EFFECT OF SELF CURING AGENT ON MECHANICAL PROPERTIES OF DIFFERENT GRADES OF CONCRETE

Mr. Vishnuvardhan Reddy Y[1], and B. Sharath Chandra[2]

[1]*PG Scholar*

[2]*Head Of the Department*

Abstract: *Maintaining moisture in concrete during its early stages, particularly within 28 days of pouring it, is essential for it to acquire the desired qualities. This is known as proper curing of concrete. The microstructure and pore structure of concrete are largely developed during the curing process. When compared to traditional concrete, the idea of self-curing concrete is to increase its water retention capacity by decreasing water evaporation. The strength of concrete can be readily diminished by improper curing. Research reveals that the use of water-soluble polymers as admixtures in concrete affects the material's strength properties. This is because the curing process of concrete has a significant role in the development of the concrete's microstructure, which enhances the material's durability and performance.*

Superabsorbent polymer (or S.A.P.) is used as the internal curing agent.Water can be absorbed and retained in enormous quantities by a type of polymeric polymers called S.A.P., which keeps the water inside their structure without dissolving. S.A.P. 0.2, 0.40, 0.6, 0.80, and 1.0 mixing percentages are used in this study, along with self-curing concrete grades M20, M30, and M40.

S.A.P. treatment does not reduce the compressive strength of self-curing concrete. Split tensile strength in self-curing concrete is not lowered by the application of S.A.P.. Cement can have up to 0.6% of its weight added to S.A.P. without compromising its various strengths.

1. INTRODUCTION

1.1 GENERAL

Appropriate curing is necessary for concrete constructions to meet the required performance and durability standards. In normal construction, this is achieved by mixing, placing, and finishing first, then applying an outside curing coat. Internal curing is a promising technique for raising the moisture content of concrete for improved cement hydration and reduced self-desiccation. The procedure of adding more moisture to concrete by injecting a curing ingredient is known as internal curing. Currently, there are two primary methods for internally curing concrete. The first method creates an internal water supply through saturated porous lightweight aggregate (LWA), which replaces the water lost to chemical shrinkage during cement hydration.

2. LITERATURE REVIEW

[1] Vivek Hareendran, V. Poornima and G. Velrajkumar April (2014) explains The internal curing agent that is utilized is superabsorbent polymer (S.A.P.).A class of polymeric materials known as S.A.P. are capable of absorbing and holding onto large amounts of water from their surroundings, allowing the water to stay inside their structure without dissolving. 0.2, 0.25, 0.3, 0.35, and 0.4 percentages of S.A.P. are utilized in this study to create several self-curing concrete mixtures. It is possible to ascertain the ideal dosage for concrete of M50 grade. The test findings have been examined using concrete that has different amounts of Super Absorbent Polymer (S.A.P). Based on the study's experimental findings, the following conclusions are drawn.

[2] M.Manoj Kumar and D.maruthachalam.(2013) The self-curing agent is a Super Absorbent Polymer (S.A.P).For the investigation, concrete of grade M40 is used.explains how the addition of a self-curring agent to concrete mixes results in a larger water retention over time as compared to traditional concrete mixes. The ideal dosage for S.A.P. addition is 0.3%, which results in a notable boost in mechanical strength.(Compressive and split Tensile Strengths)

[3] K.Vedhasakthi, M. Saravanan (2013). Development of Both High and Normal Strength An analysis of the strength qualities of self-curing concrete using Super Absorbent Polymer (S.A.P) (S.A.P.) revealed that polyethylene glycol, the self-curing agent, was more effective than sorbitol. The required strength test results were obtained by using polyethylene glycol as a self-curing agent. Based on the results of the workability test, the self-curing agent was found to boost workability. Self-curing concrete is more resilient than conventionally cured concrete, based on the Compressive Strength Test (C.S.T)findings. It was found that self-curing high strength concrete is capable of greatly outperforming traditionally cured high strength concrete in terms of strength.

[4] Ole Mejlhede Jensen, Per Freiesleben Hansen explains a novel idea for preventing self-desiccation in materials made of hardening cement. The idea is to add finely divided, superabsorbent polymer (S.A.P.) particles to concrete. Water will be absorbed by the S.A.P., resulting in macro inclusions that are virtually made entirely of free water. Water entrainment, or the creation of water-filled macropore inclusions in the fresh concrete, results from this. As a result, self-desiccation is actively controlled by the pore shape. He describes and discusses water entrainment and self-desiccation in his work. The explanation is predicated on a reworking of Powers' phase distribution model for hydrating cement paste.

[5] Wen-Chen Jau said that in order to improve the hydration of the cement in concrete, "A Self Curing Concrete is provided to absorb water from moisture from air." It resolves the issue of low cement hydration, which results from either inadequate or nonexistent curing and consequently undesirable concrete characteristics. As per the invention, during mixing, a high-performance self-curing agent is added to the concrete at a weight percentage of approximately 0.1–5% of the cement in the concrete.Concrete can get moisture from the atmosphere that is absorbed by the self-curing agent. Because of its self-curing properties, concrete does not require curing or even the need for external water supply after placement. At the very least, the invention's self-cured concrete has qualities that are superior to those of conventionally cured concrete. In addition to polyvalent alcohol—a choice among PEG, PG, DPG, and other groups—and poly-acrylic acid, which has a potent ability to absorb moisture from the atmosphere and supply water needed for curing concrete, the invention's self-curing agent also contains polyvalent alcohol. He operates between 50% and 85% relative humidity

[6] A.S. El-Dieb examined the use of water-soluble polymeric glycol as a self-curing agent to increase the water retention of concrete. To assess the water retention of self-curing concrete, measurements of internal relative humidity and weight loss in the concrete were made over time. To assess hydration, non-evaporable water at various ages was measured. Measurements of absorption%, permeable voids%, water sorptivity, and water permeability are used to assess the flow of water through concrete. Age has an impact on the water transfer through self-curing concrete.The impact of various concrete mix proportions, including cement content and water/cement ratio, on the self-curing concrete's performance was examined.

