EXPERIMENTAL INVESTIGATION ON CONCRETE BY USING SUPER ABSORBING POLYMER : A REVIEW

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ABSTRACT

The use of super absorbent polymer in concrete is proving to have many positive effects on the properties of concrete in its both stages; fresh concrete and hardened concrete. The super absorbent polymer absorbs water and converts it into gel, then releases it slowly with time. This study focuses on the use of an optimum amount of Sodium Poly-acrylate as a super absorbent polymer in ordinary plain concrete. One of the major improvements that the super absorbent polymer can contribute to the concrete is by providing internal water source. This internal water source acts as internal curing agent after the final setting of concrete. At the same time the super absorbent polymer releases water at relatively slower rate at the fresh concrete stage. Due to this internal curing, the strength of concrete increases.

Already discussed, super-absorbent polymer absorbs water and forms a gel, when a crack in construction member (slab) occurs; the super absorbent polymer absorbs water and converts into gel for retaining permeability through crack to a member. As well as the subsequent crack gets prevented. Also, addition of Super plasticizer (SP) makes the water content decrease by 12-30% and makes concrete workable or flow-able.

From the study of previous literatures, super absorbent polymer & SP gives better result of 0.4 % and 0.35% wt. of cement respectively. Thus, adding two admixtures in M30 grade of concrete for severe exposure, adopting various tests on fresh and hardened concrete. It helps to determine concrete performance like strengthening, serviceability, water reduction and internal curing.

An amount of super absorbent polymer will leave the concrete with some number of voids, which in turn reduces the concrete strength and durability. Small amount of super absorbent polymer, on the other hand, will have negligible effect on the concrete performance. The amount of water added to the fresh concrete is one of the most important key factors that affect the concrete properties, including durability and strength. super absorbent polymer acts as a opposite effect, one is voids, affect the concrete strength inversely, second is super absorbent polymer causes internal curing which is done at the same time improves the concrete performance by improving the concrete workability and place-ability, reducing the concrete susceptibility to freezing thawing cycles, and improving concrete stability. The main focus of this study will be on the effect of the super absorbent polymer on the fresh concrete as well as the hardened concrete. Several batches will be prepared to determine the effect of the super absorbent polymer on concrete when subjected to compressive, tensile and flexural stresses.

Keyword – Concrete, Crack, Strength, workability, Shrinkage, Super absorbing polymer, Super plasticizer, internal curing,

INTRODUCTION

Concrete is most widely used in construction material due to its good compressive strength & durability. Depending upon nature of work the cement, fine aggregate, coarse aggregate & water are mixed in specific proportions to produce lean concrete. Plain concrete needs suitable atmosphere by providing moisture for a minimum period of 28 days for good hydration& to attend desired strength. We know that for hydration process curing is must for the concrete. Any lack of curing will badly affect the strength & durability of concrete.

Superabsorbent polymers are materials that have the ability to absorb water and retain large volumes of water and aqueous solutions. After the absorption of water in a fresh concrete, this polymer chain will expand due to its chemical reaction will start to swell & release water after the certain time. Due to this procedure, it is also known as self-curing concrete or internal curing concrete. As early discussed, any lack in curing will badly affect the strength & durability of concrete. Self-curing concrete is one of special concrete compensation or mitigating insufficient curing due to human negligence scarcity of water in arid or severe exposure areas, in accessibility of structure in different terrains & in the areas where the presence of fluorides in water will badly

affect the characteristics of concrete. The concept of self-curing is to reduce the water evaporation from the concrete & hence increase the water retention capacity of the concrete compared to conventional concrete.

Exchange of water with the surrounding roots, causes hardened concrete to shrink, swell and probably crack. Its presence in hardened concrete influences strength and creep and it plays a central role in deterioration due to the frost action or alkali –silica reactions. Finally, we can say that, control of water is important for the concrete. In a hot region or arid areas, the moisture evaporates from the concrete surface due to this crack are formed and are known as shrinkage cracks. SAPs are polymeric materials that have the ability to absorb a liquid in 300-500 times of their own weight from the surrounding aqueous particles and retain it within its structure and produce auto fill crack. One thing to be noted that super absorbent polymer creates voids after the releasing water content but it doesn't affect their strength as well as it absorbs small quantity of water which is also less or negligible effect to water-cement ratio.

