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PERFORMANCE OF SELFCURING CONCRETE USING SAP

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ABSTRACT
Concrete is an essential building material which is widely used in construction industry all over the world due to its compressible strength. Curing of concrete plays a vital role in durability and other performance necessities. Improper curing can affect the concrete performance and durability easily. The concept of internal curing is to enhance the hydration process to maintain the temperature uniformly. The evaporation of water in the concrete is reduced by self curing agent (Super Absorbing Polymer – SAP) there by increasing the water retention capacity of the concrete. The super absorbing polymer is sodium polyacrylite material which is absorb water and convert it into gel, then thus dry/wet polymer add in fresh concrete, after final setting of concrete due to dry periphery of concrete SAP release water and it provides internally curing namely known "self curing concrete" (SCC) in short less or no external curing are required in other way if external curing may causes better heat of hydration Proper dosage of self curing agent will increase the strength of concrete. In this paper 0.1%, 0.2%, 0.3%, 0.4% by weight of cement was varied in M25 grade without admixtures and adding different dosage of SAP by powder form (dry).

1. Introduction

Concrete is most widely used construction material due to its good compressive strength and durability. Depending upon the nature of work the cement, fine aggregate, coarse aggregate and water are mixed in specific proportions to produce plain concrete. Plain concrete needs suitable atmosphere by providing moisture for a minimum period of 28 days for good hydration and to attain desired strength. Any lack in curing will badly affect the strength and durability of concrete. Self-curing concrete is one of the special concretes in mitigating insufficient curing due to human negligence paucity of water in arid areas, inaccessibility of structures in difficult terrains and in areas where the presence of fluorides in water will badly affect the characteristics of concrete.

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.

Advantages of using SAP

- To overcome from deficiencies of external curing generated by both human and hydration.
- It is reduces evaporation, so occasion of cracks are less as well as eliminated shrinkage.
- Provides continue moisture contain for hydration of cement.
- Increase or maintain the strength of concrete if the optimum dosage of self curing is used and this is polymer also use for high strength concrete.
- Some amount SAP appear on surface of concrete, thus advantages for reflect sunrays which makes concrete surface cool, which can resist thermal cracking's.
- Improve resistance to abrasion and compression action of salts and chemical.

2. Experimental details

Material used

Cement: Ordinary Portland cement of 43 grades available in local market is used in this project. The Cement used has been tested for various proportions as per IS 4031-1988 and found to be confirming to various specifications of are IS 12269-1987.The specific gravity is 3.14.

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

Coarse Aggregate: Locally available quarry stone in good strength.

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

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 SAPs 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.

Figure:1 Super Absobent Polymer

NEED FOR SELF CURING

When the mineral admixtures react completely in a blended cement system, their demand for curing water can be much greater than that in a conventional ordinary Portland cement concrete. When this water is not readily available, due to depercolation of the capillary porosity, For example: significant autogenous deformation and 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. This situation is intensified in HPC (compared to conventional concrete) due to its generally higher cement content, reduced water/cement (w/ c) ratio and the pozzalanic mineral admixtures (fly ash, silica fume). The empty pores created during self-desiccation induce shrinkage stresses and also influence the kinetics of cement hydration process, limiting the final degree of hydration. The strength achieved by IC could be more than that possible under saturated curing conditions.

ADVANTAGES OF INTERNAL CURING

- Reduces autogenous cracking
- Largely eliminates autogenous shrinkage
- Reduces permeability
- Protects reinforcing steel
- Increases mortar strength
- Increases early age strength sufficient to withstand strain
- Provides greater durability
- Higher early age (say 3 day) flexural strength
- Higher early age (say 3 day) compressive strength
- Greater utilization of cement
- Lower maintenance
- Use of higher levels of fly ash

Table: 1 Properties of SAP

Form dry	Crystalline white powder
Form wet	Transparent gel
Particle size	125-250µm
pH of absorbed water	neutral
Density	1.08
Bulk density	0.85

3. Experimental programme

The experimental program was designed to investigate the strength of self curing concrete by adding superabsorbent polymer (SAP) @ 0.1-0.4% by weight of cement to the concrete. The experimental program was aimed to study the compressive strength, Split tensile test, Flexural test. To study the above properties mixes M25 were considered. The scheme of experimental program is given in Table No.2

Table: 2 Details of casting specimens

S NO	TEST	CUBE NAME	% OF SAP	NO OF SPECIMEN CASTED 7,14,28 DAYS
1	Compression test	A1	0.1	9
		A2	0.2	9
		A3	0.3	9
		A4	0.4	9
2	Split tensile	B1	0.1	3
		B2	0.2	3

	test	B3	0.3	3
		B4	0.4	3
3	Flexural test	C1	0.1	3
		C2	0.2	3
		C3	0.3	3
		C4	0.4	3

**The size of the cube is 150x150x150mm for compressive strength, Size of the cylinder is 150mmØ and 300mm length for split tensile strength test, Size of the beam is 450x75x75mm for Flexural strength test.*

4. Experimental Results and Discussion:

The compressive test, Split tensile test and Flexural test is carried out for 7,14and 28 days with average samples being taken with above dates for the various dosage of SAP to attain optimum strength. The table as follows,

