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EXPERIMENTAL STUDY ON UTILIZATION OF E -WASTE IN CEMENT CONCRETE

Sagar R. Raut[1], Monali G. Mandaokar[2], Anurag K. Gahalod[3]

[1]*Assistant Professor, Department of Civil Engineering, Jagadambha College of Engineeering & Technology,Yavatmal, Maharashtra ,India,* ***sagar_raut19@rediffmail.com.***

[2]*Assistant Professor, Department of Civil Engineering, Jagadambha College of Engineeering & Technology,Yavatmal, Maharashtra, India,* ***monali12mandaokar@gmail.com.***

[3]*Assistant Professor, Department of Civil Engineering, Jagadambha College of Engineeering & Technology,Yavatmal, Maharashtra, India,* **anu.gahalod@rediffmail.com**

Abstract

At present demand of infrastructure is increasing day by day. The basic fundamental component for construction of any infrastructure is concrete. Due to large use of concrete as the basic construction material availability of raw materials is being questioned. The ratio of demand vs. Supply of material is increasing rapidly. Thus to overcome the demand of natural materials such as aggregate and cement, it is necessary to find alternatives of these materials. On the other hand electronic waste (e-waste) generation is also an emerging issue posing serious problems to the environment. Generation of e-waste is a very serious issue in the world. In year 2014 produce near about 650000 MT of e-waste in India that includes all electronic wastes and electrical wastes (TVs, computers, sound system etc). For solving the disposal of large amount of e-waste material, partial use of e-waste in concrete industry is considered as the most feasible application. The e-waste like non-metallic parts of PCB plates can be recovered and can be use as an ingredient in concrete. So we can use this e-waste to achieve desire concrete in terms of their properties. In this paper the coarse aggregate is replaced by e-waste and the research strongly shows possibility of e-waste being used as substitute of fine and coarse aggregate. More use of this waste material tends to reduce the demand of natural resources used in concrete and it is of prime importance that substitute of coarse aggregate can be explored.

Index Terms: *e-waste, workability, compressive strength, split tensile strength.*

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1. INTRODUCTION

We cannot imagine civil engineering structures without concrete. Concrete is a backbone of infrastructural development and hence manufactured in large quantity. At the other hand large amount of e-waste is generated every year and out of which a very small percentage e-waste is treated by either recycling it or reusing it. From the study it is found that only 12.5% of e-waste is recycled. E-waste like non-metal parts in PCB's (printed circuit boards) can be recovered & used as an ingredient in concrete. So, partial replacement of aggregate by e-waste has been experimentally carried out in various part of the world. With the use of e-waste we can overcome many environmental problems as it reduces the landfill due to e-waste and reduced the use of natural resources like aggregates. In this paper comparative study is made by replacing the coarse aggregate by e-waste in different percentages and to find the behaviour of concrete with these replacements and to find the optimum percentage replacement.

2. LITERATURE REVIEW

Many researchers gave some conclusion on effect of use of e-waste on the physical properties of concrete. Out of which some researches I would like to include in this paper.

Johan Sohail in his paper "Optimizing Non-Metallic Printed Circuit Board Waste in Cement Concrete", mentioned that the non-metallic parts of Printed Circuit Board can be Successfully used in the concrete. Also he presented a study on reclamation and reuse of non metallic material recovered from waste PCB'S.

Suchithra S.et.al. in their paper "Study on Replacement of Aggregate By E-Waste In Concrete", mentioned when E-waste as a coarse aggregate replacement, 28 days strength is found to marginally increase up to 15% replacement level. Increase in split tensile strength is almost insignificant where as gain in flexural strength have occurred even up to 15% replacement. E-waste seems to have a more pronounce effect

on flexural strength than split tensile strength. The use of e-waste in concrete is possible to improve its mechanical properties and can be one of the economical way for their disposal in environment friendly manner.