Early super absorbent polymer is sodium polyacrylate$[-CH_2-CH(CO_2Na)-]_n$ were made from chemically modified starch and cellulose and other polymers like polyvinyl alcohol, polyethylene oxide all of which are hydrophilic and have a high affinity for water. When lightly cross-linked, chemically or physically, these polymers became water-swell-able but not water-soluble. Today's superabsorbent polymers are made from partially neutralised, lightly cross-linked polyacrylate acid, which has been proven to give the best performance versus cost ratio. The polymers are manufactured at low solids levels for both quality and economic reasons, and are dried and milled into granular white solids. In water they swell to a rubbery gel that in some cases can be up to 99% wt. of water. The water absorption by super absorbent polymer is expected to happen within 10 min. This makes ideal for use in water absorbing applications such as baby nappies and absorbent medical dressings. super absorbent polymer is also used for blocking water penetration in underground power or communications cable, horticultural water retention agents, control of spill and waste aqueous fluid, and artificial snow for motion picture and stage production.

Superplasticizer has the ability to make concrete workable. Because the concrete performance plays a vital role in the development of infrastructures including commercial, industrial, residential, military structures etc. In the recent past, there is wide use of reinforced concrete not only for medium structures but also for long span heavy loaded structures. To some circumstances, there is more congestion of reinforcements which causes difficulty for its full compaction but there is shortage of skilled workers, resulting to adverse effects on properties and quality of concrete. In order to obtain workable concrete without strength loss, minerals and chemical admixtures are added in fresh mix of normal concrete, known as Self-Compacting Concrete (SCC).

By the combination of super absorbent polymer and Super plasticizer which helps to auto fill crack, internal curing, water reducer, self-compaction concrete. In short concrete performance will be enhanced.

NECESSITY

The scope of the project is to study the effect of Super Absorbent Polymer on physical properties of concrete.

To do the mix design of concrete by using Super Absorbent Polymer

design the concrete mix by using Super Absorbent Polymer to improve the degree of hydration

At a construction site there are lots of cracks visible at over all building mainly slab, so water may leak through crack and after some time the size of crack increases. super absorbent polymer fills the cracks as well as cure the concrete internally. With addition of Super plasticizer, it helps to reduce 12%-30% of water requirement. By combination of SP & super absorbent polymer in concrete where water is scarce, will be very helpful. Further Studies could be conducted to find out the effect of super absorbent polymer on shrinkage and creep of concrete. super absorbent polymer having different chemical composition can also be used in the future, when added a small percentage, which can give more strength to the concrete.

MATERIAL

CEMENT In this experimental study, Ordinary Portland Cement conforming to IS: 8112 -1989 (43 Grade Ordinary Portland Cement- Specification) is used. The physical and chemical properties of the cement used are shown in Table.

Physical property	Results
Fineness	2940 cm^2/gm
Normal consistency	29 %
Vicat initial setting time (min.)	64
Vicat final setting time (min.)	192
Specific gravity	3.12
Compressive strength at 3 days	23.91 MPa
Compressive strength at 7 days	36.95 MPa
Compressive strength at 28 days	45.86 MPa

Physical properties of cement

Oxide	Percent content
CaO	60–67
SiO_2	17–25
Al_2O_3	3.0–8.0
Fe_2O_3	0.5–6.0
MgO	0.1–4.0
Alkalies (K_2Na_2O)	0.4–1.3
SO_2	1.3–3.0

Chemical properties of cement

AGGREGATES Both fine aggregate and coarse aggregate conformed to Indian Standard Specifications IS: 383-1970.

