The Study On The Performance Of Cement Mortar By Replacing The Fine Aggregate With E- Plastic Waste

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Abstract - *Utilization of waste materials and byproducts is a partial solution to environmental and ecological problems. Electronic waste, abbreviated as e-waste, consists of discarded old computers, TVs, refrigerators, radios – basically any electrical or electronic appliance that has reached its endoflife. Efforts have been made in the construction industry to use nonbiodegradable components of E waste as a partial replacement of the coarse and fine aggregates.*

An experimental study is made on the utilization of E-plastic waste particles as fine aggregates in mortar with a percentage replacement ranging from 0 % to 50% on the strength criteria. Test were conducted on mortar with and without E-plastic waste as aggregates was observed which exhibits a good strength gain.

Key Words: **E-waste, Fine aggregates, Compressive strength, Split tensile strength , Density, Retentivity.**

1. INTRODUCTION

The advancement in technology and changing lifestyle, status or perception of consumers has driven this demand of electronic items. The new innovations in information technology because of the rising demand for higher efficiency and productivity in the businesses and work have become a matter of day to day life. Technologies which were new yesterday have become obsolete for today. Thus, there can be broad range of waste electric and electronic goods which have outlived their use, ready for disposal. These contain chemical materials considered hazardous for human beings and natural environment. The increasing rate of waste electronic products and additionally the illegal import of junk electronics from abroad create a complex scenario for solid waste management.

1.1 Waste Management Strategies

The best option for dealing with E wastes is to reduce the volume. Designers should ensure that the product is built for re-use, repair and/or upgradeability. Stress should be laid on use of less toxic, easily recoverable and recyclable materials which can be taken back for refurbishment, remanufacturing, disassembly and reuse. Recovery of metals, plastic, glass and other materials reduces the magnitude of e-waste. It is the need of the hour to have an “e waste policy” and national regulatory frame work for promotion of such activities. Sustainability of e-waste management systems has to be ensured by improving the effectiveness of collection and recycling systems

2. Objectives of the study

1. This project is to study the possibility of utilizing E plastic waste as a sand substitute in cement mortar, in order to reduce the solid waste disposal problem and thereby environmental pollution and energy consumption.

2. Determination of properties of E-plastic waste as fine aggregates.

3. Determination of properties of masonry mortar using E plastic waste as fine aggregates.

4. Determination of compressive strength and modulus of elasticity of Solid concrete block masonry using E waste replaced masonry mortar.

3. Methodology

- E- plastic waste was collected from Scrap collectors in Vitla, D.K District, Karnataka, India. The E-waste mainly consist of old television covers , computer monitor covers , etc.
- The large plastics were cut into smaller pieces by using the cutting machines.
- The handpicked E-plastic waste were collected from the scrap yard and transported to Mangalore for further shredding.
- The obtained plastics were taken to Venus pvt Its company for the further Shredding of plastics.
- Finaly the E-plastic waste were shredded to smaller pieces below 4.75 mm size

Table -1: Experiment on fine aggregate and cement

Properties	Results obtained
Specific gravity of E- waste	1.01 %
Finess of cement	1.2%
Standard consistensy of cement	33%
Intial setting time of cement	35 min
Final setting time of cement	280 min

4. Experiments on masonry mortar

4.1 Compressive strength

Test specimens – The mould of size 70.6 X 70.6 X 70.6 mm were used for conducting compressive strength test. The mould as prepared was filled with the mortar to about half height and the layer compacted by tamping it with the tamping rod in a uniform manner over the mortar surface in such a way as to produce full compaction of the mortar with neither segregation nor excessive laitance. The mould was completely filled and the upper layer of the mortar compacted in a similar manner, after which the surface of the mortar was struck off plane and leveled with the top of the mould, using a trowel.

Curing and storage – The specimens was stored at a place free from vibration, in moist air at a temperature of 27 +/- 2°C.

