An Experimental Investigation of Self Curing Concrete

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***Abstract*: Since we identify water shortage is mounting day by day, so a vital research should be needed to do the constructions without water. In early stages, water was mandatory for the curing purposes in construction. Curing of material do a chief job in rising pore structure and microstructure to increase durability and performance with water-soluble polyethylene glycol as self-curing agent and light weight aggregate as granite. The imagination of a world without concrete is impossible. Concrete is a soul of infrastructures. Concrete is necessary to gain strength in structures. Conventional concrete, which is the mixture of cement, fine aggregate, coarse aggregate and water, needs curing to achieve strength. So it is required to cure for a minimum period of 28 days for good hydration and to achieve target strength. Lack of proper curing can badly affect the strength and durability. Self-curing concrete is one type of modern concrete, which cure itself by retaining water (moisture content) in it. The use of POLYETHYLENE GLYCOL in conventional concrete as an admixture helps better hydration and hence the strength of concrete. In this admixture PEG400 on compressive strength by varying the percentage of PEG400 by weight of cement 0.5%, 1.0% and 1.5% were studied. The study shows that PEG400 could help in gaining the strength of conventional curing. It was also found that 1% of PEG400 by weight of cement was optimum for M20 grade concrete for achieving maximum strength without compromising workability. The test result indicates that use of water soluble polymers in concrete has improved performance of concrete.**

***Keywords*: Self-curing concrete, Water retention, Workability, Compressive strength, Split tensile strength.**

I. INTRODUCTION

Curing plays a chief function in the growth of concrete properties throughout construction. Curing is often used to provide the method by which hydraulic cement concrete mature and increase hardened property more than time as a product of the constant hydration of the cement in the occurrence of enough water (ACI, 2008). The function of curing is to lessen water disappearance from concrete and keep acceptable moisture content, especially throughout early ages, for continuance of the hydration method that is essential for the growth of cement microstructure. This will lead to a improved class cement adhesive and concrete and will help to attain the preferred properties. though, good curing is not realistic in lots of cases and a amount of researchers have questioned whether it is feasible to set up self-curing concrete. It was establish that the improvement of use self-curing agent is to lessen water fading from concrete, therefore rising its water preservation capability compare with that of conservative concrete and that water-soluble polymers may have this potent.

Proper curing of concrete structures is important to meet the performance and durability requirements. In conventional curing this is achieved by external curing applied after mixing, placing and finishing. Self-curing or internal curing is a technique that can be used to provide additional moisture in concrete for more effective hydration of cement and reduced self-desiccation.

Building industry make use of bunch of water in the name of curing. The days are not far-off that all the building industry has to button over to a substitute curing system, not simply to save water for the sustainable growth of the atmosphere but also to encourage inside and open-air construction behavior even in inaccessible areas where there is shortage of water.

Bare slab surfaces are chiefly receptive to curing as strength growth. And freeze-thaw resistance of the peak face of a slab can be abridged drastically when curing is imperfect. When Portland cement is assorted with water, a chemical response known as hydration takes place. newly mixed concrete usually contain more water than is mandatory for hydration of the cement; though, too much loss of water by disappearance can holdup sufficient hydration. The face is particularly vulnerable to inadequate hydration because it dry first. If temperatures are positive, hydration is comparatively fast the first few days after concrete is positioned; though, it is vital for water to be retain in the concrete throughout this era, that is, for evaporation to be banned or considerably abridged. With good curing, concrete become stronger, more impervious, and more opposed to stress, scratch, and freezing and thaw.

Curing is name set to the measures used to promote hydration of cement, and consist of a power of temperature and of dampness into the concrete. Curing allows nonstop hydration of the cement and accordingly constant increase in the strength, once curing stop strength increase of the concrete also stop. correct moisture circumstances are serious because the hydration of the cement almost cease when the relative dampness within the capillaries drop underneath 80%.