[7] Pietro Lura conducted research on internal curing and autogenous deformation of cementitious materials as a way to lessen self-induced stresses and early-age shrinkage. His study's primary goal was to gain a deeper understanding of autogenous shrinkage so that it may be modeled and potentially decreased. The benefits of avoiding self-desiccation through internal cure become evident after the significant role that self-desiccation shrinkage plays in autogenous shrinkage is demonstrated.

[8] LWASilvia Weber and Hans W. Reinhardtin established a new kind of high-performance concrete in 1996–1997 by substituting prewetted LWA for 25% of the volume of the aggregates. This created water storage inside the concrete, allowing for continuous wet curing. The microstructure of the hardened cement paste and the most significant mechanical characteristics of the concrete under various curing conditions were examined. The outcomes demonstrated that the strategy of adding a water reservoir may be effectively used to produce HPC with enhanced characteristics that is comparatively resistant to curing.

[9] S.Zhutovsky, K. Kovler and A. Bentur conducted research on "The effectiveness of lightweight aggregates for high strength concrete's internal curing to eliminate autogenous shrinkage." Saturated lightweight aggregate was used to apply the internal curing idea, which was found to be effective in removing autogenous shrinkage. In order to achieve successful internal curing with a minimum amount of such aggregate, their work describes a technique to optimize the size and porosity of the lightweight aggregate.

[10] M.R. Geiker, D.P. Bentz and 0.M. Jensen looked into two internal water supply sources to lessen the autogenous shrinkage brought on by IC. Superabsorbent polymer particles (S.A.P.) are injected after the partially soaked lightweight Fine Aggregate (F.A.) has been replenished with fresh sand. At equal water addition rates, the S.A.P. system is observed to be more efficient at reducing autogenously shrinkage at later ages. This is likely due to the extra curing water being distributed more uniformly within the three-dimensional mortar microstructure.

3. EXPERIMENTAL INVESTIGATIONS

3.1. GENERAL

The purpose of the experimental program was to determine the compressive strength and stress-strain behavior of the Super Absorbent Polymer (S.A.P) (S.A.P) in Natural Aggregate for the grades M20, M30, and M40 of Self-Curing Concrete

3.2 MATERIALS USED

TABLE 3.1: Ordinary Portland Cement (O.P.C.) (OPC) Physical Properties

CONSTITUENTS	MATERIAL USED	
Cement	Ordinary Portland Cement (O.P.C.) 53grade	
AGGREGATES	FINE AGGREGATE (F.A.)	
	COARSE AGGREGATE (C.AGG.)	20mm
		10mm
Water	Portable water	
Chemical admixture (C.A.)s	Conplast s.p. -430	
Chemical	Super Absorbent Polymer (S.A.P) (S.A.P.)	

3.2.1 Cement

In the current investigation, Ordinary Portland Cement (O.P.C.) of grade-53 (source JAYPEE. cement) meeting Indian norms IS: 12269-1987 was used.

TABLE 3.2: Ordinary Portland Cement (O.P.C.) Physical Propertiees.

S.No.	Characteristical properties of Cement	As per (IS:12269-1987)	Test results of properties of cement	Remarks
1	Standard consistency		32%	
2	Setting time of cement in minutes i. Initial setting time. ii.Final setting time.	>30 <600	112 240	Satisfactory Satisfactory
3	Specific gravity	3.15	3.12	

3.2.2 Fine Aggregate (F.A.)

A nearby source of sand has been used as Fine Aggregate (F.A.). The features and distribution of particle sizes are shown in Table 3.3. Any other foreign things discovered in the sand have been isolated before being used.

Table 3.3 presents the findings from tests done on the Fine Aggregate (F.A.), which show the characteristics of the substance.

TABLE 3.3. Sieve Analysis Of Fine Aggregate (F.A.)

1000gm Sample Weight

S.No.	**IS sieve designation**	**Weight retained (g)**	**Percentage retained**	**Percentage passing**	**Cumulative percentage retained**
1.	4.75mm	20	2	2	98
2.	2.36mm	50	5	7	93
3.	1.18mm	125	12.5	19.5	80.5
4.	600m (microns)	310	31	50.5	49.5
5.	300m (microns)	460	46	96.5	3.5
6.	150m (microns)	35	3.5	100	0
7.	Total	1000	-	-	$\sum F$=275

Total percentage retained,

$\sum F = 275$

Fineness Modulus (F.M.) of Fine Aggregate (F.A.),

$\sum F/100 = 275/100$

F.M = 2.75

(this is between acceptable limit of 2.0 and 3.5)

By viewing column no.5 (percentage passing) of table 3.2, sand confirmed to zone-II of IS:383-1970 classifications.

Table3.4. Physical Characterstics Of Fine Aggregate (F.A.)s

S.No.	**Characteristics**	**Test results**
1.	specific gravity	2.56
2.	Fineness Modulus (F.M.)	2.15
3.	Zone of Sand	II

3.2.3 Coarse Aggregate (C.Agg.)

Crushed stone aggregate with a maximum size of 20 mm that was readily available locally was employed. Table 3.4 lists the parameters. To exclude dirt and other foreign materials, Coarse Aggregate (C.Agg.) was sieved through an IS: 150-micron sieve.

Table 3.5. Sieve Analysis Of Coarse Aggregate (C.Agg.) -20mm

Sample 5000gms weight

Sieve no.	Wt retained" Kgs"	%of wt. retained	Cumulative % of wt retained	% passing
80mm	0	0	0	100
40mm	0	0	0	100
20mm	2.995	59.9	59.9	59
10mm	1.99	39.8	99.7	0.3
4.75mm	0.015	0.3	100	0
2.36mm	0	0	100	0
1.18mm	0	0	100	0
600m	0	0	100	0
300m	0	0	100	0
150m	0	0	100	0

Fineness Modulus (F.M.) of C.A = cumulative % wt. retained /100 = 7.6

F.M. should lie between 6.0 – 8.0 for economical mix.

