SELF CURING CONCRETE

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Abstract –*Inthepresentworld conservation of water is one of the mainchallengefor humankind. The construction industry consumes a global average of 30%of fresh water. Inorder to reduce the water usage, Self-curing agents are being utilized in response tothe current water scarcity crisis affecting the construction sector. This research explores the effects of using Spinaciaoleracea as a self-curing agent in concrete to meet this challenge. Dosages of 0.2%,0.4%,0.6% and 0.8% (by weight of cement) of selfcuring agent is being added to concreteand the cubes casted using selfcuring concrete is comparedwith regular-cured concrete. The specimens were cured for different periods (3,7, 28 and 56 days). Our goal was to analyze the behavior (compressive strength and flexuralstrength) of the produced concrete.*

Key Words: Self-curing concrete, Regular-cured concrete, Spinacia oleracea, Compressive strength, Flexural strength.

1. INTRODUCTION

Self-curing concrete is a material with the unique ability to reduce water loss and increase the capacity of concrete to heal itself. The use of self-curing agents in concrete is becoming more popular due to the numerous advantages it has over traditional curing methods. Self-curing agents can be added to the mix during batching or applied after casting as a surface treatment. Self-curing agents work by releasing internal water, which helps maintain a moist environment for hydration and reduces shrinkage cracks. The purpose of this project report is to look into the properties and applications of self-curing concrete, specifically its strength. The report will also compare the compressive strength and flexural strength of self-curing concrete to that of conventional curing methods.

2. LITERATURE REVIEW

Malathy et al (2017) Conducted experimental work on the new and hardened properties of organic selfcuring concrete with 30% fly ash as part of a cement substitute. In this work mostly focuses on the action of internally cured concrete of M20, M30 and M40 by utilizing naturally available vegetativematerials like Spinaciaoleracea (SP), Calatropisgigantean(CG) and chemical admixture like polyethylene glycol(PEG) at 0.6%, 0.24% and 0.3% (by weight of cement) respectively. Self-curing concrete with these ideal values had a strength activity index more than 1 at 28 days and got 1.15 at 58 this is due to pozzolonic action of fly powder at later ages. This study concentrates on the study of concrete performance in aggressive environments, and all such tests have been positive compared to standard concrete. From the point of view of durability, the weight loss is 15%, 10% and 5% less than regular concrete for ideal values of SP, PEG and CG respectively. The reason behind this is that the cube's pore structure is tight and does not enable additional acid intake. Finally, it was concluded that the vegetative materials added along with poly ethylene glycol as self-curing agents execute good strength, workability and durability characteristics in fly ash mixed concrete, and also these synthetic materials are used in pavements, RCC related works, overhead tanks and pre-stressed concrete structures to accomplish long term strength and high performance

Vaisakh et al(2018) The primary goal of this research was examine the various properties of M50 grade self- curing concrete by using poly ethylene glycol(PEG-400) as internal curing agent. The impact of PEG content on quality pointers like compressive, split tensile and elasticity modulus and durability markers like electrical resistivity, water sorptivity, chloride permeability, and water sorptivity were concentrated by differing percentage of PEG 400 from 0 to 2% with 0.5% of span. As the PEG content increased, there is an increasing trend in the mechanical properties due to hydration reaching its completeness up to a PEG content of 1.5 %. In terms of compressive, tensile and elasticity modulus, the specimens exhibited less strength beyond 1.5 %. Moreover, with increasing PEG content to 1.5 %, water absorption decreases and then increases. Water sorptivity and permeability to the chloride also show similar trends. Concrete resistivity increases with PEG content increase to 1.5 % and decreases with further PEG increase.

Daud Mohamad et al (2017) This paper exhibits the impact of using baby diapers polymer as an internal curing admixture in self curing concrete. In this process, baby diaper powder was used in different proportions (1%, 2%, 3 %, 5 % and 10 %) of cement weight. Various tests are carried out using 100mm*100mm*100 mm cube moulds on the new and solidifying characteristics of concrete. Hardened concrete characteristics are performed at room temperature at 3, 7, 28 and 90 days of air curing. With expanding the level of infant diapers flowability of concrete is expanded got maximum slump at 10%. Eventually it is found that at 1% diaper polymer concrete got optimum values in terms of compressive strength. Due to the polymer inside the concrete, the concrete that has a higher percentage of polymers had absorbed large amounts of water compared with the fewer polymers.

