Experimental Study on Self Curing Concrete with Replacement of Cement with Fly Ash & Silica Fume and Sand with Quarry Dust

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Abstract - *Concrete is the most widely used construction material due to its good compressive strength and durability. Conventional concrete need water curing for a minimum of 28 days to achieve its target strength. Hence water curing is very much essential to prevent unsatisfactory properties of cement concrete. In order to have good curing, excess of evaporation from the surface need to be prevented. The aim of the investigation is to evaluate the use Fosroc Concure Wb White of as self-curing agent . Self-curing concrete of M30 grade were cast by replacing fine aggregate with 50% quarry dust and by varying quantity of fly ash and silica fume by 5%, 10%, 15%, 20%,25%. In this study, compressive strength, split tensile strength of self-curing concrete with optimum.*

Compression strength of concrete test on cubes at different replacements of fly ash and silica fume for 28days increased. Split tensile strength of concrete test on cylinders at different replacements of fly ash and silica fume for 28 days increased.

Key Words: Flyash, Silica Fume, Quarry Dust, Self-Curing Concrete, Concure WB, compressive strength, split tensile strength.

1. INTRODUCTION

Self-curing refers to the process by which the hydration of cement occurs because of the availability of additional internal water that is not part of the mixing Water. Conventionally, curing concrete means creating conditions such that water is not lost from the surface i.e., curing is taken to happen 'from the outside to inside'. In contrast, 'self-curing' is allowing for curing 'from the inside to outside through the internal reservoirs (in the form of saturated lightweight fine aggregates, super absorbent polymers, or saturated wood fibers) created. 'Self-curing' is often also referred as 'Internal–curing.

1.1 Forsoc Concure wb white:

It's low viscosity wax emulsion which incorporates a special alkali reactive emulsion breaking system. This system ensures that the emulsion breaks down to form a non-penetrating continuous film immediately upon contact with a cementitious surface. This impervious film prevents excessive water evaporation which in turn permits more efficient cement hydration, thus reducing shrinkage and increasing durability. Once formed, the membrane will remain on the concrete surface until eventually broken down and eroded by natural weathering. Where it is required to apply a further treatment to such concrete surface, it may be necessary to remove the membrane remaining after curing by wire brushing or other mechanical means. The use of curing membranes on internal floor slabs is generally to be avoided where additional surface finishes are to be applied. Concur WB is however ideal where the concrete surface of a floor slab is to be left as finished.

1.2 Silica Fume:

Condensed Silica fume, also known as micro silica, is a dry amorphous powder which, when added with standard cements will increase the durability and strength of the concrete as well as reducing permeability and improving abrasion-erosion resistance. It may also be used in many applications where high strength is required. The addition of silica fume produces concrete with reduced permeability resulting in increased water tightness enhanced chemical resistance and reduced corrosion of reinforcing steel. Silica fume has a bulk density of approximately 610kg/m^3.

1.3 Fly Ash:

Fly ash, an artificial pozzolanna is the unburned residue resulting, from combustion of pulverized coal or lignite. It is collected by mechanical or electrostatic separators called hoppers from flue gasses of power plants where powdered coal is used as fuel. This material, once considered as a by-product finding difficulty to dispose off, has now become a material of considerable value when used in conjunction with concrete as an admixture.

1.4 Quarry Dust:

The reduction in the sources of natural sand and the requirement for reduction in the cost of concrete production has resulted in the increased need to identify substitute material to constituent materials as aggregates in the production of concretes. Several types of materials have been investigated for this purpose both in developing and developed countries and the outcome of success has been varying. The materials usually researched for this purpose are either by-product materials or even sometimes manufactured aggregates. Manufactured aggregates are mostly used to produce concretes to meet specific purposes such concrete with superior properties or structural lightweight concrete. On the other hand, the advantages of utilization of by-products or aggregates obtained as waste materials are pronounced in the aspects of reduction in environmental load and waste management cost, reduction concrete production cost and enhancement in some properties of concrete. Quarry dust, a by-product from the crushing process during quarrying activities is one of those materials being studied, especially as substitute material to sand as fine aggregates. Quarry dust have been used for different activities in the construction industry such as for road construction and manufacture of building materials such as lightweight aggregates, bricks, tiles and autoclave blocks It is noted that there are numerous publications available in the area of utilisation of by-product and waste materials as well as different types manufactured aggregates in concrete mixes.