Locally available natural sand with 4.75 mm maximum size was used as fine aggregate, having specific gravity, fineness modulus and unit weight as given in Table and crushed stone with 20mm maximum size having specific gravity, fineness modulus and unit weight as given in Table was used as coarse aggregate.

Physical tests	Coarse aggregates	Fine aggregates
Specific gravity	2.67	2.66
Fineness modulus	6.86	2.32
Bulk density	1540	1780

Physical properties of coarse & fine aggregate

WATER Ordinary potable water free from organic content, turbidity and salts will be used for mixing and for curing throughout the experimental work. Water quality must be established on the same line as that for using reinforced concrete or pre-stressed concrete. This is the least expensive but most important ingredient of

concrete. The water, which is used for making concrete, should be clean and free from harmful impurities such as oil, alkali, acid, etc., in general, the water, which is fit for drinking should be used for making concrete. Ordinary potable water of normally pH 7 is used for mixing and curing the concrete specimen. The water-cement ratio is a lead to higher strength and durability, but availability of water may make mix difficult to work with and form. Workability can be resolved with the use of super plasticizer.

CHEMICAL ADMIXTURE

Super plasticizer (SP) Super plasticizer is a chemical compound used to increase the workability, without using any additional water. The super plasticizer used in the present work is the commercially available various brands. We are used Condura company super plasticizer, Sharanpur road, Nashik. Dosage: 100ml to 200ml per kg bag of cement. Suggested dosage is 150ml/bag.

Super absorbent polymer Super absorbent polymer $(C_3H_3NaO_2)_n$ is powder form which varies in 0.5-2.00 mm. We are adopting spherical particle with an average particle size of approximate 1.00 mm. It is having ability to absorb about 300-500 times of their own weight as per company manufacturing.

Dosage- 0.4 % for total wt. Cement.

Ex. – 2 kg SAP per 50 kg cement bag. (2 kg super absorbent polymer replacement to 50 kg cement. Properties of super absorbent polymer are given below:

Form	**Dry-Crystalline white powder / Granules**
Particles size	1 mm (Average)
Water absorption with distilled water	150 g for 1 g of super absorbent polymer
Ph of absorbed water	Neutral
Density	1.08 g/cm^3
Bulk density	0.85 g/cm^3
Hydration / dehydration	Reversible
Decomposition in sun light	6 months
Available water	95% approx

Properties of super absorbent polymer

TESTS ON FINE AGGREGATE:

1. Specific Gravity of Fine Aggregate
2. Water Absorption Test
3. Zone of Fine Aggregate

Specific Gravity of Fine Aggregate

Water Absorption Test- IS 2386-3 (1963) Apparatus -The apparatus shall consist of the following:

Balance - A balance or scale of capacity not less than 3 kg, readable and accurate to 0.5 g, and of such a type as to permit the weighing of the vessel containing the aggregate and water.

Oven - A well ventilated oven, thermostatically controlled, to maintain a temperature of 100 to 110°C.

Vessel - Any form of vessel capable of holding 0.5 to 1 kg of material up to 10 mm in size and capable of being filled with water to a constant volume with an accuracy of f ±0.5 ml. Further of the two following vessels is suitable:

A glass vessel, referred to later as a pycnometer, of about one liter capacity having a metal conical screw top with a 6-mm diameter hole at its apex. The screw top shall be watertight when it is screwed on to the jar, and, if necessary, a rubber or fiber washer shall be inserted in the joint. If such a washer is used, a mark shall be made on the jar to correspond with a mark on the screw top so that the screw is tightened to the same position every time and the volume contained by the jar is constant throughout the test. A suitable vessel can be made from a l-kg fruit preserving jar in which the glass lid normally used is replaced by a sheet metal cone wide-mouthed glass vessel, such as a gas jar, of about 1.25 liters capacity, with a flat ground lip and a plane ground disc of plate glass to cover it, giving a virtually watertight fit.

A means of supplying a current of warm air, such as a hair drier.

A tray of area not less than 325 cm^2.

An airtight container large enough to take the sample.

Filter papers and funnel.

