



IJRASET

International Journal For Research in
Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 Issue: IV Month of publication: April 2018

DOI: <http://doi.org/10.22214/ijraset.2018.4116>

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Effect of Different Curing Methods by Durability Index Tests

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Abstract: *In the construction field Curing plays a very important role in enhancing the impenetrability of concrete, which is essential to ensure the desired service life of a concrete structure. However, their performance in the field is most often evaluated by compressive strength instead of durability parameters. This paper presents an study of the suitability of durability index tests in evaluating the performance of various field curing methods. The curing methods used in this study are: water curing, two types of curing compounds, and air curing. The field-cured concrete was tested at the age of 28 days using oxygen permeability index, water sorptivity index, water permeability test, acid attack and sulphate attack. In this study, durability index tests were able to differentiate between wet and air curing. The results of this study indicate that compressive strength as a standalone criterion is not adequate for assessing the performance of field curing methods.*

Keywords: *Curing compounds, durability index test, concrete, strength.*

I. INTRODUCTION

Curing compounds form a membrane that help in preventing the loss of water from the surface of concrete and thus, facilitate curing of concrete during the early stages of the hydration process. The use of curing compounds not only decrease the need for additional potable water and supervision for the entire period of curing but also provides a solution where the conventional wet curing methods become impractical. Some of the examples are high-rise buildings, tunnel linings, and large pavement slabs. However, rapidly increase in development of construction industry requires huge amount of water requirements, there have been very limited attempts to study performance of curing compounds and the factors affecting it. ASTM C156 provides a water loss test for the qualification of curing compounds. However, it has been observed that the properties of the surface concrete or the near-surface concrete can vary substantially from those of the interior concrete. As the effect of curing extends only to the near-surface region, the use of a bulk property such as compressive strength appears to be an ineffective way of evaluating the curing efficiency.

II. AIM AND OBJECTIVE

- A. To compare the conventional method of curing with curing compound.
- B. Compressive strength is not only criteria to evaluate the performance of concrete on field.
- C. Conventional curing method with different conditions.
- D. To study the suitability of durability index test for evaluating the effectiveness of curing methods.

III. METHODOLOGY

In this project we have performed compressive test as well as durability index parameters. For this we have casted 24 trail cubes for selection of mix design. We have tested four mix design and from that we have selected two mix proportions for the testing.

A. *In this project we used Four Different Types of Curing Methods are as Follows*

- 1) Water Curing
- 2) Air Curing
- 3) Curing Compound(Algicure)
- 4) Curing Compound (Fairmate)

B. *For this We Have Casted 128 Cubes for Testing Different tests of Durability Index Are as Follow*

- 1) Sorptivity Test
- 2) Oxygen Permeability Test
- 3) Water Permeability Test

- 4) Acid Attack Test
- 5) Sulphate Attack Test

C. Compressive Strength Tests on Cubes

For this test we have casted totally 48 concrete cubes which were cured by four different types of curing methods and took the compressive strength at the age of 7&28 days. Compressive strength was evaluated on cube specimens of size 150 mm at the age of 7, and 28 days. Each compressive strength result constitutes an average of three strength tests.

D. Cube Casting For Durability Index Test

For this test we have casted total 80 concrete cubes which were going to be tested by five different durability index test. Cubes of size 150 mm were cast for durability tests. After the age of 28 days, cores of 70-mm diameter were extracted from each of the cube specimens. Then, slices of 30 mm were extracted from 5 to 35 mm and 40 to 70 mm depths from either side of the cores. The outward surface of the slices was carefully marked as the test surface after the slicing operation.

E. Water Sorptivity Test

In this test 16 no's of cubes where casted of size 150mm. Initially, the dry mass of the specimen was recorded. Then, the specimen was placed on narrow plastic supports with the test surface dipped into saturated lime solution up to a depth of 2 mm from its surface. Mass of the specimen was recorded at 3, 5, 7, 9, 12, 16, 20, and 25 min from the time it was placed in the lime solution. The submerged surface of the specimen was wiped clean with a paper towel before weighing. After the completion of the test, the specimen was saturated with lime solution using vacuum saturation method as describe . to measure its water absorption capacity.

