Study on behavior of Concrete with Partial Replacement of Cement by Municipal Solid Waste Incinerator Ash

Sunil N N[1] Deepak S[2]
[1]PG Student [2]Assistant Professor
[1,2]Department of Civil Engineering
[1,2]East Point College of Engineering and Technology, Bangalore, India

Abstract— Disposal and treatment of harmful industrial waste is fantastically costly associations in favor of the industries, it has been a sleeping issue. The modern millennium brings challenges in place of the civil and environmental engineers next opportunities for research on the utilization of the solid waste and by-products and basic properties of concrete and its substances. The recycling of waste and byproducts attracts a greater curiosity worldwide due to the high environmental impact of the cement and concrete industries. Concrete is made using sand and stones and harmful solid wastes. The check describes how substances and mineral admixtures facilitate in existing properties of concrete. Cement binder can be replaced up to forty% ash in concrete. Ash increases existing strength, improves sulfate resistance, decreases permeability, reduces the water content required to lubricate concrete and improves the workability of concrete. Partial substitution solid harmful waste does not strongly affect the strength and supplementary properties of concrete. This mixed concrete is secure enough to be used in sustainable concrete works.

Key words: MSWI Ash, Cement, Concrete, Strength Parameters

I. Introduction

A. Municipal/Metropolitan solid waste incinerator ash (MSWIA)

The generation of solid waste has been unexpectedly increasing due to the growth of manufacturing hundreds of million tons of municipal solid waste produced every day. Usually the incineration technique for treating MSW decreases seventy% by weight and ninety% by volume in this process it produces ash. One of the paper gives the greatly improved power received with ash that has been uncovered to a new additive these effects show that as much as thirty five% of the concrete can be made up of ash, while still getting compressive capacity. A cube consists of 35-sixty% combined ash, 25-fifty% of sand and fifteen% of OPC is act like a toughest plasticizer. The environmental friendliness of concrete cannot be absolutely preferred without taking consideration of cement and concrete industries are presenting a super domestic for extensive quantities of waste products from different industries. The cement and its industries are uniquely placed to remove lot of wastes from surroundings even as receiving huge economic and technical advantages meanwhile. The usage of industrial by-products in substitute of herbal substances is extensively encouraging in production thus permitting residual materials to be recycled and valorized, while at the same time saving herbal resources and power.

II. Objective

The main objective of this research work is to find the characteristic strengths such as compressive strength, tensile strength, flexural strength and durability of concrete for different mixes where cement is partially replaced by municipal solid waste incinerator ash.

III. Materials

The materials used for project work are cement, fine aggregate, coarse aggregate, water, incinerator ash and super plasticizer and the basic tests are conducted.

- Cement: OPC 53 Grade
- Fine aggregate: River sand
- Coarse aggregate: 20mm down size
- Super plasticizer: Fosroc Conplast-SP430

IV. Experimental investigati0n

Those fundamental target of the available test investigations will be will acquire particular test data, which serves on see those cement What's more its aspects (Strength, Thermal and durability). In the available test investigation, investigations bring been conveyed crazy on the conduct for solidified properties of M20 grade concrete. Those solidified properties like compressive strength, durability aspects, flexural strength of concrete and thermal properties of concrete are found by doing suitable lab tests of hardened state.

A. Mix Design

1) Mix Proportions

- Cement = 291.66 kg/m3
- Water = 140 lts
- Fine aggregate (sand) = 828.97 kg/m3
- Coarse aggregate (crushed stones) = 1265 kg/m3
- Chemical admixture (super plastisizer) = 0.48 kg/m3
- Water/Cement ratio = O.4O
- Mix proportion =1: 2.35: 4.33

2) Mixes

- Mix 1: cement 100%
- Mix 2: cement 90% + incinerator ash 10%
- Mix 3: cement 80% + incinerator ash 20%
- Mix 4: cement 75% + incinerator ash 25%
- Mix 5: cement 70% + incinerator ash 30%
- Mix 6: cement 65% + incinerator ash 35%
- Mix 7: cement 60% + incinerator ash 40%

V. Results

A. Compressive Strength

The compressive strength of concrete was carried out for cubes of size (150x150x150) mm.

Mix	Compression strength (MPa)		
Curing in days	7	28	56
1	16.16	20.50	20.95
2	14.7	21.21	21.42
3	13.77	20.69	21.42
4	13.13	17.64	18.07
5	12.86	17.40	17.50
6	11.24	16.04	17.27
7	6.56	11.6	12.35

Table 1: Compression test results of cubes

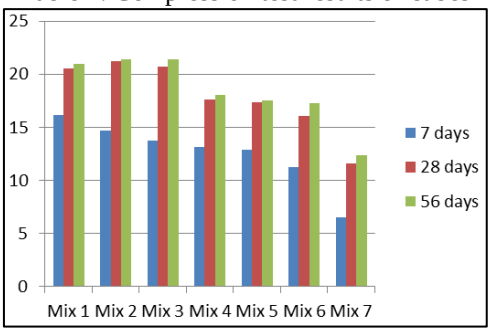

Fig. 1: Compression test results of cubes of different mixes at 7, 28 and 56 days curing

Based on the above compression test results the optimum percentage of replacement is considered as 20%.

B. *Tensile Strength*

The tensile test is carried out for Mix1 and Mix3 (for optimum percentage of replacement). Tensile strength of the specimens is done by testing of cylinders of size 150mm diameter and 300mm length.

Mix	Tensile strength at 28 days curing
1	0.26
3	0.24

Table 2: Tensile strength of cylinders at 28days curing

C. *Flexural Strength*

The flexural strength is carried out for Mix1 and Mix3 (for optimum percentage of replacement). Flexural strength of the specimens is found by testing of prisms of size 100mm x 500mm x 500mm.

Mix	Flexural strength at 28 days curing
1	7.16
3	6.08

Table 3: Flexural strength of prisms at 28days curing

D. *Acid Test*

Acid test is done, after 28days of ordinary water curing and placed in water with 10% of HCL, then cured for 28 days.

Mix	Compressive strength MPa
1	19.34
3	17.52

Table 4: Compression strength of cubes after acid attack

E. *Base Test*

Base test is done, after 28days of water curing and then placed in water with 15% of Na2So4, then cured for 28days.

Mix	Compressive strength MPa
1	19.94
3	19.48

Table 5: Compression strength of cubes after base attack

F. *Thermal Test*

Thermal test is conducted for 7days cycle.

Mix	Compressive strength MPa
1	20.97
3	19.96

Table 6: Compression strength of cubes after thermal attack

VI. Conclusion

- By using municipal/metropolitan solid waste incineration ash as ingredients of concrete the water demand can be reduced.
- The strength of concrete in which the ash is replaced the earlier strength is less but as days goes on the strength will be increased.
- Good workability can be achieved.
- Due to the replacement the heat of hydration is reduced.
- The optimum percentage of replacement is 20%, later on strength does on decreasing.
- For M20 grade the ash can be replaced by 20%.
- A slight variation in strength is achieved do acid and base attack when compared to the 0PC.
- The sulphate and chloride attack can be reduced.
- Due to the presence of some chemicals in ash it reacts with acid and base tests.
- The thermal expansion 0f the c0ncrete is good up to 8O°C in case of fire attack.

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