Experimental Study on Self Curing Concrete using Polyethylene Glycol 400 using Different Quality of Water

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Abstract – *The mechanical properties of concrete containing self curing agents are investigated in this paper. To carry out this study the cement content 360, 380 kg/m³, water/cement ratio of 0.5, 0.4 and 0.5%, 1%, 1.5%, 2% Polyethylene Glycol-400 were used in concrete mixes. The results show that, the use of self curing agents in concrete effectively improved the mechanical properties. The concept of several self-curing agents to reduce water evaporation from concrete. Increase the water retention capacity of concrete compared to conventional concrete. As per the result compression strength of various mixes of M20 and M30 Grade of concrete we conclude that the compression strength of mixes using self curing compound (PEG-400) are at par with that of the concrete with conventional curing.*

Key Words: Compressive Strength, Harvested Rain water, PEG-400, Self-Curing Concrete, Split Tensile Strength.

1. INTRODUCTION

Curing is the name given to the procedures used for promoting the hydration of the cement, and consists of a control of temperature and moisture movement from in to the concrete. Curing allows continuous hydration of cement and consequently continuous gain the strength, once curing stops strength gain of the concrete also stops. The 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. Self-curing concrete is one of the special concretes which is gaining importance in recent days as it avoids errors which were caused by human, structures which are not accessible, terrains where curing becomes difficult and in places where the fluoride content badly influences the property of concrete. This kind of curing technique can widely be practiced in places where there is scarcity of water. Polyethylene glycol is non-toxic, odourless, neutral, lubricating, non-volatile and non-irritating and is used in a variety of pharmaceuticals. Thus, it is a shrinkage reducing admixture. The aim of this investigation is to study the strength properties of concrete using water soluble Polyethylene Glycol (PEG 400) as self-curing agent using M20 and M30 grade concrete. The results should help explain the effect of self curing agent ratios and best type to optimize the mechanical properties of concrete.

2. EXPERIMENTAL PROGRAMME

Materials and Mix Proportion

Cement: The Ordinary Portland cement of 43-grade PPC was used in this study conforming to IS: 12269-1987 [8]. The specific gravity of cement is 3.15. The initial and final setting times were found as 30 minutes and 600 minutes respectively. Standard consistency of cement was 29%.
Fine Aggregates: The river sand is used as fine aggregate conforming to the requirements of IS: 383-1970 [4], having specific gravity of 2.54 and fineness modulus of 3.25 has been used as fine aggregate for this study.
Coarse Aggregate: Coarse aggregate obtained from local quarry units has been used for this study, conforming to IS: 383-1970 [4] is used. Maximum size of aggregate used is 20mm with specific gravity of 2.6 and fineness modulus of 7.3.

Water

Conventional water: The water used for experiments was tap water conforming as per IS: 456-2000 [5].
Treated Sewage Water: these water collected from AIeMS College treated STP water.
Harvested rain water: Rainfall on the roof top has been diverted to the tank via PVC pipe collected in AIeMS college.
Polyethylene Glycol-400(PEG-400): The polymers added in the mix mainly form hydrogen bonds with water molecules and reduce the chemical potential of the molecules of water which in turn reduces the vapor pressure, thus reducing the rate of evaporation from the surface.

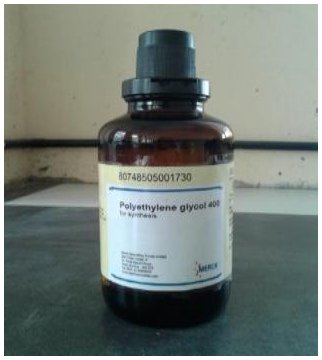

Fig -1: Polyethylene Glycol-400

Table -1: Physical and Chemical Properties of Poly-Ethylene-Glycol

Sl.No.	Description	Properties
1.	Molecular Weight	400
2.	Appearance	Clear Fluid
3.	Moisture	0.2%
4.	pH	6
5.	Odour	Mild Odour
6.	Solubility	Soluble In Water
7.	Density	1.1 – 1.2
8.	Specific Gravity	1.12

Experimental procedure:
In this investigation, the collection of water sample and M20 and M30 Grade mixes were designated in accordance with IS: 10262-2009. Conventional concrete was casted with M20 and M30 mix and made to water curing. Another set of cubes were casted using PEG-600 of 0.5%, 1%, 1.5% and 2% with M20 and M30 concrete and allowed for atmosphere curing. Similarly cubes were casted for 7and 28 days for conventional and PEG 400 to study the strength properties (compressive strength and split tensile strength). For this experimental study a total of 45 cubes and 45 cylinder were casted for determine the strength properties.

