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# Effect of Temperature on Strength of Self-Curing Concrete

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**ABSTRACT:** To understand this, we intend to conduct a relative study using different concrete cubes, which is cured by different temperature with the help of glycol 400 chemical for perfect results. This experiment is to find proper temperature of curing which is good, useful and also effective to concrete members. This particular analysis is concentrated on look into the felicity of concrete with different temperature of curing suitable to boost the compressive strength of concrete, bring down its weakness by different temperature of curing process. Concrete is very necessary to gain the strength in regular structures. The Conventional concrete, which is the mixture of cement, fine aggregate, coarse aggregate and water, which required curing to achieve strength. So, it's needed to cure for a minimal period of 28 days for good hydration and to achieve target strength. One particular point of self-cure concrete is that it is good absorbing moisture content. In this practical we will make the self-curing concrete so that we don't have to do curing of concrete for separate days. In this project self-curing is used and this test is carried out by using M25 grade concrete with temperature of normal room temperature, 10 °C, 20 °C, 30 °C, 40 °C, 50 °C by keeping the cubes in incubator for self-curing and it's carried out to determine the maximum compressive strength which is achieved by the cubes, the properties of the material are analyzed. This particular system is extremely appealing the good future strength of concrete members, (i.e., increase the compressive strength and durability of concrete).

**KEYWORDS:** Self-curing, self-curing concrete, concrete, compressive strength, conventional temperature.

## I. INTRODUCTION

Concrete is an ancient substance that is essential for the construction of buildings, foundations, water treatment facilities, factors, large industrial sectors, and other types of structures. The imagination of a world without concrete is impossible. Concrete is a soul of infrastructures. Concrete is necessary to gain strength in structures. Conventional concrete, which is the mixture of cement, fine aggregate, coarse aggregate and water, needs curing to achieve strength. So it is required to cure for a minimum period of 28 days for good hydration and to achieve target strength. Lack of proper curing can badly affect the strength and durability. Self-curing concrete is one type of modern concrete, which cure itself by retaining water in it. It is adaptable to the specific requirements of the construction project, but susceptible to cracking due to poor internal strain. With the advancement of technology, concrete can gain more strength by using different chemicals, and also it's depend on proper curing which is economical and a simple process to achieve the strength. Temperature can have a significant effect on the self-curing process of concrete, with higher temperatures accelerating the chemical reactions that occur during curing, while lower temperatures slow down the curing process. To optimize the self-curing process of concrete, it is important to carefully control the temperature and humidity conditions during and after placement. Chemical admixtures and internal curing agents can also help to improve the self-curing process and ensure the long-term durability of the concrete. Concrete mix design as per IS specification. Self-curing concrete (SCC) can cure without using any external curing methods. Polyethylene glycol



(PEG) is one of the chemical agents which minimizes the loss of water and also attracts moisture from the atmosphere and helps in continuous curing of concrete.

## II. OBJECTIVE OF WORK

1. To compare different temperature of water cured concrete cubes to know their strength effects.
2. To ensure that which one is good for proper hydration of concrete quickly.
3. To determine the behaviour of the concrete cubes in different temperature of self-curing.
4. To determine the utilization of concrete in different region with proper strength which is gained by self-curing.
5. To obtain an economy and proper strength in less time by self-curing.

## III. LITERATURE REVIEW

Different studies were done in the field of self-curing concrete and some of them are listed below. Researchers found that self-curing of concrete is an effective replacement to conventional method of curing at different temperature.

**Alaa A Bashandy, et al [1]** In his investigation, the effects of the coupled effect of elevated temperature levels of 200°C, 400°C and 600°C and heating periods of 2 h and 4 h as well as air- and water-cooling action on the compressive strength and splitting tensile strength of conventional-curing concrete and SCC are studied, respectively. Its Results show that self-curing concrete can be used at elevated temperatures considering its loss of strength. Air cooling is better for ordinary concrete but that may differ for SCC which may cool using water-cooling up to 400°C. Increasing elevated temperature and heating time decreases the values of residual strengths.

