International Journal of Engineering Research And Advanced Technology (IJERAT)

E-ISSN : 2454-6135

DOI: http://dx.doi.org/10.7324/ IJERAT.3120

Vol.3 (7) July-2017

STUDY ON MSW INCINERATOR ASH IN CONCRETE WITH PARTIAL REPLACEMENT OF CEMENT IN RC BEAM.

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ABSTRACT:

It has been a dormant issue for the industries to dispose and treatment of hazardous industrial waste and also costly. To utilize the municipal solid waste is one of the possibilities is to use municipal solid waste (MSW) *ash in concrete production. The partial use of MSWI ash shows a great contribution to waste minimization as well as resources conservation. The study reviews the characteristics of municipal solid.*

Waste incineration ash with main focus on the chemical properties of the ash. The bottom ash was used as partial replacement of cement in concrete, strength has to find if prepared concrete will get sufficient durability or not. The review describes how chemical and mineral admixtures help in strength of concrete properties. Cement is replaced by the 0-40% ash in the concrete mix.

Key words*: Concrete properties, Hazardous industrial waste,* Municipal solid waste (MSW).

1. INTRODUCTION

In every year Thousands of millions of tons of municipal solid waste (MSW) are produced. Waste management and utilization strategies are major concern in many countries. The common technique used for treating waste is Incineration to reduce waste mass by 70% and volume by up to 90%, as well as providing recovery of energy from waste to generate electricity. Generally, municipal solid waste incineration (MSWI) produces two main types of ash, are the following 1. Bottom ashes (BA) 2.Fly ashes (FA). In this review, the utilization methods of MSWI ashes will be studied.

1.1. Waste Management in Different Countries

The waste generated from MSWI usually ends up in two ways, disposed as landfill or for reuse as secondary raw materials. In most developed countries where land is scarce and environmental controls are tight, environmental policies tend to reduce landfill disposals as much as possible .In Japan, about 80% of MSW is incinerated and the recycling and reuse of MSWI ash in different ways have been described .In China, more than 80% of the MSW ends up as landfill, and compost production ranks as the second major application; only few processes involving the recycling of ashes have been undertaken. The best management strategy for waste

Recycling and reusing. Different kinds of utilization methods are used in developed countries. Although the ashes contain high concentrations of heavy metals, salts, chloride and organic pollutants, which may limit the applications of reuse, the treatment of ashes will improve the environmental characteristics and enhance the possibility for reuse. Recycling of ashes has been undertaken.

1.2. MSW Incineration Processes

The incineration process is separated into three main parts:

- Incineration
- Energy recovery
- Air pollution control.

1.3 Ash Characterization Methods

The properties of ashes can be separated into two parts: physical properties and chemical properties, by knowing the properties of ashes, mainly chemical properties, we can ensure selection of the most suitable way for ash utilization.

1.3.1. Physical properties

- Particle size distribution Chemical properties
- Chemical composition
- Loss on ignition
- Heavy metals and leach ability
- Organic constituents
- Chloride content
- Moisture content
- Bulk density
- Compressive strength
- Permeability
- Porosity

1.4. Characterization of Incineration Ashes

The composition of municipal solid waste varies over time and from country to country, due to the differences in lifestyle and waste recycling processes of a country; the ash content will vary too. Generally, the chemical and physical characterization of ash will depend on the compositions of the raw MSW, the operational conditions, the type of incinerator and air pollution control system design .The chemical composition shows that the major elements are Si, Al, Fe, Mg, Ca, K, Na and Cl. Further, SiO_2, Al_2O_3, CaO, Fe_2O_3, Na_2O, K_2O are the common oxides found in ash. CaO is the most abundant compound that exists in MSWI fly ash, which constitutes up to 46%, but SiO_2 is the most abundant compound that exists in MSWI bottom ash, containing up to 49%.

1.5. Process Treatment Methods

In order to utilize the waste and reduce the environmental impact, three treatment methods have been introduced and may be classified as follows

- Separation processes
- Solidification/Stabilization
- Thermal methods

In practice, it is common to start the treatment of ashes with the separation techniques, followed by thermal treatments or stabilization/solidification .Based on different objectives of treating the ashes, strategies may vary. Reducing the environmental impact involves processes such as lowering the total concentration of the contaminants through washing, reducing the leachablity of contaminants by stabilization or decreasing the rate of contaminants leaching by solidification.

