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A Study on Mechanical Properties of Concrete by Partial Replacement with Hospital Waste Ash-A Review

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Abstract

Hospital waste is being generated from hospitals, clinics & laboratories. Disposal of this waste ash is an environmental concern and it will lead to spreading of diseases. In every country the generation of hospital waste is increasing rapidly. There is scope of utilization of this waste ash in concrete. In this work different parameters of concrete like compressive strength, split tensile strength, flexural strength was studied by partially replacing

1) *Cement with HWA*
2) *Cement with HWA & Metakaolin*
3) *Fine aggregate with HWA from different authors is presented here.*

The study shows that replacement of HWA with cement at 1, 2.5%, 3, 5%, 7.5%,15%&20% increased compressive strength, Split tensile strength &Flexural Strength parameters at 3% & 5% respectively, when cement replaced with HWA and Metakaolin at 5%,10%,15% & 20% shows increase in Compressive strength, Split tensile strength &Flexural strength at 20% and when HWA replaced with fine aggregate at 10% ,20%,30% & 40% strength parameters were reduced. The results were not consistent.

Keywords: *HWA- Hospital waste ash, Compressive strength, Split tensile strength, Flexural strength.*

1. Introduction

Concrete is a composite material composed of fine and coarse aggregate bonded together with a fluid cement (cement paste) that hardens (cures) over time Hospital waste ash produced from various medical resources such as hospitals, medical institutes and research centres are causing great threat to the environment. Hospital waste is classified as hazardous and non hazardous. As per government sources, total Hospital wasteproduced is 4,05,702 kgs per day , about 72% of the waste is treated and the rest is left out untreated. Incineration is the most common process of treatment of hospital waste. In this process hospital waste is treated in incinerators specifically made for hospital waste. The ash produced in these incinerators are then disposed as landfills & large area of land is required for filling. This requirement of land can be reduced by partial replacement of cement and fine aggregate in concrete.

Metakaolin is the anhydrous calcined form of the clay mineral kaolinite. Minerals that are rich inkaolinite are known as china clay or kaolin, traditionally used in the manufacture of porcelain. The particle size of metakaolin is smaller than cement particles, but not as fine as silica fume.

Discussion

1) Anil kumar singh et,al: conducted experimental studies on concrete by replacing cement with hospital waste ash at various percentages (0, 2.5%, 5%, 7.5%, 10%, 12.5%, 15%) with cement and found

i) Workability of concrete decreased with increase in replacement level and the reason is hospital waste ash is lighter than cement , so it occupies more volume than cement of equal weight resulting in ending up with requirement of more water.

ii) Compressive strength: compressive strength of cubes with various replacement levels (0,2.5%, 5%, 7.5%,10%,12.5%,15%) were compared for 7days & 28 days average compressive strength and arrived to a conclusion of optimum % at which strength is greater than that of a conventional one.

iii) Concrete cubes with 0% (control specimen) and replacement levels (2.5%,5%,7.5%,10%,12.5%,15%) were cast & tested in UTM at 7 days and 28 days, to study the behaviour of concrete& to get an idea of optimum percentage of hospital waste ash in concrete

according to compressive strength perspective and found that at 5% replacement of HWA with cement achieved good compressive strength than conventional one at both7days & 28 days. And there was no drastic change in strength till 10% replacement when compared with conventional one.

2) Sobo bala et,al: conducted experimental studies on beam specimen of size 450mmX150mmX150mm to know the flexural behaviour, water absorption , workability of concrete beam with several replacement percentages and to compare with conventional one (0%,10%,20%,30%,40%) To determine the suitability of hospital waste ash in concrete. and the specimens were beams of size 450mmX150mmX150mm, 75 no's and tested for flexure at different curing periods of 3,7,28,60,90 days

i) The slump increased for 10% replacement when compared to normal concrete and decreased when 20%,30%,40% were replaced.

ii) And the water absorption % for all replacemen percentages (0%,10%,20%,30%,40%) at different curing periods were found and it was nearly same for 0%,10% replacement at 3,7,28,60,90 curing days, and the values of water absorption increased with increase in percentage replacement(other than 0%, 10%) at 3,7,28,60,90 curing days compared with conventional concrete

iii) The setting time also increased with increase in hwa percentage.

iv) The flexural strength decreased (modulus of rupture) due to addition of hwa compared to conventional one. And the results were satisfactory(nearly same as conventional) for 20% replacement when compared to other replacement percentages.

