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Experimental Study on Utilization of E -Waste in Cement Concrete

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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 used 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.*
KEYWORDS- *compressive strength, e-waste, split tensile strength, workability.*

I. 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. As the use of concrete and the generation of the e-waste is increasing rapidly

to meet the demand and technological advancement In this paper comparative study is made by replacing the coarse aggregate by e-waste in different percentages and to find

the behavior of concrete with these replacements and to find the optimum percentage replacement.

II. 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 nonmetallic 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 whereas 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 used of E-waste in concrete is possible to improve its mechanical properties and can be one of the economical ways for their disposal 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 hazards 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 percentile replacement ranging from 0-30% on the strength criteria of M20 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.

III. METHODOLOGY

Collection, separation, grading and grading the e-waste sample material, testing the physical properties of test material i.e. e-waste, cement, sand, aggregates. Casting the cube of size 15cmX15cmX15cm with replacement of coarse aggregates by e-waste and test them for 7days, 14days and 28days for compressive strength test and cylinders for the split tensile strength. The result is then compared with the control mix.

IV. RESULT AND DISCUSSION

4.1. Workability results for different percentages of e-waste:

From the below graph of slump value test (Fig-1), 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. These
aggregates are flaky in shape and of rough texture so the internal friction is very high between these aggregates and results in reduced workability.

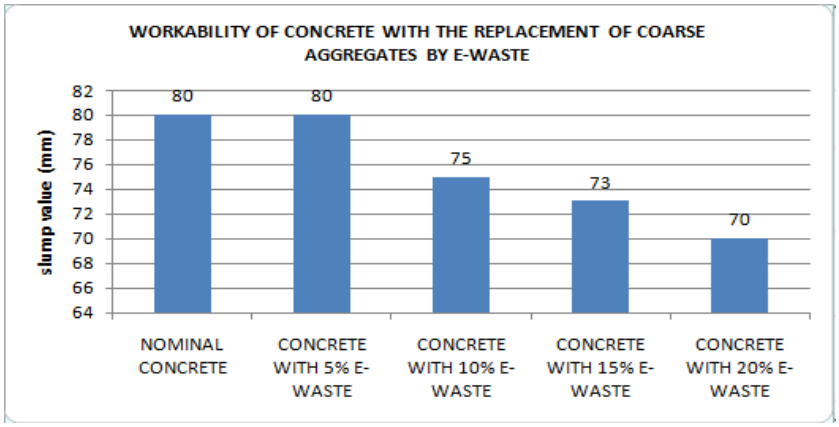

Fig. -1:- workability of concrete with e-waste.

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:-

The graph (Fig.2) shows that the 7-day compressive strength of concrete increases with the increase in percentage of e-waste replacement to the coarse aggregates up to certain extent, and then it goes down. This relation shows that we can partially replace the aggregates up to some extent, and experimentally it is found that we can replace about 15 % of coarse aggregates with the e-waste.

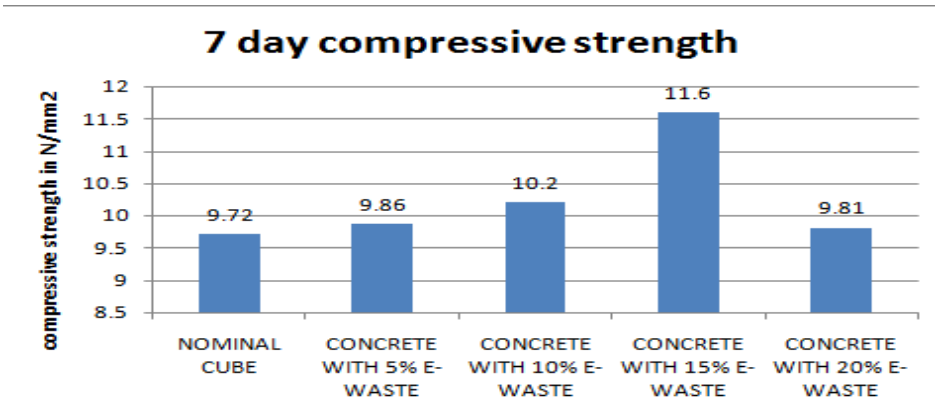

Fig. 2:- 7-days compressive strength with e-waste.

