https://dx.doi.org/10.22161/ijaers.4.2.12 *ISSN: 2349-6495(P) | 2456-1908(O)*

Experimental Study on Strength Characteristics of Self Curing Concrete with Cement Replacement by Fly Ash

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Abstract— *Curing is an important process in construction. It regulates the strength properties of concrete. More water (with the domestic usage quality)is required for the curing process in construction. Large quantity of water is required in construction only in the curing stage. During the curing process, large amount of water is wasted as evaporation. Scarcity of water around the globe gives insufficient quantity and inefficient quality of water for domestic purpose. In this situation, water for curing purpose is a joke. For this many experiments are done on self curing concrete. Self curing agents like polyethylene glycol etc., is used in concrete. These agents retard the water loss from concrete, so that sufficient amount of water (poured at the time of mixing of concrete) is retarded and sufficient for curing of concrete in later stages. Polyethylene Glycol-400 is used in this experiment as a self curing agent. It is a harmless polymer and easily available in laboratory chemical suppliers and its effectiveness is very high even in the small quantities. The effectiveness of PEG-400 is high up to 0.5% of weight of cement. Many experiments are done on conventional concrete to convert into self curing concrete without any replacement of fly ash. Now-a-days fly ash is used as a cement substitute.*

The objective of the present experimental study is to analyse the possibility of using fly ash in the place of cement in self curing concrete up to 30% (because is code-10262:2009 gives fly ash replacement in concrete up to 20%).

This experimental study was carried out on the three mixes-conventional mix, self curing concrete mix with PEG-400 (0.3%of weight of cement as constant),self curing concrete with replacement of cement by fly ash up to 30% with PEG-400 (at 0.3% of weight of cement is taken as constant).

The obtained results are describing the comparisons between the strength characteristics of the conventional concrete specimen with curing, self curing concrete with no fly ash without curing and self curing concrete with fly ash (in place of cement upto30%by weight) without curing. These results are taken at constant proportions of self curing agent, i.e.PEG-400 (0.3% by weight of cement).

Keywords— ***Polyethylene Glycol-400, fly ash, Ordinary Portland cement, Compressive strength.***

I. INTRODUCTION

Concrete is an artificial material in which the aggregates both fine and coarse are bonded together by the cement when mixed with water. The concrete has become so popular and indispensable because of its inherent in concrete brought a revolution in applications of concrete. Concrete has unlimited opportunities for innovative applications, design and construction techniques. Its great versatility and relative economy in filling a wide range of needs has made it is a very competitive building material.

In this project I want to know about the variations in strength characteristics of self curing concrete on cement replacement by fly ash. The self curing concrete used in many countries with scarcity of water resources are very high. Curing is not required in self curing concrete. Prevention of curing in construction saves a large quantity of water. So, self curing concrete is the water management system in construction process .Water is utilized in the concrete mixing stage, is enough for the curing of concrete. Polyethylene Glycol is used as a self curing agent in this self curing concrete. Because of properties like harmless, water soluble, easy to handle, etc., many observations are revealed that PEG is the best self curing agent at 0.1-0.5% by weight of cement. At this proportion, self curing concrete strength is more than the conventional concrete. So in my project, I maintain constant PEG quantity i.e.0.3% by weight of cement. Now-a-days fly ash is used as an alternative cement material. Fly ash used in this self curing concrete and study the changes in strength characteristics of this concrete. This helps us in the study of "fly ash behaviour in self curing concrete up to 30%replacement by weight of cement".

II. EXPERIMENTAL PROCEDURE

MATERIAL USED AND THEIR PROPERTIES

Cement: Ordinary Portland cement of 53 grades are available in local market is used in the investigation. The cement used for all tests is from the same batch. The cement

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used has been tested for various properties as per IS: 4031-1988 and found to be conforming to various specifications of IS: 12269-1987.

Coarse Aggregate: Crushed angular granite from local quarry is used as coarse aggregate. The cleaned coarse aggregate is chosen and tested for various properties such as specific gravity, fineness modulus, bulk modulus, etc. The physical characteristics are tested in accordance with IS: 2386–1963. The aggregates are free from alkali contents.

Fine Aggregate: The locally available river sand is used as fine aggregate in the present investigation. The cleaned fine aggregate is chosen and tested for various properties such as specific gravity, fineness modulus, bulk modulus etc. in accordance with IS: 2386-1963. The fine aggregate belongs to the zone-II. It is free from harmful ingredients.