2. SCOPE OF THE WORK:

- The aim of this investigation is to evaluate the use of forsoc concure wb as self-curing agent
- In this study the physical properties of self-curing at different percentages of concure wb will be evaluated and compared with conventional concrete specimen
- To study the strength properties of concrete made with curing compound i.e. Forsoc concure wb as self-curing agent with that of concrete made from conventional curing.
- To reduce the quantity of water in making concrete and in constructions by using self curing agent.
- To determine the effect of mineral admixtures (Silica Fume, Fly Ash, quarry dust) on the Compressive Strength of concrete.
- To determine the effect of self curing agent on the split tensile, Compressive Strength of concrete.

3. LITERAURE REVIEW

Basil M Joseph et.al:" Studies On Properties Of Self-Curing Concrete Using Poly-Ethylene Glyco" vol 3 march2016, IOSR journal of mechanical and civil engineering. In this paper Curing of concrete is maintaining satisfactory moisture content in concrete during its early stages in order to develop the desired properties. However good curing is not always practical in many cases. Therefore the need to develop self-curing agents attracted several researchers. The concept of several self-curing agents to reduce water evaporation from concrete. And hence increase the water retention capacity of concrete compared to conventional concrete. It was found that water soluble polymers can be used as self-curing agents in concrete. Concrete incorporating self-curing agents will represent a new trend in concrete construction in the new millennium .The aim of this investigation is to evaluate the use of water-soluble polymeric glycol as self-curing agents. the use of self-curing admixture curing admixtures is very important from the point of view that the water resources are getting valuable every day (ie; each 1 m3 of concrete require about 3 m3 of water for construction. Most of which is for curing). The benefit of self -curing admixtures is more significant in desert areas where water is not adequately available. In this study the mechanical properties of self-curing at different percentages of poly ethylene glycol will be evaluated and compared with conventional concrete specimen.

V. Revathy et.al: "Experimental Study On Self Curing Concrete With FlyAsh And Quarrydust'' special issue april 2017 SSRG international journal of civil engineering.In this paper Self-curing concrete of M40 grade were cast by replacing fine aggregate with 50% quarry dust and by varying quantity of fly ash by 5%, 10%, 15%, 20%,25%. In this study, compressive strength, split tensile strength, and modulus of rupture of self-curing concrete with optimum result of fly ash is evaluated and compared with the conventional concrete specimens.

The main objectives of this paper were:

a) To study the mechanical properties of self curing concrete using self curing agent, partial replacement of cement by fly ash and fine aggregate by quarry dust.

b) To compare the concrete mixes with and without self curing agent is subjected to indoor curing and conventional curing respectively.

4. EXPERIMENTAL PROGRAM:

Mix details of Self-Curing Concrete:

MIX DESIGN FOR M30 GRADE CONCRETE

Table-1.1 Mix Details of M30 Grade Concrete

C	F.A	C.A	W/C
1	1.672	2.779	0.45

4.1 MATERIALS:

CEMENT: An ordinary Portland cement OPC 53 grade was used.

FLY ASH: In the present work, fly ash brought from Bhupalpally, KTPP is used.

NATURAL SAND: Natural river sand passing through 4.75mm was used as fine aggregate and was tested following IS: 383-1970. The sand conformed to zone II

COARSE AGGREGATE: The aggregates were selected based on the limitation of IS 881 and 882 of 20mm size

FOSROC CONCURE WB WHITE: External self-curing concrete is the one which can cure itself by retaining its moisture content. Concrete can made to self-cure by the application of curing compounds on the surface of the concrete. The curing compound is applied by means of brushing or spraying.

QUARRY DUST: Quarry dust is collected from local stone crushing units. The physical properties of quarry dust obtained by testing the sample as per IS standard. The sand conformed to zone II.

5. TESTING:

Two types of specimens namely cubes and cylinders were cast. Cubes were used for compression strength test and cylinders for split tensile strength test.

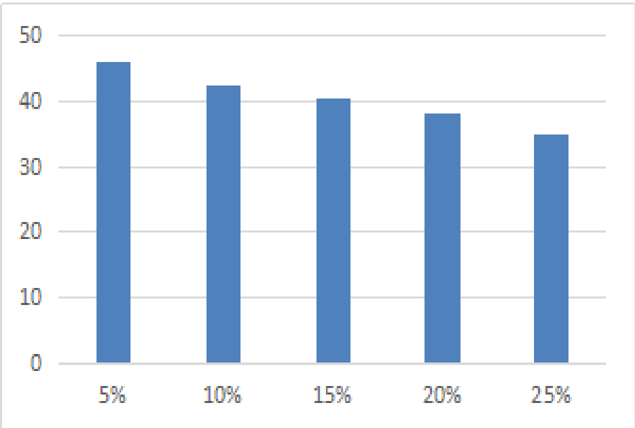
Test for compressive strength:

The specimens were removed from the curing tank and its surfaces are cleaned with cotton waste. They were tested in wet condition in a Compression Testing Machine. The rate of loading was maintained at 140 kg/cm

Minute as per the requirements given in the code of practice (IS: 516-1969). Three specimens of 150mm cubes were tested for required age and the average value of compressive strength was calculated. The results of compressive strength test were tabulated in table

Table1: Compression strength with replacement of fly Ash

S.No	Partial replacement of cement with flyash	Compressive Strength (N/mm^2)
1	5%	46.18
2	10%	43.87
3	15%	41.71
4	20%	40.48
5	25%	38.23



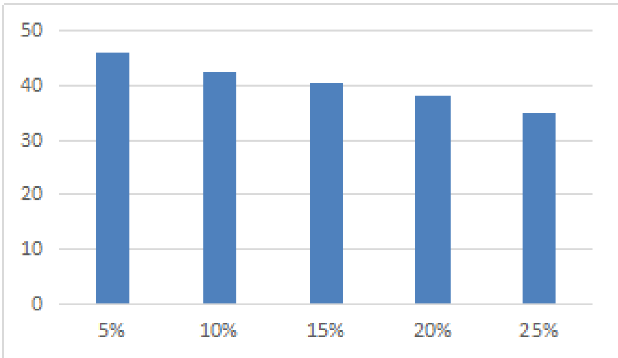
Graph 1: Compression strength with replacement of fly Ash

Table 2: Compression strength replacement of silica fume

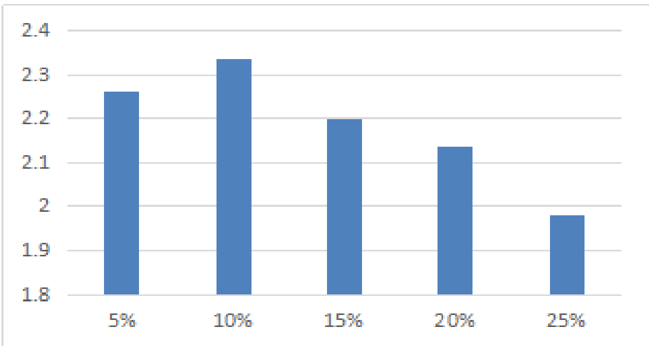
S.No	Partial replacement of cement with silica fume	Compressive Strength (N/mm2)
1	5%	45.89
2	10%	42.4
3	15%	40.57
4	20%	38
5	25%	35

Table 3 Split tensile Strength replacement of fly Ash

S.No	Partial replacement of cement with flyash	Split tensile Strength (N/mm2)
1	5%	2.263
2	10%	2.335
3	15%	2.200
4	20%	2.137
5	25%	1.981



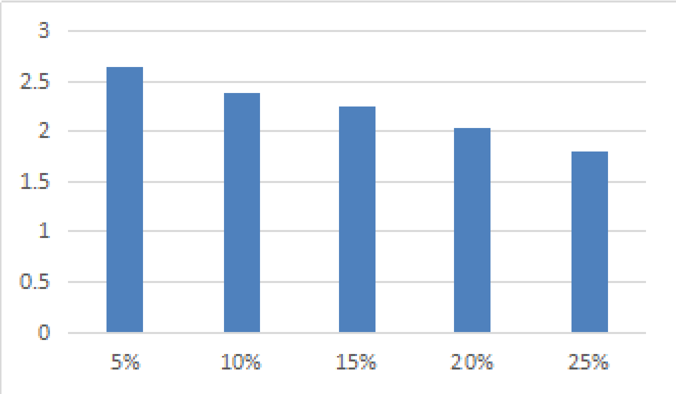
Graph 2: Compression strength replacement of silica fume



Graph 3: Split tensile Strength replacement of fly Ash

Table 4: Split tensile Strength replacement of Silica Fume

S.No	Partial replacement of cement with silica fume	Split tensile Strength (N/mm2)
1	5%	2.641
2	10%	2.392
3	15%	2.245
4	20%	2.04
5	25%	1.8



Graph 3: Split tensile Strength replacement of Silica Fume

6. CONCLUSIONS:

- Compression strength of concrete tested on cubes at different replacements of fly ash for 28days has highest strength at 5%
- Compression strength of concrete tested on cubes at different replacements of silica fume for 28days has highest strength at 5%
- Split tensile strength of concrete test on cylinders at different replacements of fly ash for 28 days has highest strength at 10%
- Split tensile strength of concrete test on cylinders at different replacements of silica fume for 28 days has highest strength at 5%
- Compare to silica fume the fly ash has has more compression.

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