

# Internal Cured Concrete by Using Polyethylene Glycol

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**ABSTRACT:** The durability of concrete materials under lack of water condition is always an important research topic. The main idea to conduct this study is to reduce the water content while curing of concrete. For proper curing of concrete structures, it is essential to meet the performance and durability requirements of the structure. Hence water curing is very much important to prevent unsatisfactory properties of cement concrete, to have good curing. In conventional curing of concrete, this is achieved by external curing applied after mixing, placing, and finishing. Self-curing is a technique that can be used to provide additional moisture in concrete for more effective hydration of cement. Self-curing concrete avoids mistakes which were caused by human, structures which are not accessible, terrains where curing becomes difficult and places where there is lack of water. In this project, we compared self-curing concrete to standard concrete. The admixture was used in self-curing concrete to retain the water from the concrete surface. The admixture used is Polyethylene glycol which is a non-toxic, odorless, neutral, non-volatile, and non-irritating chemical. This investigation aims to review the sturdiness and durability properties of concrete using Polyethylene Glycol as a self-curing agent using M30 grade concrete.

**KEYWORDS:** Self-Curing Concrete, Strength, Polyethylene Glycol

## I. INTRODUCTION

Day by day the water requirement is increasing as it results in depletion of water sources due to this its big impact is on the construction field. Hence construction industries are under pressure and finding out alternative curing methods of curing concrete. Internally cured concrete is the one that can meet the present and future requirement of curing concrete. Proper curing of concrete is very beneficial to gain the strength and durability of the concrete structure. In conventional concrete, it is done externally and in internally cured concrete it is done internally with help with admixtures. In internally cured concrete additional moisture gets added for more effective hydration of cement and reduced self-desiccation. The plan of self-curing admixtures is to decline the water evaporation from concrete and hence increases the water preservation capacity of the concrete. Internally cured concrete can be used where there is water scarcity; the cost of water is too high, etc.

## II. MECHANISM OF INTERNAL CURED CONCRETE

Continuous evaporation of moisture takes place from an exposed surface due to the difference in chemical potentials between the vapors and liquid phases. The admixture added in the mix mainly forms hydrogen bonds with water molecules and reduces the chemical potential of the molecules which in turn reduces the vapor pressure, thus reducing the rate of evaporation from the surface. A thin layer or film of the monomolecular membrane is formed on the surface of the concrete which retards the loss of water from the concrete.

## III. WORK OUTLINE

Curing has a strong influence on the properties of hardened concrete, proper curing can increase durability, strength, water tightness, volume stability, etc. The quantity of water normally mixed for making concrete is sufficient to hydrate the cement content unless there is no heat of hydration. Internally cured concrete is the one that can itself by retaining its moisture content. Concrete can be made to internally cured either by adding curing admixtures or by application of curing compounds. In this project, we had casted cube of M30 grade and determined the optimum percentage of Polyethylene Glycol-400(PEG-400). We study the mechanical characteristic of concrete i.e., compressive strength by varying the percentage of PEG from 1% to 3% by weight of cement for both M30 grade of concrete. We compare



internally cured concrete to conventional concrete. The casting of cubes was done under mentor supervision with proper techniques, tests, mix-design.

#### IV. MATERIALS AND ITS PROPERTY

##### 4.1 Cement

Cement is a binder, a substance used for construction that sets, hardens, and adheres to other materials to bind them together. The Ordinary Portland cement of 43-grade PPC was used in this study conforming to IS: 12269-1987. The specific gravity of cement is 3.15. The initial and final setting times were found as 43 minutes and 424 minutes respectively and the standard consistency of cement was 32%.

**Table: 1 Test results of cement**

Particulars	1	2	3
Weight of cement (W) gm.	100	100	100
Weight of cement retain (w1) gm.	5	3	2
% weight of cement retained on sieve	5%	3%	2%

##### 4.2 FineAggregates

The river sand is used as fine aggregate conforming to the requirements of IS: 383-1970, having specific gravity of 2.54 and fineness modulus of 2.5 has been used as fine aggregate for this study.

