Split Tensile Strength Study of Self-Curing Concrete and Conventional Concrete

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Abstract— The present study involves the use of super absorbent polymer (SAP) in concrete which helps in self-curing and helps in better hydration. In the present study, the effect of super absorbent polymer (SAP) on split tensile strength by varying the percentage of SAP by weight of cement from 0.2%, 0.3% and 0.4% were studied for both mixes M30 and M20, and it is compare with same grade of concrete which is made by conventional method. It was found that SAP could help in self-curing by giving strength on par with conventional curing.

Key words: Concrete, Self-Curing Concrete, Curing, Self-Curing, Self-Curing Agent (Super Absorbent Polymer)

I. INTRODUCTION

Curing of concrete is maintaining satisfactory moisture content in concrete during its early stages in order to develop the desired properties and therefore it is one of the most important requirements for optimum concrete performance in any environment or applications. However, good curing is not always practical in many cases. Therefore, the method of using self-curing agents will be a good alternative.

Proper curing of concrete structures is important to meet 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. When this water is not readily available, significant autogenously deformation and (early-age) cracking may result. Due to the chemical shrinkage occurring during cement hydration, empty pores are created within the cement paste, leading to a reduction in its internal relative humidity and also to shrinkage which may cause early-age cracking.

To attain desirable strength and other properties, curing is necessary. Curing is the process of maintaining the proper moisture content to promote optimum cement hydration immediately after placement. As a result, adequate curing is essential for concrete to obtain advanced structural and durability properties and therefore is one of the most important requirements for optimum concrete performance in any environment or application.

II. EXPERIMENTAL DETAILS

Materials Used- Material used in the study were cement (PPC), fine aggregate (river sand passing through 4.75 mm), coarse aggregate, SAP, and Water.

A brief description of the material used in this research work is presented below.

A. Cement:

Portland pozzolona cement (ACC) with specific gravity 3.10, available in local market was used in this entire investigation.

B. Fine Aggregate:

Locally available river sand conforming to Indian standard (Zone-II).

C. Coarse Aggregate:

Locally available quarry stone in good strength passing through 20 mm and retain in 10mm sieve.

Water: Ordinary potable water without acidity and alkaniety available in the Material Testing laboratory was used.

D. Super Absorbent Polymer:

The common SAPs are added at rate of 0.2, 0.3 and 0.4 wt % of cement. The SAPs are covalently cross-linked. They are Acryl amide/acrylic acid copolymers. One type of SAP are suspension polymerized, spherical particles with an average particle size of approximately 1.00 mm; another type of SAP is solution polymerized and then crushed and sieved to particle sizes in the range of 0.50–2.00 mm. The size of the swollen SAP particles in the cement pastes and mortars is about three times larger due to pore fluid absorption. The swelling time depends especially on the particle size distribution of the SAP. It is seen that more than 50% swelling occurs within the first 5 min after water addition. SAP images.

Fig. 1: SAP

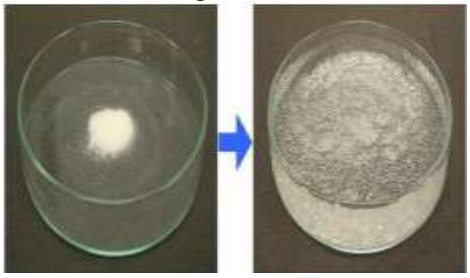


Fig. 2: Swelling of SAP after Adding Water

SAP is a chemical polymer that is widely used in a variety of consumer products for its ability to absorb several hundred times its mass in water this property given below. (Table 1)

Form	Dry - Crystalline white powder
Particle size	1 mm (Average)
Water absorption with distilled water	150 g for 1 g of SAP
pH of absorbed water	Neutral
Density	1.08
Bulk density	0.85
Hydration / Dehydration	Reversible
Decomposition in sun light	6 months
Available water	95% approx.

Table 1: Properties of Super Absorbent Polymer

III. EXPERIMENTAL PROGRAMME

The experimental program was designed to investigate the strength of self curing concrete by adding super absorbent polymer (SAP) 0-0.4% by weight of cement to the concrete. The 0% of SAP concrete is prepared by conventional method. The experimental program was aimed to study the split tensile strength. To study the above properties mixes M20 and M30 were considered. The scheme of experimental program is given in Table No.2

Fig. 3: Cylindrical mould

The size of each cylinder is 150 mm in dia and 300 mm in height for split tensile strength.

Test performed on the 48 specimen for split tensile strength in different % of sap content.

Sr. No.	Test	Cylinder Sets	Grade	Cylinder Name	% Of SAP	7 Days	28 Days
1	Split Tensile Strength Test	C		C1	0%	3	3
			M20	C2	0.20%	3	3
				C3	0.30%	3	3
				C4	0.40%	3	3
		D		D1	0%	3	3
			M30	D2	0.20%	3	3
				D3	0.30%	3	3
				D4	0.40%	3	3
				TOTAL		24	24

Table 2: Details of specimens cast

IV. EXPERIMENTAL RESULTS AND DISCUSSION

For cylinder specimen total two sets of cylinder C (C1,C2,C3 and C4) and D (D1,D2,D3 and D4) were tested for their Split tensile strength for different proportions of SAP such as C sets for M20 (0%,0.2%,0.3% and 0.4% of SAP by weight of cement) and D sets for M30 (0%,0.2%,0.3% and 0.4% of SAP by weight of cement) respectively. The 0% of SAP concrete is prepared by conventional method. It was observed that the specimen sets C3 and D3 have improved maximum split tensile strength in 28 days.