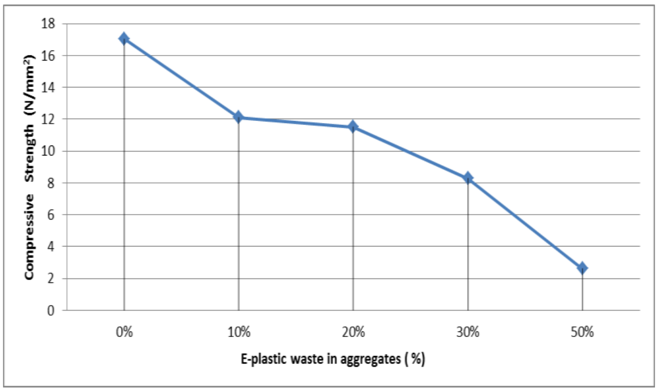

Chart -1: Compressive strength at 3days in MPa

Discussion : The compressive strength of mortar with various percentage of E-plastic waste at 3 days curing age. It indicates clearly that the replacement of sand by E- plastic waste in mortar reduces the compressive strength. Fig 4.6 shows the reduction in compressive strength of 29.05% , 32.5 % ,51.37% and 84.6 % is obtained respectively for mortar with E-waste ratio 10%,20%,30% and 50% at age of 3 days curing.

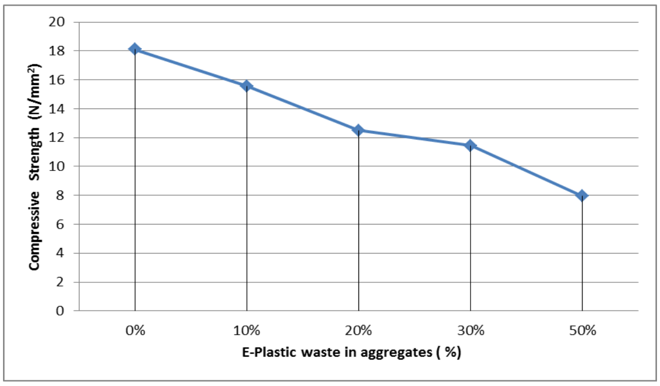

Chart -2: Compressive strength at 7 days in MPa

Discussion : The compressive strength of mortar with various percentage of E-plastic waste at 7 days curing age. It indicates clearly that the replacement of sand by E- plastic waste in mortar reduces the compressive strength. Fig 4.8 shows the reduction in compressive strength of 14.0% , 35.7 % ,36.9% and 53.7 % is obtained respectively for mortar with E-waste ratio 10%,20%,30% and 50% at age of 7 days curing.

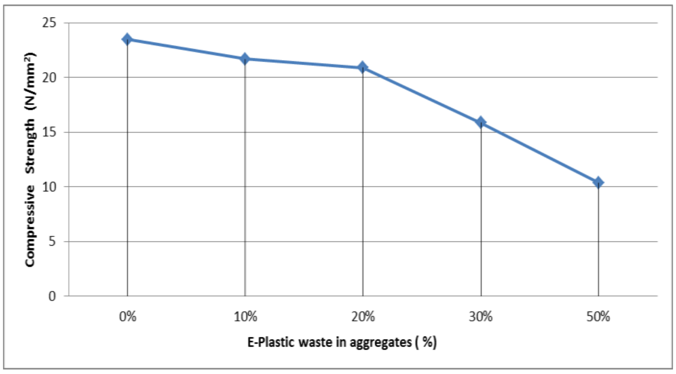

Chart -3: Compressive strength at 28 days in MPa

Discussion : The compressive strength of mortar with various percentage of E-plastic waste at 28 days curing age. It indicates clearly that the replacement of sand by E- plastic waste in mortar reduces the compressive strength. Fig 4.10 shows the reduction in compressive strength of 7.6% , 11.1 % ,32.46% and 55.81 % is obtained respectively for mortar with E-waste ratio 10%,20%,30% and 50% at age of 28 days curing.

4.2 Split tensile strength

The mix proportion of 1:3 with water cement ratio of 0.55 was taken. E-plastic waste was replaced to sand by 0%,10%,20%,30% and 50% . Mixed them thoroughly until uniform colour was obtained. The mix was casted in cylinders of the size 100mm diameter X 200 mm length. The cylinder mould was filled in four layers and ram each layer more than 35 times with evenly distributed strokes.