Test Procedure-

Using the pycnometer –

a. A sample of about 1 kg for 10 mm to 4.75 mm or 500 g if finer than 4.75 mm shall be placed in the tray

and covered with distilled water at a temperature of 22 to 32°C. Soon after immersion, air entrapped in or bubbles on the surface of the aggregate shall be removed by gentle agitation with a rod. The sample shall remain immersed for 24 ± l/2 hours.

b. The water shall then be carefully drained from the sample, by decantation through a filter paper, any material retained being return & to the sample. The aggregate including any solid matter retained on the filter paper shall be exposed to a gentle current of warm air to evaporate surface moisture and shall be stirred at frequent intervals to ensure uniform drying until no free surface moisture can be seen and the material just attains a 'free-running' condition. Care shall be taken to ensure that this stage is not passed. The saturated and surface-dry sample shall beweighed (weight W1).

Note - If the apparent specific gravity only is required, the operations described in this paragraph may be omitted, although for material finer than 4.75 mm some surface drying may be desirable to facilitate handling.

c. The aggregate shall then be placed in the pycnometer which shall be filled with distilled water. Any trapped air shall be eliminated by rotating the pycnometer on its side, the hole in the apex of the cone being covered with a finger. Thepycnometer shall be topped up with distilled water to remove any froth from the surface and so that the surface of the water in the hole is flat. The pycnometer shall be dried on the outside and weighed (weight W2).

d. The contents of the pycnometer shall be emptied into the tray, care being taken to ensure that all the aggregate is transferred. The pycnometer shall be refilled with distilled water to the same level as before, dried on the outside and weighed (weight W3).

e. The difference in the temperature of the water in the pycnometer during the first and second weighings shall not exceed 2°C. The water shall then be carefully drained from the sample by deeantation through a filter paper and any material retained returned to the sample. The sample shall be placed in the oven in the tray at a temperature of 100 to 110°C for 24 f l/2 hours, during which period it shall be stirred occasionally to facilitate drying. It shall be cooled in the air-tight container and weighed (weight W4).

Two tests shall be made-

Using the second (gas jar) apparatus described, the procedure shall be the same except that in filling the jar with water it shall be tilled just to overflowing and theglass plate slid over it to exclude any air bubbles.

Calculations - Specific gravity, apparent specific gravity and water Absorption shall be calculated as follows:

- Specific gravity = $\frac{W4}{W1-(W2-W3)}$
- Apparent specific gravity = $\frac{W4}{W4-(W2-W3)}$
- Water absorption (percent of Dry weight) = $\frac{100 X (W1-W4)}{W4}$

Where, A = weight in g of saturated surface-dry sample

B = weight in g of pycnometer or gas jar containing sample and filled with distilled water,

C = weight in g of pycnometer or gas jar filled with distilled water only,and

D = weight in g of oven-dried sample.

Tests on Coarse Aggregate

Specific Gravity of Coarse Aggregate

Water Absorption Test - IS 2386-3 (1963)

Aggregate Impact Value Test

Flakiness and Elongation Test

Specific Gravity of Coarse Aggregate

Water Absorption Test - IS 2386-3 (1963)Objective

For determination of specific gravity & water absorption of aggregates.

Equiepment & Apparatus-

a. Wire basket

b. Oven (300^0c)

c. Container for filling water and suspending the basket

d. An air tight container

e. Balance [0-10 kg]
f. Shallow tray & absorbent clothes.

Preparation of sample-The sample to be tested is separated from the bulk by quarteringor by using sample divider.