Table. 3.6. Properties Of Coarse Aggregate (C.Agg.) -20mm

S.No.	Characteristics of C.Agg.	Test results of C.Agg.
1	specific gravity	2.61
2	Maximum size	20mm
3	Fineness Modulus (F.M.)	6.8

Table 3.7. Properties Of Coarse Aggregate (C.Agg.) -10mm

S.No.	Characteristics of C.Agg.	Test results of C.Agg.
1	specific gravity	2.61
2	Maximum size	10mm
3	Fineness Modulus (F.M.)	4.9

Table 3.8 Sieve Analysis Of Coarse Aggregate (C.Agg.) -10MM.

Sieves no.	Wt ret. in Kgs	% of wt. retained	Cumulative % of wt. retained	% passing
80mm	0	0	0	100
40mm	0	0	0	100
20mm	0.415	8.3	8.3	91.7
10mm	4.410	88.2	96.5	3.5
4.75mm	0.0175	3.5	100	0
2.36mm	0	0	100	0
1.18mm	0	0	100	0
600m	0	0	100	0
300m	0	0	100	0
150m	0	0	100	0

3.2.4. Water

According to IS: 456-2000, concrete should have portable grade water with a PH of 6.8 to 8.0. All concrete mixes and cures were made with ordinary drinking tap water for the sake of this experiment.

3.2.5. Super Plastisizers Conplast Sp 430-

The purpose of this chemical addition is to lessen concrete's frictional qualities.

Super plasticizer, based on sulphonated napthalene formaldehyde, is widely accessible and is used to improve the concrete's workability.

3.2.6. Super Absorbent Polymer (S.A.P)

Super Absorbent Polymer (S.A.P) is a high molecular swelling polymer with a specific degree of cross-linking and strong hydrophilic polymer groups like carboxy and hydroxyle. S.A.P. possessed all the benefits of high molecular weight materials and polymers, which are able to absorb and hold a remarkably large volume of liquid in relation to their own mass. They can also absorb pure water up to 500 times their own weight and release the water under pressure.

listed in table 3.9

TABLE 3.9. Chemical Properties of Super Absorbent Polymer (S.A.P).

Super Absorbent Polymer (S.A.P)	
Form of S.A.P	Crystalline powder (C.P)
Residual Manometer of S.A.P	300.00PPM
PH Value of S.A.P	6.40
Density of S.A.P	0.61g/Cm3
Absorption rate of S.A.P	0.90% of Nacl @30˚C at 1 Min.
Whiteness of S.A.P	75.0%
Liqiud Permeability of S.A.P	30ml./min.

3.3. DESIGN MIX OF CONCRETE

For the concrete cubes' compressive strength and the cylinder's stress-strain curve, respectively, standard 150 mm x 150 mm x 150 mm cast iron molds and 150 mm dia. and 300 mm length cast iron cylindrical molds were used. The samples have been divided into five groups: cement substitution percentages by volume using Super Absorbent Polymer (S.A.P.) representing 0.20%, 0.40%, 0.60%, 0.80%, and 1.00% of S.A.P., and plain aggregate. The Super Absorbent Polymer (S.A.P.)% composition (by cement mass) has been utilized to categorize them into the subsequent groups: Basic Concrete WorkstationSuper absorbent polymer (S.A.P.) concentrations in concrete range from 0.2% to 0.4%.0.6%: concrete injected with Super Absorbent Polymer (S.A.P.); 0.8%: 0.8%-containing concrete 1.0% Super Absorbent Polymer (S.A.P.): 1.0% of it in concrete

TABLE 3.10. Mix Praportions:

Grade of Concrete	**Cement in Kg. / m3**	**Fine Aggregate (F.A.) In Kg. / m3**	**Coarse Agg. (C.Agg.) in Kg. / m3**	**Water in Ltrs**
M20	342.00	585.00	1225.00	174.00
Ratio’s	1	1.71	3.58	W/c 0.51
M30	381.00	712.00	1282.00	164.0
Ratio’s	1	1.86	3.35	W/C 0.41
M40	410.00	725.00	1360.00	155.8
Ratio’s	1	1.81	3.45	W/C 0.38

TABLE 3.11. Details Of Specimens To Be Casted

Type of Mix	**Compressive Strength (Cubes)**			**Split tensile Strength (Cylinders)**			**Stress - Strain Behaviour (Cylinders)**		
	M20	**M30**	**M40**	**M20**	**M30**	**M40**	**M20**	**M30**	**M40**
Plain	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
0.20%	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
0.40%	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
0.60%	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
0.80%	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
1.00%	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
Total	54.0 Cubes			54.0 Cylinders			54.0 Cylinders		
	54.0 CUBES			108.0 CYLINDERS					

TABLE 3.12. Specimens and Dimensions.

Test	**Specimen's Size**	**No. of mixes**	**Each mix's no. of specimens f**	**Total specimen No.s**
Compressive strength test	150mmx150mmx150 mm cube	3.0	18.0	54.0
Stress strain behavior	150mmx300mm cylinder	3.0	18.0	54.0
Stress strain behavior	150mmx300mm cylinder	3.0	18.0	54.0

