

## Comparative study on compressive strength of Self cured SCC and Normally cured SCC

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### ABSTRACT

Curing is the process of maintaining proper moisture content particularly within 28 days to promote optimum cement hydration immediately after placement. Self-compacting concrete is made up of admixture i.e. superplasticizer. In recent years, self-compacting concrete (SCC) has gained wide use for placement in congested reinforced concrete structures with difficult casting conditions. Also various curing methods are adopted in the construction industry especially for vertical structures, inaccessible areas s.a. high rise buildings, water scarce areas etc. In such structures conventional curing is not practically possible in most of the cases. But we need efficient curing which improves the strength and durability of concrete.

In the present work, comparison of compressive strength of normally cured SCC and SCC cured with self curing material i.e. wax based, white pigmented, membrane forming concrete curing compound has been done. This study is investigating that weather the use of self curing compound is economical or not in remote areas of water without compromising with the compressive strength of concrete.

**Keywords** – Admixture, Curing, Self Curing, Self-Compacting Concrete, Self Curing Concrete, Superplasticizer.

### I. INTRODUCTION

Construction industry use lot of water in the name of curing. The days are not so far that all the construction industry has to switch over to an alternative curing system, not only to save water for the sustainable development of the environment but also to promote indoor and outdoor construction activities even in remote areas where there is scarcity of water.

Curing is the process of controlling the rate and extent of moisture loss from concrete during cement hydration. It may be either after it has been placed in position or during the manufacture of concrete products, thereby providing time for the hydration of the cement to occur [4]. Since the hydration of cement does take time days and even weeks rather than hours curing must be undertaken for a reasonable period of time.

The need for adequate curing of concrete cannot be overemphasized because Curing has a strong influence on the properties of hardened concrete; proper curing will increase durability, strength, water tightness, abrasion resistance, volume stability, and resistance to freezing and thawing effect [7]. Curing may be achieved in a number of ways and the most appropriate means of curing may be dictated by the site or the construction method [9].

### Concrete can kept moist by following curing methods:

1. **Air curing:** Concrete cube left in open air to cure.
2. **Standard Water curing:** Concrete cube immersed in the water pond for curing.
3. **Self-curing:** Water soluble polymeric glycol or any other internal curing admixture is mixed along with water at the time of making the concrete, and left in open air to cure.
4. **Non standard water curing:** The concrete specimens are wrapped with thin hessian cloth similar to site condition and spraying water 3 times in a day up to 7 days.
5. **Membrane curing:** Curing compounds are liquids which are usually sprayed directly onto concrete surfaces and which then dry to form a relatively impermeable membrane that retards the loss of moisture from the concrete.

### II. SELF CURING CONCRETE

Self curing concrete is the one which can cure itself by retaining its moisture content [8]. A concrete can made to self cure by adding curing admixtures or by the application of curing compounds.

#### 2.1 Applications of external self curing compound

The curing compound is applied by brush or

by spraying while the concrete is wet. In case of columns and beams the application is done after the removal of formwork. On the horizontal surface, the curing compound is applied upon the complete disappearance of all bleeding water

It is Suitable for all general concreting applications and gives particular benefit for large area concrete surfaces, such as airport runways, roads and bridgeworks. It is also suitable for piece works where, it is difficult to curing and suitable for tunnel lining work also.



### III. EXPERIMENTAL INVESTIGATION

To understand the behavior of curing on the compressive strength of concrete by normal curing and external self curing i.e. by applying curing compounds on concrete surface this work has been done. In this experimental work, the mix design is carried out using Nan-su Method for M70 grade of self compacting concrete.

#### Materials used

##### 3.1. Cement

53 grade ordinary Portland cement from Deccan cement Ltd. conforming to IS: 12269-1987 having specific gravity 3.15 is used.

##### 3.2. Fine Aggregate

Locally available river sand conforming to Indian standard passing from 4.75 mm, having Specific gravity 2.60, Fineness Modulus 2.783 is used for this study. Particle size distribution is given in table 1.

Table 1: Particle size distribution

IS sieve size	Weight retained gm	Cumulative Weight retained gm	Cumulative % Weight retained gm	Cumulative % Passing
4.75 mm	00	00	00	100
2.36 mm	117	5.85	5.85	94.15
1.18 mm	364	18.2	24.05	75.75
0.6 micron	762	38.1	62.15	37.85
0.3 micron	536	26.8	88.95	11.05
0.15 micron	168	8.40	97.35	2.65
Pan	53	2.65	100	00
Total	2000 gm			

##### 3.3. Coarse Aggregate

Coarse aggregate used in this study are passed from 16mm and retained on 10mm. Specific gravity of coarse aggregate used is 2.9.

### 3.4. Filler

Silica fume imparts very good improvement to rheological, mechanical and chemical properties. It also helps in achieving high early strength [3]. So silica fume having specific gravity 2.38 is used as a filler material. Chemical composition of silica fume is given in Table no. 2.

Table 2. Chemical composition of silica fume

Sr. No.	Constituents	Quantity (%)
1	SiO <sub>2</sub>	91.03
2	Al <sub>2</sub> O <sub>3</sub>	0.39
3	Fe <sub>2</sub> O <sub>3</sub>	2.11
4	CaO	1.5
5	LOI	4.05

### 3.5. Water

Water is an important ingredient of concrete as it actually participates in the chemical reaction with cement. Ordinary potable water available in the laboratory is used.