Mix Design Proportion:

Table -2: Mix Design Proportion for M20 and M30

Mix design	Water (ltr)	Cement (kgs)	Fine aggregate (kgs)	Coarse aggregate (kgs)	Proportion
M20	180	360	584	1223.8	1:1.6:3.4
M30	160	380	711	1283	1:1.9:3.4

3. RESULT AND DISCUSSION

Water analysis: The result for water analysis provided in table 3 An experimental investigation shows that there was significant difference in analyzed parameter i.e. , pH, TDS calcium, Bicarbonate, sulphate ,magnesium, Chloride. The pH of conventional water, treated sewage water, harvested rain water is above 6 and the conventional water, treated sewage water, harvested rain water is less than 2000mg/lt of total solids.

Table -3: water quality analysis of conventional, treated sewage and harvested rain water.

Parameters	Conventional Water	Treated STP water	Harvested Rain water
pH	7.5	7.9	6.8
TDS mg/l	300	554	60
Sulphate mg/l	30	15	2.4
Bicarbonate mg/l	150	120	50
calcium mg/l	250	200	80
Magnesium mg/l	20	50	2
Chloride mg/l	250	230	110

Workability test: The result of slump tests and compaction factor test performed on the three types of water mixes are presented in table 4 and table 5 the result shows that workability of mixes is within the acceptable range.

Table -4: Result of Slump Test for different % PEG-400

Sl.No	PEG 400	Slump (mm) Conventional water		Slump(mm) Treated sewage water		Slump (mm) Harvested rain water	
		M20	M30	M20	M30	M20	M30
1	0	80	75	82	78	80	76
2	0.5	92	88	90	90	92	85
3	1.0	112	119	120	110	112	120
4	1.5	140	130	138	128	140	135
5	2.0	175	165	170	165	178	165

Table -5: Result of Compaction factor test for different % PEG-400

Compaction factor Conventional water		Compaction factor treated sewage water		Compaction factor Harvested rain water	
M20	M30	M20	M30	M20	M30
0.88	0.86	0.87	0.85	0.86	0.84
0.90	0.88	0.89	0.87	0.90	0.86
0.91	0.91	0.92	0.90	0.93	0.88
0.93	0.92	0.94	0.93	0.95	0.91
0.96	0.93	0.97	0.95	0.98	0.94

Compressive strength: The table - 6 shows, the compressive strength of all the concretes study either self curing or conventional concrete, with increase gradually with time different rates under curing. Compressive strength systematically increases a self curing agent used in the concrete as shown in the figure 1-4.

Table -6: Compressive strength test result for M20 Grade of Concrete

Grade	% of PEG400	CONVENTIONAL WATER		TREATED SEWAGE WATER		RAIN HARVESTED WATER	
		7 days	28 days	7 days	28 days	7 days	28 days
M20	0	16.25	28.2	17.32	28.52	15.68	26.4
	0.5	17.6	28.4	18.2	28.84	16.76	27.07
	1	18.5	28.9	18.9	29.02	17.25	27.58
	1.5	18.53	29.02	19.53	29.5	17.96	27.84
	2.0	18.78	29.12	19.78	30.32	18.2	28.22
M30	0	17.2	38.5	18.25	39.2	16.5	37.5
	0.5	19.2	38.9	19.25	39.9	18.25	37.9
	1	20.5	39.3	21.6	40.03	19.23	38.93
	1.5	21.2	39.8	22.02	40.88	20.27	39.02
	2.0	21.8	40.02	22.88	42.02	20.98	39.85