4. RESULTS AND DISCUSSIONS

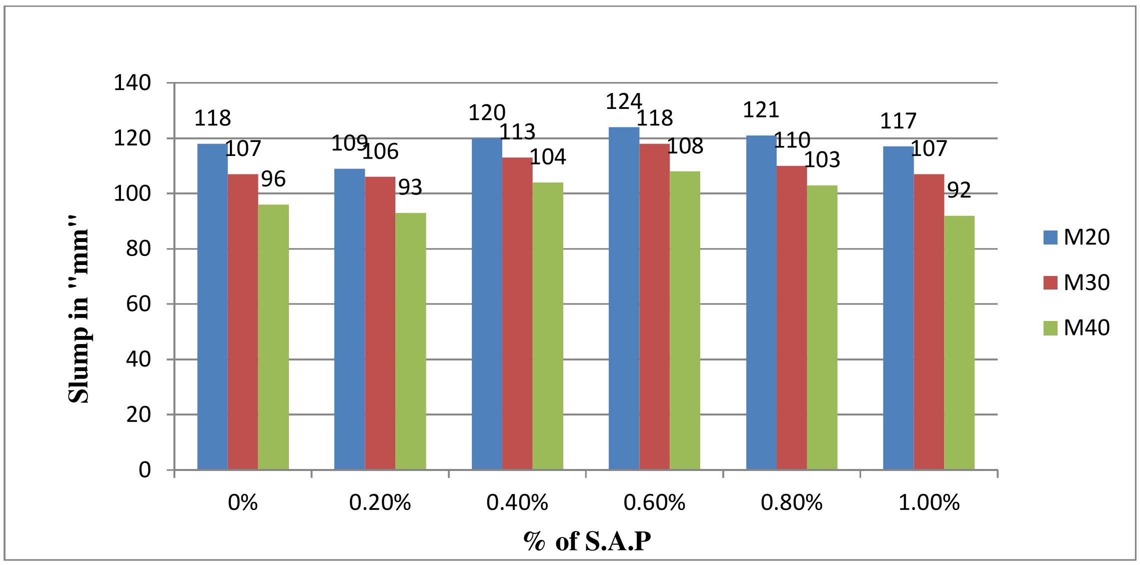
4.1 SLUMP CONE TEST: -To assess if fresh concrete is workable, perform a slump test. The IS: 1199–1959 slump test is used. Tamping rods and slump cones are the tools used in the slump test.The findings for various percentages of S.A.P. for various mixtures of M20, M30, and M40 grade concrete are displayed in Table. The findings for various percentages of S.A.P. for various mixtures of M20, M30, and M40 grade concrete are graphically displayed in Fig. (4.1).

Slump increases as the percentage of S.A.P. for concrete grades M20, M30, and M40 increases.

Table 4.1:- Results of Slump cone test for various % of S.A.P. of diff. Grades of conc. M20,M30 and M40 for Self curing concrete

S No	Percentage of S.A.P.	Slump in MM		
		M20	M30	M40
1	Plain	118.0	107.0	96.0
2	0.20%	109.0	106.0	93.0
3	0.40%	120.0	113.0	104.0
4	0.60%	124.0	118.0	108.0
5	0.80%	121.0	110.0	103.0
6	1.00%	117.0	107.0	92.0

Fig4.1:-Graphical representation of slump cone test result for M20, M30, M40 grades of concrete.



4.2.Compaction Factor Test:-

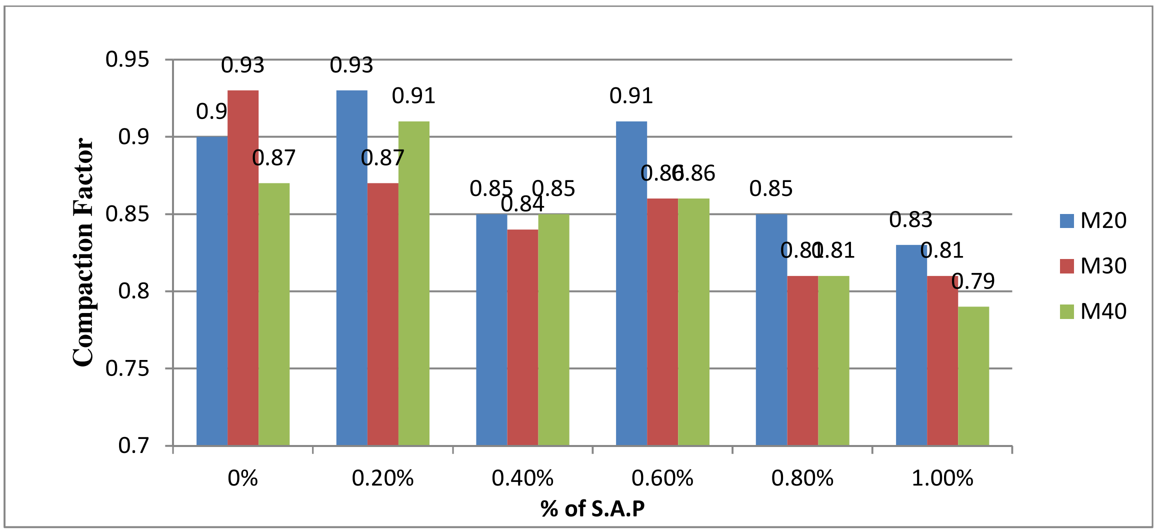
In accordance with IS: 1199–1959, the compacting factor test is used to ascertain the workability of fresh concrete. Compacting factor apparatus is the apparatus that is utilized. Table 5.2 lists the specific test findings for the various percentages of S.A.P. of self-curing concrete for the mixes M20, M30, and M40 grades. The findings are displayed visually in Figs. 4.2.

A workability test reveals that improved workability can be achieved by adding up to 0.60% more Super Absorbent Polymer (S.A.P).

Table 4.2:- Compaction factor (C.F) for various %s of S.A.P. of diff. grades of conc. M20, M30 and M40 for Self curing.

S No	% of S.A.P.	Compaction Factor (C.F)		
		M20	M30	M40
1	0%	0.90	0.93	0.87
2	0.20%	0.93	0.87	0.91
3	0.40%	0.85	0.84	0.85
4	0.60%	0.91	0.86	0.86
5	0.80%	0.85	0.81	0.81
6	1.00%	0.83	0.81	0.79

Fig4.2:-Graphical Representation of compaction factor Test Result for M20,M30, M40 grades of concrete.