Chaitanya et al (2019)A study is being conducted to report on the use of pre-saturated lightweight aggregates (LECA) to resist self-desiccation and autogenous shrinkage.In this study, the properties of concrete with M30 grade are investigated using various dosages of LECA (0%, 10%, 15%, and 20% by volume) as a selfcuring agent for water retention. They are primarily concerned with compressive, split, and flexure qualities and are unconcerned with fresh and durability attributes. Finally, the study indicated that the consolidated properties of concrete are increased by up to 15% of LECA. The compressive, split tensile, and flexure strengths are increased by 1.67%, 1.29%, and 2.47%, respectively, at 15% LECA.

3. EXPERIMENTAL PROGRAM

3.1 Materials

Throughout the investigation, ordinary Portland cement OPC 53 Grade conforming to IS: 12269 was used. Concrete was prepared using locally available blue granite metal.We used locally available hard blue granite metal, well graded 20mm and down size. As fine aggregates, river sand passed through a 4.75mm sieve according to IS383 specifications and confirmed to zone II.

Table -1: Preliminary tests

Preliminary tests			
Materials	**Specific Gravity**	**Unit Weight KN/M^3**	**Fineness**
Cement	3.15	1440	7%
Coarse Aggregate	2.74	1650	6.8
Fine Aggregate	2.65	1560	2.78

3.2 Self-Curing Agents

When compared to conventional concrete, concrete with a curing agent produced better results with Spinacia oleracea, curing agent was used in different concrete mix proportions with varying amounts of curing agent and compressive strength was tested. Polyethylene glycol is a commercially available curing agent with a molecular weight of 190 to 210. The specific gravity ranges between 1.12-1.13. The hydroxyl value ranges from 535 to 590 (mg KOH/g), and the pH ranges from 5 to 7.Spinaciaoleracea, also known as Palak, is a type of green that is widely consumed as a food product. After thoroughly grinding the filtrate extract of Spinacia oleracea as shown in the fig-1, a curing agent was prepared. It has a pH of 6.59. This extract base is added during the concrete preparation process, when water is added to the dry ingredients. Fresh concrete is placed and compacted in the same way standard concrete, but without curing.The chemical structure reveals the presence of (-O-) and (-OH) functional groups. As a result, the Spinacia oleracea used as an internal curing agent has hydroxyl and ether functional groups, as evidenced by Fourier Transform Infrared (FTIR) results.

Fig -1: Extracted spinach Juice

3.3 Proportioning of the Mix

The mix design for concrete M30grade is based on the IS 10262:2019 code. The dosage of curing agents was optimized and found to be 0.6% by weight of cement, with strength studies showing promising results.As a result, those proportions were used to create concrete samples for strength testing.

3.3.1 Mix DesignProcedure

The concrete mix design is a process of selecting the suitable ingredients of concrete and determining their most optimum proportion which would produce, as economically as possible, concrete that satisfies a certain compressive strength and desired workability.

[1] Stipulations for proportioning:

a) Grade designation : M30

b) Type of cement : OPC 53 grade confirming to IS 12269

c) Exposure condition : Moderate

d) Maximum nominal size of aggregate : 20mm

e) Cement content : 380 Kg/m^3

f) Water cement ratio : 0.45

g) Workability : 25mm to 50mm (slump)

h) Method of concrete placing : Normal

i) Degree of Supervision : Good

j) Type of aggregate : Crushed angular aggregate

[2] Test data for materials:

a) Cement used : OPC 53 grade confirming to IS 12269

b) Specific gravity of cement : 3.15

c) Specific gravity of coarse aggregate

i. For 20mm : 2.74

d) Specific gravity of fine aggregate : 2.65

Fine aggregate confirming to grading Zone-II of table 4 of IS 383

[3] Target strength for mix proportioning:

$f^1_{ck} = f_{ck} + 1.65\ S$

Where,

f^1_{ck} = target mean strength at 28 days

f_{ck}= characteristic compressive strength at 28 days

S = standard deviation

From table 1 of IS 10262-2019, standard deviation (s) = 5.0 N/mm²

f^1_{ck} = 30 + 1.65 (5) = 38.25 N/mm²

[4] Selection of water cement ratio:

From table 5 of IS 456, maximum water cement ratio = 0.45 for very severe exposure condition

[5] Selection of cement content:

From table 5 of IS 456, Minimum cement content for M30 grade concrete = 320 Kg/m³.