A tough concrete is one that perform adequately beneath the predictable exposure state throughout its intended service time.

II. LITERATURE REVIEW

Wen-Chen Jau declared selfcuring is provided to absorb water from dampness and from atmosphere to attain improved. It lessen the difficulty when the amount of cement hydration is lesser due to no curing or inappropriate curing by tough potential of fascinating moisture from environment and provide water necessary cure .

PietroLura The major aspire of his study was to attain a improved beginning of autogenous contraction in order to be capable to replica it and perhaps lessen it. Once the significant position of self-desiccation contraction in contraction is exposed, the profit of avoiding throughout inner curing turn into obvious.

Mohanraj Rajendran M strength of chop by compression test engine for Self-cured concrete is superior than of concrete cure by complete curin. The tear tensile strength of self-cured cylinder sample is superior than that of the conservatively cure sample. Self-cured concrete is establish to have fewer water absorption value compare with concrete cure by supplementary technique. thus have less quantity of absorbent. The achievement of the first study things to see the assure of extra job.

David Darwin, Diane Reynolds In this experimental work carried out to investigate self curing concrete by using prewetted, vacuum-saturated (PVS) lightweight aggregate (LWA). In this experimental work shrinkage was evaluated at curing period of 7 and 14 days. In this study normal weight aggregate was replaced by lightweight aggregate at volume replacement levels ranging from 8.9 to13.8%. Due to partial replacement of PVS LWA results in small reduction in concrete density but it should not effect on concrete compressive strength and a substantial decrease in concrete shrinkage for drying period up to 365 days. As increase in curing period from 7 to 14 days reduce the concrete shrinkage. Also the 30 and 60% volume replacements of Portland cement with slag cement result in reduction in shrinkage when used with a porous lightweight aggregate or normal weight aggregate. From results it was conclude that after 30 and 365 days of drying all mixture with lightweight aggregate exhibited less shrinkage than the mixtures with either low or high absorption normal weight aggregates.

M. Manoj Kumar, D. Maruthachalam study on selfcuring. fabulous permeable polymer was used as self-curing agent. M40 grade of the concrete is adopt for study. Based on this new study was approved out. The subsequent conclusion were drawn. Water preservation for the concrete mix incorporate a self-curing agent is higher compare to conservative concrete mixes. As establish by the mass loss with moment. The finest quantity is 0.3 % adding up of SAP guide to a vital increase of mechanical strength. There was a balanced boost in the strength for amount from 0.2 to 0.3 % and afterward slowly abridged. Self-cured concrete using SAP was additional inexpensive than conservative cured concrete. In the study cubes were casted and reserved for curative in room temperature concerning 250 to 300 c almost viability of self-cured associate is wanted to be check in warm regions. The efficiency of inner curing by income of SAP apply to concrete was the maximum if 45 kg/m3 water is additional by mean of 1 kg/m3 SAP.

III. MATERIALS USED

Portland Pozzolona Cement:

Cement is a binder, a substance that sets and hardens and can bind other materials together. Cement sets or cures when mixed with water which causes a series of hydration chemical reactions. Carbon concentration in cement spans from approximately 5% in cement structures to approximately 8% in the case of roads in cement. Cement manufacturing releases CO2 in the atmosphere both directly when calcium carbonate is heated, producing lime and carbon dioxide and also indirectly through the use of energy if its production involves the emission of CO2. Type of cement used: Ultratech Portland Pozzolona Cement.

Fine Aggregate:

Sand is a naturally occurring granular material composed of finely divided rock and mineral particles. The most common constituent of sand, in inland continental settings and non-tropical coastal settings, is silica (silicon dioxide, or SiO2), usually in the form of quartz which, because of its chemical inertness and considerable hardness, is the most common mineral resistant to weathering. It is used as fine aggregate in concrete.

Coarse Aggregate:

The coarse aggregate are the crushed stone is used for making concrete. The commercial stone is quarried, crushed, and graded. The coarse aggregate are used of 20 mm and it retained on 12.5mm sieve.