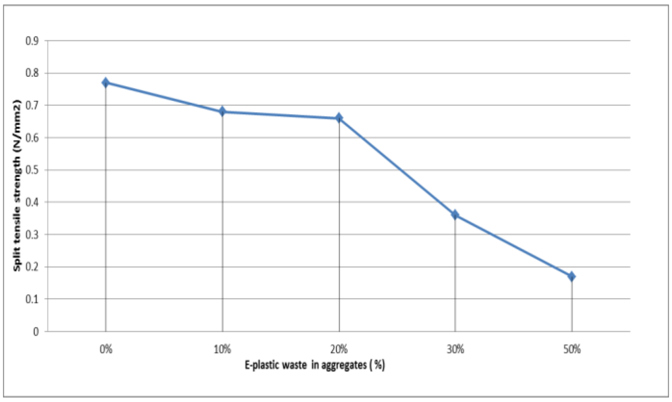

Chart -4: Split tensile strength of mortar cylinder at 28days (%)

Discussion : The tensile strength of mortar with various percentage of E-plastic waste at 28 days curing age. It indicates clearly that the replacement of sand by E- plastic waste in mortar reduces the tensile strength. Fig 4.25 shows the reduction in density of 11.65% , 14.5 % ,53.3% and 73.7 % is obtained respectively for mortar with E-waste ratio 10%,20%,30% and 50% at age of 28 days curing.

4.3 Water transportation test

The ability of mortars to retain water against suction and evaporation is termed as water retentivity. It is indirectly a measure of the workability of mortars. It is measured by the flow of mortar when tested on masonry block.

A two brick prism was prepared by sandwiching the fresh mortar bed joint between the bricks . The water from fresh joint was sucked by the bricks. After one hour the top brick is removed and the portion of mortar is scooped out and the amount of water present in the mortar is estimated. By knowing the initial water content in the mortar, the water loss in the fresh bed joint can be calculated.

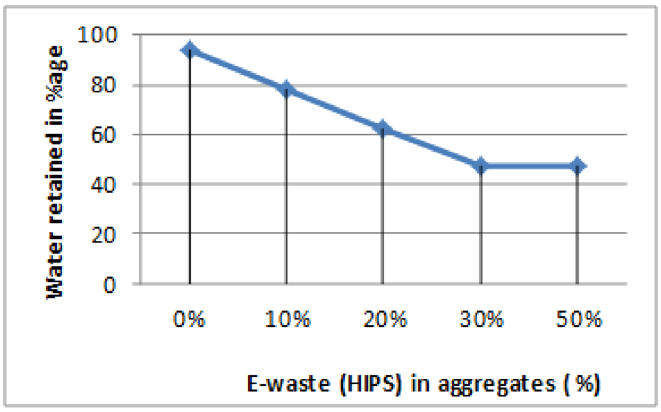

Chart -5: Water retained in Percentage

4.4. Dry density test

Test specimens – The mould of size 70.6 X 70.6 X 70.6 mm were used for conducting density test. The mould as prepared was filled with the mortar to about half height and the layer compacted by tamping it with the tamping rod in a uniform manner over the mortar surface in such a way as to produce full compaction of the mortar with neither segregation nor excessive laitance. The mould was completely filled and the upper layer of the mortar compacted in a similar manner, after which the surface of the mortar was struck off plane and leveled with the top of the mould, using a trowel.

Curing and storage – The specimens was stored at a place free from vibration, in moist air at a temperature of 27 +/- 2°C.

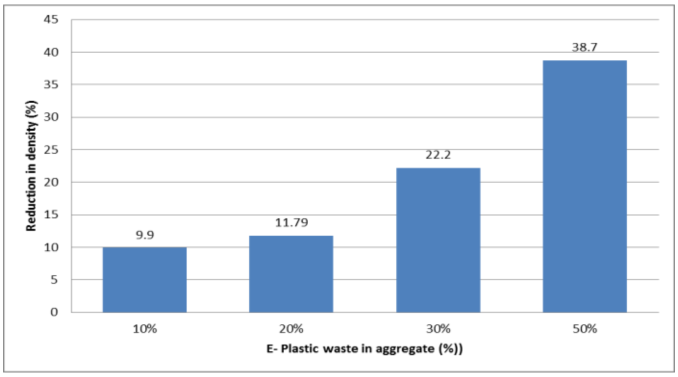

Chart -6: Reduction in density of mortar cube at 3days (%)

Discussion : The density of mortar with various percentage of E-plastic waste at 3 days curing age is shown in Fig 4.16. It indicates clearly that the replacement of sand by E- plastic waste in mortar reduces the density. Fig 4.17 shows the reduction in density of 9.9% , 11.7 % ,22.2% and 38.7 % is obtained respectively for mortar with E-waste ratio 10%,20%,30% and 50% at age of 3 days curing.

