Experimental Studies on Effects of Sulphate Resistance on Self-Curing Concrete

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Abstract

This paper presents a detailed experimental study on sulphate attack measurement on self curing concrete at ages 28 days, and 56 days. The main investigation in this study is variation of water soluble polymer dosage of 0.05% and 0.1%. The concrete produced by the addition of fly ash as a partial replacement of cement. The percentage of weight loss and of concrete was studied. The test result indicates that use of water soluble polymers in concrete has improved performance of concrete.

Key words: Sulphate attack, Self-curing, PEG, Fly ash.

1. Introduction

1.1 Introduction to self curing

The major objective of the present invention is to provide a method for self-curing concrete. Adding water soluble polymers into concrete while mixing is called as self curing concrete. The self-curing agent can absorb moisture from atmosphere and then release into concrete, that concrete which is self-cured without any need of external curing after placing of concrete. So, the evaporation of water after removal of formwork can be minimized, and the degree of hydration of cement is improved without external curing, and the compressive strength will be enhanced together with reduced shrinkage arising from evaporation of water, and make the concrete ideal for placing without any external curing. In this paper we deals with the effects of sulphate attack on self curing concrete.

There are several tests are available to find out the durability of concrete. Here, the Sulphate resistance test was done, the amount of soluble sulfates present in the material is a vital factor in determining the potential for sulfate attack on concrete. It depends on the penetration in the concrete specimen.

The end result of sulphate attack can be excessive expansion, delamination, cracking, and loss of strength. So the concrete should have the ability to resist the penetration of sulphate component to become a durable concrete. The objective of this work was to evaluate the behavior of self curing concrete when exposed to sulphate. The deterioration of concrete (weight loss) was evaluated.

2. Experimental Part

2.1 Materials Used

2.1.1 Cement:

Ordinary Portland cement (53grade) was used in this study.

2.1.2Fly ash:

Fly ash is the best known and one of the most commonly used “pozzolans”. Class F is generally low in lime, usually under 5 per cent and contains of silica, alumina and iron (greater than 70 percent) than class C fly ash. Fly ash from Mettur Thermal power plant was used. It improves the cement paste microstructure because of production of C-S-H, and it is reactive, but at a much slower rate.

2.1.3 Fine Aggregate:

Clean and dry river sand available locally was used as fine aggregate. IS 4.75 mm sieve was used.

2.1.4 Coarse Aggregate:

20 mm aggregate was used as coarse aggregate.

2.1.5 Water:

For the casting work and for the curing of specimens were done with the potable well and bore water at locally presented As per IS 456 -2000.

2.1.6 Poly Ethylene Glycol (PEG):

PEG-400 Molecular weight was used as a self curing agent.

2.2 Test procedure:

The concrete mix were mixed and presented using a tilting drum mixer. The workability of self curing concrete was measured using the slump cone method. The workability of concrete mixes was comparable with slump ranging from 100 mm. The mix design is as per IS 10262:2000. The cube size of 100mm x 100 mm was taken for this test. The concrete mix design is for different grades like M20, M30, M40 and M50. The percentage of fly ash replacements are 10%, 15%, 20%, 25% used. The percentage of PEG dosages 0.05% and 0.1% are used for all grades of concrete with different replacements of fly ash.

2.2.1 Sulphate attack on concretes

The sulphate attack testing procedure was conducted by immersing concrete specimens after the specified initial curing in a water tank contacting 5% sodium sulphate and 5% magnesium sulphate separately for 28, and 56 days respectively. This type of testing represents an accelerated testing procedure, which indicates the performance of particular concrete mixes to sulphate attack on concrete. The sulphate solution was replaced whenever the pH value is exceeding 9.5. The percentage of sulphate attack was evaluated by measuring the weight losses of the specimens were conducted at 28, and 56 days respectively.

Formula used:

% of weight loss = [(Final weight - Initial weight)/ Initial weight] x 100

3. Results and Discussion

3.1 Sulphate Resistance Test:

Sulphate attack on ordinary Portland cement matrix is generally characterized by sulphate ions with products of cement hydration will cause expansion, cracks and spalling as well as loss of mass and strength.Various studies to minimize the attack and prolong the service life of concrete structures exposed to sulphate environments have been carried out. By the visual examination it is clear that the specimen subjected to sulphate attack behaves very differently and also degree of deterioration is high.