F. Water Penetration Test

Water penetration test have been performed to find out total water penetrate into the concrete. For this test concrete cube samples were tested under penetration cell. Initially weight of concrete cubes were taken. After that all the cubes are placed under penetration cell machine for 24hrs at the 5kpa pressure. Initial and final water level was note down. Also depth of water penetrate into the concrete cube was measured.

G. Sulphate Attack

For this test we have casted 16 cubes for both mix design and all where cure from different method of curing for 28 days. After that all were kept in open air for 1 day and then initial weight where taken. Then all the cubes were treated in sulfate solution i.e. Magnesium sulfate $MgSO_4$ and Na_2SO_4 Sodium Sulfate for next 28 days. Then after completion of sulfate curing all cubes were taken out and washed with water and kept for 1 day for air curing. After that final weight where taken and also the compression strength on that cubes.

H. Acid Attack

The concrete cube specimens of various concrete mixtures of size 150 mm were cast and after 28 days of water curing, the specimens were removed from the curing tank and allowed to dry for one day. The weights of concrete cube specimen were taken. The acid attack test on concrete cube was conducted by immersing the cubes in the acid water for 28 days after 28 days of curing. Hydrochloric acid (HCL) with pH of about 2 at 5% weight of water was added to water in which the concrete cubes were stored. The pH was maintained throughout the period of 28 days. After 28 days of immersion, the concrete cubes were taken out of acid water. Then, the specimens were tested for compressive strength.

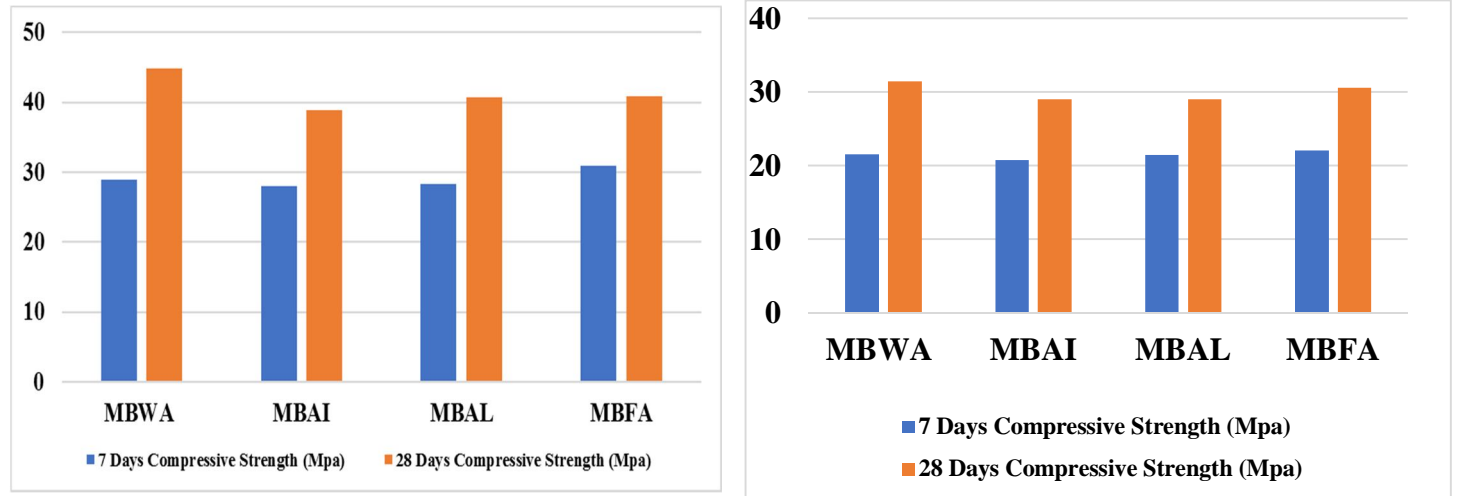
I. Oxygen Permeability Test

For this test specimen where drilled out from cubes of size 70mm in dia. & 30mm thickness. Place the sample, collar and rigid sleeve on top of the test chamber so that it covers the hole. Partially tighten the top screw into the cover plate to ensure that it is center. On the underside of the cover plate is a groove. Once the specimen has been centred, tighten the apparatus – first finger tight and then one and a half revolutions with a spanner. Open the oxygen inlet and outlet valves of the permeability cells and allow oxygen to flow through the permeameter for 5 seconds. This will purge the test chamber of gases other than oxygen. Close the oxygen outlet valve of the permeability cells. When the pressure is above 100 kPa on the gauge of the permeability cell, close the inlet valve. Record the pressure after 15 mins of time interval. If pressure decreases quickly then there is leakage. The test may be