M.D. Jalal Uddin in his Journal and conference paper on e-waste management, states that the major pollution of e-waste generated domestically as well as illegally imported are recycled in crude manner leading to pollution of the environment. e-waste contains lead, cadmium, mercury, plastics (P.V.C), barium, beryllium, chromium, phosphor & additives. Through innovative changes in product design, use of environmental friendly substitutes for hazardous substances these impacts can be mitigated.

Laxami. R, Nagan. S in Study on concrete containing e-plastic waste. e-waste particles as coarse aggregate in concrete with a partial replacement ranging from 0%- 30% on the strength criteria of M-20 grade concrete has been experimentally carried out successfully.

Many researchers gave the positive conclusions on using this material as a partial replacement to coarse aggregates. Some researchers gave the ill effects of generation of e-waste and disposal problems of it. From the literature survey we can conclude that the utilization of e-waste in concrete upto certain extent is possible.

3. METHODOLOGY

Collection, separation, grinding and grading the e-waste sample material, testing the physical properties of test material i.e. e-waste, cement, sand and aggregates. Casting the cube of size 150mm X 150mm X150mm, with replacement of coarse aggregates by e-waste and test them for 7 days, 14 days and 28 days for compressive strength test and cylinders for the split tensile strength. The result is then compared with the control mix.

4. RESULT AND DISCUSSION

4.1. Workability results for different percentages of e-waste

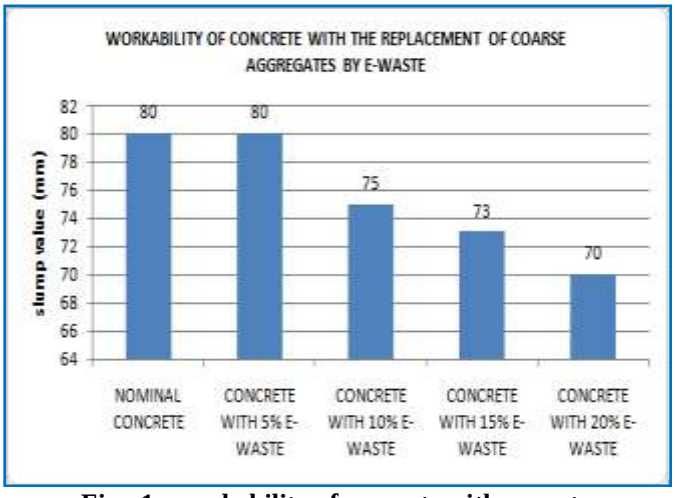

Fig. -1:- workability of concrete with e-waste.

From the above result of slump value test, it is found that the workability decreases with the increase in the percentage of e-waste in concrete. It is due to the rough, irregular shape of e-waste aggregate as compared to the natural aggregates.

4.2. Compressive strength test results at different ages and with replacement of Coarse Aggregates by e-waste :

4.2.1 7-days compressive test

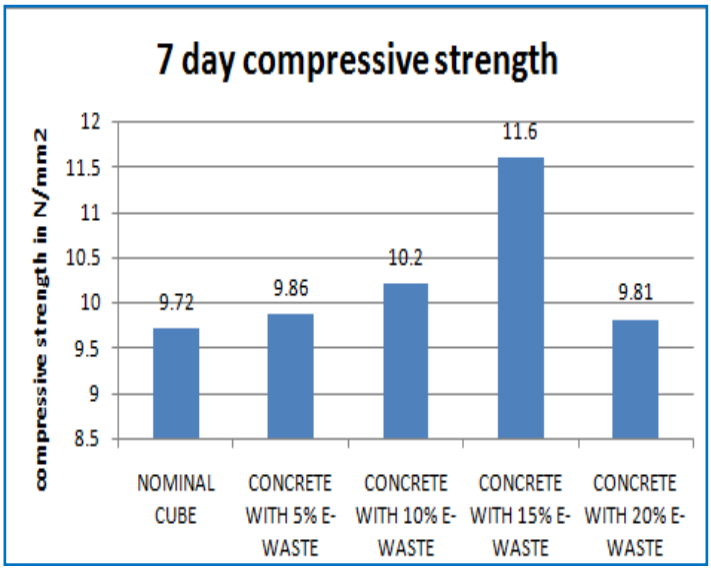

Fig.-2:- 7-days compressive strength with e-waste.

