International Journal of Research in Engineering, Science and Management
Volume-2, Issue-10, October-2019
www.ijresm.com | ISSN (Online): 2581-5792

# Intramural Healing of Concrete

N. Navya[1], G. A. Pallavi[2], G. M. Sanjana[3]
[1,2,3]*Assistant Professor, Department of Civil Engineering, Sapthagiri College of Engineering, Bangalore, India*

***Abstract*: The concept of internal curing has come into the marketplace after 50 years of unobtrusively improving concrete through the use of curing compound for the purpose of providing water for the hydration of cement. As a result of successful and recent tests and research, have recently put internal curing in the forefront of breakthroughs of ideas of how to make better concrete. It improves the results obtained by low water/cement (w/c) ratio. In the last 100 years there has been placed a certain amount of long – lasting, good performing and economical concrete. However, the deficiencies of much of the concrete have been obvious. In the last 75 years there has been a great amount of knowledge generated of how to take concrete better through the incorporation of specifically engineered ingredients and methods of batching and mixing. Internal curing can make better concrete. It can make up for some of the deficiencies brought on by human beings not following the best practices with external curing it can even make up for some of the problems brought on by hot or windy weather. For low low w/c concretes, internal curing may be necessity, but research makes it obvious that there are benefits from internal curing in many low w/c ratio. The need for it became obvious with the advent of high performance concrete. Because of it , more of the cement in a mixture is hydrated in a timely fashion. It results in greater early age strength, much lower autogenous shrinkage and racking, lower permeability, greater internal relative humidity with elimination of self-desiccation and other beneficial characteristics. It can benefit many different application, among which the most obvious are bridges, parking structures, high performance concrete, pavements, precast concrete and high fly ash concrete. Because its benefits are unique to different applications, other uses will be developed. Construction industry use lot of water in the name of curing. The days are not so far that all the construction industry have 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. Concrete is said to be self-cured, if it is able to retain its water content to perform chemical reaction for the development of its strength. This paper explains the performance of a self-curing concrete by the application of a wax based curing compound.***

***Keywords*: Concrete, curing.**

## 1. Introduction

This is by far the most common cement in use. This is the basic type of cement which is used on large scale in all general types of construction works. The details regarding the composition and properties of this type of cement are given in IS: 269.This cement is admirably suitable for use in general concrete constructions where there is no exposure to sulphates in the soil or ground water. These cements are available in different grades viz. 33, 43 and 53 grade. The use of high grade cement should not be taken for granted to yield high grade [strength] concrete as the strength of concrete depends on the mixture of cement, sand, coarse aggregate and water. In fact, the cement's grade has no relationship to the strength of concrete. It is possible to produce concrete of wide-ranging strength using a particular grade of cement. Moreover the "grade" has nothing to do with quality; increase in the grade does not increase the quality of the cement. The quality guarantees a set of minimum standards prescribed. Two cement of different grades can have the same quality.Every structure has to satisfy the requirement of strength and durability. Strength is the ability of the structure to withstand load. Durability refers to the period of trouble free life. A structural cement of concrete may possess high strength, but may deteriorate sooner than expected, making it a material of poor quality. Here the quality is with reference to concrete and not that of the cement. A grade of cement can be said to be of good quality if the concrete made with it satisfies both strength and durability requirements.The strength requirements [i.e. the strength of concrete] is satisfies by choosing the proper amount of cement, limiting the amount of water, consolidating the mixture well and curing the hardened concrete as long as possible. Durability on the other hand depends on the several factors that are attributable both to the material and to the exposed environment. During a recent survey made in Chennai, the only grades of cement freely available was found to be grade 53 and grade 43 was available on special order only and grade 33 was not found available.

## 2. Materials used and their properties

The materials used in the present investigations are as follows.

1. 53 grade O.P.C.
2. River sand as fine aggregate
3. Quarried and crushed stone as coarse aggregate
4. Tap water.
5. Curing compound CONCURE WB

## 3. Test on cement

Table 1
Results on test on cement

| S.No. | Particulars | Test Results | references |
|---|---|---|---|
| 1 | Typeof cement | 53 grade O.P.C. | ------------- |
| 2 | Normal Consistency | 34.0 | IS:269-1958 |
| 3 | Specific Gravity | 2.78 | IS:269-1976 |
| 4 | Setting time (in min) | | IS: 269-1976 |
| | Initial setting time | 90 | Should be more Than 30 min |
| | Final setting time | 270 | Should not be More than 600 |