2. MATERIALS

The materials used in the experiment

- Cement
- Fine aggregate
- Coarse aggregate
- Water

MINERAL ADMIXTURE:

- M.S.W INCINERATOR ASH

CHEMICAL ADMIXTURE:

- Super plasticizer –fosroc (conplastsp 430)

FOSROC super plasticizer

Specific gravity	1.140 to 1.145 at 30^0c
Chloride content	Nil to is : 456
Air entrainment	Approx. 0.5% additional air is entrained

3. METHOD OF INVESTIGATION STEP

- Collection of burnt MSW incinerator ash.
- Physical test to ash
- Preparation of mix design M30 grade.
- Adding of ash from 0, 10, 20, 25, 30, 35, and 40% in cement.
- Making number of sample of concrete cube.
- Testing of cubes is to be done for 7, 28 and 56 days.
  Following testes are to be conducted on specimens
  - Compressive strength
  - Flexural strength
  - Tensile strength
  - Thermal test
  - Acid and base test
  - Flexural strength of RC beam

4. MIX PROPORTIONS FOR M30 GRADE

4.1 Mix Proportions

Cement = 370 kg/m^3

Water = 140 liter

Fine aggregate = 762kg/m^3

Coarse aggregate = 1264kg/m^3

Chemical admixture = 3.7 kg/m^3

Water – Cement ratio = 0.38

4.2 Mix proportions obtained are as shown in the table

Cement	Fine aggregate	Coarse aggregate	Water- Cement ratio
1	2.05	3.41	0.38

4.3 DESIGN OF RC BEAM.

A Reinforced concrete beam is having dimension of 1.5x0.23x0.3m is casted with a partial replacement of MSW incinerator ash with optimization percentage of ash to concrete. A reinforced beam for the flexure is having tension and compression reinforcement with vertical stirrups designed spacing and cranked at supports.

4.4 Design and Details of RC beam.

- Length of beam =1.5m
- Width of beam =0.23m

- Depth of beam =0.3m
- Grade of concrete =M30
- Percentage of ash =20%
- Cover =30mm
- Stirrups =2L#8mm @150mm c/c
- Ast=2#12mm+1#10mm
- Asc=2#10mm
- Admixture=super plasticizer. fosroc (conplastsp 430)

5. EXPERIMENTAL WORK

5.1. 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. This strength of a concrete is the one of the most important and useful properties of concrete. In the most structural applications concrete is employed primarily to resist compressive stresses. In those cases where the strength in tension or in shear is of primary importance, Compressive strength is the 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-molded and the specimens were kept for curing under water.

5.2. Flexural strength

The modulus of rupture, fracture strength or bend strength is a mechanical parameter for brittle material, is known as a material's ability to resist deformation under any load. Transverse bending test is the most frequently used, in which a specimen having either a circular or rectangular cross-section is bent until fracture or yielding using a two point flexural test technique. Flexural strength represents the highest stress experienced within the material at its moment of rupture and it is measured in terms of stress.

5.3. Tensile test: -

Tensile test carried by cylinder s having 150mm dia with 300mm length split tensile test .

5.4. Acid Test:-

Acid test is done after 28days of normal water curing and it is placed in HCL of having 10% in water and cured for a period of 28days.

5.5. Base Test:-

Base test is done after 28days of normal water curing and it is placed in Na2So4 of having 15% in water and cured for a period of 28days.