Poly Ethylene Glycol:

Polyethylene Glycol is a condensation polymer of ethylene oxide and water with the general formula H(OCH2CH2)nOH, where n is the average number of repeating oxyethylene groups typically from 4 to about 180. The abbreviation (PEG400) is termed in combination with a numeric suffix which indicates the average molecular weights. Some features of PEGs are the water-soluble nature, nontoxic, odorless, neutral, lubricating, non-volatile and nonirritating and is used in a variety of pharmaceuticals.

Water:

Water used in making concrete should be free from impurities and pH of the water should be 6.5–8. It is important that water is added based on the water-cement ratio as adopted in mix design or standards.Water is an important ingredient of concrete as it actively participates in the chemical reactions with cement to form hydration products. The strength of cement concrete depends mainly on the binding action of the hydrated cement paste gel. Water conforming to the requirements of BIS: 456-2000 (37). It is generally stated that water fit for drinking is fit for making concrete.

IV. RESULTS & DISCUSSIONS

Grading results for fine aggregates:

The fine aggregates to be used require being well graded and therefore the sieve analysis or grading was carried out. For the fine aggregates to show that they are well graded, they need to fit well within the envelope. Therefore this was achieved as shown in Figure 1 for the fine aggregates used in this research study.

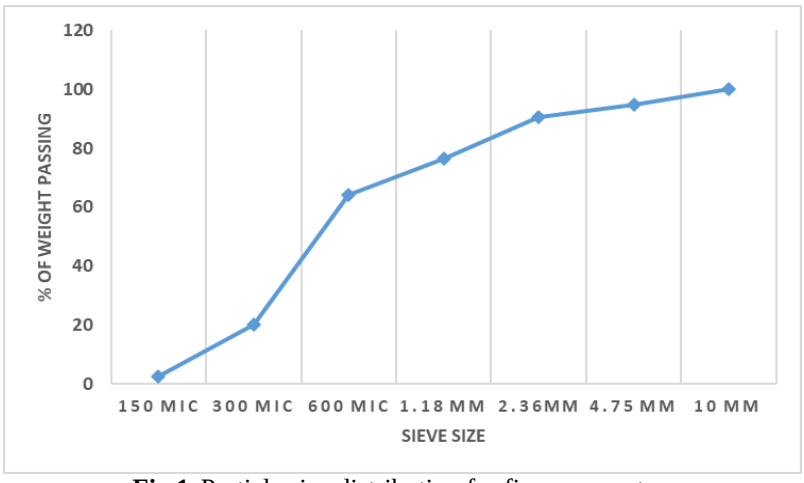

Fig 1: Particle size distribution for fine aggregates

Grading results for coarse aggregates:

The coarse aggregates to be used need to be well graded and therefore the sieve analysis or grading was performed according to (BS 812: Part 103.1:1985). The coarse aggregates were well graded since they fit well within the envelope as shown in Figure 2 below.

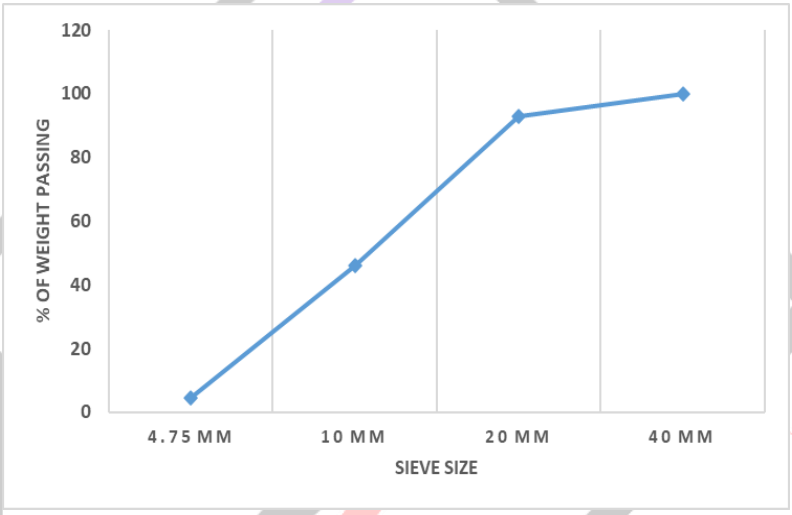

Fig 2: Particle size distribution for coarse aggregates

Slump Test:

Figure 3 shows the variation of slump with percentage of PEG. From the graph it is observed that the slump value of the fresh concrete increases with increase in the percentage of PEG. This indicates the increase in workability of the concrete.

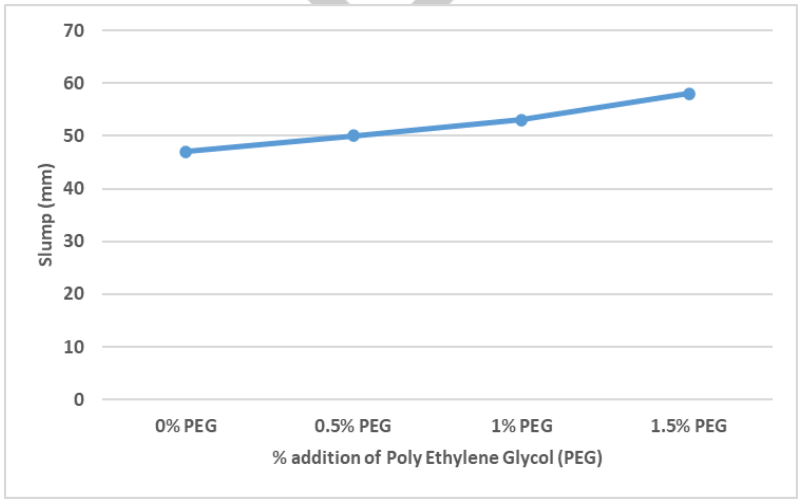

Fig 3: Slump values for the different percentage addition of PEG

Compressive strength test results:

The compressive strength of the concrete was determined by crushing three 150 mm squared size cubes at ages 7 and 28 days for each mix. The test was carried out according to B.S.1881 part 116:1983 using a compressive testing machine with a constant loading rate. The compressive strength results with and without addition of PEG for M20 grade concrete are shown below in Table 1.

Table 1: Compressive strength test results

Mix	**Compressive strength in N/mm^2**			
	7days strength (N/mm2)	Avg. strength (N/mm2)	28days strength (N/mm2)	Avg. strength (N/mm2)
0% PEG	22.56	21.78	26.43	25.75
	21.82		25.67	
	20.96		25.15	
0.5 % PEG	17.58	16.44	25.04	23.97
	16.30		22.56	
	15.44		24.31	
1% PEG	22.92	22.89	28.60	27.53
	20.84		26.36	
	24.91		27.63	
1.5% PEG	21.52	18.44	18.11	20.64
	17.35		21.29	
	16.45		22.52	