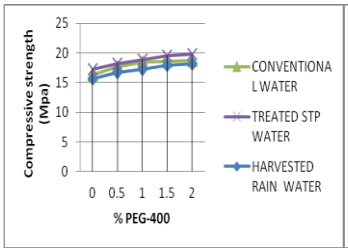

Chart -1: Compressive Strength for M20 concrete 7 days

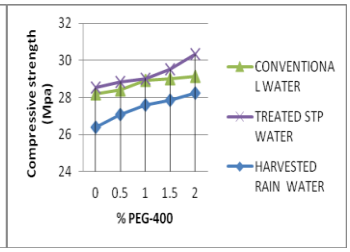

Chart - 2: Compressive Strength for M20 concrete 28 days

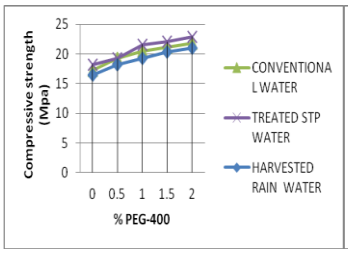

Chart -3: Compressive Strength for M20 concrete 7 days

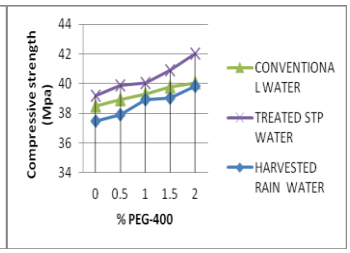

Chart -4: Compressive Strength for M20 concrete 7 days

Split tensile strength:

Split tensile strength are calculated by taking 3 different waters with admixtures PEG400 . Tested samples for each type of mix are different ages. M20 and M30 grade concrete results are shown in the following table -7

Table -7: Split tensile test result for M20 Grade of Concrete

Grade	% of PEG400	CONVENTIONAL WATER		TREATED SEWAGE WATER		RAIN HARVESTED WATER	
		7 days	28 days	7 days	28 days	7 days	28 days
M20	0	2.25	3.2	2.51	3.35	2.11	3.02
	0.5	2.53	3.56	2.75	3.84	2.39	3.35
	1	2.69	3.86	2.96	4.02	2.63	3.4
	1.5	2.75	3.97	3.09	4.28	2.72	3.67
	2.0	2.97	4.03	3.27	4.76	2.92	3.93
M30	0	3.22	4.85	3.63	4.98	3.13	4.38
	0.5	3.29	4.98	3.98	5.08	3.24	4.79
	1	3.55	5.05	4.52	5.15	3.47	4.90
	1.5	4.08	5.36	4.78	5.58	3.98	5.03
	2.0	4.52	5.68	4.90	5.73	4.24	5.26

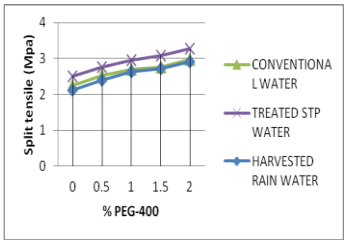

Chart -5: Split tensile test for M20 concrete 7 days

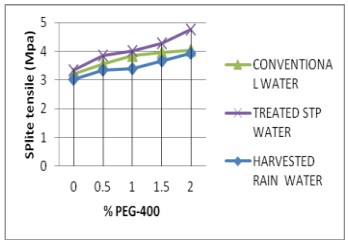

Chart -6: Split tensile test for M20 concrete 28 days

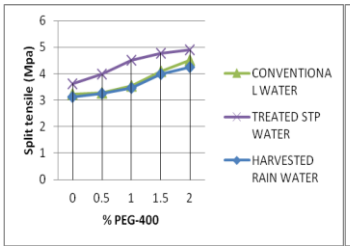

Chart -7: Split tensile test for M30 concrete 7 days

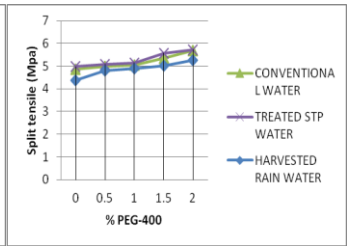

Chart -8: Split tensile test for M20 concrete 28 days

4. CONCLUSION

A maximum Compressive strength was found for 2.0% of PEG-400 in M20 and M30 grade of concrete. Hence self curing concrete showed a better performance with respect to its compressive and split tensile properties. Thus Self-cured concrete is thus found to be less porous compared to the conventional types. It shows that the self curing concrete is able to withstand extreme conditions and corrosion effects. Viewing the above strength characteristics properties it can be concluded that self curing concrete is a better option in field conditions where there is scarcity of water.

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BIOGRAPHIES

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