Tabe-1: Percentage of weight loss at 28th and 56th day for different grades:

Sl.No	GRADE OF CONCRETE	% OF WEIGHT LOSS AT 28TH DAY	% OF WEIGHT LOSS AT 56TH DAY
01	M20	0.8	2.70
02	M30	0.39	1.87
03	M40	0.79	1.46
04	M50	0.77	0.72

Tabe-2: Percentage of weight loss at 28th and 56th day for different grades with the replacement of fly ash:

Sl. No	GRADE OF CONCRETE	% OF FLY REPLACEMENT	% OF WEIGHT LOSS AT 28TH DAY	% OF WEIGHT LOSS AT 56TH DAY
01	M20	10%	3.38	3.47
		15%	3.20	2.82
		20%	3.10	2.64
		25%	2.35	2.0
02	M30	10%	2.26	1.97
		15%	2.04	1.85
		20%	1.58	1.851
		25%	1.56	1.56
03	M40	10%	0.793	1.55
		15%	0.790	1.45
		20%	0.780	1.15
		25%	0.781	1.11
04	M50	10%	0.781	1.098
		15%	0.76	0.72
		20%	0.386	0.40
		25%	0.384	0.378

Tabe-3: percentage of weight loss at 28th and 56th day for different grades with replacement of fly ash and different dosages of PEG:

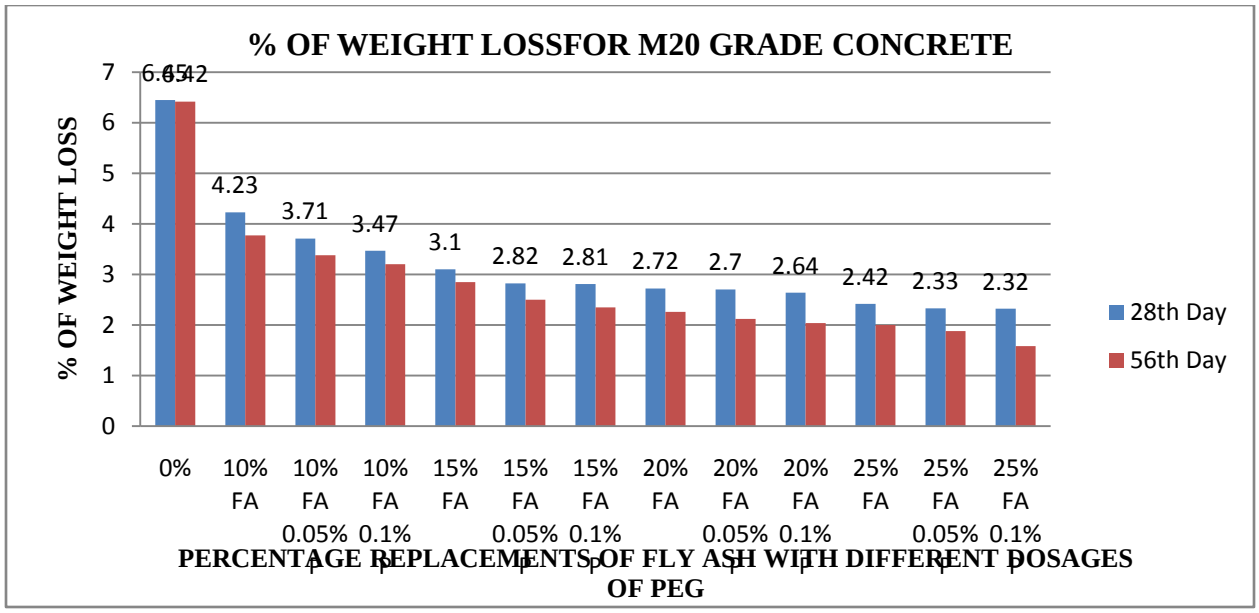
Sl.No	GRADE OF CONCRETE	% OF FLY ASH	PEG DOSAGES	% OF WEIGHT LOSSAT 28TH DAY	% OF WEIGHT LOSS AT 56TH DAY
01	M20	10%	0.05%	6.45	6.42
			0.1%	3.77	4.23
		15%	0.05%	2.60	3.71
			0.1%	2.50	2.85
		20%	0.05%	2.12	2.81
			0.1%	2.0	2.72
		25%	0.05%	1.88	2.42
			0.1%	1.55	2.33
02	M30	10%	0.05%	1.48	2.32
			0.1%	1.29	2.25
		15%	0.05%	1.19	1.93
			0.1%	1.08	1.88
		20%	0.05%	0.92	1.82
			0.1%	0.84	1.67
		25%	0.05%	0.79	1.56
			0.1%	0.78	1.54
03	M40	10%	0.05%	0.766	1.47
			0.1%	0.763	1.40
		15%	0.05%	0.756	1.25
			0.1%	0.754	1.22
		20%	0.05%	0.749	1.22
			0.1%	0.746	1.20
		25%	0.05%	0.740	1.18
			0.1%	0.729	1.14
04	M50	10%	0.05%	0.740	1.140
			0.1%	0.40	1.132
		15%	0.05%	0.39	1.11
			0.1%	0.38	1.10
		20%	0.05%	0.386	0.93
			0.1%	0.3819	0.78
		25%	0.05%	0.3816	0.72
			0.1%	0.371	0.36