Table 2
Compressive strength of cement
70.6mm*70.6mm*70.6mm= Size of the specimen

| S. No. | Particulars | Compressive Strength in N/mm$^2$(MPa) | | |
|---|---|---|---|---|
| -- | No of days | 3 days | 7 days | 28 days |
| 1 | 53 grade O.P.C. | 31.2 | 47.7 | 62.7 |

Table 3
Properties of aggregates used

| S. No. | Particulars | Fine Aggregate | Coarse Aggregate | Reference |
|---|---|---|---|---|
| 1 | Specific gravity | 2.5 | 2.6 | IS:2386(partIII)-1963 |
| 2 | Fineness modulus | 2.91 | 7.12 | Is;2836(partIII)-1963, IS:383-1970, IS:460-1962 |
| 3 | Grading zone | Zone II | 20 mm and Downsize | IS 383-1963 |

Table 4
Sieve analysis of fine aggregate (Weight of sample taken =1000gm)

| S.No. | IS sieve size | Weight retained(gm) | Cumulative Wt. retained | Cumulative % Wt. Retained | % finer |
|---|---|---|---|---|---|
| 1 | 10mm | 2 | 2 | 0.2 | 99.8 |
| 2 | 4.75mm | 16 | 18 | 1.8 | 98.2 |
| 3 | 2.36mm | 23 | 41 | 1.1 | 95.9 |
| 4 | 1.18mm | 189 | 230 | 23.0 | 77.0 |
| 5 | 600µ | 419 | 649 | 64.9 | 35.1 |
| 6 | 300 µ | 236 | 975 | 97.5 | 2.5 |
| 7 | 150 µ | 20 | 995 | 99.5 | 0.5 |
| Total | | | | | 291 |

## 4. Aggregates

Calculations:
Fineness modulus = 291.0/100
=2.91

Table 5
Sieve analysis of Coarse aggregate (Weight of sample taken =2000gms)

| | IS sieve size | Wt. retained | Cumulative Wt. retained | Cumulative % wt. retained | %finer |
|---|---|---|---|---|---|
| 1 | 80mm | 0 | 0 | 0 | 100 |
| 2 | 40mm | 0 | 0 | 0 | 100 |
| 3 | 20mm | 545 | 545 | 27.2 | 72.8 |
| 4 | 10mm | 1345 | 1890 | 94.5 | 5.50 |
| 5 | 4.75mm | 99 | 1989 | 99.45 | 0.55 |
| 6 | 2.36mm | 2 | 1991 | 99.55 | 0.45 |
| 7 | 1.18mm | 1 | 1992 | 99.6 | 0.40 |
| 8 | 600 | 0 | 1992 | 99.6 | 0.40 |
| 9 | 300 | 0 | 1992 | 99.6 | 0.40 |
| 10 | 150 | 0 | 1992 | 99.6 | 0.40 |
| Total | | | | | 719.1 |

Calculations:
Fineness modulus = 712.9/100
=71.2

## 5. Tests on fresh concrete

Table 6
Average Slump test values of concrete mixes

| S. No. | Grade of concrete | w/c ratio | Slump (mm) |
|---|---|---|---|
| 1 | M25 O.P.C. | 0.55 | 95 |

## 6. Tests on hardened concrete

Table 7
Details of the standard specimens used in the investigation

| S. No. | shape of the specimen | Sectional dimensions (mm) | | | | Volume (mm$^3$) |
|---|---|---|---|---|---|---|
| | | L | B | D | IA | |
| 1 | cube | 150 | 150 | 150 | - | 3.375*10$^6$ |
| 2 | cylinder | 200 | - | - | 100 | 1.57*10$^{-3}$ |

## 7. Results

*D. Compressive Strength*

*1) Conventional Curing*

Table 8
Details of the conventional curing

| Days | Strength [N/mm$^2$] | | |
|---|---|---|---|
| 3 days | 13.51 | 13.87 | 13.52 |
| 7 days | 27.92 | 26.46 | 27.1 |
| 28 days | 33.1 | 32.3 | 33.84 |

*2) Internal Curing*

Table 9
Details of the Internal curing

| Days | Strength [N/mm$^2$] | | |
|---|---|---|---|
| 3 Days | 16.10 | 15.62 | 15.69 |
| 7 Days | 25.22 | 24.61 | 24.98 |
| 28 Days | 29.30 | 28.83 | 29.61 |

*E. Split Tensile Strength*

*1) Conventional Curing*

Table 10
Details of the conventional curing

| Days | Strength[N/mm$^2$] | | |
|---|---|---|---|
| 3 Days | 1.29 | 1.62 | 1.62 |
| 7 Days | 1.12 | 1.18 | 1.15 |
| 28 Days | 1.78 | 1.82 | 1.95 |

