www.ijecs.in
International Journal Of Engineering And Computer Science ISSN:2319-7242
Volume 4 Issue 6 June 2015, Page No. 12317-12321

Experimental investigation on different properties of hazardous incinerator bottom ash concrete

V.Manjunatha, Dr V.Ramesh

M.Tech

Department of Civil Engineering

Abstract: - **The disposal and treatment of hazardous waste is very costly affairs for the environment, it has been a dormant issue. The new millennium brings challenges for the civil and environmental engineers and opportunities for research on the utilization of the solid waste and by-products and basic properties of concrete and its materials. The recycling of waste after burnt in incinerator attracts an increasing interest worldwide due to the high environmental impact of the cement and concrete industries.**

Normal concrete is manufactured using sand and stones, but in this concrete the bottom ash can be utilized by partial replacement of cement. Hazardous solid wastes such as expanded fly ash, slag, sludge, etc. The performance of concrete is measured in terms of physical, engineering, and chemical properties.

Keywords: **Hazardous waste; incineration; bottom ash; concrete; compressive strength**

1. INTRODUCTION

From the viewpoint of application of the HW Rules, waste can be classified as hazardous, if the waste substance is solid, semi-solid or non-aqueous liquid which because of its quantity, concentration or characteristics in terms of physical, chemical, infectious quality:

- can cause or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitate reversible illness, or
- Pose a substantial present or potential hazard to human health or environment when it is improperly treated, stored, transported, disposed off or otherwise managed.

Thus, a waste is hazardous if it exhibits whether alone or when in contact with other wastes or substances, any of the characteristics identified below:

- corrosivity
- reactivity
- ignitability
- toxicity
- explosive
- acute toxicity
- infectious property

Hazardous waste characterization

Corrosivity

Waste exhibits characteristics of corrosivity if a representative sample of waste has either of the following properties:

- any liquid which has a pH less than or equal to 2 or greater than or equal to 12.5, as determined by the standard test procedure
- waste, which can corrode steel at a rate greater than 6.35 mm per year at a test temperature of 55°C as determined by the standard test procedure

Reactivity

Waste exhibits the characteristics of reactivity, if a representative sample of the waste has any of the following properties:

- normally unstable and readily undergoes violent change without detonating
- reacts violently with water

- forms potentially explosive mixture with water
- Cyanide or sulphide bearing waste which when exposed to pH conditions between 2and 12.5 can generate toxic gases, vapors or fumes in a quantity sufficient to pose danger to human health or environment is an explosive.

Ignitability

Waste exhibits the characteristics of ignitability if representative samples of the waste have any of the following properties:

It is a liquid other than an aqueous solution containing less than 24% organic solvents by volume and has flash point less than 60°C as determined by a Pen sky Martin closed cup tester using the standard test method

It is not a liquid and is capable under standard temperature and pressure, of causing fire through friction, absorption of moisture or spontaneous chemical changes, and when ignited burns so vigorously and persistently that it creates a hazard

- Any oxidizing substance, when in contact with moisture or other materials/wastes, results in spontaneous fire or combustion.

Toxicity

A solid waste exhibits the characteristics of toxicity if leach ate from the representative sample by Toxicity Characteristics Leaching Procedure (TCLP) test method (as followed by USEPA, vide No: S.W 46, till Indian standards are notified by MoEF/CPCB) contains any of the contaminants listed in Table 3-1 below in excess of the concentration limits mentioned there upon.

Explosive

Solid waste exhibits the characteristics of sudden, almost instantaneous release of gas, heat, and pressure, accompanied by loud noise when subjected to a certain amount of shock, pressure, or temperature.

Infectious property

Wastes containing viable micro-organisms or their toxins which are known or suspected to cause disease in animal or humans fall under this category.