4.2.2: 14-days and 28 days compressive test:-

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. The experimental study is also shows the effectiveness of using the e-Waste in cement concrete and can be the substitute for the coarse aggregates.

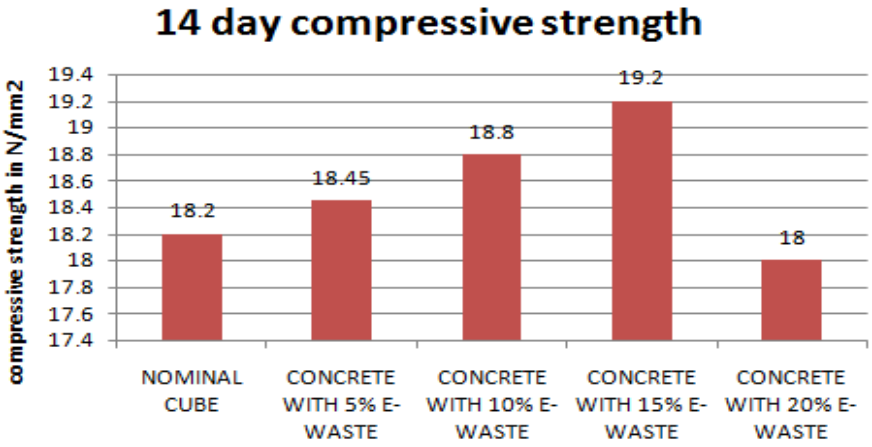

Fig. -3:- 14-days compressive strength with e-waste.

As the above graph(Fig.-3) shows the change in compressive strength for 14-day age; it is found that the compressive strength of concrete increases with increase of e-Waste percentage upto the 15% replacement and it falls considerably after this replacement is reached to 20%. Similarly in graph (Fig. 4) the same relation is observed the 28th day strength is also shows some increment upto 15% replacement and further it reduces at 20% replacement.

Fig. no. 5 and 6 gives the combined behavior of the concrete made up of part e-waste and part aggregates in it. It also shows the increase of the compressive strength and pattern of variation in strength and also gives the actual representation of the behavior of the concrete with different replacement levels.

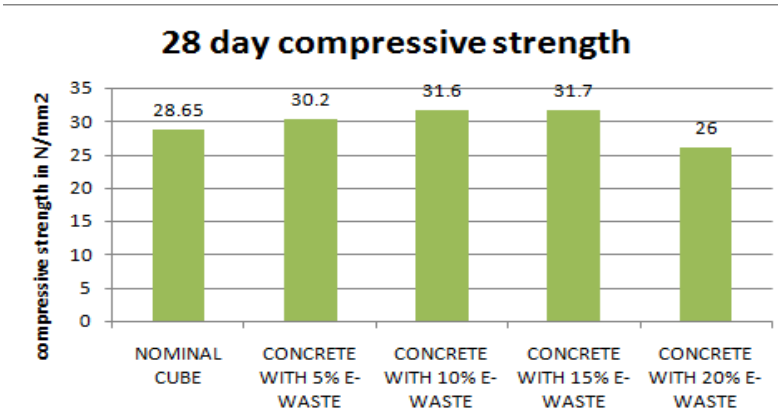

Fig. 4:- 28-days compressive strength with e-waste.

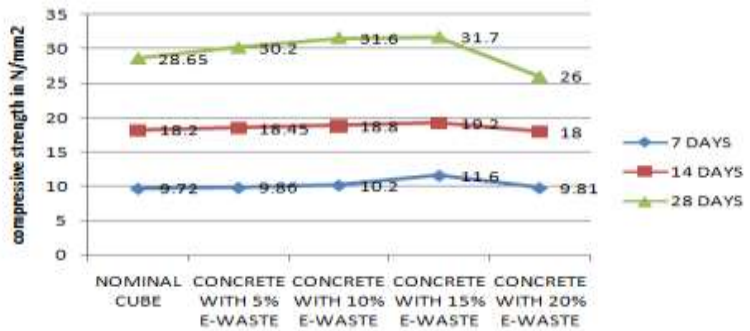

Fig.-5:- compressive strength of concrete with e-waste at different ages.