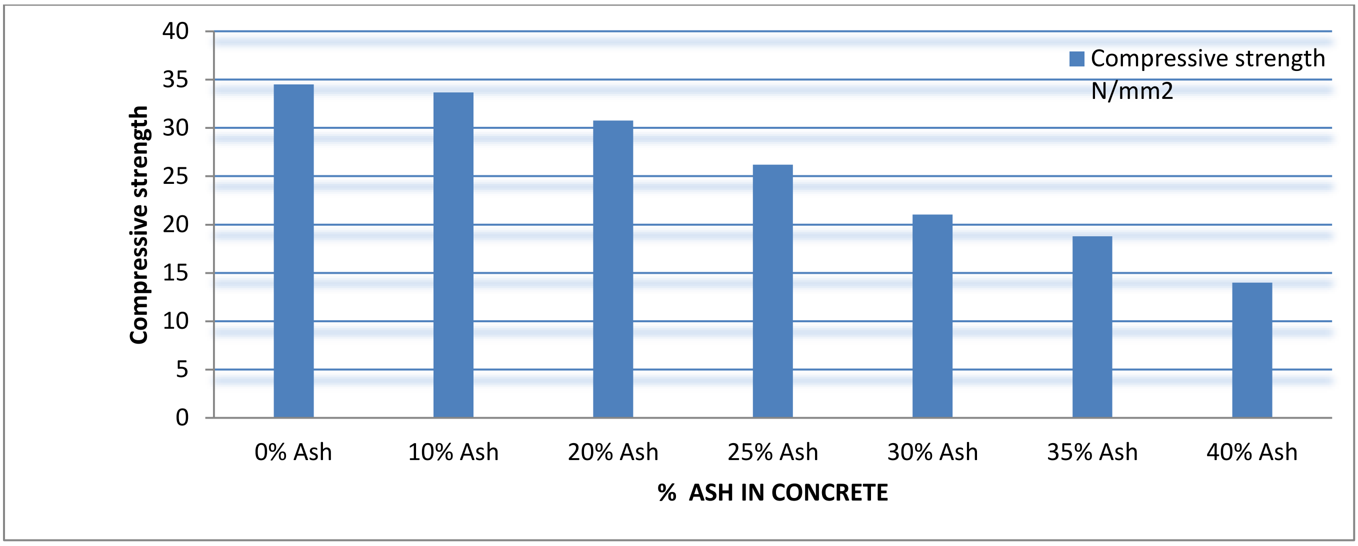
5.6. Thermal expansion of concrete

Thermal conductivity is a specific property of a gas, liquid, or solid. The coefficient of thermal conductivity *k* is a measure of the rate at which heat (energy) passes perpendicularly through a unit area of homogeneous material of unit thickness for a temperature difference of one degree; *k* is expressed as