Water: Water used for mixing and curing is fresh potable water, conforming to IS: 3025-1964 part 22, part 23 and IS: 456-2000.Sometimes an image may contain text embedded on to it. Detecting and recognizing these characters can be very important, and removing these is important in the context of removing indirect advertisements, and for aesthetic reasons.

Poly Ethylene Glycol-400:

Polyethylene glycol is a condensation polymer of ethylene oxide and water. General formula $H(OCH_2CH_2)_nOH$ where n is the average number of repeating Oxy-ethylene groups typically from 4 to about 180. The abbreviation (PEG) is termed in combination with a numeric suffix which indicates the average molecular weights. One common feature of PEG appears to be the water-soluble nature. Polyethylene Glycol is non-toxic, odourless, neutral, lubricating, non-volatile and non-irritating and is used in a variety of pharmaceuticals.

Fly ash: This is waste material from thermal power stations. Fly ash used in this experiment is taken from the RAYALASEEMA THERMAL POWER STATION located in KADAPA District. The various properties of fly ash are determined in laboratory and fly ash is dried before its use in concrete mixing for correct water content as described in IS: 10262-2009.

Mix proportions:

Consideration of M-25 mix for this experimental analysis with a constant water-cement ratio (w/c) as 0.5 and the quantity PEG-400 is constant as 0.3%by weight of cement. Mix design is done by IS: 10262-2009.

Procedure:

Cubes [150X150X150(all in mm)] and Cylinders [(300mm height (30cm) and 150mm diameter)] are casted and cured in water for conventional concrete mix to 7days and 28 days.

1. General concrete mix- 2mixes; per each mix:-Cubes-3No.s and Cylinders-3No.s
2. Self curing concrete mix without fly ash- 2mixes; per each mix:-Cubes-3No.s and Cylinders-3No.s
3. Self curing concrete with fly ash - 2mixes; per each mix:-Cubes-3No.s and Cylinders-3No.s

(gradual increment of fly ash upto30% in the place of cement by weight)

III. EXPERIMENTAL RESULTS

Table.1: Compressive strength in N/mm^2 of cubes after 7days and 28 days

Mix	**Description**	**Cube Compressive strength N/mm^2**	
		7 DAYS	28 DAYS
M1	Conventional concrete with curing	25.674	33.820
M2	Self curing concrete without fly ash	25.834	34.313
M3	Self curing concrete+5%cement replacement by fly ash	26.103	35.114
M4	Self curing concrete+10%cement replacement by fly ash	26.453	35.523
M5	Self curing concrete+15%cement replacement by fly ash	25.453	34.103
M6	Self curing concrete+20%cement replacement by fly ash	25.164	33.872
M7	Self curing concrete+25%cement replacement by fly ash	25.105	33.361
M8	Self curing concrete+30%cement replacement by fly ash	24.892	33.012

Table.2: Split tensile strength in N/mm^2 of cylinders after 7days and 28 days

Mix	Description	Cylinder Split tensile strength N/mm^2	
		7 DAYS	28 DAYS
M1	Conventional concrete with curing	2.112	2.394
M2	Self curing concrete without fly ash	2.135	2.573

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M3	Self curing concrete+5%cement replacement by fly ash	2.163	2.732
M4	Self curing concrete+10%cement replacement by fly ash	2.434	2.913
M5	Self curing concrete+15%cement replacement by fly ash	1.924	2.524
M6	Self curing concrete+20%cement replacement by fly ash	1.783	2.173
M7	Self curing concrete+25%cement replacement by fly ash	1.573	2.074
M8	Self curing concrete+30%cement replacement by fly ash	1.382	1.892