*2) Internal Curing*

Table 11
Details of the Internal curing

| Days | Strength[N/mm$^2$] | | |
|---|---|---|---|
| 3 Days | 1.13 | 1.13 | 1.29 |
| 7 Days | 1.62 | 1.62 | 1.78 |
| 28 Days | 1.94 | 1.62 | 1.94 |

*F. Average compressive strength and density of cubes of internal curing specimens*

Table 12
Internal curing specimens

| Cube no. | Age in days | Weight of specimen (kg) | Density ($Kg/cm^3$) | Crushing load (KN) | Compressive strength (Mpa) | Avg. compressive strength (Mpa) |
|---|---|---|---|---|---|---|
| 1 | 3 | 7.81 | $2.35*10^{-3}$ | 36 | 16.10 | 15.80 |
| 2 | | 7.85 | $2.37*10^{-3}$ | 35 | 15.62 | |
| 3 | | 7.82 | $2.35*10^{-3}$ | 35 | 15.69 | |
| 1 | 7 | 7.72 | $2.33*10^{-3}$ | 56 | 25.22 | 24.93 |
| 2 | | 7.75 | $2.34*10^{-3}$ | 55 | 24.61 | |
| 3 | | 7.79 | $2.35*10^{-3}$ | 55 | 24.98 | |
| 1 | 28 | 7.62 | $2.30*10^{-3}$ | 65 | 29.30 | 29.24 |
| 2 | | 7.72 | $2.33*10^{-3}$ | 64 | 28.83 | |
| 3 | | 7.71 | $2.35*10^{-3}$ | 66 | 29.61 | |

*D.Average split strength and density of cubes of internal curing specimens*

Table 13
Internal curing specimens

| Cube no. | Age in days | Weight of specimen (kg) | Density ($Kg/cm^3$) | Crushing load (KN) | Compressive strength (Mpa) | Avg. compressive strength(Mpa) |
|---|---|---|---|---|---|---|
| 1 | 3 | 3.73 | 0.0189 | 7 | 1.13 | 1.183 |
| 2 | | 3.66 | 0.01857 | 7 | 1.13 | |
| 3 | | 3.66 | 0.01857 | 8 | 1.29 | |
| 1 | 7 | 3.56 | 0.01807 | 10 | 1.62 | 1.673 |
| 2 | | 3.62 | 0.01837 | 10 | 1.62 | |
| 3 | | 3.55 | 0.01801 | 11 | 1.78 | |
| 1 | 28 | 3.57 | 0.01812 | 6 | 1.94 | 1.833 |
| 2 | | 3.60 | 0.0182 | 5 | 1.62 | |
| 3 | | 3.62 | 0.01837 | 6 | 1.94 | |

## 8. Conclusions

1. Internal curing can contribute to accelerated construction technology transfers (ACTT).
2. The self-cure agent is reducing the vapour pressure at the pore water surface sufficiently below the 75% critical level.
3. On addition of the curing compound workability of concrete mix increases.
4. The surface of the self-cured cement paste is less permeable to water vapour than that of normal cured cement paste.
5. Curing compound increases early strength of concrete than normal cured concrete.
6. Autogenious shrinkage and self dessication of concrete has been checked by the addition of curing compound.
7. Concrete with curing compound gives smooth and fine finished surface than concrete without curing compound.
8. About 90% of results has been attained in compressive strength with small amount of water, this method can be implemented in construction field.

## References

[1] Dhir R. K., Hewlett P. C. and Dyer T. D, “Mechanism of water retention in cement pastes containing a self- curing agent,” Magazine of concrete research, vol. 50, 1998.
[2] Marks R, “Curing compounds and Internal curing admixtures- Latest Developments,” Proc. of seminar of march 2000. The Institute of Engineers, Australia.
[3] Bilek et. al. “The possibility of self-curing concrete,” Proc.of International Conference on Innovations and developments in concrete materials and construction., September 2002.
[4] R. Marks, N. Gowri Palan, R. Sun, “Early age properties of self-cured concrete’. general references on self-curing concrete (internally cured concrete), civil aid Techno Clinic Pvt. Ltd., Bangaluru.
[5] M. S. Shetty, “Concrete Technology, Theory and Practice,” S. Chand & Company Ltd.
[6] A. M. Neville, “Properties of concrete,” ELBS Edition, Longman Ltd., London.
[7] IS:269-1958
[8] IS:269-1976
[9] IS:2386 (Part III)-1963
[10] IS:383-1970
[11] IS:460-1962
[12] IS 383-1963