2. MATERIALS

The materials used in the experiment are:

a. Cement

b. Fine aggregate

c. Coarse aggregate

d. Water

MINERAL ADMIXTURES

The admixtures used in these experiments are:

a. M.S.W incinerator ash

CHEMICAL ADMIXTURES

The chemical admixtures used in this experiment:

a. Super plasticizer-Fosroc (For workability)

3. METHOD OF NEXT INVESTIGATION STEP

A) Collection of burnt HW Incinerator bottom ash

B) Physical Tests to be conducted on incinerator ash

C) Preparation of mix design for M25 grade

D) Adding of I. Ash from 0, 10, 20, 30, 40% in cement

E) Making number of samples of concrete cubs

F) Testing of cubes is to be done for 7, 28 & 56 days

The following testes are to be conducted on specimens

- Compressive strength
- Flexural strength
- Durability test
- Thermal test

Specific gravity of HW.I ash

Specific gravity of HW I.Ash = 2.24

4. Mix Proportions for M25 Grade

Cement = 316 kg/m^3

Water = 158 litre

Fine aggregate = 848 kg/m^3

Coarse aggregate = 1100 kg/m^3

Chemical admixture = 0.5 kg/m^3

Water – Cement ratio = 0.50

5. Compression test:

Compression test is the most common test conducted on hardened concrete, partly because it is an easy to perform, and partly because most of the desirable characteristic properties of concrete is related to its compressive strength. The compressive strength of concrete is one of the most important and useful properties of concrete. In most structural applications concrete is employed primarily to resist compressive stresses. In those cases where strength in tension or in shear is of primary importance, the compressive strength is frequently used as a measure of these properties.

Compression test is carried on specimens of cubical in shape. The cube specimen is of the size 150mmX150mmX150mm. The cube moulds were coated with mould oil on their inner surfaces and were placed on Plate. Concrete was poured in to the moulds in three layers each layer being compacted using mechanical vibrator. The top surface was finished using trowel. After 24 hours concrete cubes were de-moulded and the specimens were kept for curing under water.

6. Casting and curing

The Cubes and beam moulds are assembled on the concrete leveled flooring with a paper between the mould and the floor. The inner side of the mould is lubricated properly. Cover blocks of sufficient thickness are placed below the bottom of the case so that the required effective depth is maintained. The materials are mixed in the electronically operated mixer thoroughly to get the uniformity. The concrete is placed in the moulds in two layers and compacted with tamping rod. The moulds are de moulded after 24 hours of casting. After the required period of curing, the specimens are taken out of the curing tank, wiped off the moisture and the surface is made dry.

The physical properties of concrete depend to a large extent on the degree of hydration of the cement and the resultant microstructure of hydrated cement. It is necessary to create conditions of temperature and humidity during a relatively short period immediately after placing and compaction of concrete, favorable to the setting and hardening of concrete. The process of creation of a favorable environment is termed as curing. The cube specimen was kept in water for 28 days and column specimens are kept in water for 28 days of curing before conducting the tests.

Experimental work

The specimens required for compressive strength test (both number of specimens and its size) are cast with established Concrete mix proportion, as per the relevant codal requirement, the details of which are as given below. To study the compressive strength behavior of M25 grade incinerator ash concrete in which cement is partially replaced. The cube specimens of size 150mmx150mmx150mm are prepared. The cubes each tested for 7, 28 & 56 days. Compressive strength of modified concrete is compared with normal concrete.

7. Results and Discussion

- **Compressive Strength**

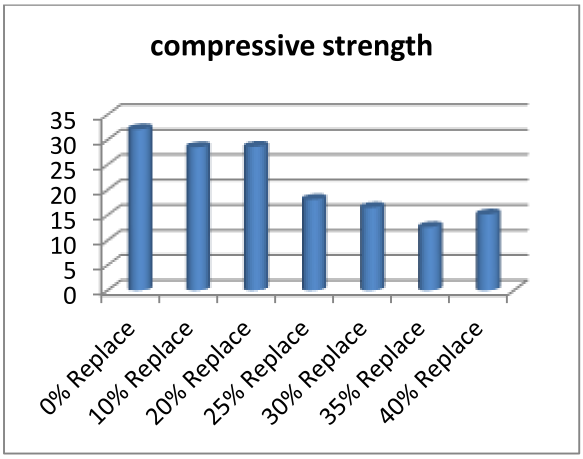

Fig.1 The strength variation is to be shown in graph

After the curing period the test results are carried out for all the specimens and found the optimization where the strength is reducing. The strength is varying in the range of 20 to 25%. The value of M25 is in between 20% & 25% replacement so that the further value to be fixed to find in between 21, 22, 23 & 24% replacement.