380 Kg/m³ > 320 Kg/m³,

Hence OK.

[6] Selection of water content:

From table 2 of IS 10262:2019, Maximum water content for 20mm aggregate = 186 litres.

Water content = 0.45 x cement content

= 0.45 x 380

= 171litres. < 186 litres Hence OK.

[7] Proportion of volume of coarse aggregate and fine aggregate:

From table 3 of IS 10262:2009, volume of coarse aggregate corresponding to 20mm size aggregate and fine aggregate (Zone II) for water-cement ratio of 0.5 = 0.62.

In the present case water-cement ratio is 0.45.

Hence from IS 10262:2009 we can find the volume of coarse aggregate corresponding to 20mm size aggregate and fine aggregate (Zone II) for water-cement ratio of 0.45 as 0.63

Volume of coarse aggregate for water-cement ratio of 0.45 = 0.63

Volume of fine aggregate = 1-0.63 = 0.37

[8] Mix Calculations:

Volume of concrete = 1m³

$$\text{Volume of cement} = \frac{\text{mass of cement}}{\text{specific gravity of cement x density of water}}$$

$$= \frac{380}{3.15 \times 1000}$$

= 0.120 m^3

c) Volume of water $= \dfrac{\text{mass of water}}{\text{specific gravity of water x density of water}} = \dfrac{171}{1 \times 1000}$

= 0.17 m^3

d) Volume of all in aggregate (d) = 1- (0.120 + 0.17) = 0.71m^3

e) Mass of coarse aggregate

= d × volume of coarse aggregate × specific gravity of coarse aggregate × 1000

= 0.71 × 0.63 × 2.74 × 1000 = 1225.60 Kg

f) Mass of fine aggregate

= d × volume of fine aggregate × specific gravity of fine aggregate × 1000

= 0.71 × 0.37 × 2.65 × 1000

= 696.155 Kg

[9] Mix proportions:

a) Cement = 380 Kg/m^3

b) Water = 171 Litres

c) Fine aggregate = 696.155 Kg/m^3

d) Coarse aggregate = 1225.60 Kg/m^3

Mix Proportions is Water : cement : fine aggregate : coarse aggregate

0.45 : 1 : 1.83 : 3.22

4. METHODOLOGY

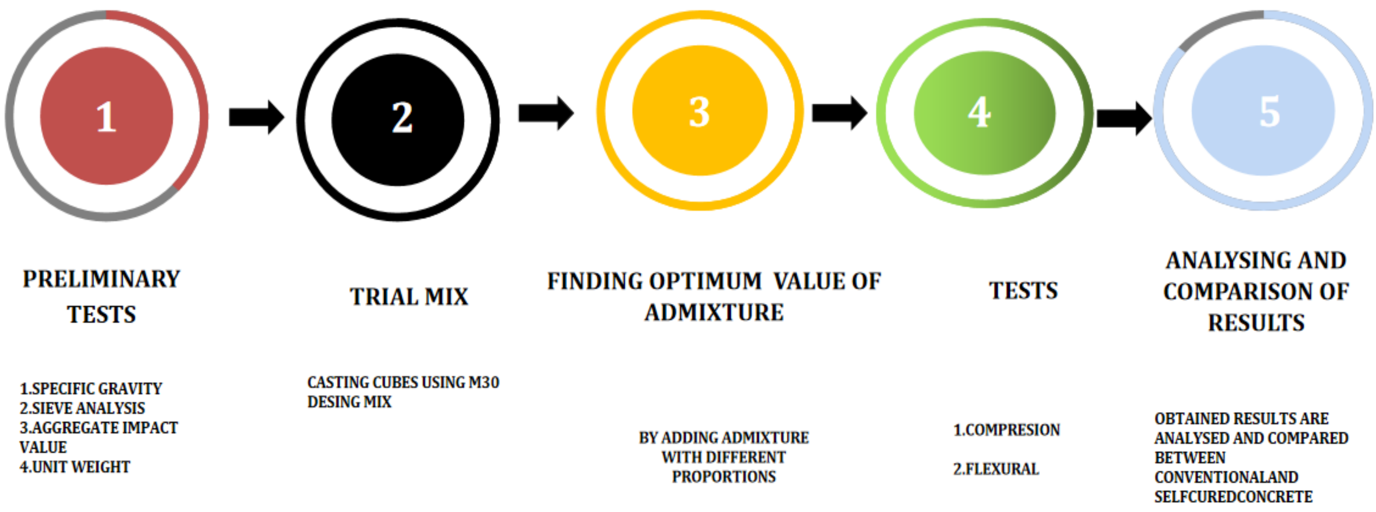

Fig-2: Methodology

5. RESULTS AND DISCUSSIONS

5.1 Optimum Dosage of Bio Admixture

The compressive strength of concrete improved with the rise of admixture up to 0.6% of Admixture (to weight of cement), and any additional increase in admixture content lowered the strength of concrete, so the ideal percentage of admixture is 0.6%.

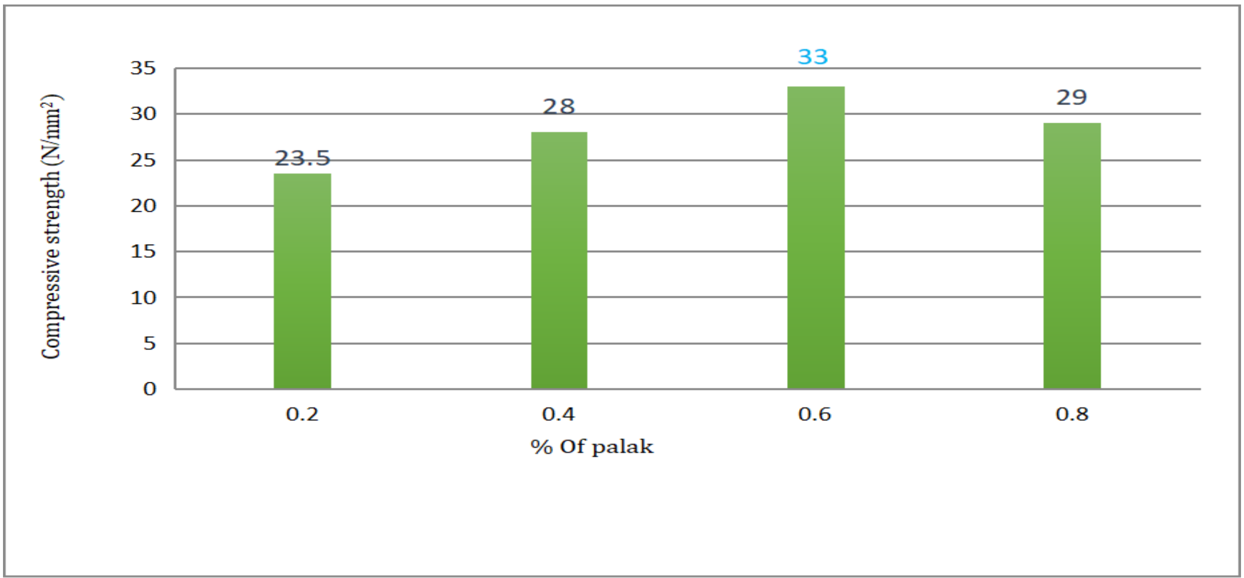

Chart-1 Compressive strength for M30 grade Self curing Concrete with different percentages of spinaciaoleracia (spinach) for 7 days curing

