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EXPERIMENTAL INVESTIGATION OF CONCRETE USING SUPER ABSORBING POLYMER & SUPER PLASTICIZER

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Abstract:
Super absorbing polymer (SAP) an insert in fresh concrete is to prove that to have lots of many positively effects on the properties of its fresh concrete & harden concrete stages. Sodium polyacrylite is present in SAP, this absorbs the water converting it into the gel hence when addition of dry/wet polymer in fresh concrete it tends to releases the water after final setting of concrete. This release of water by SAP makes internal curing of concrete, namely known "self curing concrete" (SCC).Due self curing of concrete the external curing required is minimum or nothing, other way if required for better heat of hydration. The dosage of self curing gels added in essential quantity will increase the strength and serviceability of concrete. In this investigation 0.1%, 0.2%, 0.3% by total weight of cement were used in M25 grade of concrete and then the results were compared with Standard M25 grade of concrete. And also different content of dosage is added in concrete in a different form such as gel (wet stage) and powder (dry stage). Present investigation involves various strength aspect experiment (only compression strength) on a concrete with curing, without curing and gunny bag curing. Here also studied that what strength is achieved by concrete in an actual site condition if less/ no external curing is applied.
Key Words**:** *Curing, Compression strength, Gel, Powder, Super Absorbing polymer.*

1. INTRODUCTION:

Concrete is a composition of cement, coarse aggregate, Fine aggregates, water with or without any suitable admixture. For attaining desirable strength and serviceability curing is necessary, Thus Curing is the procedure which maintain the proper moisture content for completion of cement hydration. The strength Concrete is basically derived by the hydration reaction of cement particles, and thus process continues for long time. The process of hydration initiates by the mixture of molecules of the cement with water. Due to Losing of mass at molecular level the energy gets released, this forms bonds of molecules giving rise to thermo-chemical reaction which is heat of hydration. In field work higher water cement ratio is used, since the concrete is open to atmosphere and evaporation takes place which losses the water and the available in concrete becomes insufficient for completion hydration reaction to take place particularly in the upper layer. For the continuation of hydration, extra water must be added to overcome the loss of water due to absorption and evaporation, As soon as the cement is mixed with water the hydration starts resulting in increase in gain strength and serviceability with time. SAP gives some amount of internal curing to concrete. The absorption of water takes place in SAP thus converting it into gel, then releases it slowly with time.

From a strength point of view, the addition of SAP to concrete has to opposite-: while the SAPs generate voids in the concrete and thus reduces strength, the internal water curing provided by SAP enhances the degree of hydration and increases the strength [1]. In particular, at high water cement ratio (>0.45) SAP addition has very little effect on hydration and therefore generally reduces compression strength. At low water cement ratio (<0.45), SAP addition may increases compressive strength [1]. The concept of super absorbing polymers (SAPs) are Sodium polyacrylite materials that have the ability to absorb a liquid in 170-200 times (as per manufacturer company) of their own weight. After the dried periphery it spread water that time SAP provides internally curing. One point noted this is admixture not a cement replacement. For maintain the slump, amount of SAP may require in gel form. Gel form means sufficient water added in a SAP powder. As per studied and literature there are main focus is to SAP dosage should be added in powder form or gel form? Also there are main question is creates how many quantity should be added in SAP powder. Water quantity is shown in mix design. Here also studying that what a strength achieve in a actual site condition which is proven the help of wet/dry gunny bag.

1.1 Advantages of using SAP:

- The difficulties of external curing can be countered by this.
- It decreases evaporation, so appearance of cracks are less as well as eliminated shrinkage.

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- Feeds continuously moisture contain for heat of hydration of cement.
- Increase or maintain the strength of concrete if the optimum dosage of Internal curing is used and this is polymer also use for high strength concrete.
- As the SAP gets accumulated on small quantity on surface, this helps to reflect sunrays which making concrete surface cool thus resisting thermal crackings.
- Water quantity required less.
- Enhancing resistance to abrasion and compression applications of salts and chemical at Sea shore places.

2. EXPERIMENTAL INVESTIGATION: Materials:

2.1.1 Cement :- OPC grade 53 are used in this investigation.
2.1.2 Fine aggregate :- Partial Natural + Artificial.
2.1.3 Coarse aggregate :- Crushed stone Locally available.
2.1.4 Water :- Potable water is use.
2.1.5 Super-plasticizer:-Locally plasticizer is used to increase workability or reduce frictional property of concrete.
2.1.6 Super absorbing polymer:- SAPs are sodium polyacrylate material when it is contact with water then thus polymer chain will be expand and water held within a structure. Here SAP absorbing 200-250 times of their own weight. It is seen that it totally swell within a 15 min as shown in (fig-2.1 and 2.2). SAP is sodium basis but their no any chemical reaction to concrete and steel.

Fig.2.1- SAP in Powder Form and gel.