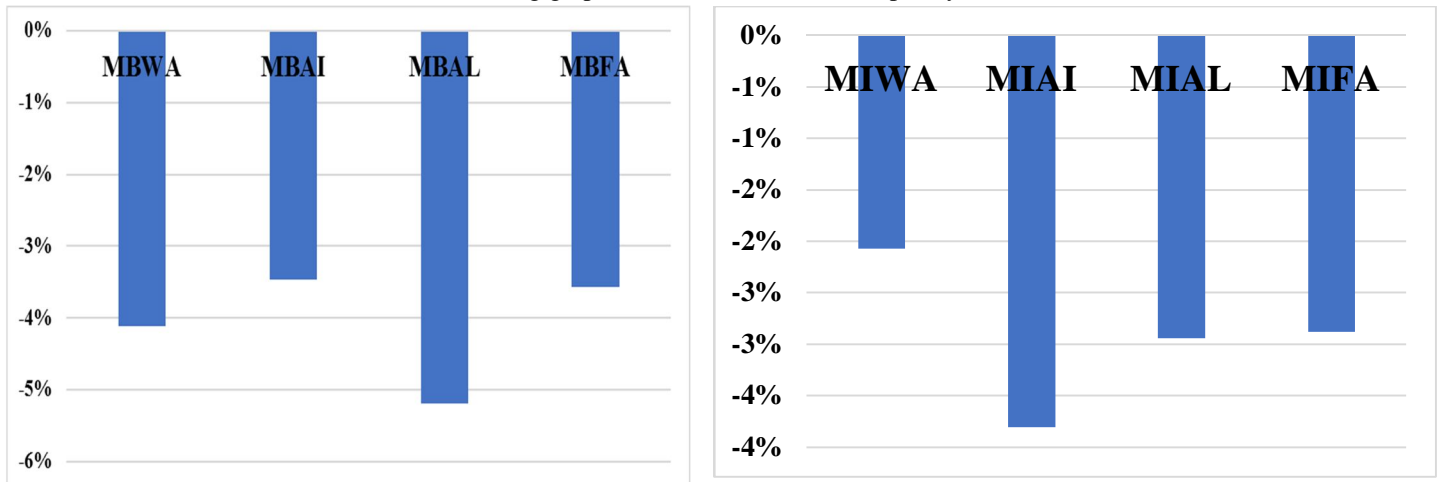
terminated when the pressure has dropped to 2.5 kPa or after 6 hours 15 min, whichever occurs first. A minimum of 8 readings is required.

IV. RESULTS

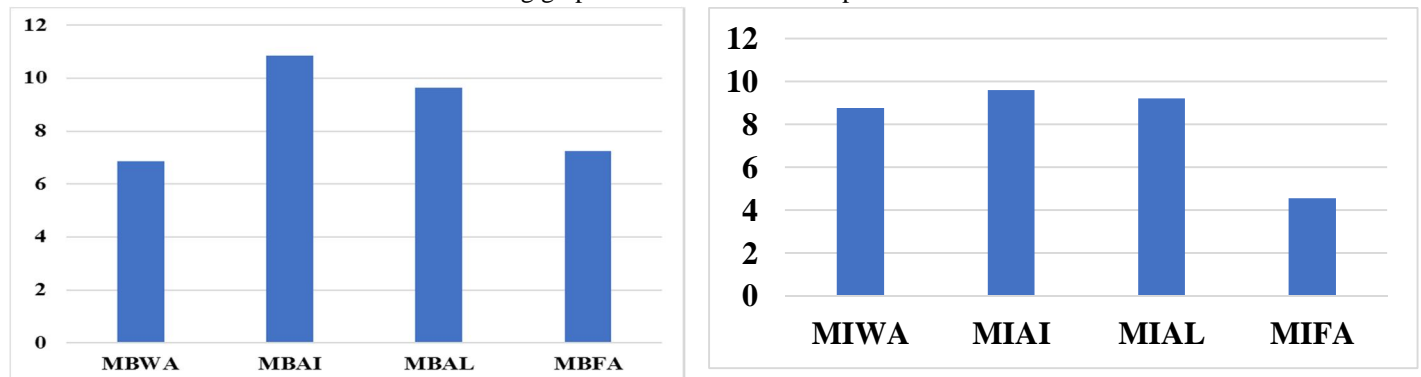
Following graphs shows result of compressive strength at age of 7 and 28 days.