Fig 4: Filling of cylindrical mould

V. RESULTS

The split tensile strength values at 7 and 28 days of concrete are shown in Table no.3 and Table no.4. There is an increase in split tensile strength of sets C3 and D3. All other concrete mixes containing SAP show a variation in strength with the increase in SAP content.

Fig. 5: Testing of cylindrical mould

Fig. 6: After Testing of cylindrical mould

Grade	M20			M30		
Days	7days			7 days		
% of SAP	Cylinder sets	Split Tensile strength (N/mm2)	Average Split Tensile strength (N/mm2)	Cylinder sets	Split Tensile strength (N/mm2)	Average Split Tensile strength (N/mm2)
0%	C1	2.12	2.17	D1	2.41	2.55
		2.26			2.69	
		2.12			2.55	
0.2%	C2	2.12	2.22	D2	2.55	2.59
		2.26			2.69	
		2.26			2.55	
0.3%	C3	2.41	2.50	D3	3.11	3.07
		2.55			2.97	
		2.55			3.11	
0.4%	C4	2.41	2.36	D4	2.69	2.78
		2.26			2.83	
		2.41			2.83	

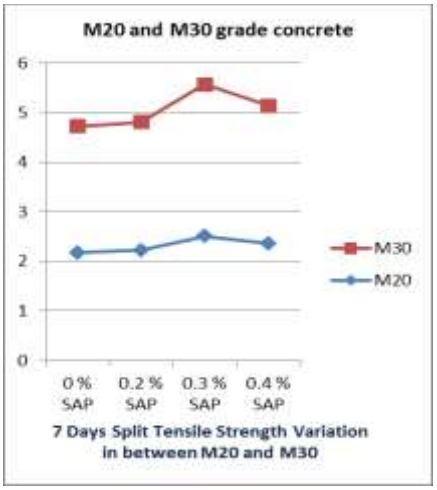
Result of split tensile strength testing for 7 days showing in Table 3:

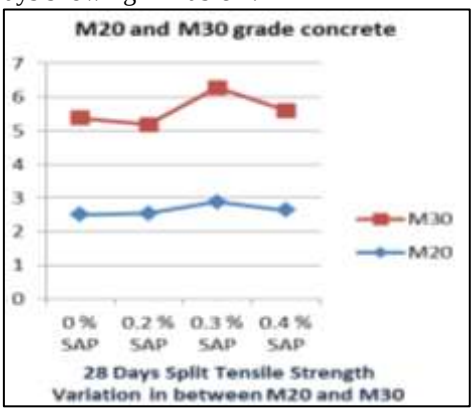
Grade	M20			M30		
Days	28days			28 days		
% of SAP	Cylinder sets	Split Tensile strength (N/mm2)	Average Split Tensile strength (N/mm2)	Cylinder sets	Split Tensile strength (N/mm2)	Average Split Tensile strength (N/mm2)
0%	C1	2.55	2.50	D1	2.83	2.88
		2.55			2.83	
		2.41			2.97	
0.2%	C2	2.69	2.55	D2	2.69	2.64
		2.41			2.55	
		2.55			2.69	
0.3%	C3	2.83	2.88	D3	3.40	3.40
		2.97			3.54	
		2.83			3.26	
0.4%	C4	2.55	2.64	D4	2.97	2.97
		2.69			2.83	
		2.69			3.11	

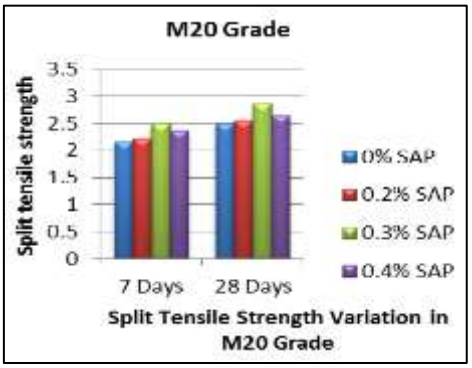
Result of split tensile strength testing for 28 days showing in Table 4:

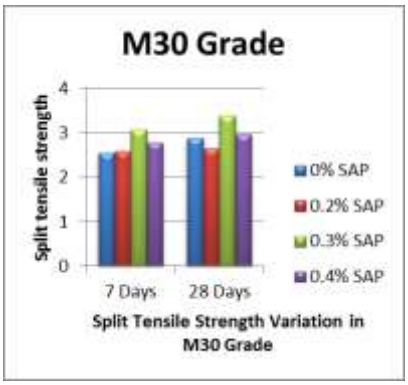
VI. DISCUSSION ON RESULTS

Tables show the results of split tensile strength experimental investigation on the specimens. Specimen strengthened with replacing different percentage of SAP. From the result for 7 days and 28 days, specimen sets C3 and D3 are given the effective results compare to standard set C1 and D1 for split tensile test. The all cylindrical split tensile strength results in graph form in below.









VII. Conclusions

Super Absorbent Polymer was used as self-curing agent. M20 and M30 grade of concrete is adopted for the investigation. Based on the experimental investigation carried out, the following conclusions were drawn:

- The optimum dosage is 0.3%.Addition of SAP leads to a significant increase of Splitting tensile.
- The Self-cured concrete using SAP was more economical than conventional cured concrete.
- Sets C3 and D3 have more split tensile strength compare to all other sets in same grade.
- Sets D2 show very less split tensile strength compare to all other sets in same grade in 28 days.

From the study it can be concluded that the specimen can be used with SAP to increase their strength to a great extent. The 0.3% SAP specimens to increase the result in this test compare to the 0%, 0.2% and 0.4% SAP specimens. The 0% of SAP concrete is prepared by conventional method it mean the using of SAP is good for concrete. This material may be used in RCC compression members and pre-stress concrete. This research study is used for different Engineering areas (like desert) where scarcity of water is a major problem.

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