Procedure-

1. About 2 kg of the aggregate sample is washed thoroughly to remove fines, drained and then placed in the wire basket and immersed in distilled water at a temperature between 22 to 32^0C with a cover of at least 50 mm of water above the top of the basket.
2. Immediately after the immersion the entrapped air is removed from the sample by lifting the basket containing it 25 mm above the base of the tank and allowing it to drop 25 times at the rate of about one drop per second. The basket and the aggregate should remain completely immersed in water for a period of 24±0.5 hours afterwards.
3. The basket and the sample are then weighed while suspended in water at a temperature of 22 to 32^0C. The weight is noted while suspended in water (W1) g.
4. The basket and the aggregate are then removed from water and allowed to drain for a few minutes, after which the aggregates are transferred to one of the dry absorbent clothes.
5. The empty basket is then returned to the tank of water, jolted 25 times and weights in water (W2) g.
6. The aggregates placed in the dry absorbent clothes are surface dried till no further moisture could be removed by this clothe.
7. Then the aggregate is transferred to the second dry cloth spread in a single layer, covered and allowed to dry for at least 10 minutes until the aggregates are completely surface dry. 10 to 60 minutes drying may be needed. The surface dried aggregate is then weighed W3 g.
8. The aggregate is placed in a shallow tray and kept in an oven maintained at a temperature of 110^0C for 24 hours. It is then removed from the oven, cooled in air tight container and weighed W4 g.

Calculation-

Weight of saturated aggregate suspended in water with basket = W1 gWeight of basket suspended in water = W2 g
Weight of saturated aggregate in water = (W1-W2) g = Ws gWeight of saturated surface dry aggregate in air = W4 g
Weight of water equal to the volume of the aggregate = (W3-Ws) g

$$\text{Specific gravity} = \frac{W4}{W3-(W1-W2)}$$

$$\text{Apparent sp. Gravity} = \frac{W4}{((W4-(W1-W2))}$$

$$\text{Water absorption} = \frac{(W3-W4) \times 100}{W4}$$

$$\text{Specific gravity} = \frac{985}{1000-(3372-15530)}$$

$$= 2.62$$

$$\text{Water absorption} = \frac{(990-982) \times 100}{982} = 0.81\ \%$$

Coarse Aggregate Impact Value Test- IS 2386- part 4-1963

Objective - This method of test covers the procedure for determining the aggregate impact value of coarse aggregate.

NOTE -The 'aggregate impact value' gives a relative measure of the resistance of an aggregate to sudden shock or impact, which in some aggregates differs from its resistance to a slow compressive load.

Apparatus-

a. Aggregate Impact Test Machine
b. Sieves (12.5mm,10mm)
c. Cylindrical metal measure
d. Tamping Rod
e. Balance (0-10kg)
f. Oven (300^0c)
g. Sieves-The IS Sieves of sizes 12.5, 10 and 2.36 mm.
h. Measure - A cylindrical metal measure, tared to the nearest gram, of sufficient rigidity to retain its form under rough usage, and of the following internal dimensions: Diameter 75 mm Depth 50 mm
i. Tamping Rod-A straight metal tamping rod of circular cross-section 10 mm in diameter and 230 mm long, rounded at one end.
j. Balance - A balance of capacity not less than 500 g, readable and accurate to 0.1g.
k. Oven- A well-ventilated oven thermostatically controlled to maintain a temperature of 100 to 110°C.

Test Procedure-

The impact machine shall rest without packing upon the level plate, block or floor, so that it is rigid and the hammer guide columns are vertical.

The cup shall be fixed firmly in position on the base of the machine and the whole of the test sample placed in it and compacted by a singletamping of 25 strokes of the tamping rod.

The hammer shall be raised until its lower face is 380 mm above the upper surface of the aggregate in the cup, and allowed to fall freely on to the aggregate. The test sample shall be subjected to a total of 15 such blows each being delivered at an interval of not less than one second.

The crushed' aggregate shall then be removed from the cup and the whole of it sieved on the 2.36-mm IS Sieve until no further significant amount passes in one minute. The fraction passing the sieve shall be weighed to an accuracy of 0.1 g (Weight. e). The fraction retained on the sieve shall also be weighed (Weight C) and, if the total weight (B+C) is less than the initial weight (Weight A) by more than one gram, the result shall be discarded and a fresh test made. Two tests shall be made.