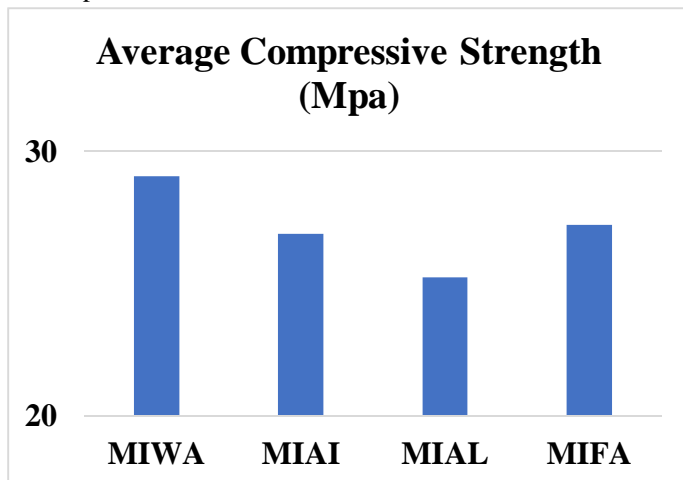
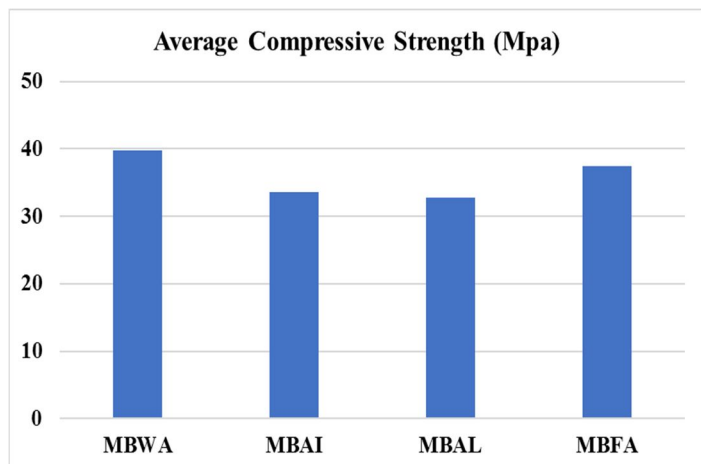
Following graph shows result of water sorptivity test:



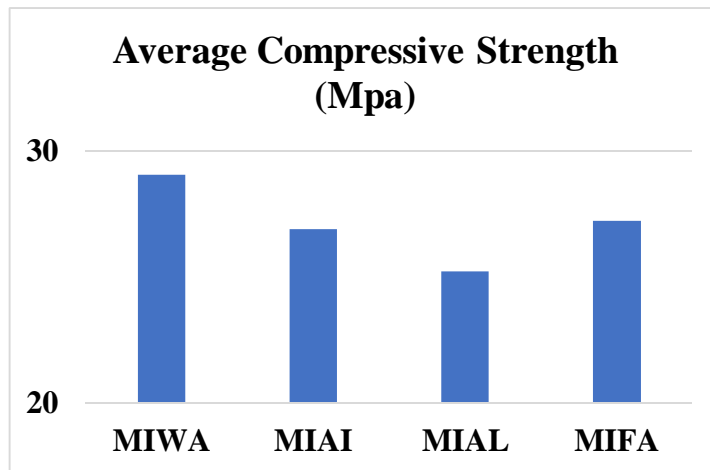
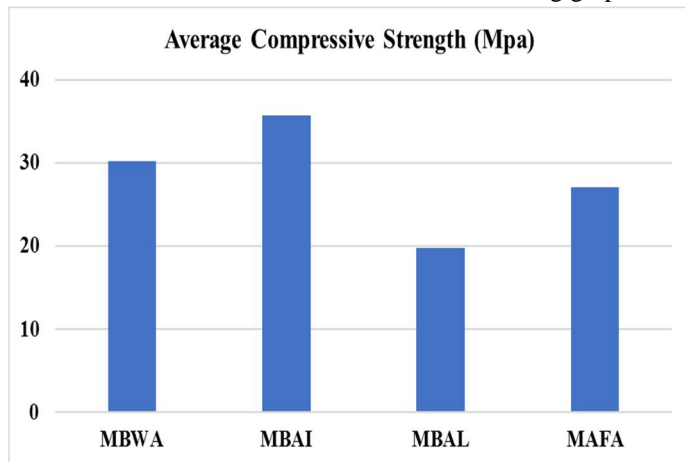
Following graph shows result of water penetration test:



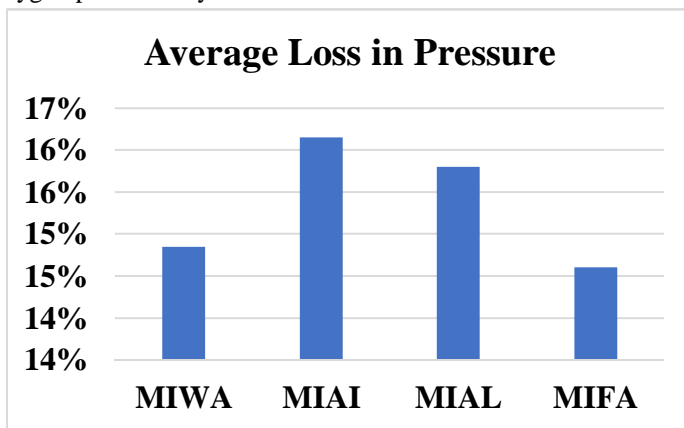
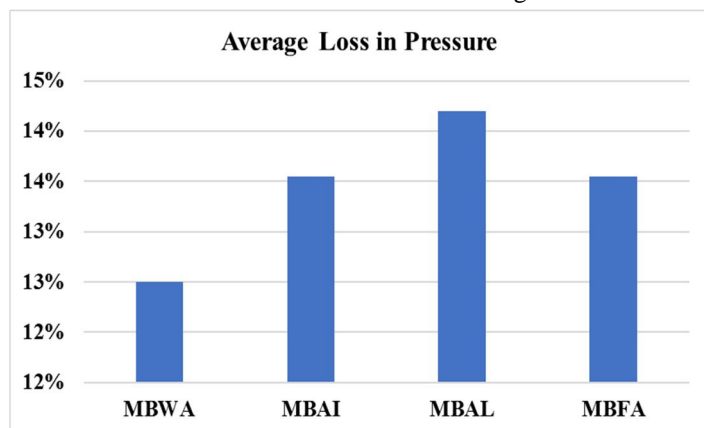
Following graph shows result of sulphate attack test:



Following graph shows result of acid attack test:



Following are the results of oxygen permeability test:



V. CONCLUSION

At the age of 28 days, compressive strength demonstrated variations according to the adopted curing method although with only minor changes. From this study it is cleared that the acceptance criterion for concrete on field is compressive strength. However, despite satisfactory strength achievement, concrete could not achieve satisfactory durability performance in some cases.



- A. Water sorptivity test shows large scatter in the result but it is still able to distinguish between water curing and air curing.
- B. Oxygen permeability test shows higher the rate of oxygen permeability less durability to concrete. So from above results water curing is best curing method to adopt.
- C. Acid attack and sulphate attack clearly distinguish between the different curing methods.
- D. From this study we conclude that compressive strength is not standalone criteria for durability of concrete but also durability parameters must be consider.

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