Fig-1: The container contains Na2So4 solution

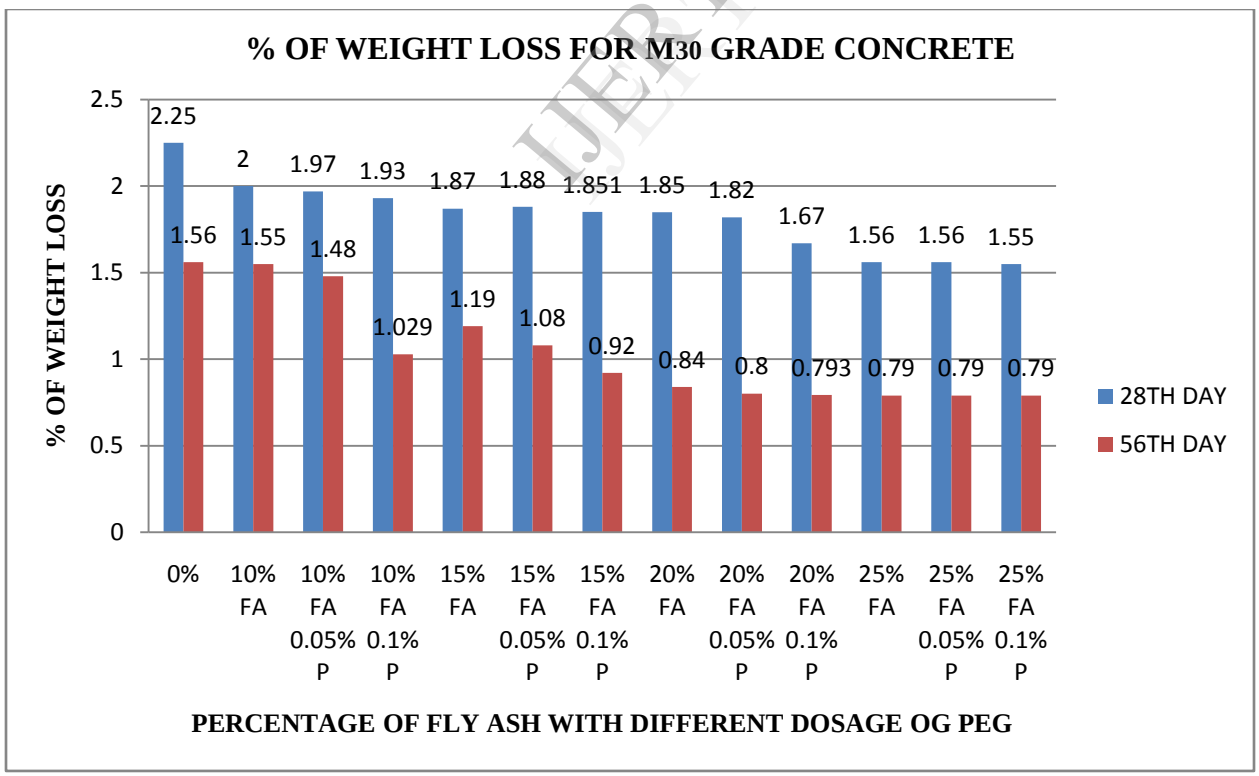
Fig-2: The cubes were immersed in the Na2So4 solution