Calculations. -The ratio of the weight of fines formed to the total sample weight in each test shall he expressed as a percentage; the result being recorded to the first decimal place:

$$\text{Aggregate impact value} = \frac{Bx100}{A}$$

Where;
B=Weight of fraction passing 2.36-mm IS Sieve
A =weight of oven-dried sample.

determination of Flakiness and Elongation Test- IS 2386 (Part I) - 1963

One of the important properties of aggregate shows flakiness

Aim-

Determine flakiness & elongation index of aggregate.

Apparatus-

Set of sieves, thickness gauge, length gauge enamel tray, weighing balance, pan, scoopsample, observation sheet.

Sieve- 20 mm, 16mm, 12.5mm, 10mm, and 6.3mm

Procedure-

1. Arrange this all sieve consequently.
2. Count 200 pieces of aggregate & wt this aggregate.
3. Pour sample for sieve analysis.
4. After the shaking check all sieve & taken for testing.
5. Pass this all retained aggregate to width gauge.
6. All particles passed through slot w.r.t. this sample.
7. Take sample of passing 16mm & retaining 12.5mm again pass through anotherslot.
8. Passing sample take weight & Record.
9. Another sample takes from consequent sieve & again passing to slot.

Flakiness index = Total wt of material passing through various thickness gauge / Total weight of sample taken.

Determination of Elongation Test- IS 2386 (Part I) – 1963

1. Take 200 pieces of sample.
2. Again same set up of sieve.
3. Check passing & retained sieve & take for testing.
4. Pass aggregate w.r.t. length to length gauge.
5. Note down passed aggregate.
6. Again, carry on testing.
7. Elongation Index= Total weigh of material retained various length gauges / Totalweight of sample taken.

Tests on Cement

Initial and Final Setting Time of Cement- IS: 4031 (Part 5) 1988
Standard Consistency Test of Cement Paste- IS: 4031 (Part4)-1988
Initial and Final Setting Time of Cement- IS: 4031 (Part 5) 1988

Objective
To determine the initial and final setting time of cement.

Apparatus

Vicat apparatus conforming to IS: 5513-1976.
Balance of capacity 1kg and sensitivity 1 gram.
Gauging trowel conforming to IS: 10086-1982.

PROCEDURE

1. Unless otherwise specified this test shall be conducted at a temperature of 27 ± 2ºC and 65 ± 5% of relative humidity of the Laboratory.
2. Prepare a paste of 300 grams of cement with 0.85 times the water required to agive a paste of standard consistency IS: 4031 (Part 4) 1988.
3. The time of gauging in any case shall not be less than 3 minutes not more than 5.
4. Minutes and the gauging shall be completed before any sign of setting occurs.
5. Count the time of gauging from the time of adding water to the dry cement untilcommencing to fill the mould.
6. Fill the Vicat mould with this paste making it level with the top of the mould.
7. Slightly shake the mould to expel the air.
8. In filling the mould the operator hands and the blade the gauging trowel shall onlybe used.

Initial Setting Time

1. Immediately place the test block with the non-porous resting plate, under the rod bearing the initial setting needle.
2. Lower the needle and quickly release allowing it to penetrate in to the mould.
3. In the beginning the needle will completely pierce the mould.
4. Repeat this procedure until the needle fails to pierce the mould for 5 + 0.5 mm.
5. Record the period elapsed between the times of adding water to the cement to thetime when needle fails to pierce the mould by 5 + 0.5mm as the initial setting time.

Final Setting Time

1. Replace the needle of the vicat apparatus by the needle with an annular ring.
2. Lower the needle and quickly release.
3. Repeat the process until the annular ring makes an impression on the mould.
4. Record the period elapsed between the time of adding water to the cement to the time when the annular ring fails to make the impression on the mould as the final setting time.