**Patel Manishkumar Dahyabhai, et al [2]** In his research paper, the individual effect of admixture PEG600 & PEG1500 on compressive strength by varying the percentage of PEG600 and PEG1500 by weight of cement 0.5%, 1.0%, 1.5% and 2% were studied. The study shows that PEG600 and PEG1500 could help in gaining the strength of conventional curing. It was also found that 1% of both PEG600 and PEG1500 by weight of cement was optimum for M25 grade concrete for achieving maximum strength without compromising workability. The test result indicates that use of water-soluble polymers in concrete has improved performance of concrete.

**Er. Mayuri Kale, et al [3]** his present work deal with the results of experimental investigation on Polyethelene glycol 400, Effect of these Admixture on various Strength of concrete are studied. Polyethylene glycol content varied from 1 to 3% by weight of cement. Various Strength are considered for investigation are Compressive Strength, Flexural Strength. Cube size 100mm for Compressive Strength, beam size 500x100x100mm for Flexural Strength were cast, all the specimen were Self Cured for 7 and 28 days and tested subsequently. The optimum measured quantity of PEG 400 for maximum Compressive and Flexural Strength was found 2 % for M60 grade concrete. Various microstructure crack appear in a low water content specimen while Self curing process to overcome this problem of cracking Glass fibers and Silica Fume are used.

**Metin Husem, Serhat Gozutok, et al [4]** in his study, the changing of the compressive strength of ordinary and high performance concrete after having cured at low temperature was investigated experimentally. To accomplish this purpose, concrete specimens of 150 mm diameter and 300 mm high were prepared. After their production the specimens were cured at different conditions for 7 days. Some of them were at 23+2°C (standard curing); the others were at 10, 5, 0 and -5 °C, respectively. In the 7th day, some of the specimens cured at different temperature (10, 5, 0 and -5°C) were broken under uniaxial compression. On the other hand, some of the specimens were applied to standard curing during 28 days. In the end of 28 days, compressive strength of all specimens was obtained. According to the results, compressive strength of the specimens at 10 °C and less than 10 °C during 7 days was lower than that of the specimens at standard curing. In the end of 28th day loss of compressive strength of concrete specimens cured at different temperatures were more than that of specimens cured at standard cure.

**Mahmoud Moataz Mahmoud Abd, et al [5]** Comprehensive study was made of compressive and flexural strengths by different types of Portland cement used in concretes mixed, placed, and cured at various temperatures, and includes tests indicate that there is a temperature during the early life of concrete which is considered optimum with regard to



strength at later ages. This objective provides an overview of the effects of temperature on the behavior of concrete materials and structures. In meeting this objective, the effects of temperatures as it elevates and depresses from ambient temperature, are worked out.

#### IV. METHODOLOGY

##### 1. Materials:

- a. **Cement:** The binding materials used in concrete are ordinary Portland cement. This cement is of 53 grades and is having desired properties. The properties of cement is determined by standard procedure. The normal consistency, initial and final setting time, specific gravity and fineness are the basic properties which is determined.

**Table No. 1 Properties of Cement**

a)	Normal consistency	32%
b)	Initial setting time (min)	30
c)	Final setting time (min)	340
d)	Specific gravity	3.15
e)	Fineness	90 $\mu$ .
f)	Compressive strength	53 Pa

- b. **Fine Aggregate:** Fine aggregate used is N-sand. Fine aggregates of physical properties as per IS 2386 (part-3)-1963(Reaffirmed 2002) is being used the fineness is obtained using the sieve analysis and the result is such that the fine aggregate is confirming to IS 383-1970. Natural River Sand is used as fine aggregate, as per Zone-II of IS 383. The physical properties of fine aggregate are as follows.