The above graph shows that the 7-day compressive strength of concrete increases with the increase in percentage of e-waste replacement to the coarse aggregates upto certain extent, and then it goes down. This relation shows that we can partially replace the aggregates upto some extent, and experimentally it is found that we can replace about 15 % of coarse aggregates with the e-waste.

4.2.2 14-days compressive test

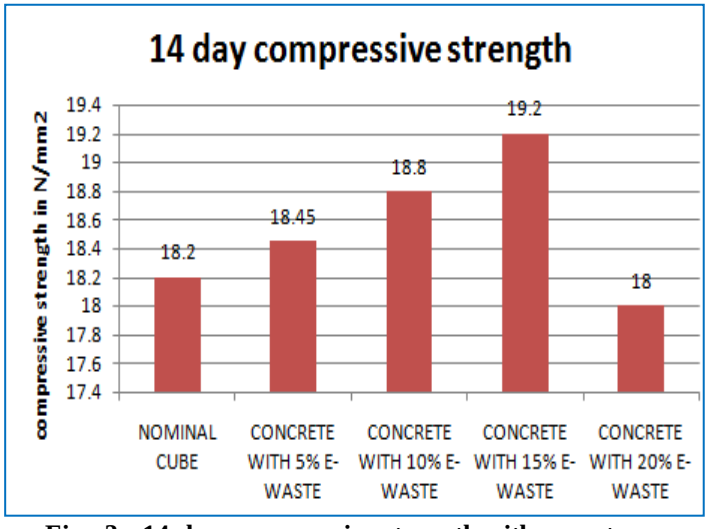

Fig. -3:- 14-days compressive strength with e-waste.

4.2.3 28-days compressive test:-

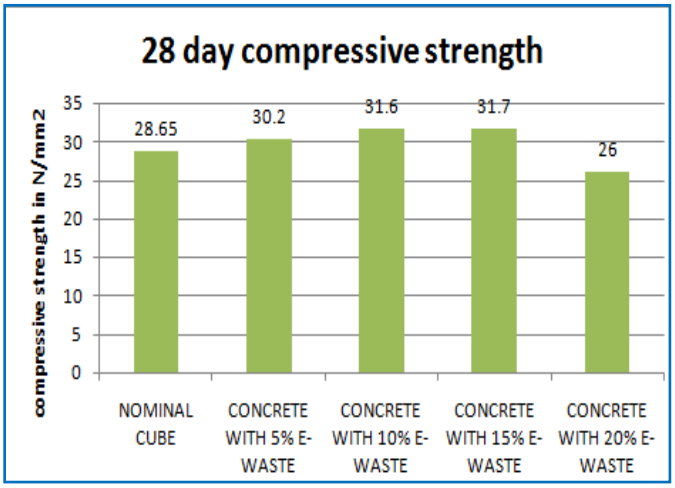

Fig.-4:- 28-days compressive strength with e-waste.

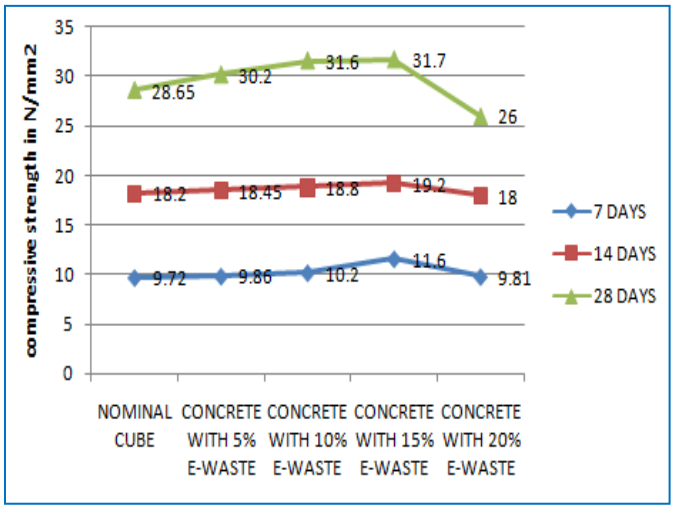

Fig.-5:- compressive strength of concrete with e-waste at different ages.