**Table: 2 Sieve analysis of fine aggregate**

SieveDesignation	Weight retained (gms)	% of weight retained	Cumulative % of weigh
4.75mm	2000	100	100
2.36mm	---	---	---
1.18 mm	1120	56	56
600 μ	388	19.4	75.4
300 μ	388	19.4	94.8
150 μ	88	9.4	99.2

**Table: 3 Physical properties of fine aggregate**

Property	Value
Specific Gravity	2.54
Fineness Modulus	25%
Grading	25%

### 4.3 Coarse Aggregate

Coarse aggregate obtained from local quarry units has been used for this study, conforming to IS: 383-1970 is used. Maximum size of aggregate used is 20mm with specific gravity of 2.6 and fineness modulus of 25%.

**Table: 4 Sieve analysis of coarse aggregate**

I.S. Sieve Designation	Weight retained (gms)	% of weight retained	Cumulative % of weight retained
40 mm	0	0	0
20 mm	143	7.15	7.15
10 mm	1865	93.25	100.4
4.75 mm	3	0.15	100.55

**Table: 5 Physical properties of coarse aggregate**

Property	Value
Specific Gravity	2.66
Bulk Density Kg/m <sup>3</sup> )	1
Water absorption (%)	0.52

#### 4.4 PolyethyleneGlycol-400(PEG-400)

The polymers added in the mix mainly form hydrogen bonds with water molecules and reduce the chemical potential of the molecules of water which in turn reduces the vapor pressure, thus reducing the rate of evaporation from the surface.

**Table: 6 Physical and Chemical Properties – Polyethylene Glycol**

Content	Property
Appearance	Clear liquid or white solid
Odour	Mild odour
Solubility	Soluble in water
Density range	1.1 to 1.2 (increases as molecular weight increases)

#### 4.5 Water

The water used for experiments was potable water used for concreting, conforming as per IS: 456-2000.

### V. METHODOLOGY

The collection of material was done for internally cured concrete such as PEG400, cement, fine aggregate, etc, for M30 grade concrete. The conventional cubes, as well as internally cured concrete, were casted as per mix design. The internally cured concrete was casted same as a conventional cube but in internally cured concrete some percentage (1%, 2%, 3% of cement) of polyethylene glycol was added to the mortar. The cubes were casted in a set of three of 1%, 2%, 3% of polyethylene glycol cubes as well as conventional cubes. The compressive strength was calculated after 28 days. The conventional concrete was cured and internally was not cured for 28 days. And the result of three sets of cubes was taken after 28 days to give accurate results.

### VI. RESULT AND DISCUSSION

The result of compressive strength of conventional concrete after 28 days curing and Compressive strength of concrete by using of polyethylene glycol in 1%, 2% and 3% without curing as shown in table No.7.

**Table No.07. Compressive strength of concrete**

Cube No.	Conventional Concrete	Concrete with 1% Polyethylene Glycol	Concrete with 2% Polyethylene Glycol	Concrete with 3% Polyethylene Glycol
1	34 N/mm <sup>2</sup>	24 N/mm <sup>2</sup>	25 N/mm <sup>2</sup>	16 N/mm <sup>2</sup>
2	34 N/mm <sup>2</sup>	26 N/mm <sup>2</sup>	21 N/mm <sup>2</sup>	22 N/mm <sup>2</sup>
3	38 N/mm <sup>2</sup>	28 N/mm <sup>2</sup>	19 N/mm <sup>2</sup>	13 N/mm <sup>2</sup>

From table No.07 the Average compressive strength of conventional concrete is 36 N/mm<sup>2</sup> after 28 days curing for M30 grade of concrete and Average compressive strength of Concrete with 1%, 2% and 3% of polyethylene glycol is 26 N/mm<sup>2</sup>, 21.66 N/mm<sup>2</sup> and 17 N/mm<sup>2</sup>. From the above discussion it is finally concluded that the 1% polyethylene



glycol is suitable in concrete as compared to 2% and 3% of polyethylene glycol and for obtaining the full compressive strength of concrete like concrete we need to do 3 days curing with 1% of polyethylene glycol in concrete to complete the hydration process because 1% polyethylene glycol is responsible for near about 80% Hydration Process.

## **VII. CONCLUSION**

This research reveals that internally curing concrete is an alternative to conventional concrete in desert regions where there is a scarcity of water. The result shows that for M30 grade concrete 1% Polyethylene Glycol is the optimum percentage. The average compressive strength of 1% Polyethylene Glycol cube is 26 N/mm<sup>2</sup>. for obtaining the full compressive strength of concrete like concrete we need to do 3 days curing with 1% of polyethylene glycol in concrete to complete the hydration process because 1% polyethylene glycol is responsible for near about 80% Hydration Process.

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