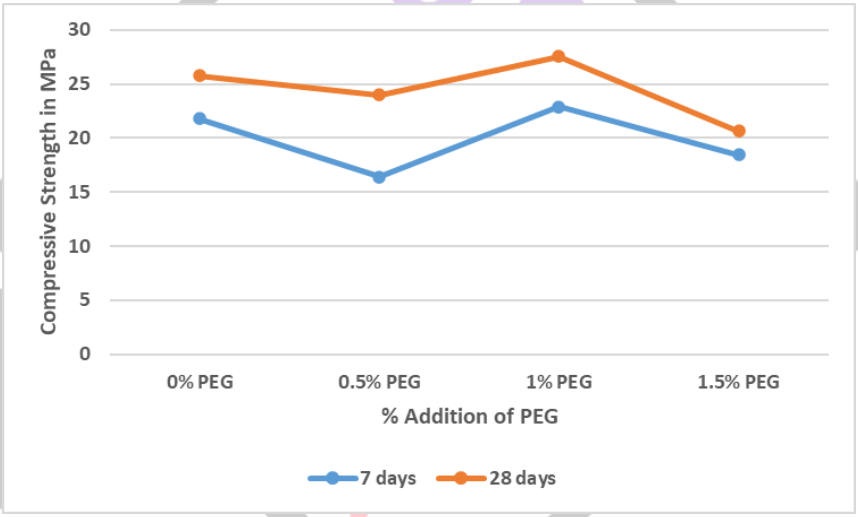

Fig 4: Compressive strength for the different percentage addition of PEG

Split tensile strength test results:

From the Table and Figure below, the splitting tensile strength test results show a similar trend to the compressive strength of concrete cubes shown in Figure 5 below. The splitting tensile strength results with and without addition of PEG for M20 grade concrete are shown below in Table 2.

Table 2: Split tensile strength test results

Mix	Spilt Tensile strength in N/mm^2			
	7days strength (N/mm2)	Avg. strength (N/mm2)	28days strength (N/mm2)	Avg. strength (N/mm2)
0% PEG	2.88	2.72	3.42	3.32
	2.69		3.33	
	2.61		3.21	
0.5 % PEG	2.92	2.76	3.48	3.36
	2.67		3.23	
	2.71		3.39	
1% PEG	3.04	2.96	3.56	3.81
	2.97		4.02	
	2.89		3.87	
1.5% PEG	2.91	2.75	3.46	3.34
	2.64		3.22	
	2.70		3.35	

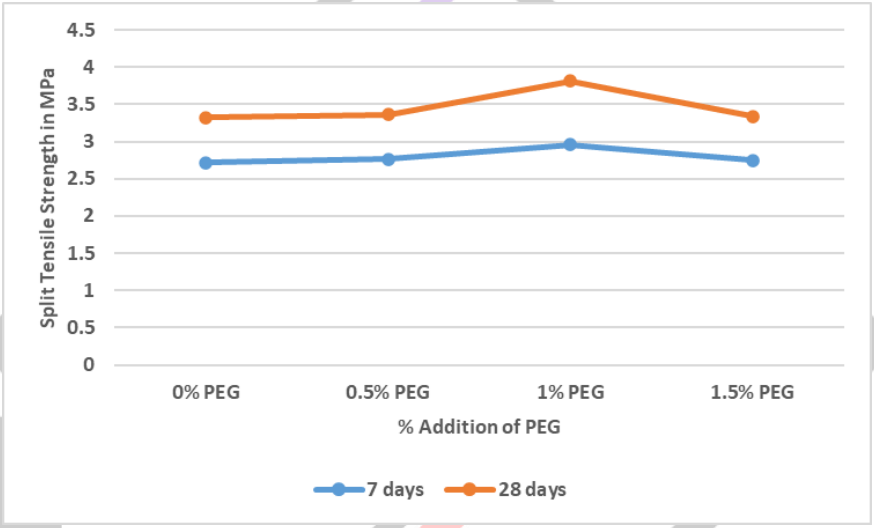

Fig 5: Splitting tensile strength for the different percentage addition of PEG

V. CONCLUSIONS

The following conclusions are drawn from this study;

1. The optimum dosage of PEG400 for maximum strength compressive and tensile was found to be 1% for the M20 grade concrete.
2. As percentage of PEG400 increased slump increased for M20 grade of concrete.
3. The increase in PEG400 amount increased the workability of concrete.
4. The self-curing concrete mix performed exceptionally better with 1% of PEG400
5. Self-curing concrete is the answer to many problems faced due to lack curing.
6. Self-curing concrete is an alternative to conventional concrete in desert regions where scarcity of water is a major problem.

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