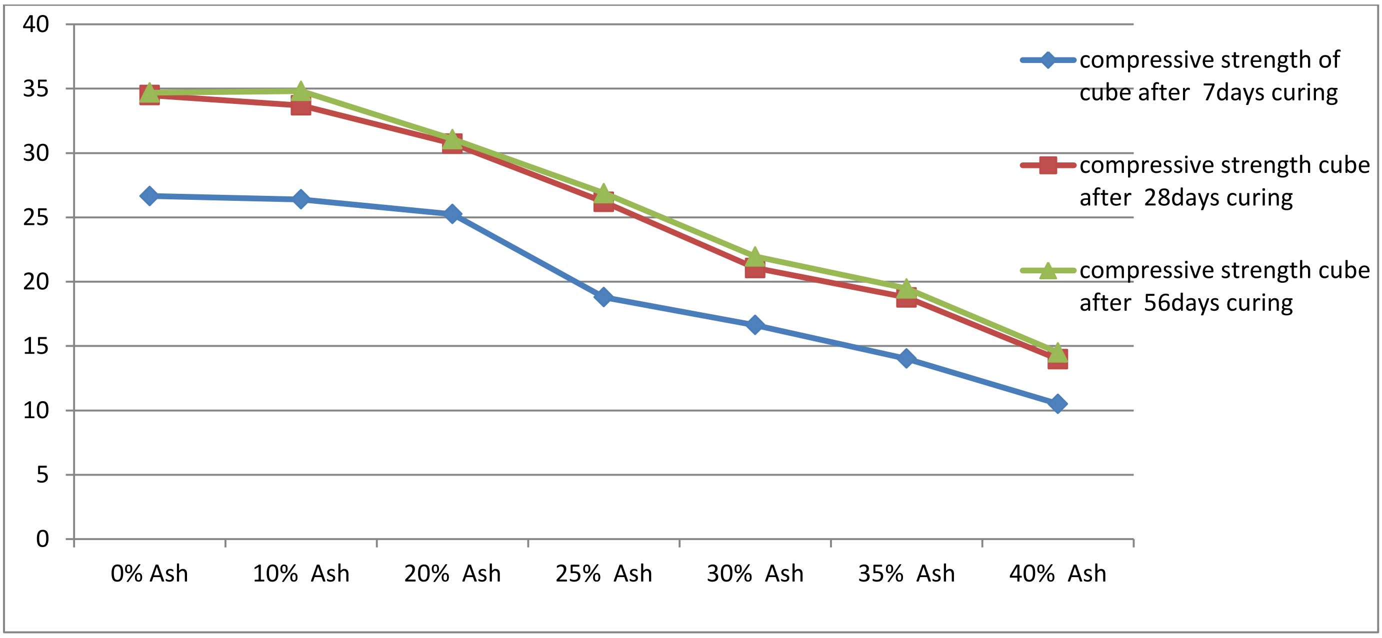
6. CASTING AND CURING

The Cubes and beam moulds are assembled on the concrete leveled flooring with a paper between the mould and Floor. The inner side of the mould is lubricated properly.The cover blocks of sufficient thickness are placed below the bottom of the case so that the required effective depth is maintained. Materials are mixed in electronically operated mixerThoroughly to get the uniformity. The concrete is placed in the Moulds in two layers and compacted with tamping rod. The moulds areDemolded 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.

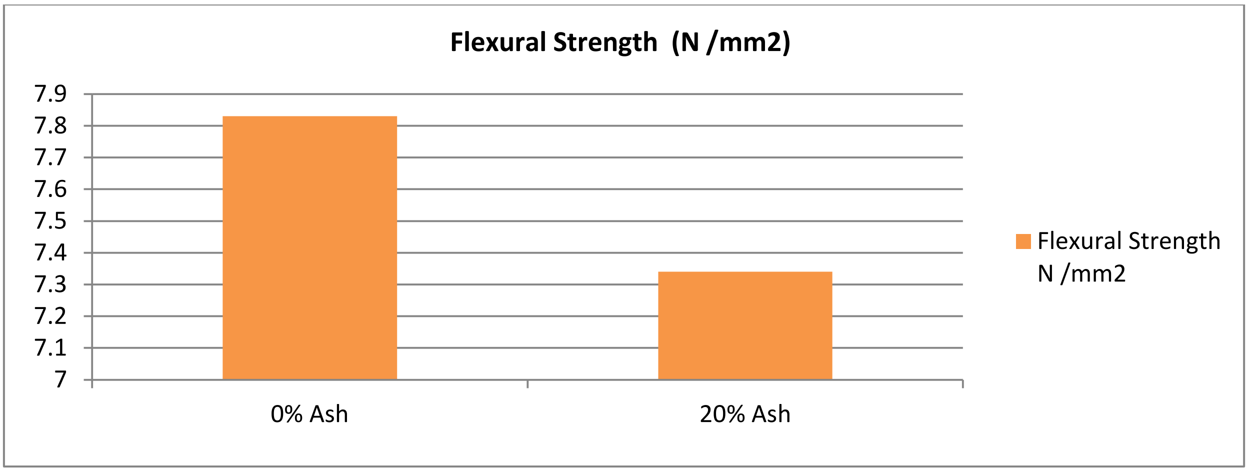
7. RESULTS AND DISCUSSIONS



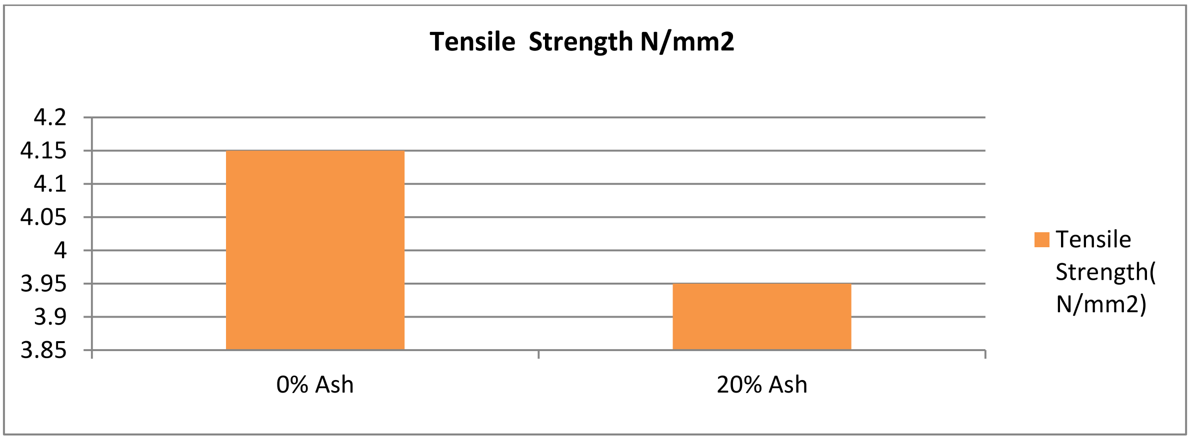
Graph: 1 The Graphical representation of compressive strength of concrete cubes after partial replacement with municipal solid waste incinerator ash in concrete. (0 to 40%)