Fig-3: The deteriorated concrete specimen On the 3rd day

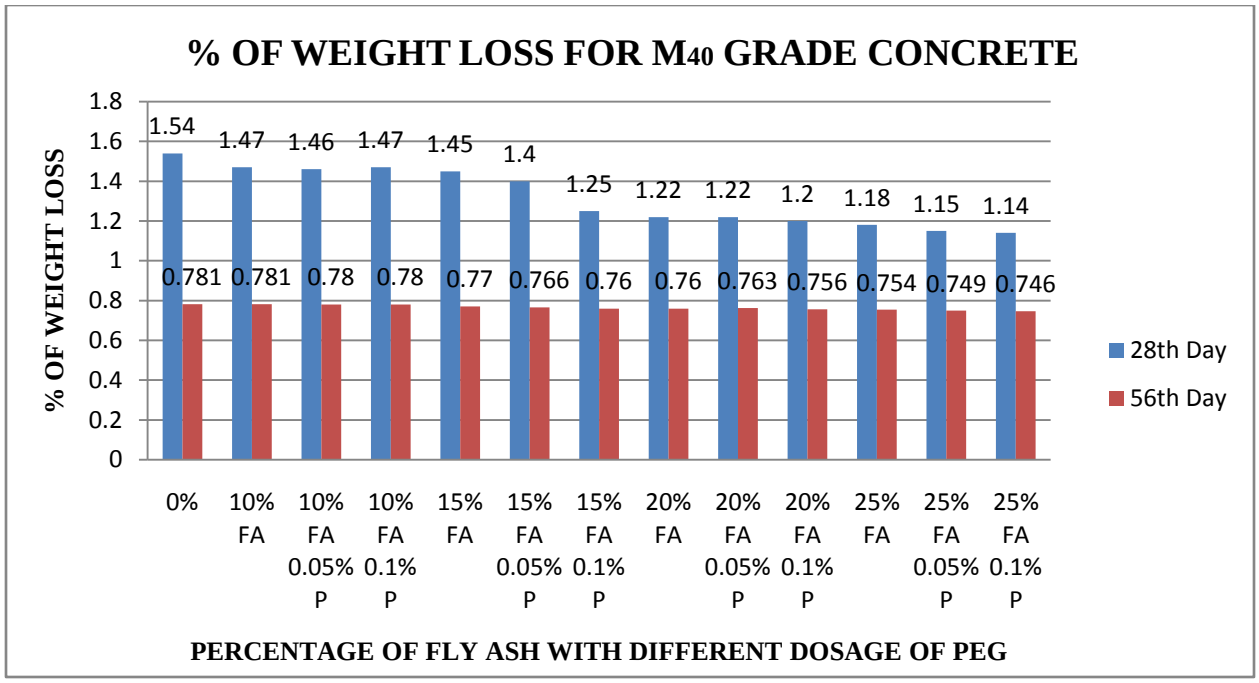
Fig-4: The concrete specimens are cured in room temperature



