

# Concrete Curing using Internal & External Curing Compounds

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**Abstract**— In our experimental analysis, we have considered that curing plays an important role while considering the compressive strength of the concrete. Basically in general, curing is done by water. But in our experimental analysis, we have used the curing compounds for the curing purpose. Comparative studies were carried out for compressive strength. The present investigations were done for M20 grade of concrete. The investigation involved four types of curing method which are water curing; air dried curing, external curing & internal curing.

**Key words:** Emcorial as External Curing Compound, Sunplast as Internal Curing Compound, Compressive Strength, Water Retention & Curing Methods

## I. INTRODUCTION

In order to obtain good quality concrete, placing of an appropriate mix must be followed by curing in suitable environment during the early stages of hardening. Curing is the process of controlling the rate & extent of moisture loss from concrete during cement hydration. Curing can be done by various methods; however there are some drawbacks of improper curing in vertical & inclined members, dependency on unskilled labours for wet curing, water scarcity, time issues & consequent missed opportunities to gain higher strength & durability. Thus to overcome with these drawbacks some new curing methods are used with the help of curing compounds

In case of external curing compound, the curing is done by using the impermeable coating of the compounds known as membrane curing. It is laid on the surface of the concrete. Thus it allowed for Curing itself. As the coating is done, it helps to reduce the rate of heat of hydration, thus curing is done. However the moisture content i.e. water added while preparation of mix is also contributes to curing.

In case of internal curing compound, the admixture is used for curing. The admixtures are able to accommodate water for more time i.e. retardation & use for the water curing. This curing is takes place as inside out curing.

## II. METHODOLOGY

This experimental analysis was designed to investigate the compressive strength of concrete. For this purpose four types of methods of curing are used. The methods are water curing, air-dried curing, external curing & internal curing. The investigations are aimed to study about compressive strength & comparative study of results for compressive strength by the curing methods. Firstly the curing is done by water only. Then the curing is done by air dried curing, where curing is done by water content from the cube i.e. curing is done. While considering the external curing is done by membrane curing. In internal curing, curing is done by using admixture while mixing & afterwards water is used for curing. The admixture used is 1% by weight of the cement. For these experimental investigations the results of water curing were compared with internal curing. And

results of air dried curing were compared with external curing. The results taken for compressive strength test was conducted on 7, 14 & 28 days of curing. However, the aim of the experimental analysis was to satisfy the required compressive strength on particular days of curing, where curing is done by various methods. The strength achieved satisfies require strength criteria for the particular days of curing. The compressive strength satisfied the criterion is 67% on 7days of curing, 85% on 14 days of curing & 100% on 28 days of curing.

## III. EXPERIMENTAL ANALYSIS

### A. Material used

The different types of material used in this investigation are as follows,

#### 1) Cement

The cement used for the investigation was Ordinary Portland cement (OPC) of 53 grades, conforming IS: 12269-1987.

1.	Specific gravity	3.15
2.	Initial setting time	30 min.
3.	Final setting time	600 min.

Table 1: Physical properties of cement

#### 2) Fine Aggregates

The fine aggregates conforming to zone II according to IS: 383-1970 was used.

For fine aggregate		
1.	Specific gravity	2.74
2.	Fineness modulus	2.98

Table 2: Physical properties of F.A

#### 3) Coarse Aggregate

The coarse aggregate used was produced from local crushing unit having 20mm & 10mm nominal size. 10 & 20 mm well-graded aggregate according to IS: 383-1970 is used.

For coarse aggregate		
1.	Specific gravity	2.94
2.	Fineness modulus	7.30

Table 3: Physical properties of C.A

#### 4) External curing Compound

Emcorial was used as external curing compound for the experimental analysis. It is wax based curing compound.

#### 5) Internal curing Compound

Sunplast was used as an internal curing compound. It was used as an admixture.

#### 6) Water

Potable water was used in the experimental work for both mixing & curing.

1.	Cement	320 kg/m <sup>3</sup>
2.	Fine aggregate	859 kg/m <sup>3</sup>
3.	Coarse aggregate (10mm)	460 kg/m <sup>3</sup>
4.	Coarse aggregate (20mm)	691 kg/m <sup>3</sup>
5.	Admixture	3.2 liters
6.	W/C ratio	0.47

Table 4: Material as per mix design

**B. Test**

**1) Compressive Strength Test**

This test is performed to calculate the compressive strength on particular days of curing.

Basically to have approximate results, 3 specimen of the cube are casted. After 24 hours cubes are taken out from mould. Then these cubes are allowed for curing for particular days of curing.

After curing, the specimens are tested through the CTM & results are computed. Fig.1 shows the CTM, while testing the cube.