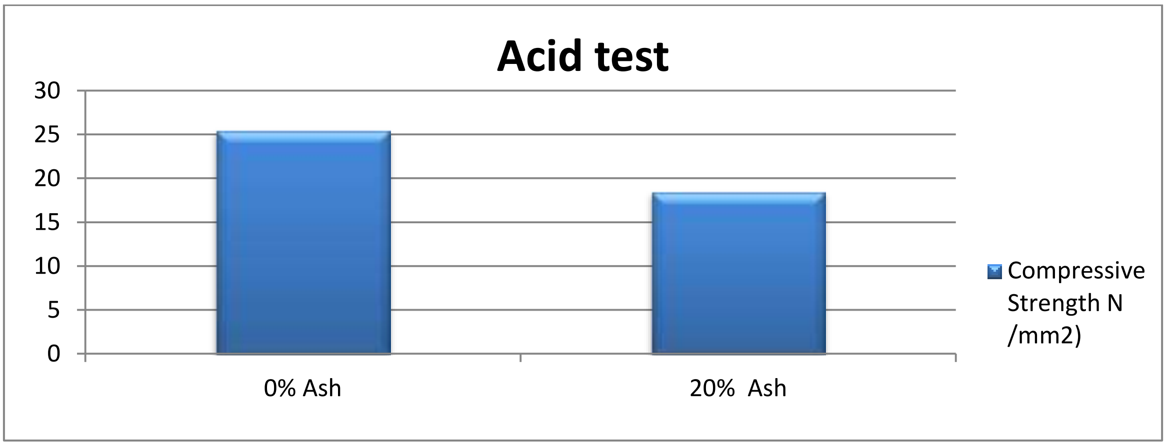
Graph.2 The Graphical representation of compressive strength of cubes after 7, 28 & 56dayscuring with partial replacing municipal solid waste incinerator ash in concrete with 0% to 40%.



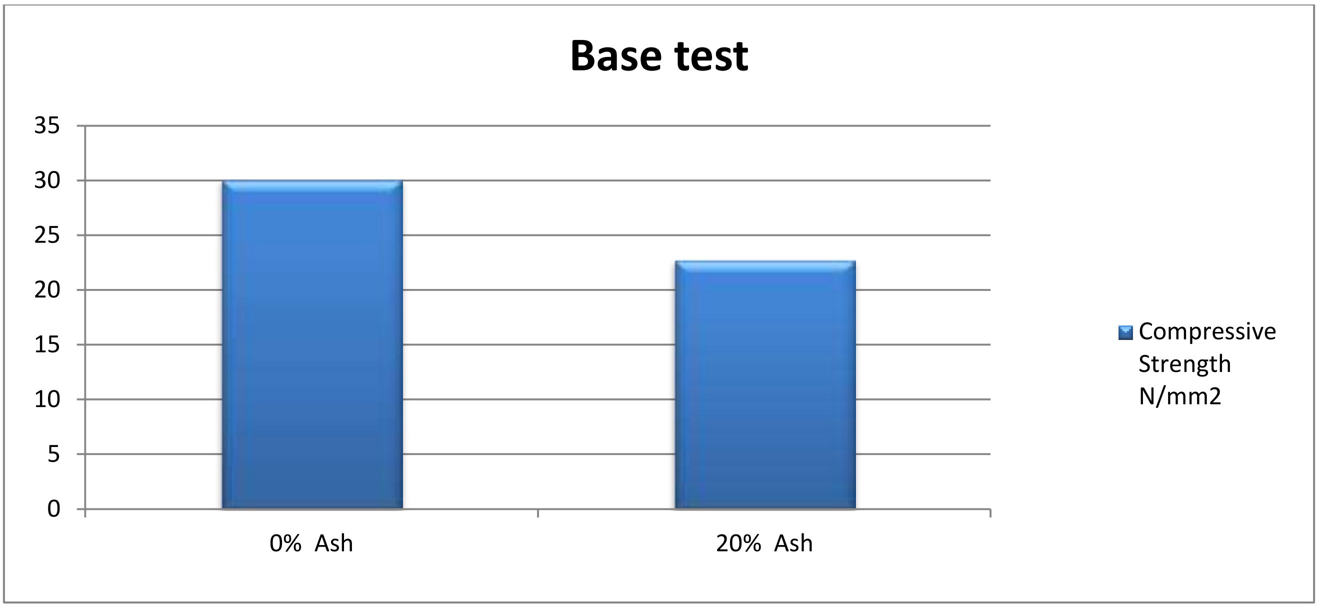
Graph .3 The Graphical representation of flexural strength of concrete prism Replacement of MSWI Ash of 0 and 20%