The Fig. 5 and Fig. 6 gives the behaviour of concrete with the e-waste replacement at different ages. From Fig. 5, we can observe the changes in compressive strength with the increase in percentage of e-waste replacement. Fig. 6 shows the change in compressive strength with e-waste replacement. As mentioned earlier in Fig. 2, 3, and 4.

From Fig. 7, we can conclude the tensile strength of concrete increases with increase in percentage of e-waste replacement up-to certain extent and then it goes down as the replacement percentage increases. As concrete is week in tension this replacement give the appreciable results. In this study we found that the split tensile strength properties is enhances with the use of e-Waste in concrete.

Many researchers have given the positive results of the e-waste replacements in concrete. As the disposal of e-waste will become a serious problem in coming days this use of e-waste in concrete become a best solution for the utilization of this waste.

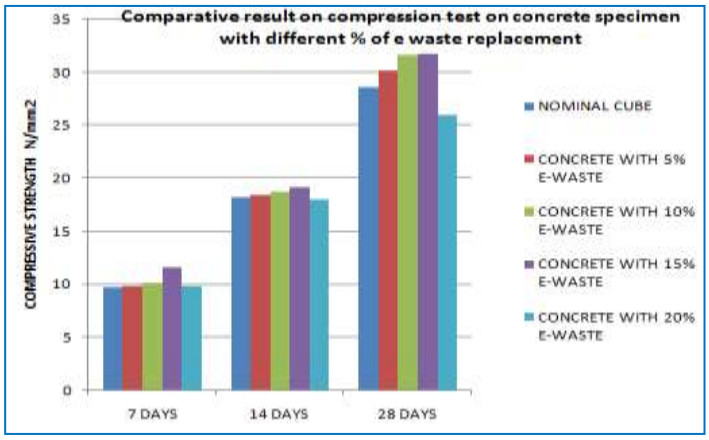

Fig.-6:- Combined behaviour of compressive strength of concrete at different ages and with different percentage of e-waste replacements.

4.3. Split Tensile Strength Test

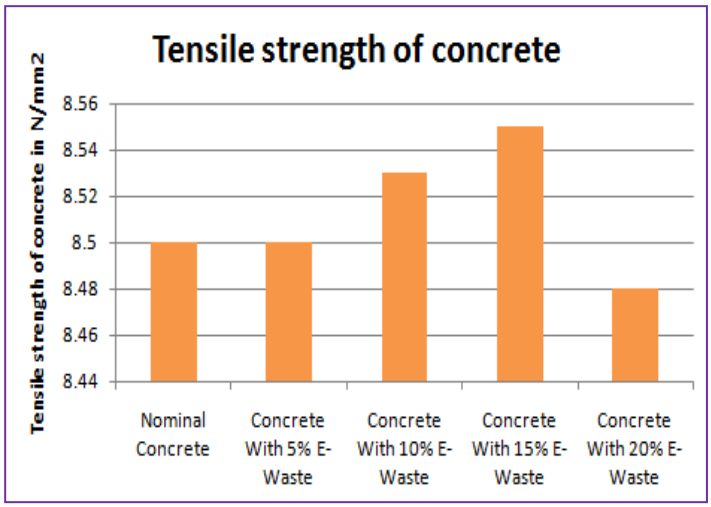

Fig.-7. Tensile strength of concrete.

5. CONCLUSION

From the above experimental study the following conclusion can be drawn:-

1. It is experimentally found that the partial replacement of aggregates by the e-waste is possible upto certain extent.
2. The 15% replacement of aggregates gives the optimum results for compressive strength test.
3. e-waste can be dispose in concrete as a coarse aggregate.
4. Split tensile strength is maximum up to 15% replacement of coarse aggregate by e-waste.
5. This replacement gives the sustainable approach.

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