**Table No. 2 Properties of Fine Aggregate**

a)	Specific Gravity	2.65
b)	Fineness modulus	2.86
c)	Water Absorption	1.8%

- c. **Coarse Aggregate:** The coarse aggregate for the work is crushed stone. Angular shape aggregate is of size 20mm and below. The aggregate which are passes through 75mm sieve and retain on the size of sieve 4.75mm are called as coarse aggregate. The grading of coarse aggregates should be as per IS specifications.

**Table No. 3 Properties of Coarse Aggregate**

a)	Specific Gravity	2.67
b)	Sieve Analysis As per IS code limit	–
c)	Water Absorption	0.349%

- d. **Polyethylene glycol 400 with water:** (PEG 400) is not commonly used in civil engineering as it does not possess properties that are particularly useful in this field. In Concrete curing PEG 400 could potentially be used as an

additive in concrete mixtures to improve the curing process. It could act as a humectants to retain moisture and prevent the concrete from drying out too quickly.

**Table No. 4 Properties of Polyethylene Glycol 400**

Sr. No.	Property Name	Property Value
1	Specific gravity	1.12 at 27°C
2	pH	>6
3	Molecular weight (gm/mol)	400
4	Appearance	Clear liquid
5	Colour	Transparent / white
6	Hydroxyl value ( mg KOH/gm)	300
7	Nature	Water soluble
8	Molecular formula	H(OCH <sub>2</sub> CH <sub>2</sub> ) <sub>n</sub> OH
9	Density g/cm <sup>3</sup>	1.125

## 2. Testing:

For the following study, we have employed the Polyethylene glycol 400 with water and concrete. To know the properties of that particular cube sample .the compression test was conducted and results were recap as follows:

## V. EXPERIMENTAL RESULT

We have done compression test on different temperature samples that are (room temperature, 10oC, 20 °C, 30 °C, 40 °C, 50 °C, etc.).Following table showing the test results -6 different temperature samples are tested for each combination 3 for 7 days strength and for 28 days strength then average is taken to get approximately value.

### Compressive test: -1 at 7 days

**Table No 5 The Test Carried Out On 7th Day of Curing on Concrete Cube (M25) At A Temperature of Normal Room Temperature, 10 °c, 20 °c, 30 °c, 40 °c, 50 °c.**