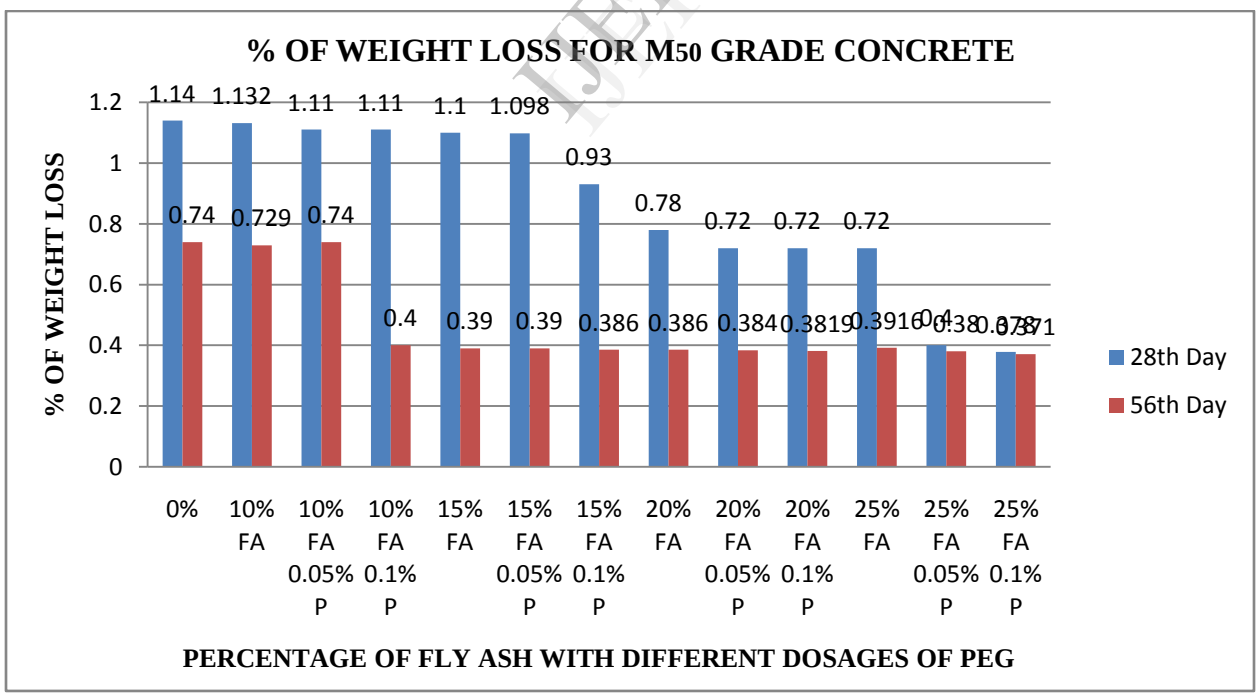
Graph-1: Percentage of weight loss at 28th and 56th day for M_{20} grade with replacement of fly ash and different dosages of PEG



Graph-2: Percentage of weight loss at 28th and 56th day for M_{30} grade with replacement of fly ash and different dosages of PEG



Graph-3: Percentage of weight loss at 28th and 56th day for M_{40} grade with replacement of fly ash and different dosages of PEG



Graph-4: Percentage of weight loss at 28th and 56th day for M_{50} grade with replacement of fly ash and different dosages of PEG

4. Results and Discussion:

The permeability of concrete decreases with increase in the replacement of fly ash with cement and in addition of P.E.G dosages.

So the penetration of chemicals is decreased with the addition of PEG and the concrete is safe against sulphates.

The percentage of weight loss of the concrete specimens are also decreased for every grades of concrete.

From the results, we know that the self-curing concrete has the ability to resist the sulphates present in the soils and in the sea waters. It is very economical also, So it can be adoptable for the constructions.

5. References:

a) **Aiminxu** "*Test methods for sulphate resistance of concrete and mechanism of sulphate attack*" September 1998.

b) **Ian Longworth** "*Sulfate damage to concrete floors on sulfate-bearing hardcore"* February 2008.

c) **QCL Group "***sulphate attack and chloride ion penetration: their role in concrete durability"* March 99.

d) **Corral-Higuera R, Arredondo-Rea S.P, Neri-Flores M.A., Gómez- Soberón J.M., Almeraya Calderón F, Castorena-González J.H, Almaral-Sánchez J.L** *"Sulfate Attack and Reinforcement Corrosion in Concrete with Recycled Concrete Aggregates and Supplementary Cementing Materials"* 1 March 2011.