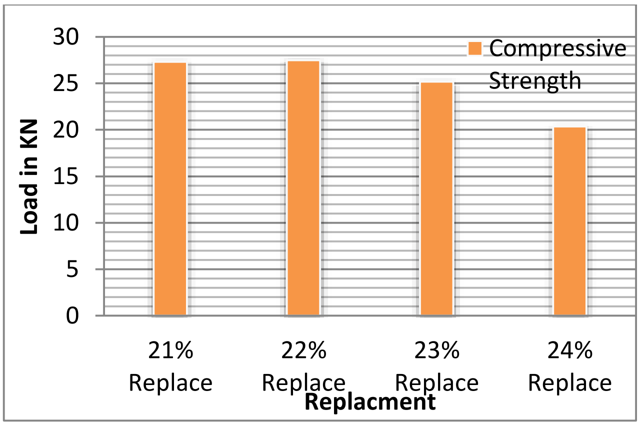

Fig.2 the Graphical representation of compressive strength of concrete cubes after replacing with Hazardous waste incinerator in concrete

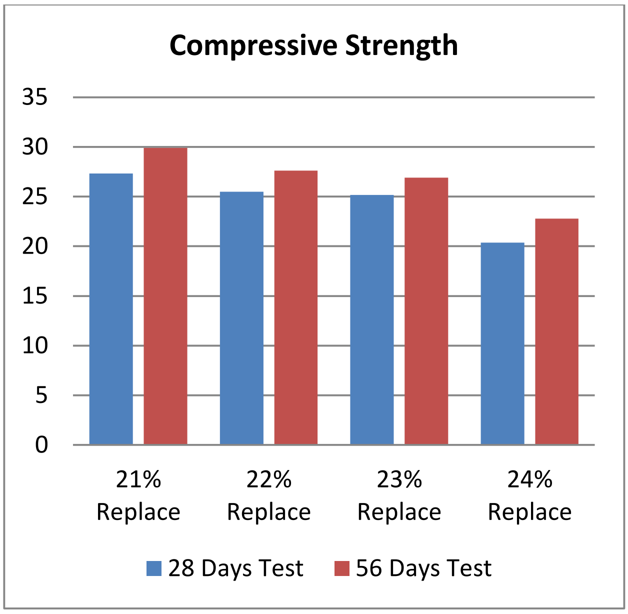

Fig.3 the final compressive strength results of HW Incinerator Ash

The dependence of concrete compressive strength up to level of cement replacement is plotted in fig. 3. The replacement up to 23 % does not affect the strength negatively.

Flexural Strength

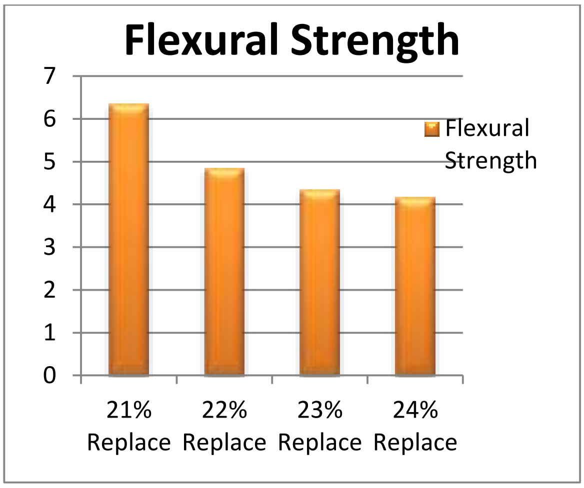

Fig.4 the final flexural strength results of HW Incinerator Ash

The dependence of concrete flexural strength up to level of cement replacement in plotted in fig. 4. The replacement up to 23 % does not affect the strength negatively.

Durability Test

Acid Test (HCL) of 10%

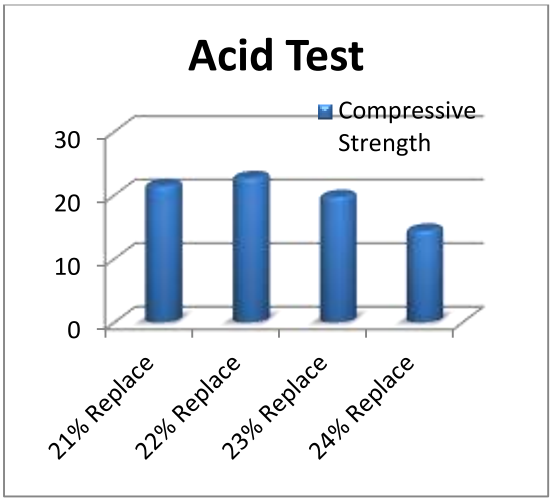

Fig.5 the final compression strength results after acid attack on HW Incinerator Ash concrete