GRAPHS

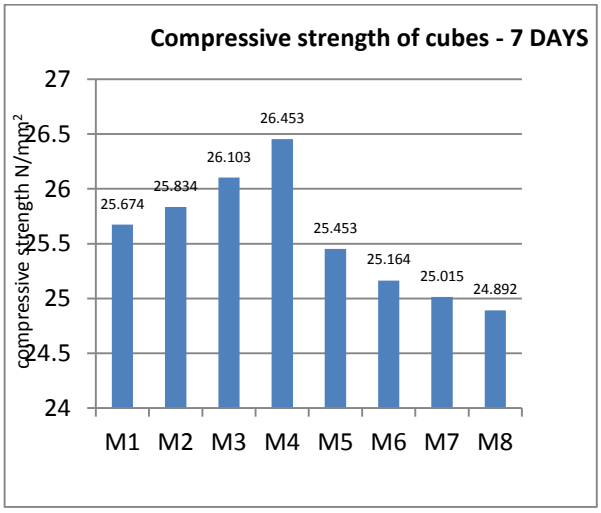

Fig.1: Compressive strength in N/mm² of cubes after 7 days

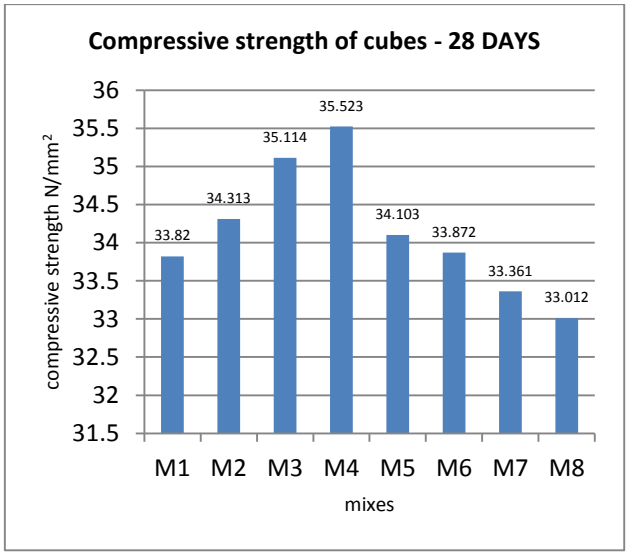

Fig.2: Compressive strength in N/mm² of cubes after 28days

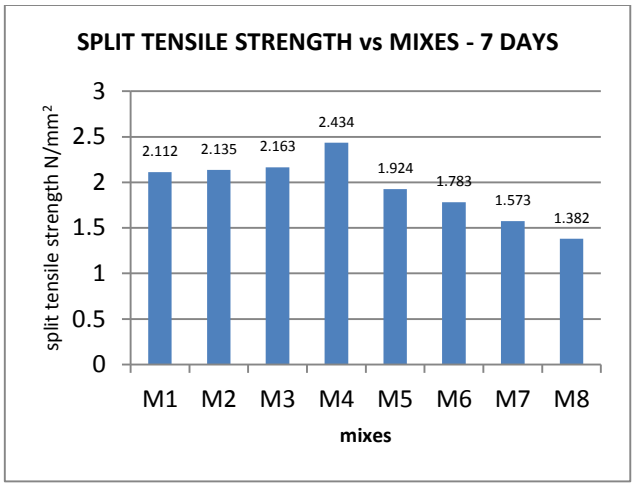

Fig.3: Split tensile strength in N/mm² of cylinder after 7days

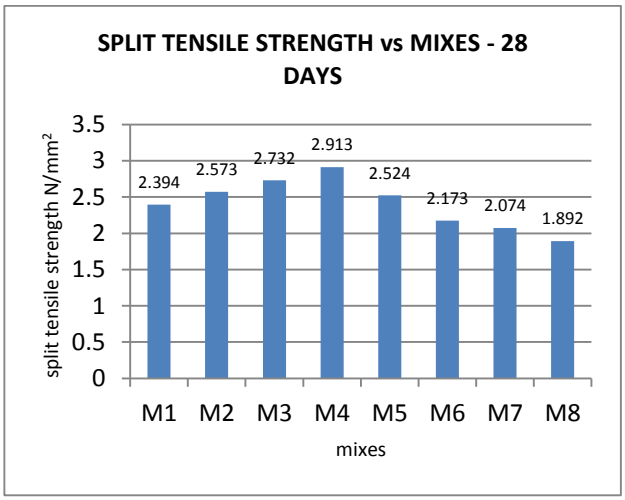

Fig.4: Split tensile strength in N/mm² of cubes after 28days

IV. CONCLUSION

Based on the above results of the investigation M-25 self curing concrete properties with cement replaced by fly ash at 10%, gives maximum value of compressive strength of the cube. Compressive strength increases gradually up to 10% cement replacement by fly ash and then decreases gradually. Hence, self curing concrete at 10% cement replacement by fly ash is the optimum value for this M-25mix with 0.5W/C at constant quantity of self curing agent i.e.PEG-400 (0.3% by weight of cement). And also, at 10% cement replacement by fly ash gives maximum split tensile strength of self curing concrete.

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