4.3. COMPRESSIVE STRENGTH

The compressive strength of self-curring concrete is ascertained using a compression test, per IS: 516-1959. The compressive strengths of both untreated and treated concrete treated with Super Absorbent Polymer (S.A.P.) ranging from 0% to 1.0% are summarized in Table 4.3. The results for M20 grade concrete for various S.A.P. addition percentages to self-curing concrete are shown in Table 4.3.Fig. 4.3 shows the findings visually for concrete of M20 grade at various S.A.P. percentages applied to self-curing concrete..

Compressive strength rises and strength falls from 0.6% to 1.0% for every 0.6% increase in S.A.P. Concrete that has S.A.P. added to it without curing has a higher strength than regular concrete that has been allowed to cure.

TABLE 4.3:- Compressive Strength Of Concre -M_{20}Grade Concrete

S.No.	Concrete type	Strength of Compressive "MPa"
1	0%	22.50
2	0.20%	23.30
3	0.40%	23.70
4	0.60%	24.10
5	0.80%	23.03
6	1.00%	22.70

Table 5 shows the results for M30 grade concrete at various S.A.P. addition percentages to self-curing concrete.2.Fig. 4 shows the findings for M30 grade concrete for various S.A.P. percentages utilized in self-curing concrete graphically.3. When S.A.P. is mixed in at 0.6%, strength rises, and when it is mixed in between 0.6% and 1.0%, strength falls.

Table-4.4:-Compressive Strength of Concrete For-M_{30}grade at 28 Days Curing Period

S.No.	Type of Concrete	Strength of Compressive "MPa"
1	0%	34.13
2	0.20%	34.73
3	0.40%	34.92
4	0.60%	35.15
5	0.80%	33.19
6	1.00%	33.69

Table 4.5 displays the findings for M40 grade concrete for different percentages of S.A.P. added to self-curing concrete.The results are graphically displayed in Fig. 4.3 for concrete of M40 grade at different percentages of S.A.P. added to self-curing concrete.

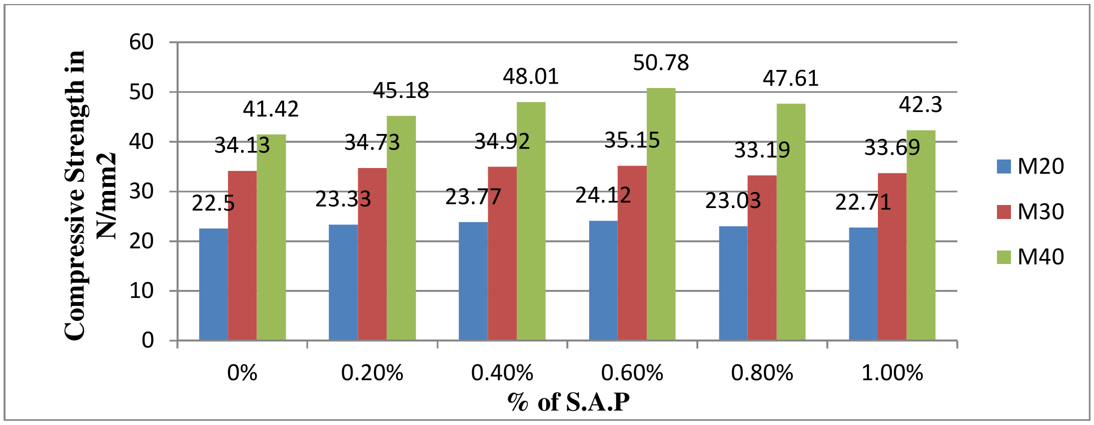
When compared to a standard mix, the compressive strength increases as the percentage of S.A.P. increases.

Table-4.5:-Compressive Strength Of Concrete For M_{40}grade

S.No.	Type of Concrete	Strength of Compressive "MPa"
1	0%	41.43
2	0.20%	45.17
3	0.40%	48.00

4	0.60%	50.777
5	0.80%	47.609
6	1.00%	42.299

Fig4.3. Graphical representation of Compressive Strength test result for-M20, M30, M40grades of concrete.



4.4.SPILT TENSILE STRENGTH (SPT)

According to IS: 5816-1999, the split tensile strength of self-curing concrete has been determined via compression testing. Table 4.5 provides a summary of the split tensile strength for both plain concrete and concrete that has been blended with Super Absorbent Polymer (S.A.P) ranging from 0% to 1.0%.

Table 4.5 displays the split tensile strength findings for M20 grade concrete for varying percentages of S.A.P. applied in self-curing concrete.The split tensile strength values for M20 grade concrete at different percentages of S.A.P. added to self-curing concrete are graphically displayed in Fig. 4.4.

At different percentages, the use of Super Absorbent Polymer (S.A.P) has increased the split tensile strength. A smaller increase in strength was seen in the concrete specimen using 0.60% Super Absorbent Polymer (S.A.P) compared to other percentages.

Table 4.5:-Split Tensile Strength Of Concrete For M_{20}grade

S.No.	Type of Concrete	Split Tensile strength "MPa"
1	0%	1.20
2	0.20%	1.23
3	0.40%	1.28
4	0.60%	1.35
5	0.80%	1.21
6	1.00%	1.12

The split tensile strength values for M30 grade concrete for varying S.A.P. percentages applied in self-curing concrete are shown in Table 4.5. Fig. 4.4 shows a graphic representation of the split tensile strength data for M30 grade concrete for various S.A.P. percentages utilized in self-curing concrete.

The split tensile strength has risen with the addition of Super Absorbent Polymer (S.A.P.) at varying percentages. In comparison to other percentages without curing, the concrete specimen containing 0.35 Super Absorbent Polymer (S.A.P.) showed a little lesser improvement in strength. The split tensile strength of self-curing concrete is not lowered when S.A.P. is added.