Standard Consistency Test of Cement Paste- IS: 4031 - (Part4)-1988

Overview-
Standard consistency of a cement paste is defined as that consistency whichwill permit a Vicat plunger having 10 mm dia. and 50 mm length to penetrate to a depthof 33-35 mm from top of the mould.
Apparatus –

a. Vicat apparatus
b. Balance
c. Measuring cylinder
d. Tray
e. Glass plate

Procedure -

1. Take 400 g of cement and place it in the enameled tray.
2. Mix about 25% water by weight of dry cement thoroughly to get a cement paste. Total time taken to obtain thoroughly mixed water cement paste i.e. "Gauging time" should not be more than 3 to 5 minutes.
3. Fill the vicat mould, resting upon a glass plate, with this cement paste.
4. After filling the mould completely, smoothen the surface of the paste, making itlevel with top of the mould.
5. Place the whole assembly (i.e., mould + cement paste + glass plate) under the rodbearing plunger.
6. Lower the plunger gently so as to touch the surface of the test block and quickly release the plunger allowing it to sink into the paste.
7. Measure the depth of penetration and record it.
8. Prepare trial pastes with varying percentages of water content and follow the steps(2 to 7) as described above, until the depth of penetration becomes 33 to 35 mm.

Calculation -

Calculate percentage of water (P) by weight of dry cement required to prepare cement paste of standard consistency by following formula, and express it to the firstplace of decimal.

$$P = \frac{W}{C} \times 100$$

Were,

W=Quantity of water addedC= Quantity of cement used

Test on Super Absorbent Polymer
Water Absorption Test on SAP
Object –

To determined water absorption capacity of super absorbent polymer

Apparatus -

1. Weighing machine(balance)
2. Beaker (1000 ml)

Procedure -

1. Set zero reading to the weighing machine.
2. Weight 1 gm of SAP (Super Absorbent Polymer).
3. Take 1 liter of water in beaker.
4. Mix SAP sample in the water.
5. Put this mixture for 10 minutes.
6. Remove excess water which is not absorbed by the SAP with the help of sieve.
7. After that measure the water absorbed by polymer, with help of water measuring water in beaker.

PROCEDURE

TEST ON FRESH CONCRETE

SLUMP CONE TEST -IS: 7320 (1974)

The slump test is the simplest workability test for concrete, involves low cost and provides immediate results. Due to this fact, it has been widely used for workability tests since 1922.Generally concrete slump value is used to find the workability, which indicates water-cement ratio, but there are various factors including properties of materials, mixing methods, admixtures etc. also affect the concrete slump value. Where we are use the admixture that is super plasticizer and superabsorbent polymer. The fresh concrete dimension should be as per equipment size.

Slump value for SAP in gel form

MIX PROPORTION	SLUMP(MM)
Normal concrete	110
SAP 0.1%	125
SAP 0.2%	130
SAP 0.3%	140

Slum value for SAP in powder form

MIX PROPORTION	SLUMP(MM)
Normal concrete	110
SAP 0.1%	70
SAP 0.2%	65
SAP 0.3%	50

TEST ON HARD CONCRETE

COMPRESSION TESTING MACHINE- IS : 14858 (2000)

The compression strength of a sample is to be determined on a compression testing machine. A compression testing machine has two compression plates/heads. The upper head moveable while the lower head is stationary. One of the two heads is equipped with a hemispherical bearing to obtain. Uniform distribution of load over the test- piece ends. A load gauge is fitted for recording the applied load.(as shown in fig). As per IS the concrete cube should be 15 x15 x 15 cm.

compression testing

Sr. No	Code	days	Specimen no.			Average breaking load	Average Comp. strength
			1	**2**	**3**		
I	compressive test	@7 days	353	383	372	369.33	16.41
		@28 days	409.3	537.4	497.7	481.46	21.39

FLEXURE STRENGTH MACHINE -IS : 9399 (1979)

The flexural strength is stress at failure in bending. Flexural strength, also known as modulus of rupture, or bend strength, or transverse rupture strength is a material property. The flexural strength of concrete specimen is conducted on flexural strength machine. As per IS the specimen should be 15 x 15 x 70 cm beam by third point loading method with help of UTM.