Fig. 1: Compressive testing machine

a) Results of compressive strength for Water curing: The results were computed on the basis of water curing on 7, 14 & 28 days. The results stated as below,

Compressive strength (7 days) MPa	Compressive strength (14 days) MPa	Compressive strength (28 days) MPa
Strength	Strength	Strength
16	19.55	31.55
18.66	22.22	36.57
19.55	25.33	23.2

Table 5: Results for water curing

b) Results for Air-dried curing: The results were computed on the basis of air-dried curing on 7, 14 & 28 days. The results stated as below,

Compressive strength (7 days) MPa	Compressive strength (14 days) MPa	Compressive strength (28 days) MPa
Strength	Strength	Strength
16.88	12.88	23.11
16.44	14.67	23.55
17.33	20	22.67

Table 6: Results for air-dried curing

c) Results for external curing: The results were computed on the basis of external curing on 7, 14 & 28 days. The results stated as below,

Compressive strength (7 days) MPa	Compressive strength (14 days) MPa	Compressive strength (28 days) MPa
Strength	Strength	Strength
17.78	21.33	24.53
18.57	20	22.98
16.45	21.33	22.75

Table 7: Results for external curing

d) Results for internal curing: The results were computed on the basis of internal curing on 7, 14 & 28 days. The results stated as below,

Compressive strength (7 days) MPa	Compressive strength (14 days) MPa	Compressive strength (28 days) MPa
Strength	Strength	Strength
16.88	26.22	34.22
18.66	26.67	25.33
20	25.33	25.13

Table 8: Results for internal curing

**2) Slump Cone Test**

Slump cone test is carried out to know the workability of the fresh concrete. Slump cone test is followed as per the IS code 199-1959. Slump cone & tamping rod is used to perform the test.

The Procedure is summarized as follows,

- 1) First of all the internal surface of the mould is cleaned & oiling is done.
- 2) Then the mould is placed on the clean, rigid, smooth & non-absorbent surface.
- 3) The mould is filled with four layers of concrete equally.
- 4) Each layer is then compacted 25 times by tamping rod having rounded surface with equal distribution.
- 5) After tamping, the mould is removed by raising it slowly in vertical direction.
- 6) Then slump is measured that is the difference between height of mould & highest point of subsided concrete

**C. Results**

The initial slump was 170 mm. And final slump was 100 mm.



Fig. 2: Slump cone test

**IV. RESULTS**

Fig 3, 4 & 5 shows the graphical representation of all the experimental analysis. The graphical representation is of

average compressive strength by using various curing methods.

It shows that the highest compressive strength is achieved by internal curing compound. However, results from the other curing compounds satisfied the basic strength criteria on particular days of curing. By comparing the results of water curing & internal curing compound, internal curing gives better result in the investigation. This is satisfactory. Same is happened in the case of air-dried curing & external curing compound

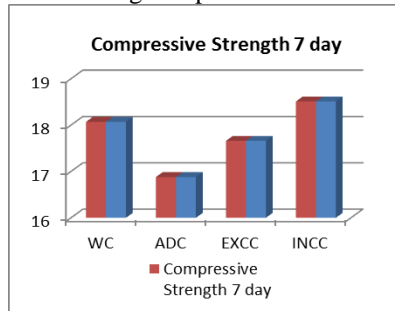


Fig. 3: Average strength on 7 days

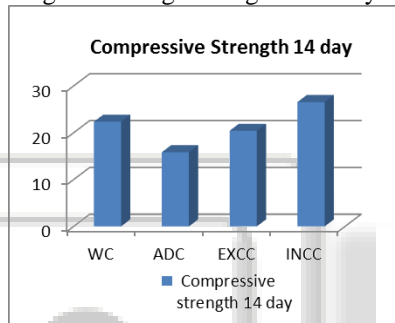


Fig. 4: Average strength on 14 days

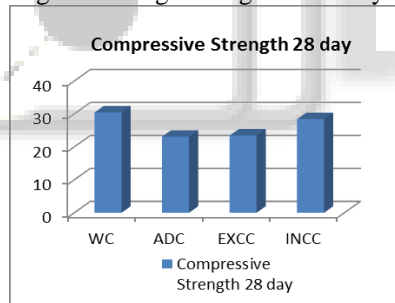


Fig. 5: Average strength on 28 days

## V. CONCLUSION

Thus this experimental analysis proved to be satisfactory from the results. It shows the overall performance of the concrete by using these curing methods with respect to compressive strength of concrete. Also these methods satisfied the required strength criteria with good results. Thus there is no any issue to use these methods, excepting the air-dried curing because this is not in general method of curing. We have used this method only for comparison purpose.

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