Table 4.6 :-Split tensile strength for M_{30} grade concrete

S.No.	Concrete Type	Split tensile strength "MPa"
1	0%	1.81
2	0.20%	2.10
3	0.40%	2.31
4	0.60%	2.71
5	0.80%	2.35
6	1.00%	2.24

The split tensile strength results for M40 grade concrete for various S.A.P. addition percentages to the self-curing concrete are shown in Table 4.7.Fig. 4.4 shows the split tensile strength values for M40 grade concrete for different S.A.P. percentages utilized in self-curing concrete.

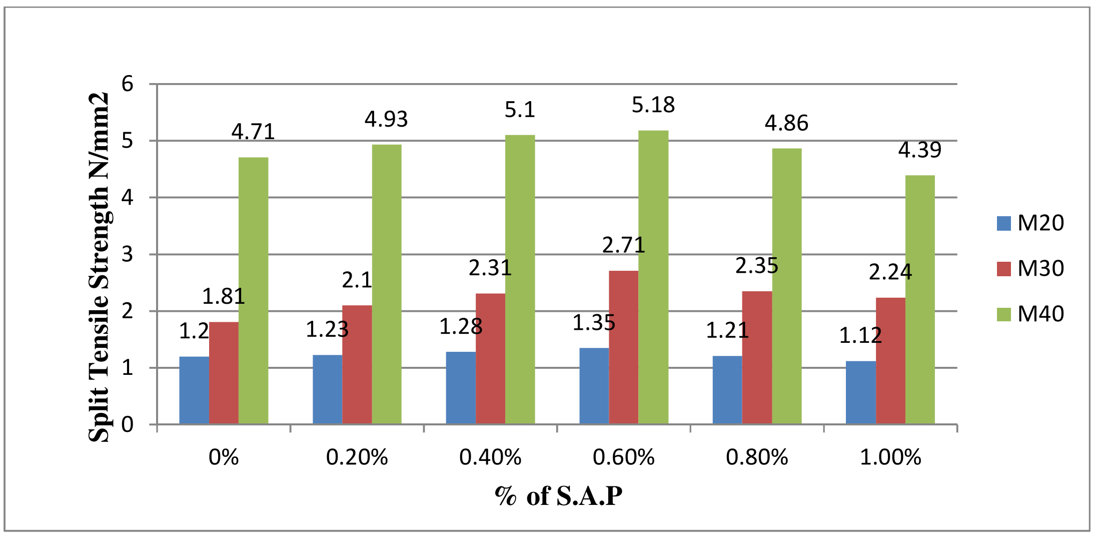
The split tensile strength of self-curing concrete is not lowered when S.A.P. is added. When utilizing S.A.P. without curing, the split tensile test will be higher than when using regular concrete that has been cured for 28 days.

Table 4.7 :-Split Tensile Strength For M_{40}grade Concrete

S.No.	Concrete Type	Split Tensile strength "MPa"
1	0%	4.71
2	0.20%	4.93

3	0.40%	5.10
4	0.60%	5.18
5	0.80%	4.86
6	1.00%	4.39

Fig4.4. Graphical representation of Split Tensile Strength test result for-M20, M30, M40grades of concrete.



4.6 STRESS-STRAIN BEHAVIOR.

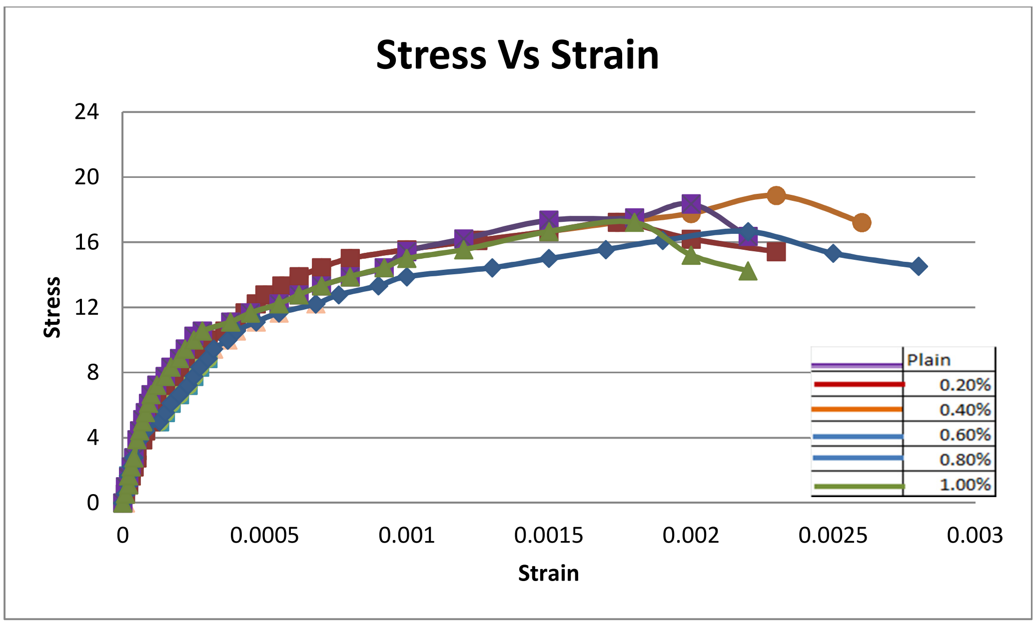
Table 4.6 lists the findings of the stress-strain behavior self-curring concrete for M20 grade concrete for different S.A.P. percentages. Figure 4.5 shows the stress-strain behavior self-curing concrete results for different percentages of S.A.P. in M20 grade concrete. The strain of M20 of concrete, which corresponds to the ultimate stress (€p), was rising from 0.6% of S.A.P..

Table 4.7 :- Self Curing Concretes Results Of Stress – Strain Behavior For M20 Grade of Concrete.

% S.A.P.	**σu(MPa)** **Ulimate Stress**	**€p** **Strain corresponding Ultimate stree**	**σb(MPa)** Breaking Stress	**€u** **Ultimate Strain**	**f_{ck}** **Characteristic strength**
0%	22	0.0018	17	0.0029	22.50

0.20%	21	0.0020	19	0.0031	23.30
0.40%	19	0.0021	17	0.0031	23.70
0.60%	17	0.0023	17	0.0032	24.10
0.80%	16	0.0024	16	0.0033	24.30
1.00%	18	0.0023	15	0.0031	22.70

Fig4. 5. Self Curing Concretes Results Of Stress – Strain Behavior For M30 Grade of Concrete.