So, it can be conclude that the e-waste can partially replaces the coarse aggregate in concrete and it gives a sustainable solution to the natural resources like aggregates and reduction in the accumulation of e-waste and also reduces the excess landfill due to this e-Waste.

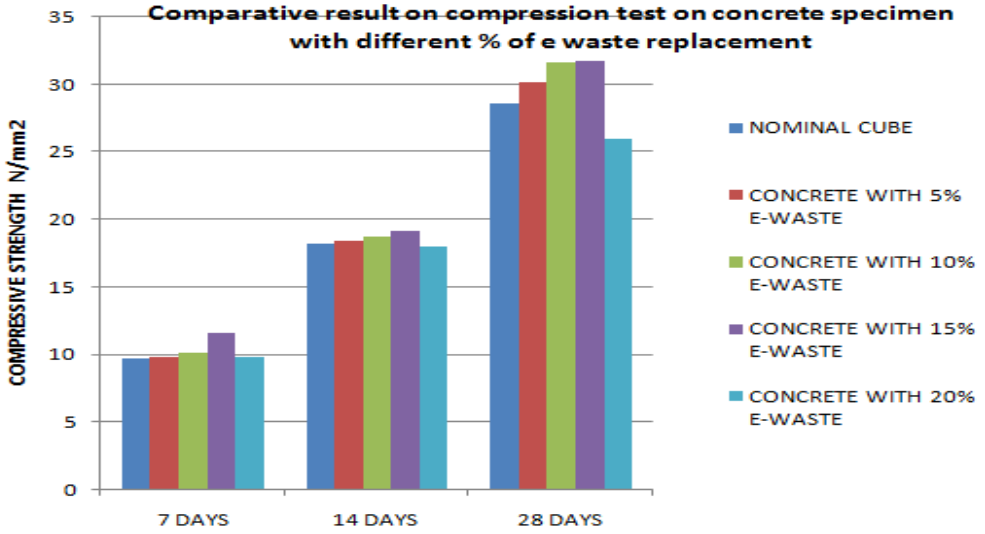

Fig.-6:- Combined behaviour of compressive strength of concrete at different ages and with different percentage of e-waste replacements.

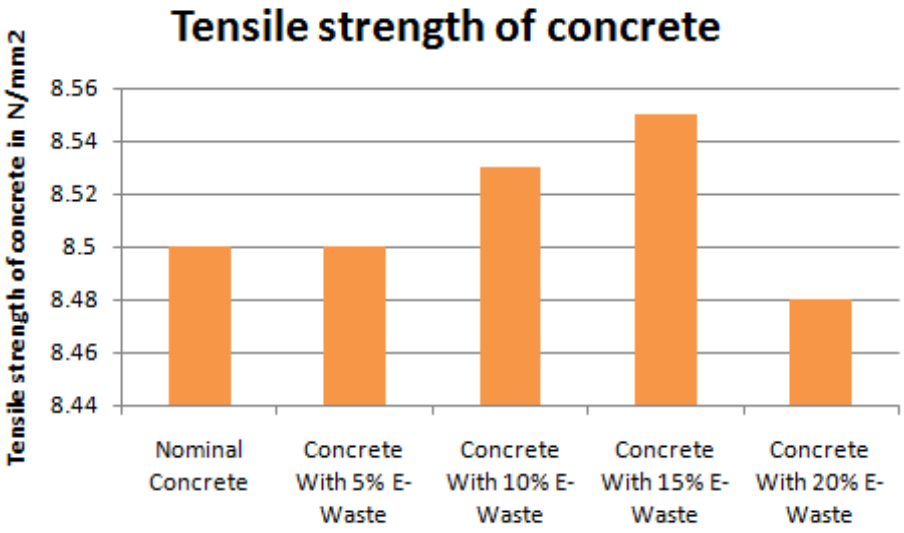

Fig.-7. Tensile strength of concrete.

From Fig. 7, we can observe that the tensile strength of concrete increases with increase in percentage of e-waste replacement up to certain extent and then it goes down. As concrete is week in tension this replacement give the appreciable results. The e-waste increases the interlocking of the aggregates and increases the tensile properties considerably.

V. 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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