3. Prasanth et,al: conducted experimental studies on concrete cubes & cylinders to know the compressive strength, split tensile strength & durability properties of concrete with addition of HWA as a replacement to cement with different percentages(5%,10%,15%,20%) and keeping metakaolin as consistent replacement (20%) in every replacement of HWA and several parameters like compressive strength, split tensile strength,flexural behaviour and durability were compared between conventional and replacement specimens.

i) compressive strength values was maximum for 15%, 20% replacementof hwa % 20% metakaolin in concrete when compared with conventional specimen

ii) the split tensile strength value was maximum with 20% replacement of HWA & 20% of metakaolin in cement, when compared to conventional one at all curing days 7,14,28 days.

iii) Durability test: the specimen with 20% replacement of HWA & 20% metakaolin took maximum compressive strength after being exposed to chloride attack

iv) The flexural strength was also high for 20% of HWA & 20% metakaplin than conventional specimen

The study suggests a replacement percentage of 20% HWA & 20% metakaolin in replacement with cement.

4. shamila habeeb et,al: have done experimental study on partial replacement of cement with hospital waste ash in M20 grade concrete with different percentages of replacement byweight of cement (5%,10%,15%) and observed the reduction in workability (slump) with increase in replacement & also observed the reduction in density of concrete with increased % of replacement.

i) the flexural strength of specimen with 5% replacement got high flexural strength than control specimen and 10%, 15% HWAreplacement under performed compared to control specimen.

ii) the split tensile strength of all replacements percentages of hwa performed well and took more load to break than compared to control specimen

iii) to know the compressive strength parameter of concrete with HWA replacement 3 specimens were cast at each replacement level (5%,10%,15%) along with a control specimen, and the results were found to be good for 5%,10% replacement than the control specimen and for 15% the value was abit less than the control specimen.

From the above results of the investigation it is concluded that 5% replacement is suggested from the perspective of compressive strength, split tensile strength & flexural strength.

5.Malvan et,al: investigated the behaviour of concrete with HWA on replacement to fine aggregate in different percentages (0%,10%,20%,30%,40%) and found the reduction in compressive strength with increase in replacement level , at all the replacement levels the strength was less than the conventional one at both 7 and 28 days.

i) Split tensile strength was also found to be less for replacement specimen at all levels (0%,10%,20%,30%,40%) when compared to conventional one at both 7 and 28 days.

ii) flexural strength of specimen was found to be nearly same for 10% replacement compared to conventional one at 28 days.

iii) ultrasonic pulse velocity test was carried and after the result interpolation of all the specimens, 10% replacement specimen value and conventional specimen value was categorized as good quality concrete

iv) Rapid chloride penetration test results showed that, chloride permeability was very low for (0%,10%,20%,30%) replacement values of concrete and for 40% replacement value it was observed as low.

v) Flexural behaviour of conventional one & 10% BMW ash was observed at various values and the deflection at every point of load was more than conventional one and the ultimate load carrying capacity of control mix & bmw 10% concrete beams were 294 KN & 299 KN respectively.

6. Ghulam Mustafa Khanzada et,al: investigated the behaviour of concrete by adding HWA as a replacement to cement at different dosages 1%,3%,5%,7%,9% by weight of cement at a mix proportion of 1:2:4 . To

know the compressive strength parameters of concrete with HWA 288 standard size cylinders were castand tested in 6 batches. 48 cylinders each for 0%, 1%, 3%,5%,7%,9% and each batch of 48 cylinders were tested at 7days, 14 days, 28 days, 90 days (for each curing period 12 cylinders were tested). And after the interpolation of results, the compressive strength of 3% replacement specimen resulted in good strength. So it is suggested that to use 3% as optimal replacement percentage

Conclusions

- When Cement replaced with hospital waste ash

a. Compressive strength increase when 3% & 5% was replaced.

b. Workability increased for 10% replacement concrete.

c. Split tensile strength increased with 5%, 10% & 15% replacement percentages and 5% is taken as optimum percentage of replacement.

d. There was spike in flexural strength with 5% replacement.

- When Cement replaced with hospital waste ash and Metakaolin

a. When HWA and Metakaolin were replaced to cement all the properties(Compressive strength, split tensile strength and flexural strength) were increased for an optimum percentage of 20%HWA & 20% metakaolin.

- When Fine aggregate replaced with HWA

a. There is a sharp reduction in Compressive strength, Split tensile strength.

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