The stress-strain behavior self-curing concrete findings for M30 grade concrete at various S.A.P. percentages are listed in Table 4.8. The stress-strain behavior self-curing concrete findings for M30 grade concrete at various S.A.P. percentages are displayed in Figure 4.6.

The breaking stress (σb) of concrete grades M20, M30, and M40 falls from 0.6% of S.A.P. to 1.0% of S.A.P. following their peak stress.

Table 4.8 :- Self Curing Concretes Results Of Stress – Strain Behavior For M30 Grade of Concrete.

%of S.A.P.	σu(MPa) Ultimate Stress	€p Strain corresponding Ultimate strain	σb(MPa) breaking stress	€u Ultimate Strain	f_{ck} Characteristic strength

0%	33	0.0017	35	0.0029	34.13
0.20%	32	0.0019	33	0.0030	34.73
0.40%	34	0.0019	31	0.0030	34.92
0.60%	36	0.0020	32	0.0031	35.15
0.80%	37	0.0021	34	0.0032	33.19
1.00%	34	0.0023	31	0.0028	33.69

Fig4. 6:- Self Curing Concretes Results Of Stress – Strain Behavior For M30 Grade of Concrete.

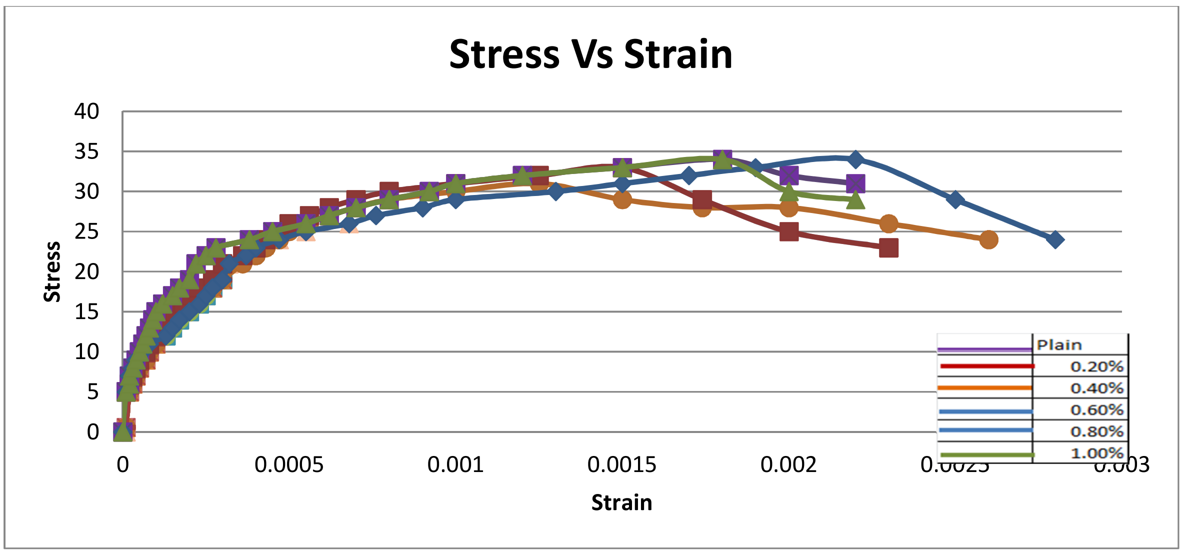


Table 4.8 lists the findings of the stress-strain behavior self-curring concrete for M40 grade concrete for varying percentages of S.A.P..Fig. 4.7 shows the stress-strain behavior self-curing concrete results for different percentages of S.A.P. in M40 grade concrete.

It has been noted that when the S.A.P. increases, the ultimate stress for different concrete grades is somewhat decreased. As the percentage of S.A.P. in concrete increases, strain increases as well.

Table 4.9:- Self Curing Concretes Results Of Stress – Strain Behavior For M20 Grade of Concrete.

%of S.A.P.	σu(MPa) Ulimate Stress	Strain corresponding Ultimate strain	σb(MPa) breaking stress	Ultimate Strain	f_{ck} Characteristic strength

0%	42.0	0.0018	39.0	0.0027	41.402
0.20%	40.0	0.0020	37.0	0.0029	45.180
0.40%	36.0	0.0022	33.0	0.0030	48.010
0.60%	32.0	0.0024	32.0.	0.0031	50.780
0.80%	30.0	0.0025	30.0	0.0032	47.610
1.00%	31.0	0.0028	31.0	0.0035	42.300

Fig4. 7. Self Curing Concretes Results Of Stress – Strain Behavior For M40 Grade of Concrete.