Base (Na2So4) of 15%

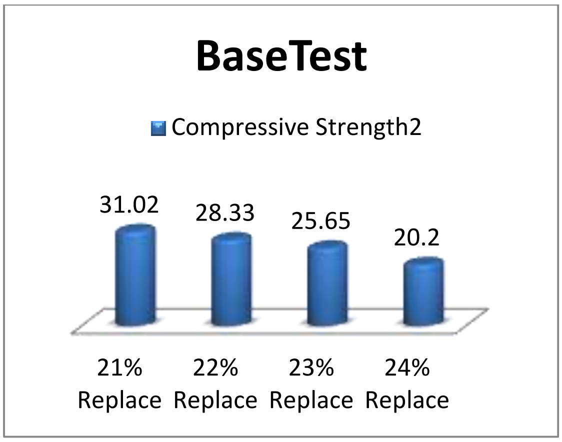

Fig.6 the final compression strength results after base attack on HW Incinerator Ash concrete

The concrete compression strength after acid and base attack up to level of cement replacement is plotted in fig. 5 & 6. The replacement up to 23 % will not affect negatively with the strength.

Thermal test

Test results of concrete cubes for 7Days, 7Cycle in Oven

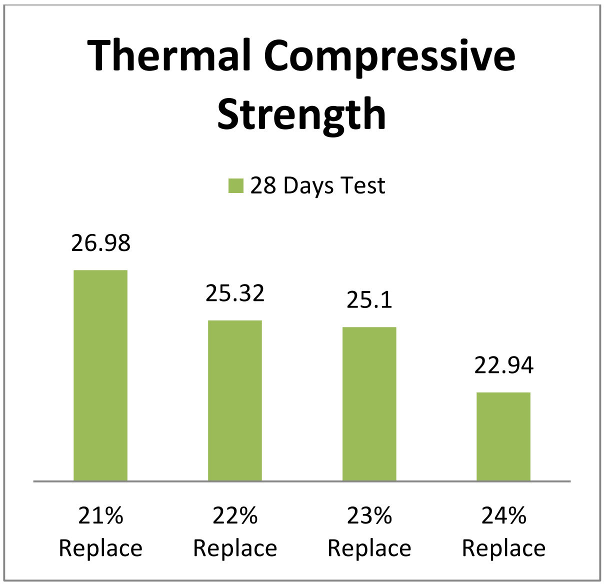

Fig.7 the final compression strength results after thermal treatment on HW Incinerator Ash concrete

8. Conclusions

The untreated HWI bottom ash was used as partial cement replacement in concrete after sieving in 90microns. This ash, by its chemical composition, does not fulfill the standard requirements on concrete admixtures but the prepared concrete had acceptable properties. The 28-days compressive strength of material with 23 % cement replacement was comparable with the reference concrete; the 56-days strength was also acceptable. The frost resistance of bottom ash containing concrete was very good. The prepared concrete contained relatively low content of HWI ash; this approach represents a compromise between the ecological request on a practical utilization of HWI ashes and properties of the acquired product. Higher ash dosage without any accompanied loss of concrete properties would be possible only when the ash would be treated in some way but in such case there would arise additional costs suppressing the HWI ashes utilization attractiveness for building industry.

REFERENCES

[1]. 2012 IACSIT Coimbatore Conferences

IPCSIT vol. 28 (2012) © (2012) IACSIT Press, Singapore

[2]. ISWA, Management of APC residues from W-t-E plants; An overview of management options and treatment methods. International Solid Waste Association, Copenhagen, 2008

.

[3]. M. Pohořelý, M. Šyc, M. Tošnarová, M. Zychová, M. Keppert, M. Punčochář, “Immobilization of heavy metals in

municipal waste incineration ashes”, Paliva, vol. 2, pp. 113-118 (in Czech).

[4]. ČSN EN 12390-3, Testing hardened concrete Part 3: Compressive strength of test specimens, 2002.