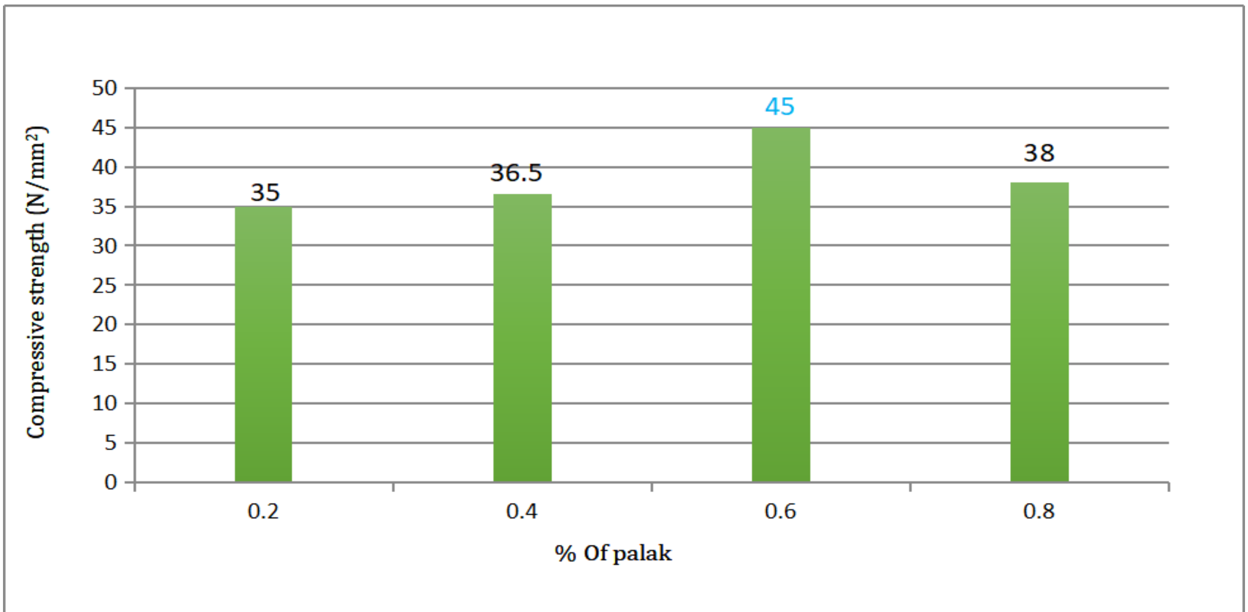

Chart -2 Compressive strength for M30 grade Self curing Concrete with different percentages of spinaceaoleracia (spinach) for 28 days curing

5.2 Compressive Strength

It is observed that selfcuring concrete attaining higher compressivestrength after28days of curing, when compared toconventional cured concrete.

It is observed that in self curing concrete there is an increase of 1.1% and 2.7% of compressive strength at 28 and 56 days of selfcuring, when compared to conventional concrete.