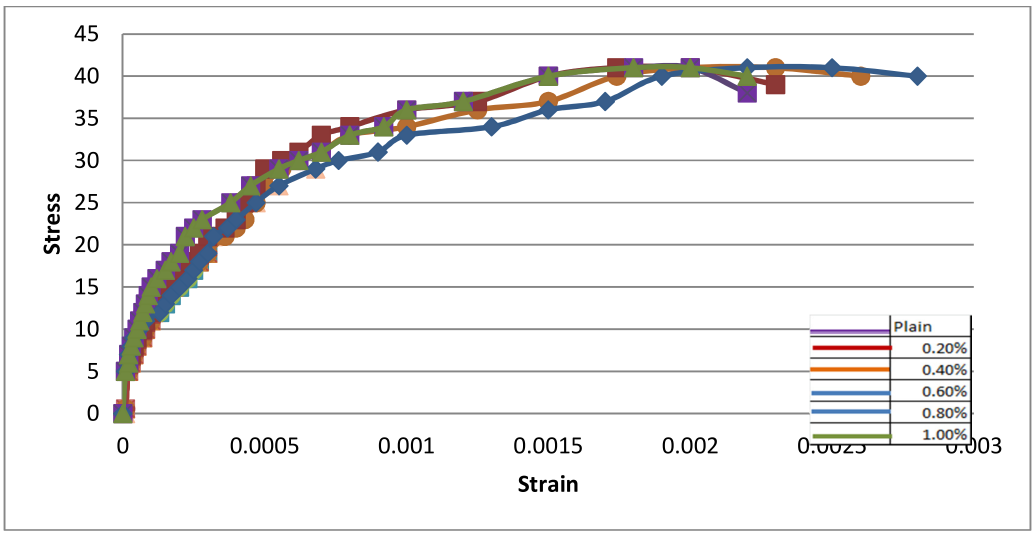


Fig4. 16. Some of the Specimens photos before testing .

5. CONCLUSIONS

i. The current study leads to the following conclusions: S.A.P. can be employed as a curing agent for self-curing concrete.

ii. The application of S.A.P. in self-curing concrete does not result in a decrease in either the split tensile strength or the compressive strength.

iii. It is possible to use up to 0.6% of S.A.P. on the cement weight without sacrificing the concrete's different strengths.

iv. It has been noted that when the S.A.P. increases, the ultimate stress for different concrete grades is somewhat decreased as S.A.P. dosages increase, there is a modest increase in strain.

v. When compared to traditional concrete, self-curing agent-incorporated concrete mixtures retain more water.

REFERENCES

[1]. Vivek hareendran, V. Poornima and G. Velrajkumar —Experimental investigation on strength aspects of internal curing concrete using super absorbent polymer‖ International Journal of Advanced Structures and Geotechnical Engineering ISSN 2319-5347, Vol. 03, No. 02, April 2014 pp. 134-137.

[2]. M. Manoj Kumar, and D. Maruthachalam. "Experimental Investigation on Self-Curing Concrete." International Journal of Advanced Scientific and Technical Research, vol. 2, no. 3, Apr. 2013.

[3]. K.Vedhasakthi, M.Saravanan. (2014). "Development Of Normal Strength And High Strength Self Curing Concrete Using Super Absorbing Polymers (S.A.P.) And Comparison Of Strength Characteristics". International Journal of Research In Engineering And Technology,10(3),2319-1163

[4]. Jensen, Ole Mejlhede, and Per Freiesleben Hansen. 'Water-Entrained Cement-Based Materials: II. Experimental Observations'. Cement and Concrete Research, vol. 32, no. 6, 2002, pp. 973–978, https://doi.org/10.1016/S0008-8846(02)00737-8.

[5]. Wen-Chen Jau, "Self-Curing Concrete", United States Patent Application Publication, (2008), Pub. No: U.S. 2008/0072799.

[6]. El-Dieb, A. S. 'Self-Curing Concrete: Water Retention, Hydration and Moisture Transport'. Construction and Building Materials, vol. 21, no. 6, 2007, pp. 1282–1287, https://doi.org/10.1016/j.conbuildmat.2006.02.007.

[7] Lura, Pietro, et al. 'Autogenous Shrinkage in High-Performance Cement Paste: An Evaluation of Basic Mechanisms'. Cement and Concrete Research, vol. 33, no. 2, 2003, pp. 223–232, https://doi.org/10.1016/S0008-8846(02)00890-6.

[8]. S. Maiti, C. Shankar, P. H. Geubelle, J. Kieffer, Continuum and molecular-level modelingof fatigue crack retardation in self-curing polymers, Journal of Engineering Materials and Technology.(2008)

[9]. .R. S. Trask, H. R. Williams, I. P. Bond, Self-curing polymer composites: mimicking natureto enhance performance, Bioinsp. Biomim. 2 (2007)

[10]. .D. S. R Murthy, S. Kanaka Durga"Performance of structural concrete with self curing concrete", Journal of Structural Engineering, SERC, Chennai

[11]. Wen-Chen Jau, "Self Curing Concrete", Patent Application Publication No. U.S.2008/0072799 A1 dated Mar. 27, 2008.

[12]. Khalaf FM and DeVenny Alan S. study on self curing of concrete :ASCE J Mater Civil Eng 2004:331–40.

[13]. Ambily P.S, and Rajamane N P, "Self Curing Concrete An Introduction", Structural Engineering Research Centre, CSIR, Chennai.

[14]. RolandTak Yong Liang, Robert Keith Sun:- "Compositions and Methods for Curing Concrete", Patent No. U.S. 6,468,344 B1 dated Oct. 22, 2002.

[15]. Daniel Cusson and Ted Hoogeveen:- Internal curing of high-performance concrete with pre- soaked fine lightweight aggregate for prevention of autogenous shrinkage cracking ‟Accepted for publication in Cement and Concrete Research, pp.1-32, 2007.

[16]. El-Dieb A.S:-Self-curing concrete: Water retention, hydration and moisture transport "Construction and Building Materials 21 pp.1282-1287, 2007.

[**17**]. **Geetha.M &Malathy.R**:-comparative study of strength and durability properties of polymeric materials as self curing agents "international journal of Engineering Science and Technology, vol 3, pp. 766-771, 2011.

[18] .**Gaston Espinoza-Hijazin, Mauricio Lopez**:- Extending internal curing to concrete mixtures with W/C higher than 0.42‟ Construction and Building Materials 25 pp.1236–1242, 2011.

[19]. **IS 8112-1989:-** 'Specifications for 43 grade Portland cement‟ Bureau of Indian Standards, New Delhi, India.

[20] .**IS 383- 1970:-** 'Specification for coarse and Fine Aggregate (F.A.) from natural sources for concrete‟ Bureau of Indian Standards, New Delhi, India.

[21]. **IS 10262: 2009:-** "Concrete mix proportioning- guidelines" Bureau of Indian Standards, New Delhi, India.