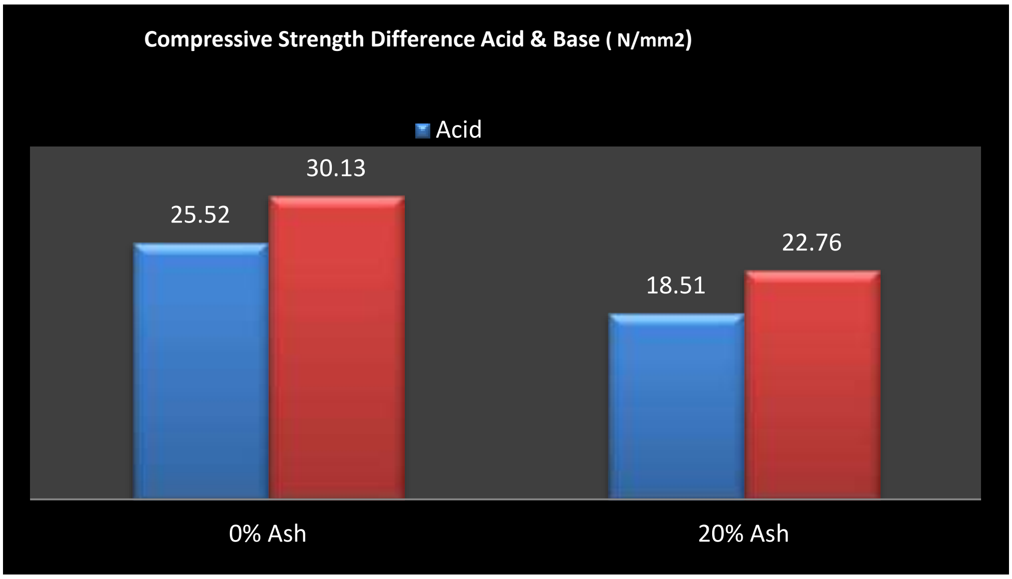
Graph.4 the Graphical representation of tensile strength of concrete cylinder Replacement of MSWI Ash of 0 and 20%



