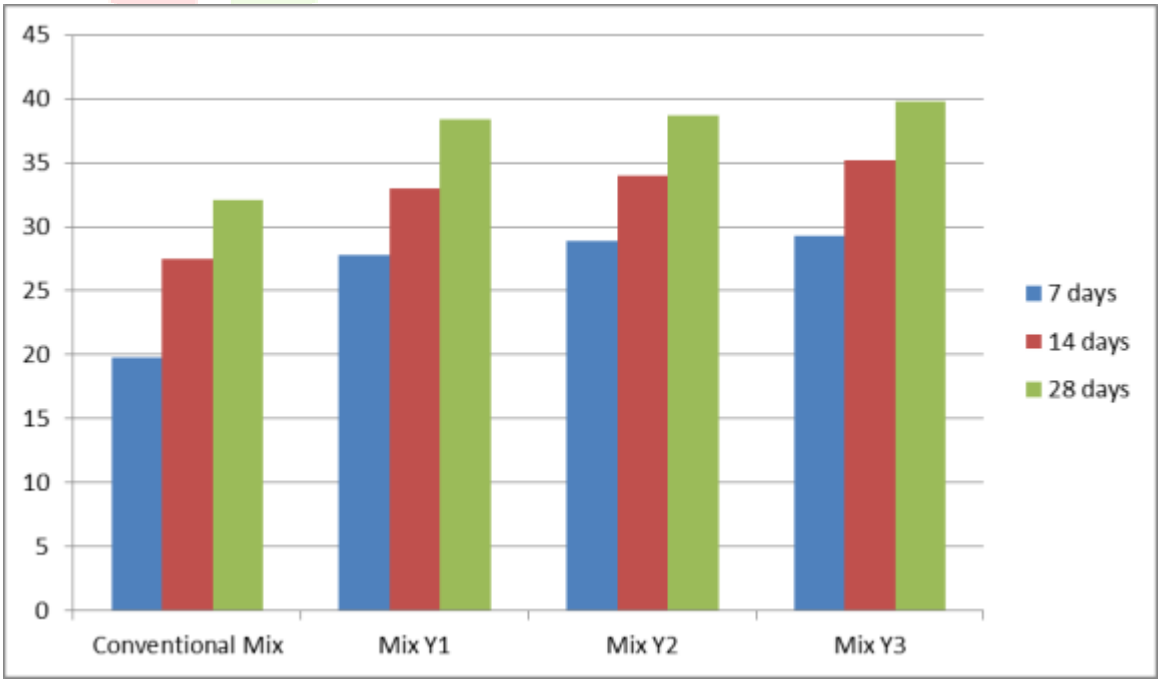

Chart2: Comparison between Conventional Mix and Yseries

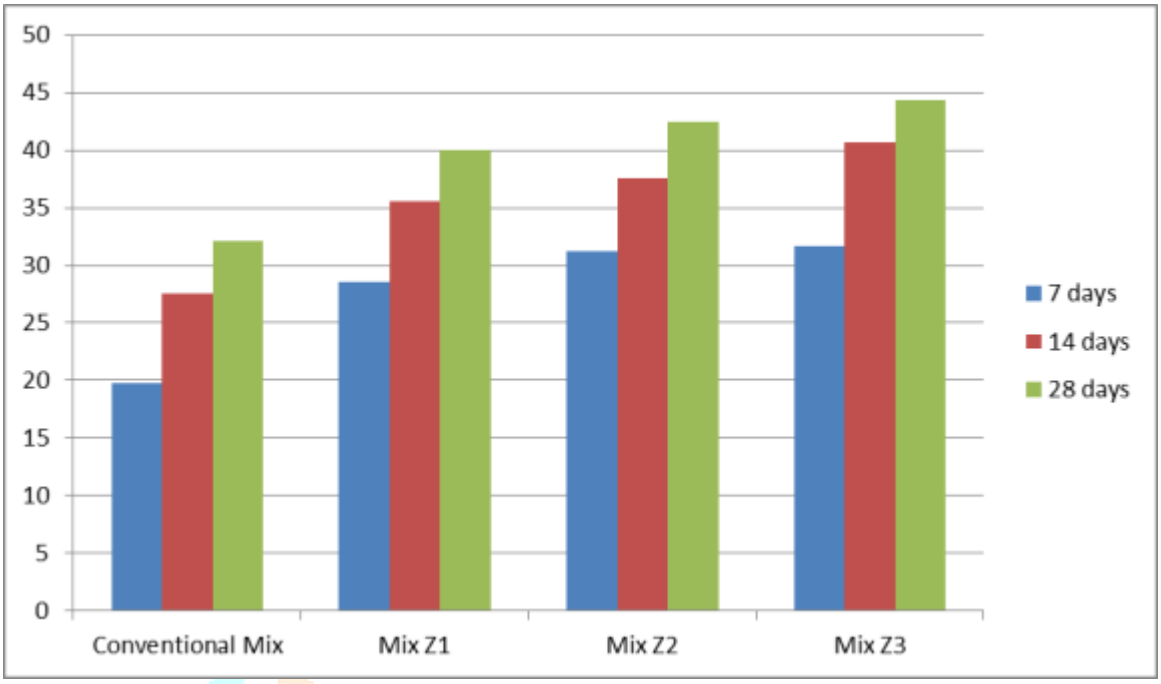

Chart3: Comparison between Conventional Mix and Z-series

VII. DISCUSSION

From the above graph it is clear that while replacing the coarse aggregate with E-waste by 1 %, 1.5% & 2%, The Strength is continuously increasing in 7days, 14 days and 28 days. The variation is more rapid in "Z" composition when PCE is used as a plasticizer which reduces w/c ratio and hence concrete get more strengthen compared to other composition.

VIII. CONCLUSION

- From the above study it is clear that the utilization of E- waste in the concrete is quite effective and compressive strength is increasing upto 2% replacement.
- Results are more effective when we used Flyash and plasticizer.
- This work can be implemented in construction industry especially in road projects which will make it more safe, eco-friendly and economical.

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