Sr. No	Code	days	Specimen no.			Average breaking load	Average flexural load
			1	2	3		
I	flexural test	@7 days	2	2.04	2.05	2.03	2.375
		@28 days	3.16	3.26	3.27	3.23	1.474

flexural strength

SPLIT TENSILE STRENGTH- IS: 5816 (1999)

The tensile strength of concrete is one of the basic and important properties. Split tensile strength test on concrete cylinder is a method to determine the tensile strength of concrete. The concrete is very weak in tension due to its brittle nature and is not expected to resist the direct tension. The concrete develops cracks when subjected to tensile forces. Thus, it is necessary to determine the tensile strength of concrete to determine the load at which the concrete members may crack. As per IS the cylinder specimen should be 150 mm in dia. & 300 mm in height.

Sr. No	Code	Buckling load	Specimen no.			Average breaking load	Average Split Tensile strength
			1	2	3		
I	split tensile	@ 7 days	86.3	59.9	75.1	73.76	1.049
		@ 28 days	140.9	196.7	154.5	164.3	2.31

Split tensile strength

CURING

Method adopted for curing:

Pond curing= Cubes are fully immersed in tank.

Without curing= Cubes are pack in dry gunny bag and keep in room temperature.

By Gunny bag= Cubes are packed in wetted bag and securely place in atmospherictemperature and as per site condition allow water daily 2 times on a gunny bag.

Tests on SuperAbsorbent Polymer Water Absorption Test on SAP –

Water absorbs by the Super Absorbent Polymer 175-180 ml. for 1gm.

Tests on Harden Concrete

Trial with SAP dosage- The strength parameters of self-cured concrete were compared with cured concrete at 7 days

a) We took 40 kg/m^3 extra for water swelling of SAP.
Ex. 0.3 % of SAP by wt. of cement = 372.11 x 0.3% = 1.16 kg/m^3
I.e., For swelling 1.16 kg/m^3 of SAP- 40 kg/m^3 of water required. b) For Cube = 40 x 0.15^3 x 3 x 1.2 x 1000 = 486
c) We are takes constant value of water quantity i.e., 486 ml for 3 cubes and apply and check variation of different to SAP dosage.
d) Here 150 slumps get averagely.

CASE-1
1) Above result fail due to increasing over water contains and slump, so based on experiment or trial, water contain of SAP to convert into gel are 25 kg/m^3.
2) For Cube = 25 x 0.15^3 x 3 x 1.2 x 1000 = 303.75
2) For cylinder = 25 x π x 0.150^2 x 0.300 x 3 x 1.2 x 1000 = 477.13
3) For beam = 25 x 0.150 x 0.150 x 0.700 x 2 x 1.2 x 1000 = 945
4) We are takes constant value of water quantity for all specimens and apply and check variation of different to SAP dosage.

CASE 2-
1) Below graph result shows, when SAP adds as powder form (no extra addition water requirement) and applying to pond curing it gives higher strength as compare to gel form pond curing.
2) Here also 0.3% gives best result.
3) When SAP powder adds in a concrete then the slump will decrease as compare normal concrete due to lowering water content but SAP use thus concrete water for internally curing.

CASE 3-
1) Below graph result shows different curing strength and applying SAPformation i.e. gel or powder.
2) Above result shows **SAP 0.3%** by wt. of cement gives best result as compare to otherSAP dosage, so best experience all below case/casting applying to only for SAP 0.3%.

CONCLUSION
The optimum dosage of SAP for internal curing was found out to be 0.3% by weightof cement.

There are observe two inverse effect-

In gel form pond and gunny bag curing SAP gives better result as compare togel form without curing.

In powder form pond curing gives lesser result as compare to powder formwithout curing.

If SAP adds as gel form in concrete, water content is increase and strength of concretewill reduces as compare to powder form.

One most important after 28 days SAP in gel form give higher result as compare toSAP in powder form due to maximum water contains available in swollen SAP.

If SAP adds as powder form in concrete SAP absorbs water then due to lowering water content strength of concrete obviously increases.

Here also studied SAP adds as gel and powder form both are work best resulted.

Powder form SAP best resulted for without curing.

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