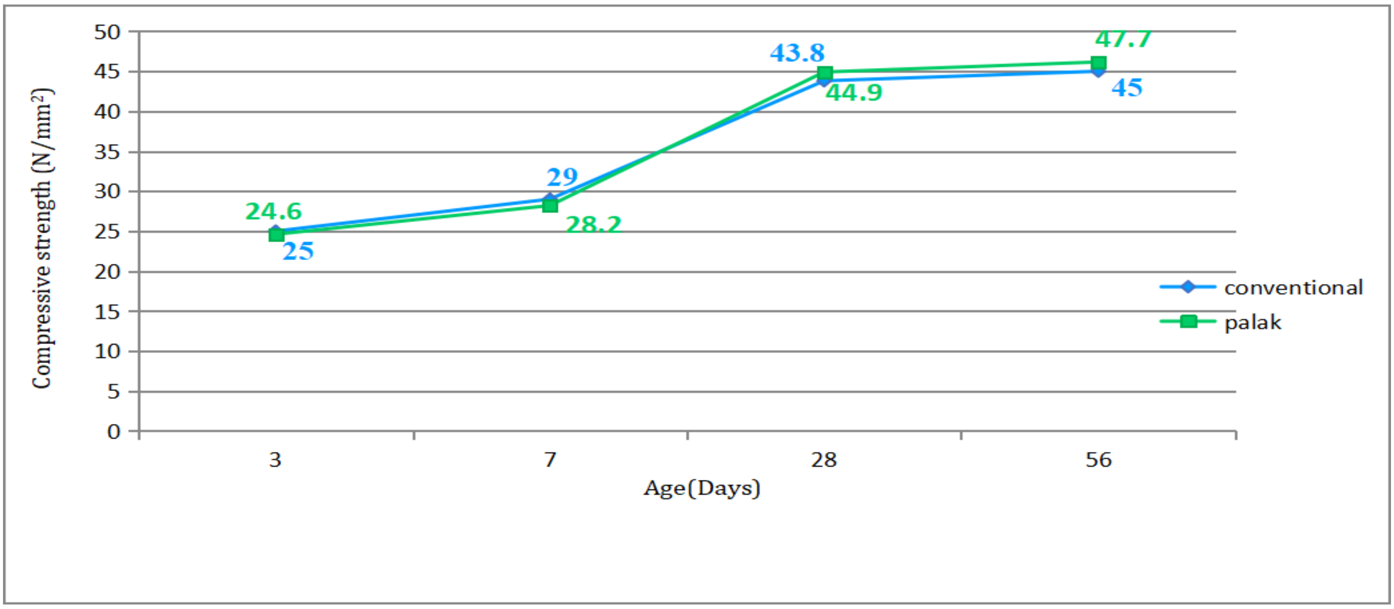

Chart -3 Comparison of compressive strength between conventional concrete and selfcuring concrete.

5.3 Flexural Strength

It is observed that selfcuring concrete attaining lower Flexural strength, when compared to conventional cured concrete. It is observed that in self curing concrete there is a decrease of 0.17%, 0.58%, 0.16%, and 0.02% of Flexural strength at 3, 7, 28 and 56 days of self curing, when compared to conventional concrete

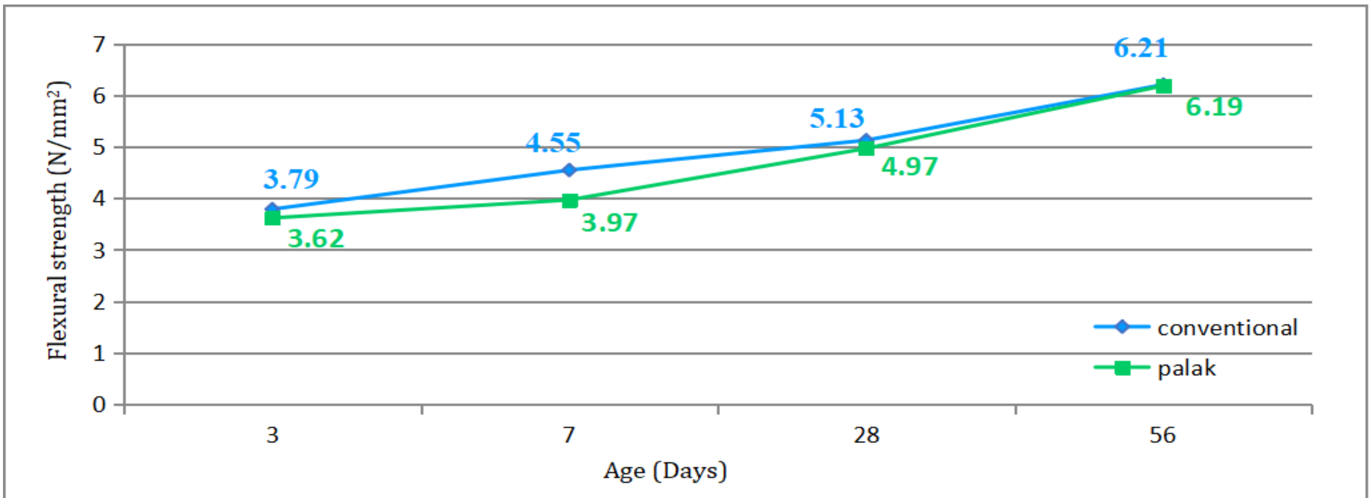

Chart-4 Comparison of Flexural strength between conventional concrete and selfcuring concrete.

6. CONCLUSION

[1] The optimum percentage of spinaciaoleracea for maximum compressive strength of M30 grade self curing concrete is 0.6% by weight of cement.

[2] When compared to conventional cured concrete, selfcuring concrete achieves higher compressive strength after 28 days of curing.

[3] It is concluded that self-curing concrete has lower flexural strength than conventionally cured concrete but the flexural strength of selfcuring concrete is greater than design flexural strength of rigid pavements as per IS:456 which is 4.33 N/mm^2 for M30 grade concrete.

[4] These biomaterials are both cost effective and environmentally friendly , they can be used in concrete road pavements without the need for additional water curing maintenance and in areas where water is scarce.

7. REFERENCES

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8. BIOGRAPHIES

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