Table 1- Properties of Super Absorbing Polymer :

Chemical formula	$[-CH_2-CH(CO_2Na)-]_n$
Form-dry	Crystalline white powder/granular
Form-wet	Transparent gel
Particle size	125 micron
Water absorbing with distilled water	200-250
pH of absorbing	Neutral
Density	1.08 (g/cm^3)
Bulk density	0.85 (g/cm^3)
Hydration/Dehydration	Reversible

2.1 Mix Design:-

The quantity of ingredients used in concrete depends upon the required performance of two states; the plastic state and the hardened state. The concrete in plastic state must be workable if this do not happen it cannot be

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placed and compacted properly, thus property of workability becomes important

The Mix design for concrete was carried out with the guidelines from IS:10262:2009 for M25 grade concrete with the water cement ratio of 0.45

Locally available Super plasticizer, water can be reduce 15% and above,

- Super plasticizer = 5.50 kg/m^3 (1.5% by wt. of cement)
- Water quantity for convert SAP powder into gel = 28.83 kg/m3 (constant) M

- Mix proportion:- 0.45: 1: 1: 2
- Factor of Safety= 1.2

2.2. Test on fresh concrete:

As per IS 7320 (1974) a light coat of oil is applied on the internal surface of the mould and is cleaned thoroughly. A cone measuring 30cm in height is filled in 4 layers, each being 1/4th of height of the cone. Tamping is done 25 times over cross section. The upper layer concrete is struck using trowel. Remove cone in a vertical direction after 20 sec of tamping and measuring a slump in mm [3].

Table-2.1: Slump value for SAP in powder form

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

Table-2.2: Slump value for SAP in gel form

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

2.3 Test on Harden concrete: Compression Test:

The test is carried out on 150 X 150 X 150 mm size cubes as per IS 516-1954
Method adopted for curing:

1) Pond curing= The Cubes of concrete are immersed in tank filled of water.
2) Without curing= Cubes are pack in dry locally available gunny bag and keep in room temperature. (Shown in fig.2.2)
3) By Gunny bag= Cubes are packed in wetted gunny bag which is also locally available and securely place in atmospheric/ East-West sun direction place such as daily routine project temperature and as per site condition allow water daily 3-4 times on a gunny bag.

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Fig 2.1- Universal Testing Machine

Fig.2.2- Wet/Dry Gunny Bag curing

3. RESULT AND DISCUSSION:

Event 3.1: The strength parameters of concrete which were Internally cured were distinguished with externally cured concrete at 7 days and 28 days shown in fig no.3.1

1) By calculation/ Visual infection 350 ml water for 3 cubes should be added for dry SAP powder into convert into gel.
2) We took equal quantity of total water i.e. 350 ml for 3 cubes and applied it in process and thus checked variation of different SAP dosage which changed the property of concrete.

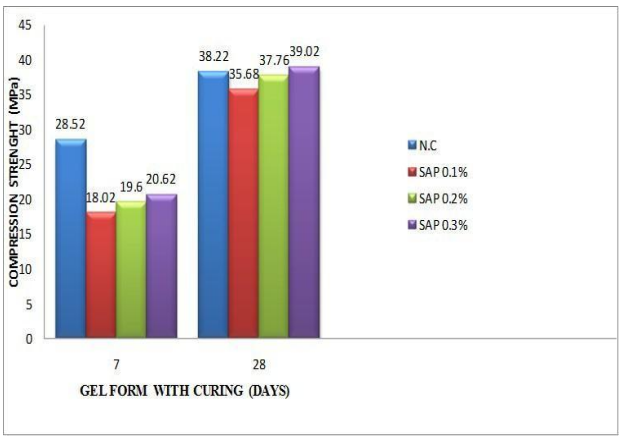

Fig 3.1-Compression Strength for Gel Form Pond Curing.

EVENT 3.2:

1) Below graph result shows (fig no.3.2), when SAP powder adds as form (no additional water requirement) and applying to pond/ Water tank curing enhancing higher strength as compare to gel form pond curing.
2) We observed also 0.3% gives best result.
3) When SAP powder added in a concrete then the slump test will decrease as compare to normal concrete

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due to lowering water content. But SAP absorbed water to uses for internally curing.

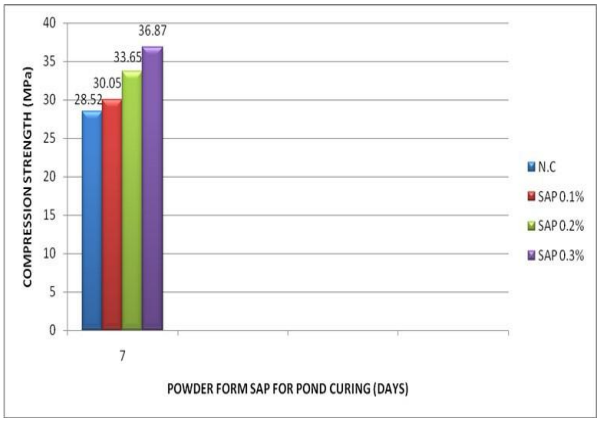

Fig 3.2- Compression Strength for powder Form Curing.

EVENT 3.3:

1) Below graph result shows (fig no.3.3) different curing strength and applying SAP formation i.e. gel or powder.

2) Above result shows SAP 0.3% by wt. of cement gives best result as compare to other SAP dosage, so best experience all below event/casting applying to only for SAP 0.3%.

Fig 3.3: Compression Strength for powder Form Curing.

4. CONCLUSIONS:-

1) The dosage of polymer which gave best result for internal curing was found out to be 0.3% by weight of cement.

2) If SAP is added as gel form in concrete,the gel used increases the water content and obviously strength of concrete will reduces as compare to powder form.

3) Here also seen that polymer added 0.3% as gel form, the strength of concrete is increases and it's gradually increase in hydration and achieving normal strength in 28 day.

4) If polymer added in concrete as powder form, SAP absorbs water and due to lowering of water content strength of concrete will enhance.

5) When polymer add as powder form it will gain their 7 days to 28 days strength normal/convention concrete.

6) Gunny bag curing strength is almost reaches to powder form pond curing. An actual practically field/ site work locally gunny bag curing mostly preferred, so thus ideal condition there are suitable.

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