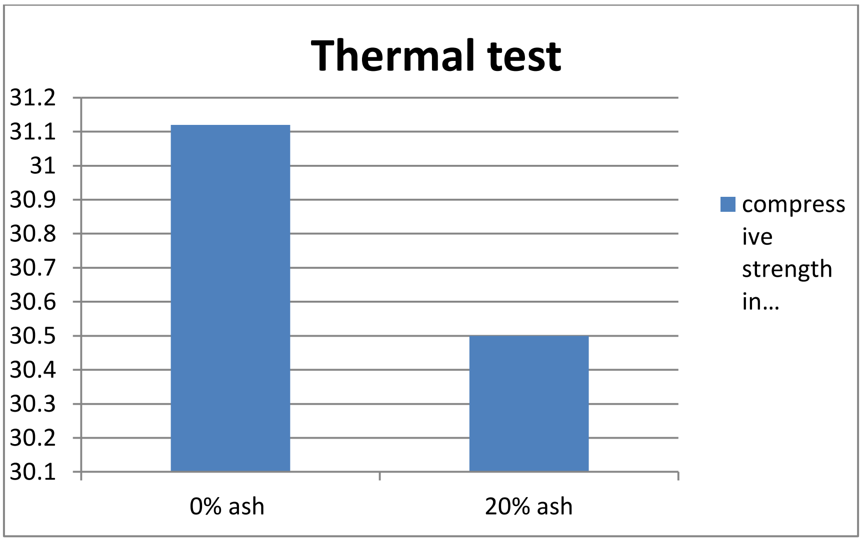
Graph .5 The Graphical representations of acid test results of cube Replacement of MSWI Ash of 0 and 20%.



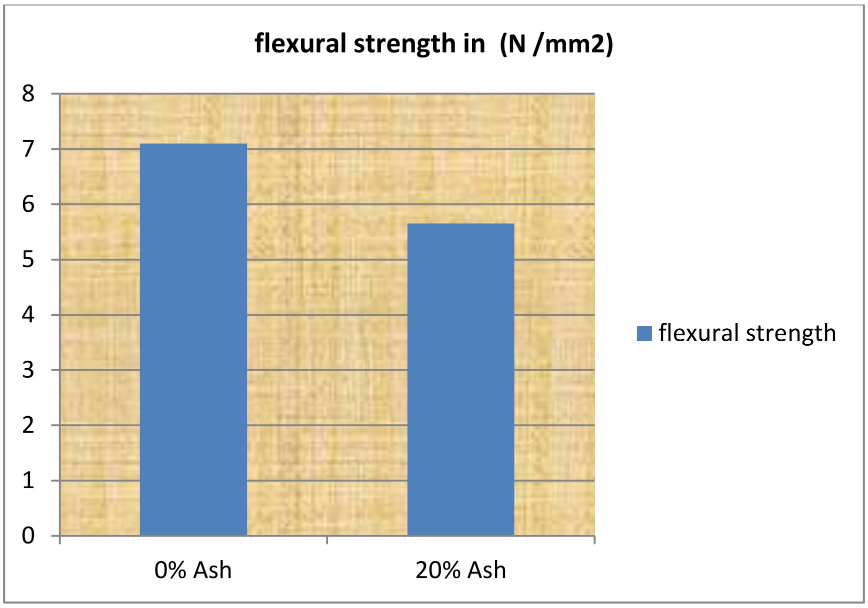
Graph .6 The Graphical representation of base test results of cube Replacement of MSWI Ash of 0 and 20%.



Graph.7 Graphical representation Compressive Strength Difference B/W Acid & Base with OPC



Graph.8 Test results of concrete cubes for 28Days, 28Cycle in Oven thermal test.



Graph 9.Comparison of flexural strength

As per above test results it was found that flexural strength of both 0% replacement and 20% replacement of M30 grade passing the requirement.

8. CONCLUSIONS

The application of MSWI ash still in under investigation, a great contribution by MSWI ash to minimize the waste and providing solution to land filling. The treatment and disposal may costly to industries and it's been dormant issue. The recycling and reuse as byproduct of MSWI ash will attract to cement and concrete industries.

This review describes the properties of municipal solid waste incinerator ash and with Partial replacement of cement in concrete M30 grade with percentage changes from 0 to 40%. By partial substitution of MSWI ash does not affect the strength of concrete and their properties .this mix is sustainable to concrete work. The strength is achieved with 20% replacement of MSWI ash in concrete. Compressive strength in 7days curing and the 28 day compressive strength of concrete acceptable with respect to this 56 day strength will have better value.

REFERENCES

[1] Utilization of hazardous wastes and by-products as a green concrete material through s/s process. SmithaBadur and RubinaChaudhary (2008) 42-61

[2] S.C Saxene and C.K Jotshi // Progress in energy and combustion science 22 (1996)401.

[3] Properties of Concrete with Hazardous Incinerator Bottom Ash Martin Keppert Robert Černý (2012 IACSIT Coimbatore Conferences)