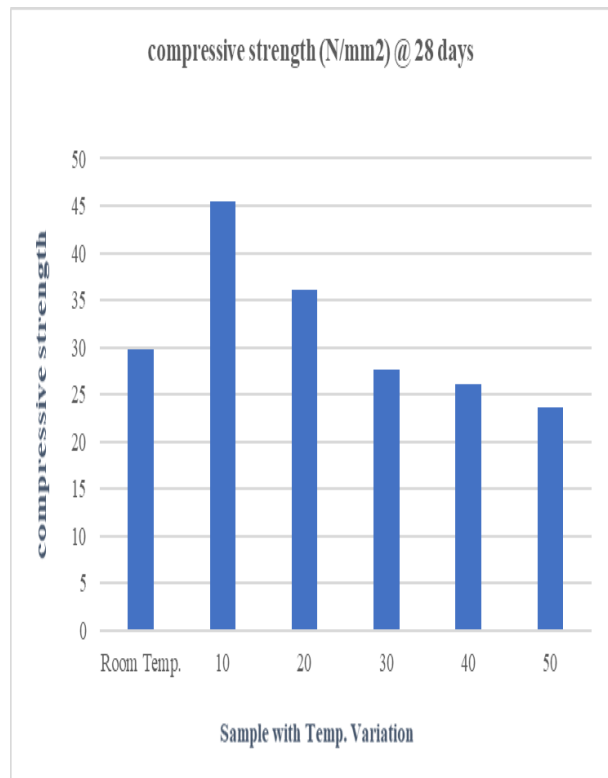
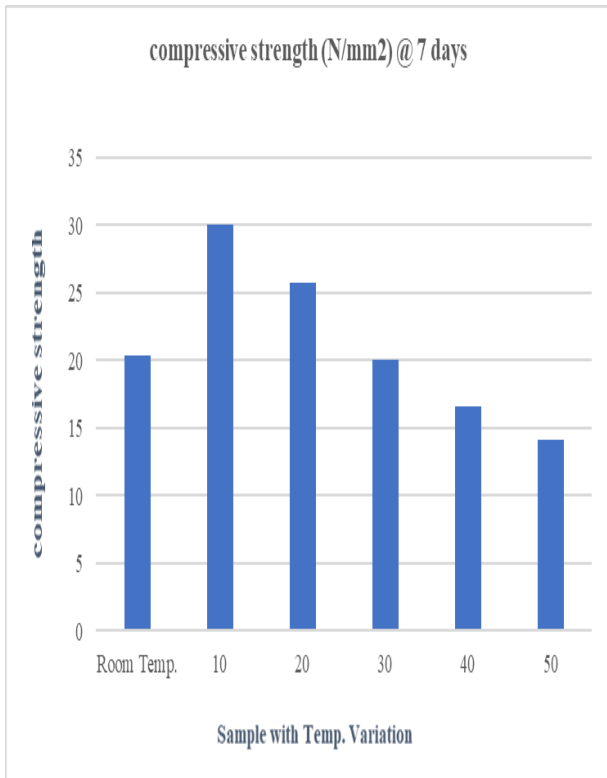
Sr. No	Sample Temp.	Age of Concrete at Testing	Avg. Wt. of Sample(Kg)	Avg. Density of Sample(Kg/m <sup>3</sup> )	Avg. Crushing Load(KN)	Avg. Compressive Strength (N/mm <sup>2</sup> )
1	Room	7 days	8.33	2469	459.3	20.41
2	10 °C	7 days	8.64	2561	677	30.09
3	20 °C	7 days	8.33	2469	580.3	25.79
4	30 °C	7 days	8.19	2427	451.6	20.70
5	40 °C	7 days	7.80	2313	374	16.62
6	50 °C	7 days	7.53	2231	317.6	14.12



**Table No 6 The Test Carried Out On 28th Day of Curing on Concrete Cube (M25) At A Temperature of Normal Room Temperature, 10 °c, 20 °c, 30 °c, 40 °c, 50 °c.**