Table: 3 Compressive Strength of cube for 7days

GRADE	**M_{25}**		
DAYS	**7**		
% of SAP	**Cube set**	**Compressive strength N/mm^2**	**Average compressive strength N/mm^2**
0.1%	A1	15.04	15.11
		15.28	
		15.00	
0.2%	A2	16.2	16.01
		15.82	
		16.01	
0.3%	A3	19.20	19.01
		18.82	
		19.00	
0.4%	A4	18.23	18.28
		18.66	
		17.95	

Table: 4 Compressive strength of cube for 14 days

GRADE	**M_{25}**		
DAYS	**14**		
% of SAP	**Cube set**	**Compressive strength N/mm^2**	**Average compressive strength N/mm^2**
0.1%	A1	19.65	19.28
		18.98	
		19.21	
0.2%	A2	20	19.72
		19.95	
		19.2	
0.3%	A3	22.95	21.29
		20.73	
		20.20	
0.4%	A4	20.01	20.01
		19.89	
		20.11	

Table: 5 Compressive Strength of cube for 28days

GRADE	25		
DAYS	28		
% of SAP	Cube set	Compressive strength N/mm^2	Average compressive strength N/mm^2
0.1%	A1	25.67	26.43
		26.89	
		26.72	
0.2%	A2	27.11	27.26
		27.56	
		27.11	
0.3%	A3	31.53	31.19
		30.76	
		31.29	
0.4%	A4	28.53	29.35
		29.95	
		29.57	

Table: 5 Split tensile strength of cylinder

Grade	**M_{25}**		
Days	**28**		
% of SAP	**Cylinder set**	**Split-tensile strength N/mm^2**	**Average Split-tensile strength N/mm^2**
0.1%	B1	2.203	2.143
		2.12	
		2.107	
0.2%	B2	2.32	2.29
		2.29	
		2.27	
0.3%	B3	2.89	2.93
		2.98	
		2.93	
0.4%	B4	2.53	2.56
		2.501	
		2.65	

Table: 6 Flexural Strength of beam

Grade	**M_{25}**		
Days	**28**		
% of SAP	**beam set**	**Flexural strength N/mm^2**	**Average Flexural strength N/mm^2**
0.1%	C1	4.98	4.91
		4.86	
		4.90	
0.2%	C2	5.12	5.19

		5.25	
		5.21	
0.3%	C3	5.90	5.85
		5.80	
		5.84	
0.4%	C4	5.56	5.58
		5.50	
		5.67	

Figure: 2 Compression

Figure: 3 Split Tensile Test

Figure: 4 Flexural Test

Discussion on Results:

Graph shows the compressive, Split tensile and Flexural test of self curing concrete by experimental investigation on the axially loaded specimen. Specimen strengthened with replacing different percentage of SAP. From the results of cube, cylinder and beam specimen set are given the effective results. The test results for various specimen set is given in graph form below,

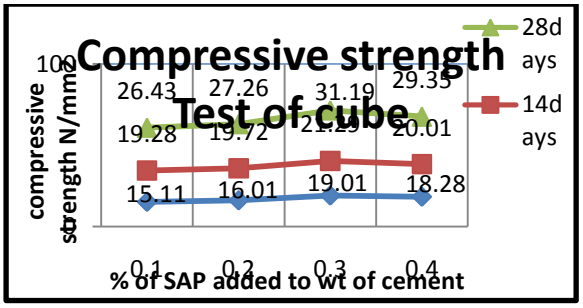


Chart: 2 Trends in Split tensile strength vs. SAP content

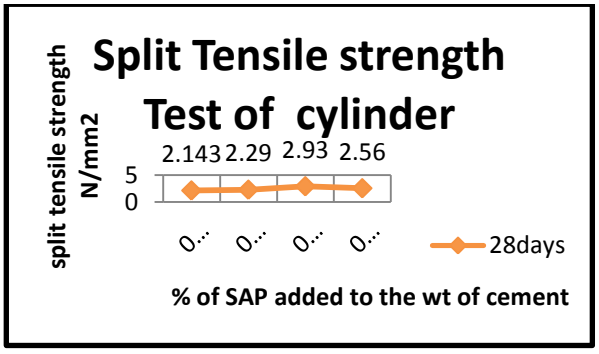
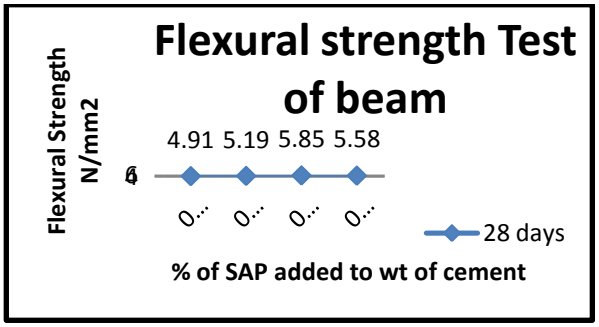


Chart: 3 Trends in Flexural strength vs. SAP content



5. Conclusion:

Super Absorbent Polymer was used as self-curing agent. M_{25} grade of concrete is adopted for the investigation. Based on the experimental investigation carried out, the following conclusions were drawn:

1. The optimum dosage is 0.3%.Addition of SAP leads to a significant increase of Compressive strength, Split tensile strength and Flexural Strength.

2. The Self-cured concrete using SAP was more economical than conventional cured concrete.

Chart: 1 Trends in compressive strength vs. SAP content

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