### 3.6. Superplasticisers

GLENIUM B233 from BASF company is used as Superplasticiser. It complies with IS: 9103-1999. The properties are:

Table 3. BASF Glanium B233

Aspect	Light brown liquid
Relative Density	1.08 ± 0.01 at 25°C
PH	>6
Chloride ion content	<0.2%

### 3.7. Curing Compound

#### 3.7.1. CONCURE WB:

CONCURE WB water based concrete curing compound is based on a low viscosity wax emulsion. It is supplied as a white emulsion which forms a clear film on drying. When first applied to a fresh cementitious surface the emulsion breaks to form a continuous, non-penetrating white coating. This dries to form a continuous clear film which provides a barrier to moisture loss, ensuring more efficient cement hydration, improved durability and reduced shrinkage.

- Curing efficiency: Concure WB curing agent complies with the internationally recognised ASTM C309-90 standard.
- Specific gravity : 1 to 1.01 g/cc
- Colour : Bulk liquid White
- Supplied in 200 litre drums.

- Covers 3.5 to 5.0 m<sup>2</sup>/litre
- Shelf life-12 months

### 3.7.2. MASTERKURE 107i :

MASTERKURE 107i is a solvent free; membrane forming wax emulsion, suitable for curing newly placed or freshly concrete, assists in the retention of water during hydration. The resultant film retains sufficient moisture in the concrete to ensure full hydration of the cement; essential for optimum strength development. Membrane cured concrete is typically harder and exhibits a dust free surface with a reduced incidence of drying shrinkage cracks.

- The product shall comply with ASTM C 309
- Type II, Class A. BS 7542: 1992
- Relative density :1± 0.05
- Colour : White liquid
- Available in 20Ltrs & 210 litre drums.
- The recommended rate of application is 5-6 m<sup>2</sup>/litre
- Shelf life is 12 months
- Drying time is less than 3 Hours



## IV. MIX DESIGN

The mix proportion was done based on the method proposed by Nan-S [5]. The mix designs were carried out for concrete grade 70MPa. The details of mixes are given in table 4. All the ingredients were first mixed in dry condition. Then 70% of calculated amount of water was added to the dry mix and mixed thoroughly. Then 30% of water was mixed with the super plasticizer and added in the mix.

Then the mix was checked for self compacting ability by slump flow test, v-funnel test and L-box test.

### Mix Design obtained by Nan-Su Method

Table 4: SCC with silica fume

Grade of concrete	Cement (kg/m <sup>3</sup> )	Fine Agg. (kg/m <sup>3</sup> )	Coarse Agg. (kg/m <sup>3</sup> )	Silica Fume (kg/m <sup>3</sup> )	Water (kg/m <sup>3</sup> )	Super Plasticizer (kg/m <sup>3</sup> )
M70	411.01	860.10	737.90	202.10	197.4	12.92

## V. RESULT AND DISCUSSION

### 5.1. Properties of Fresh Concrete

Tests on fresh concrete were performed to study the workability of SCC with silica fume. The tests conducted and their results are listed below:

Table 5: Properties of Fresh Concrete

Sr. No.	Method	Unit	Typical range of values		Result
			Min	Max	
1	Slump-flow	mm	650	800	665
2	T50 slump flow	Sec	2	5	3
3	V-funnel	Sec	6	12	8
4	L-Box	(h <sub>2</sub> /h <sub>1</sub> )	0.8	1.0	0.98

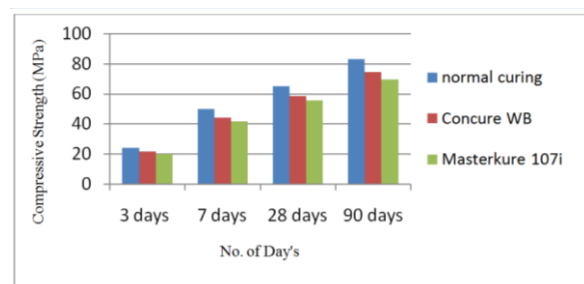
### 5.2. Properties of Harden Concrete

Test is conducted on 36 no. of standard cubes of 100 x 100 x 100 mm size, which are casted in the laboratory. The test specimens are marked and removed from the moulds. 12 no. of cubes were immediately submerged in clean fresh water and kept there for normal curing. 12 no. of cubes were cured with Materkure107i from BASF India Ltd. and remaining 12 no. of cubes were also treated with another self curing compound i.e. Concure wb from Fosroc India Ltd. 2000 KN capacity Compression Testing Machine (CTM) is used to conduct the test. The specimens are placed between the steel plates of the CTM and the failure load in KN will be observed from the load indicator of the CTM. From each type of curing 3 days, 7 days, 28 days and 90 days compressive strength results are observed.

$$\text{Compressive strength} = \text{Load} / \text{Area (MPa)}$$

Table no.6 Test result on hardened concrete

Curing Type	Compressive Strength(MPa)			
	3 Day's	7 Day's	28 Day's	90 Day's
Normal Water	24.16	49.84	65.13	83.02
Concure WB	21.62	44.19	58.60	74.71
Masterkure 107i	19.92	41.74	55.76	69.54



## VI. CONCLUSION

All knows normal curing method seems to be the best method for curing giving maximum strength[11]. But by using curing compounds also we can achieve almost 90% strength which achieved by normal curing method. So there is not major strength loss. Also following conclusions were arrived from the experimental investigation.

1. Self curing with curing compound Concure wb gives about 10% less compressive strength than Normal water curing.
2. Also Self curing with curing compound Materkure107i gives about 15% less compressive strength than Normal water curing.
3. In areas with shortage of water, sustainability of water can be achieved by using suitable chemical compounds for curing of concrete.
4. Compressive strength can also be achieved by using chemical compounds for curing.
5. Spray application reduces labor costs and eliminates the need for alternative curing systems.

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