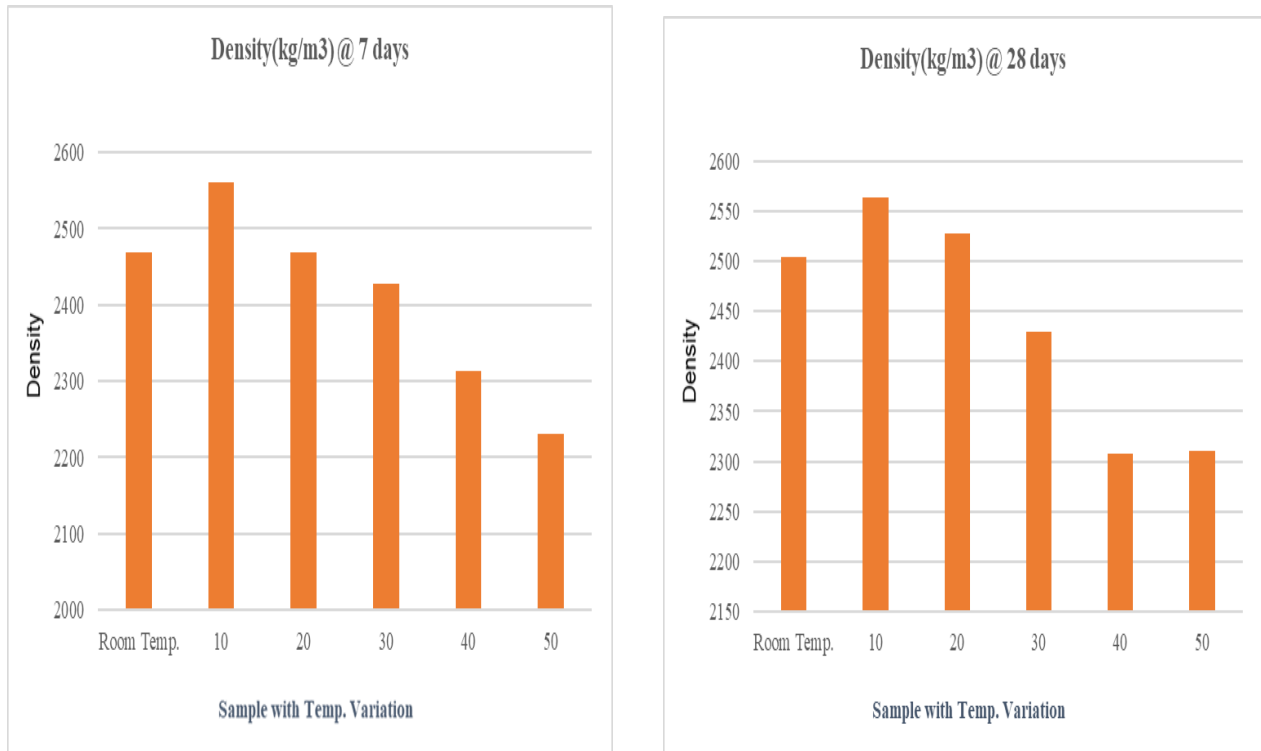
Sr. No	Sample Temp.	Age of Concrete at Testing	Avg. Wt. of Sample(Kg)	Avg. Density of Sample(Kg/m3)	Avg. Crushing Load(KN)	Avg. Compressive Strength (N/mm2)
1	Room	28 days	8.45	2505	670	29.78
2	10 °C	28 days	8.65	2564	1022	45.42
3	20 °C	28 days	8.53	2528	811.66	36.07
4	30 °C	28 days	8.20	2430	621.33	27.61
5	40 °C	28 days	7.79	2308	586	26.04
6	50 °C	28 days	7.80	2311	533	23.69

Following graph show the variation of compressive strength of concrete at 7 days and 28 days with variation of Temp.



**Graph No 1 Compressive Strength (N/mm2) @ 7 days & @28dys**

Following graph show the variation of Density of concrete at 7 days and 28 days with variation of Temp.



**Graph No 2 Density (kg/m3) @ 7 days& @28dys**

## VI. CONCLUSION

From the above study, we conclude that

1. Self-curing concrete absorb moisture form atmosphere and get self-cured.
2. We have tested the cubes cured at different temperature that is steam curing but when we analysis the results we found that the strength of concrete increasing as temperature is decreasing.
3. We have added Polyethylene glycol 400 in 2 % of proportion of water content in M25 grade of concrete.
4. Results may vary if we change the percentage of Polyethylene glycol 400 in the concrete mix.
5. If change the proportion of concrete then the results may change which is a researchable topic.
6. These techniques are useful for construction activities in cold temperature areas and regions.
7. From the above results and analysis, we found that if curing temperature is increase then strength is decreases.
8. We also found that density of concrete also increases.

## REFERENCES

- [1] Lura P. Autogenous deformation and internal curing of concrete, Ph. D. Thesis, Technical University Delft, Delft, The Netherlands, 2003.
- [2] Collepardi M, Borsoi A, Collepardi S. Ogoumah. Olagot JJ & Troli R, Cem Concr Compos (accepted).
- [3] Chan Y N. Peng G F & Anson M. Cem Concr Compo 21 (1999) 23-27.
- [4] Mohamedbhai G T G. Mag Coner Res. 38 (136) (1986) 151-158.
- [5] Toumi B, Resheidat M. Guemmadi Z & Chabi H. Jordan JCivil Eng, M4) (2009) 322-330.



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