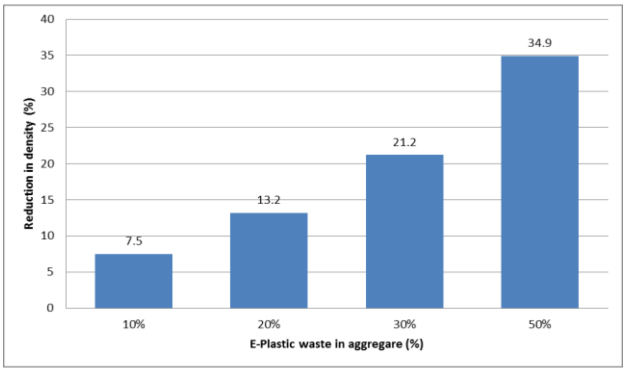

Chart -7: Reduction in Density of the mortar cube at 7 days(%)

Discussion : The density of mortar with various percentage of E-plastic waste at 7 days curing age is shown in Fig 4.18. It indicates clearly that the replacement of sand by E- plastic waste in mortar reduces the density. Fig 4.19 shows the reduction in density of 7.5% , 13.2 % ,21.2% and 34.9 % is obtained respectively for mortar with E-waste ratio 10%,20%,30% and 50% at age of 7 days curing.

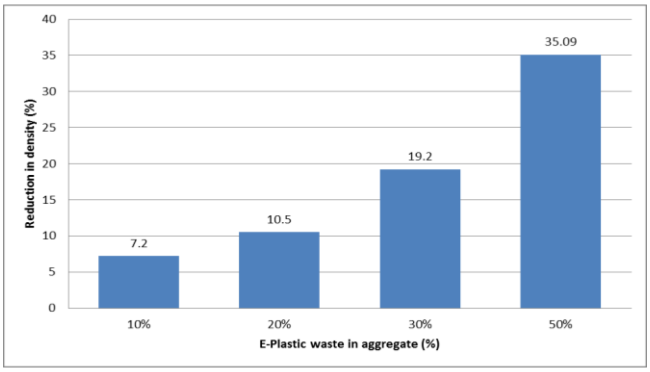

Chart -7: Reduction in Density of the mortar cube at 28days (%)

Discussion : The density of mortar with various percentage of E-plastic waste at 28 days curing age is shown in Fig 4.20. It indicates clearly that the replacement of sand by E- plastic waste in mortar reduces the density. Fig 4.21 shows the reduction in density of 7.2% , 10.5 % ,19.2% and 35.09 % is obtained respectively for mortar with E-waste ratio 10%,20%,30% and 50% at age of 28 days curing.

5. CONCLUSIONS

- The flow value by the replacement of sand less then 20% doesn't effect the workability of the mortar significantly, but the workability becomes bad when the E-waste replacement of sand is 30% and 50%.

- The plastic waste as fine aggregate decreases the density of the mortar . The 10% and 20% plastic replacement, the mortar qualified as medium weight concrete.

- A reduction in compressive strength 7.6% , 11.1 % ,32.46% and 55.81 % is obtained respectively, for mortar with Plastic waste ratio of 10%, 20%, 30% and 50% at curing age of 28 days. Here the reduction in compressive strength with 10% and 20% is not significantly different. But 30 % and 50% have less strength. This reduction in compressive strength probably comes from the worse connection of the interface between cement paste and the agaregates , become the smoother surface of the plastic granules and natural sand.

- A reduction in tensile strength 11.65% , 14.5 % ,53.3% and 73.7 % % is obtained respectively, for mortar with Plastic waste ratio of 10%, 20%, 30% and 50% at curing age of 28 days. Here the reduction in compressive strength with 10% and 20% is not significantly different. But 30 % and 50% have less strength. This reduction in compressive strength probably comes from the worse connection of the interface between cement paste and the aggregates , become the smoother surface of the plastic granules and natural sand.

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